Deloitte Sustainability

Blueprint for plastics packaging waste: Quality sorting & recycling

Final report

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Acknowledgment

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Table of contents

Figures, tables and glossary

Glossary

EoL	End-of-life
(E)PS	(Expanded) polystyrene
EVOH	Ethylene Vinyl Alcohol
HDPE	High density polyethylene
HH	Household
LDPE	Low density polyethylene
Mt	Million tonnes
PET	Polyethylene terephtalate
PO	Polyolefins
PP	Polypropylene
PS	Polysterene
PU	Polyurethane
PVC	Polyvinyl chloride
RDF	Refused derived fuel
t	Tonnes

Figures

Tables

I. Executive Summary

Due to the wide range of physical, mechanical and chemical properties of resins, plastics are used in a multitude of formulations and applications. As a result, plastics are used in various sectors in the EU with a demand of 48 million tonnes per year. Packaging which is the focus of the present study makes up for 40% of this use. Overall, the end-of-life treatment of plastics is underperforming, especially when compared to more homogenous materials such as metals or glass. The ongoing revision of the Circular Economy Package demonstrates increasing recovery targets for all materials, including plastics. Specifically, for plastics, the recycling target is expected to increase from 22.5% to 55% by 2025. The increase in target rates was in part motivated by the raising awareness among the general public on the externalities of plastics.

The present study presents a quantitative and a qualitative analysis of the main packaging resins (PET, HDPE, LDPE, PP) based on the flows in France, Germany, Italy, Spain and the UK, which represent 70% of the plastic waste generated in Europe. The analysis revealed significant areas of improvement particularly in relation to the collection rate of PET and polyolefins which are currently as low as 53%. The collection rates vary significantly between the different resins and shapes (between 0% for PET household films and 80% for household PET bottles). At the same time it is estimated that approximately 1,900 kt of the collected resins are exported to extra-EU countries which constitutes a lost opportunity for the EU recyclers. Nevertheless, the recently announced ban of importations of plastic waste in China is expected to divert a significant amount of these flows to EU recyclers.

The performance of sorting and recycling varies greatly from country to country, as this step is particularly affected by the quality and output of the collection schemes and the level of contamination of the collected waste. The increase of the performance of recycling, faces certain challenges that need to be addressed, but is also driven by opportunities that exist throughout the whole value chain.

Challenges

- Increasingly complex packaging and (other) products with design for recycling not being a priority
- High landfilling rates and the absence of bans on landfilling
- High levels of exports to non-EU countries motivated by low labour costs
- Fluctuations in the quality and quantity of supplies delivered to recyclers and end-users
- Inadequate and unharmonized monitoring of the flow and performance of plastics
- Negative image and health concerns associated with the use of recyclates

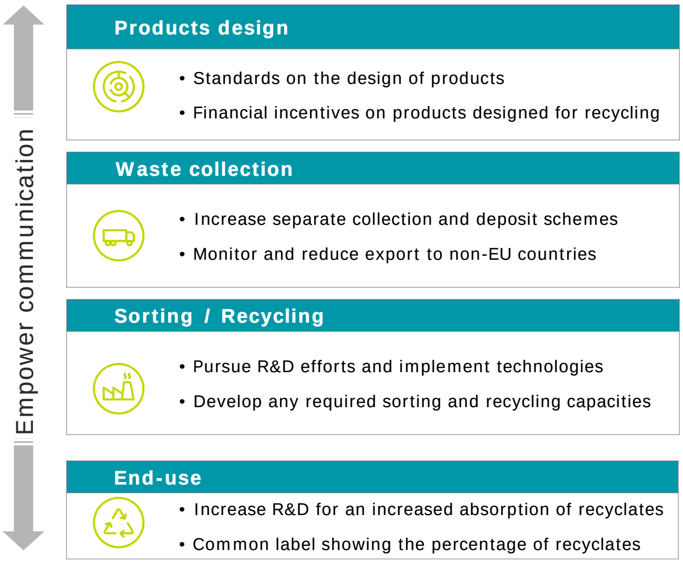
Opportunities

- Increased awareness among consumers and businesses
- Implementation of design for recycling and use of recyclates by brands
- Increased number and quality of separate collection schemes
- Existence of standards and certificates
- Positive environmental effects stimulated by circular economy models

The study also develops a 2025 forecast under which the 55% recycling target is implemented within the EU (the recycling performance reaches 65% if the extra-EU exports are included). Achieving a 55% recycling target in 2025 means that more than 10 Mt of recycled material need to be absorbed by the end-markets. Compared to 2014, this corresponds to more than twice the amount of the total recycled material and to about one third of the plastic used in the different end-markets. For the absorption of the additional tonnages, the identification of new markets is required. These markets are mainly the sectors with a high demand of plastics and a low use of recycled material.

The impact assessment carried out in the present study shows that the implementation of the 55% target by 2025 is expected to generate significant environmental benefits, as well as to create jobs within the EU territory. With regards to the economic impacts, the implementation of the target will create a profit under high and medium prices for recyclates. If the prices are low, a moderate cost will be created that could be covered through a low increase of the participation fees currently payed to the EPR schemes.

Given the complexity of the challenges and the different actors that are involved in the recycling chain, a single solution to reach the 55% target by 2025 does not exist. A multitude of measures have to be implemented by different actors, covering products design, waste collection, sorting and recycling, and end-use.



The whole value chain needs to be involved:

- **European Commission** to enforce recyclability standards/criteria, limit non-EU exports and fund research.
- **EU producers** to implement packaging recyclability, commit through voluntary agreements and develop a recyclability label.
- **Retailers** to promote recyclability through acquisition standards.
- **Standardisation organisations** to verify and validate standards.
- **EPR schemes and local authorities** to implement separate collection.
- **Recyclers** to lead a communication platform and continue R&D efforts to increase quality.
- **Public authorities, the industry, NGOs** to raise awareness on standards and safety of recyclates.

Currently the high levels of complexity and diversity of plastics put on the market lead to the development of highly heterogeneous streams. Measures to put forward specific **design for recycling standards** would create higher homogeneity on the streams thus promoting high-quality recycling. EPR schemes are in a better position to create the required financial incentives by integrating a bonus/ malus system in the participation fees. Flows that are not covered by EPR schemes (e.g. the commercial and industrial waste in some Member States) could be addressed through national fiscal measures, such as VAT discounts.

Regardless of the homogeneity of plastic waste, collection schemes have a particularly important influence on all the subsequent steps of the recycling chain. **Separate collection schemes** should be implemented in all Member States as required by the existing EU acquis. In certain cases, separate collection should be complemented or replaced by deposit schemes. Simultaneously, landfilling should be phased out or where feasible banned and incineration limited to non-recyclable streams and residues from sorting and recycling. In addition, an improved monitoring framework of extra-EU exports is necessary but not completely in line with the objectives of the circular economy. To this end, the very recent ban on waste imports in China imposes problems but at the same time poses an opportunity to focus on developing the recycling market for low-quality waste inside the EU borders.

Sorting and recycling are highly affected by the design of products and performance of the collection schemes. Even if the performance in these steps is improved, certain technical barriers need to be addressed through **increased R&D efforts** to allow the recycling of residual plastic waste. Simultaneously recycling and sorting infrastructure needs to grow in order to allow the processing of larger amounts of waste.

Currently, end-users often have a limited visibility on the supply of recyclates in terms of quantity and quality. Design for recycling and more effective collection, sorting and recycling need to be coupled with **acquisition agreements** to guarantee a timely supply of the required materials. In parallel the **development of a label** showing the content of recyclates will build trust and eventually increase the consumer demand of products with a high share of recycled plastics.

Enhanced communication throughout the whole recycling chain, from packaging designers to end-users will complement and support, as well as create synergies amongst the different measures. It will also help in identifying possible areas of improvement.

II. Context and objectives

II.1. The complexity of plastics

Plastics are composed of large molecules called polymers. Polymers are formed by monomers which are joined together in a chain. Plastics contain carbon and hydrogen elements and may also contain other elements such as oxygen, nitrogen, chlorine or fluorine.

There are two main categories of plastics:

- Thermoplastics which do not undergo chemical changes in their composition when heated. As such, they can be moulded repeatedly. This category includes polyethylene terephthalate (PET), high density polyethylene (HDPE), low density polyethylene (LDPE), polyvinyl chloride (PVC), polypropylene (PP), and polystyrene (PS). **Thermoplastics represent about 85% of overall plastic demand.** There are hundreds of types of thermoplastic polymers with new variations being regularly put on the market.
- Thermosets are plastics that are strengthened when heated, but cannot be remoulded or reheated after their initial forming. This category includes polyurethane (PU), used in coatings, finishes, gears, diaphragms, cushions, mattresses and car seats; epoxy resins, used in adhesives, sports equipment, electrical and automotive equipment; and phenolics, which are used in ovens, handles for cutlery, automotive parts and circuit boards. Thermosets account for 15% of the overall plastic demand in the EU.

In addition, certain substances can be added to develop specific properties. For example:

- **Plasticisers** modify the rheological characteristics of the resin (e.g. phthalates);
- **Fillers** modify certain properties of the material and reduce the manufacturing cost (e.g. mineral fillers such as chalk);
- **Additives** (e.g. dyes, flame retardants, stabilising additives, antifungals, etc.).

The composition of plastics, and more precisely the organisation of the polymers and the nature and proportion of these substances may change significantly according to the specific requirements of the clients. This may increase the complexity of products and consequently cause difficulties in the end-of-life treatment.

Thermoplastic resins with the highest demand are presented in the table on the following page.

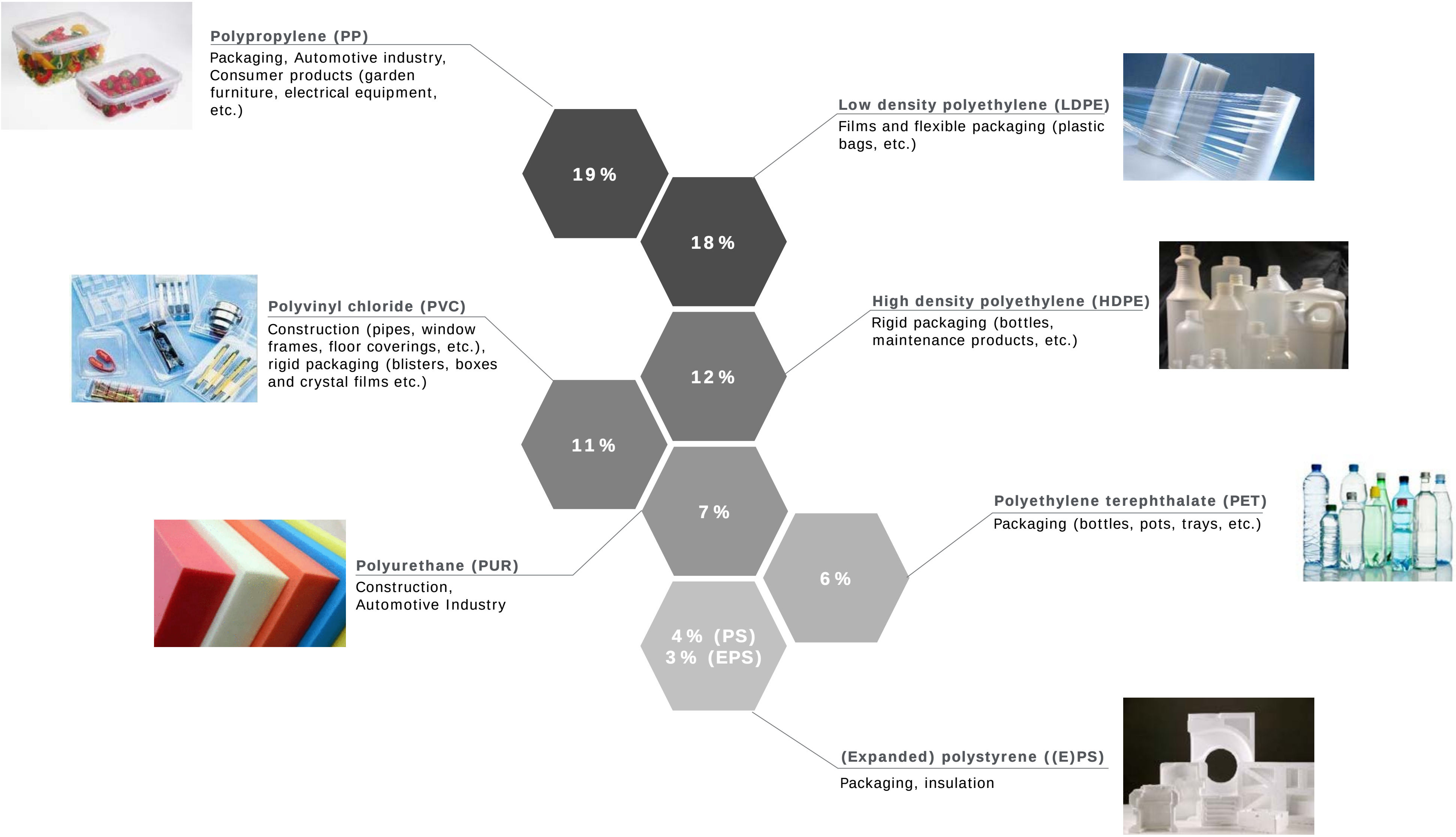


Figure 1: Global market share of the most used resins and main applications[1]

[1] Plastics Europe (2015), Plastics 2015 – An analysis of European plastics production, demand and waste data

Producers introduce a number of substances to a product in order to fulfil specific requirements (e.g. food contact applications, shape, appearance, weight, volume, durability, etc.), which cannot otherwise be attained by using pure resins. The mentioned requirements are defined by specific grades (see Table 1). Manufacturers will select a particular grade (or a mix of different grades) to obtain the desired material. The inner complexity of each plastic previously described leads to a high variety of products, and consequently difficulties during the end-of-life treatment.

Table 1: Grade criteria

Grade criteria	Description
Additives	Additives include dyes, stabilisers, plasticisers, etc. These are used to modify plasticity, to obtain certain colours, and to provide resistance to some mechanical, physical or chemical impacts (e.g. UV and oxidation).
Viscosity	Low to high, depending on the polymers chains length. For example, low viscosity facilitates mixing, but can reduce the mechanical strength.
Fireproofing	Polymers have different degrees of inherent flame resistance.
Chemical organisation of the polymer chains	Polymers can differ based on the distribution of molecular weights and shapes. Different grades are adapted to different manufacturing processes: for extrusion-blowing processes for example, a wide distribution of molecular weights is needed.
Food compliance	These grades must exclude undesirable substances (heavy metals, pollutants, PVC traces).

Another key source of difficulty in reprocessing derives from the use of different resins or other materials in products, especially packaging. The treatment of such materials is often technically challenging and can increase significantly the costs.

II.2. The demand of plastics in the EU

The wide range of physical, mechanical and chemical properties of plastics allow their use in a multitude of products. The manufacturing processes (injection, extrusion, blow moulding, thermoforming, etc.) can differ significantly depending on the product-specific requirements that define the resistance, weight and aesthetic aspects of the product.

As a result, plastics are **used in various sectors with a demand of 48 million tons per year.** As shown in Figure 2, with a 40% of the total demand, packaging is the main market for plastics in the EU[2].

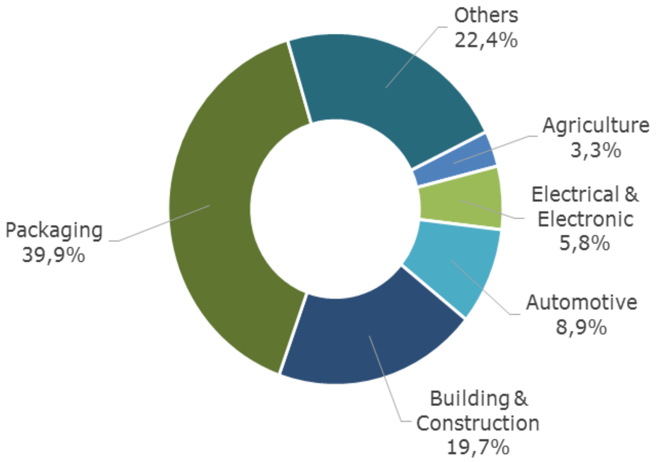


Figure 2: Plastics demand per main market sectors in 2014

For this reason, **the focus of this study is the recycling performance of plastic packaging waste.** The recycling output is either used for the production of packaging or for other products. The study considers all sectors that absorb this output.

[2] PlasticsEurope (2015), Plastics 2015 – An analysis of European plastics production, demand and waste data

As shown in the following table, 5 EU Members States make up for approximately 65% of plastics demand. For this reason, the outcomes of the present study are based on the analysis of the recycling chain in these countries.

Table 2: EU countries with the highest demand in plastics in 2014[3]

Country	Market share	Tonnages (in Mt)
Germany	24.60%	12.1
Italy	14.30%	7.0
France	9.60%	4.7
Spain	7.70%	3.8
United-Kingdom	7.50%	3.7
Total	**63.70%**	**31.3**

II.3. Increasing awareness

Overall, the end-of-life treatment of plastics is underperforming, especially when compared to more homogenous materials such as metals or glass. The ongoing revision of the Circular Economy Package demonstrates increasing recovery targets for all materials, including plastics. **The recycling target for plastics is expected to reach 55% by 2025.** This represents a significant increase from the current target imposed by the Packaging Directive 94/62/EC, which set a 22.5% recycling target.

In line with an increased target, the recently adopted European Commission's plastics strategy[4] aims at decoupling plastics production from virgin materials, improving the economics and uptake of recycling and reducing the leakage of plastics into the environment. In addition, the new legislation is expected to impose more ambitious and homogenous requirements as for the calculation and monitoring of the target.

In parallel to the policy developments, **a significant increase of public awareness and readiness of the industry to improve performance across the whole value chain are currently observed.** Notably, this trend is demonstrated by a report recently published by the Ellen McArthur Foundation[5] which calls for further action to be taken at different levels of the value chain.

II.4. Objectives and scope

II.4.1. Objectives of the study

The overall objective of the study is to propose effective measures to be taken or promoted throughout the whole value chain to achieve the expected 55% recycling target.

The operational objectives of the study are the following:

- Provide a better understanding of the material flows in terms of quantities and qualities;
- Collect data on the collection and sorting infrastructure in place and estimate the requirements for the plastic recycling sector to meet the future recycling targets;
- Estimate the needs of the industry involved across the value chain, including end-users;
- Identify the best options and provide recommendations;
- Assess the economic, environmental and social impacts of the most effective options for the improvement of the waste management schemes (including collection, sorting, recycling and other recovery schemes such as energy recovery).

[3] Plastics Europe (2015), Plastics 2015 – An analysis of European plastics production, demand and waste data
[4] European commission (2017), Strategy on Plastics in a Circular Economy
[5] Ellen MacArthour Foundation (2017), The new plastics economy – Catalysing action

II.4.2. Scope

The table below summarises the scope of the study and the expected results.

Table 3: Synthesis of the scope

Topic	Scope / Description
Players covered	The whole value chain is considered. A particular focus is directed towards the needs of end-users.
Waste flows and streams	• Packaging • Household and industrial & commercial
Resins	Main resins used in the packaging sector: PET, PP, HDPE, LDPE. Other resins such as PS and PVC, are not considered due to their decreasing use in packaging. Emerging materials such as PEF, biobased or degradable plastics are excluded due to lack of data.
Recycling targets and timescale	A 55% recycling target is considered to be achieved by **2025**
Geographical scope	• Detailed analysis for the 5 main countries that correspond to 65% of the EU demand (Germany, Italy, France, Spain, UK) • Extrapolation at the EU level
Indicators	• Economic: required investments and potential revenues • Environmental: GHG emissions • Social: direct jobs

In 2015, Deloitte carried out an impact assessment[6] on behalf of PRE to assess the environmental, social and economic impacts of increased recycling targets. **The overarching objective of the present study is to develop specific measures to reach the target in a more holistic manner**.

Figure 3 lists the key differences between the 2 studies.

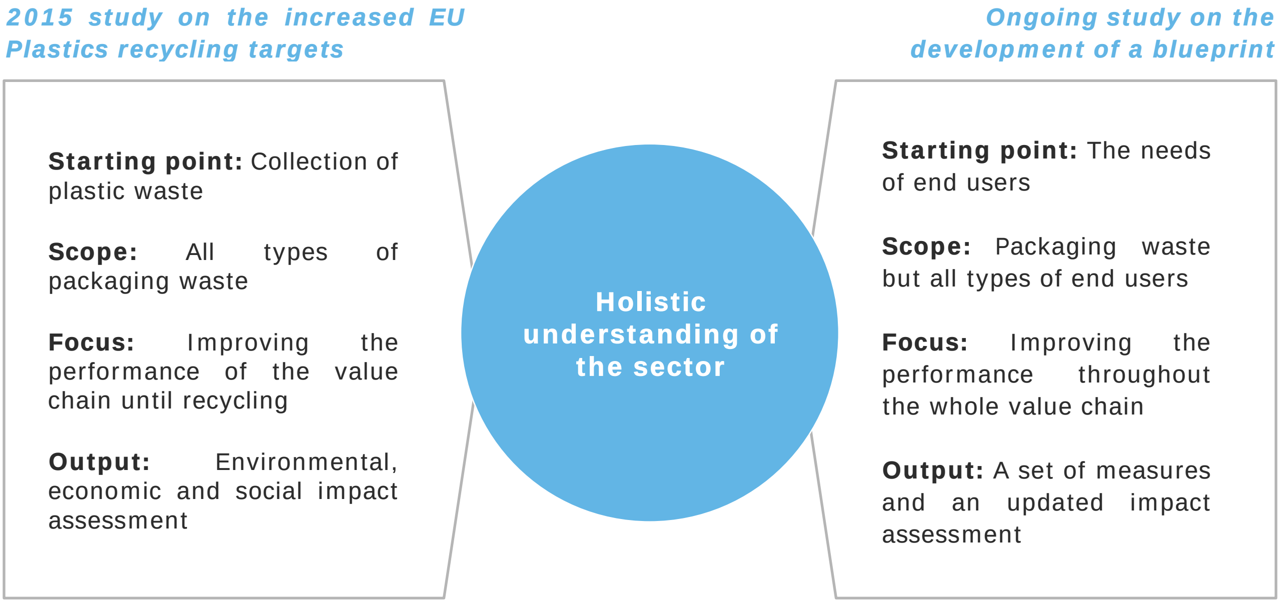


Figure 3: Differences between the 2 studies carried out by Deloitte

As seen in the figure, the starting point of the analysis in the previous study was the collected amount of plastic whereas the present study identifies solutions based on the actual needs of end users in terms of quantities and quality of plastics. These needs were excluded from the scope of the previous study.

[6] Deloitte (2015), Increased EU Plastics Recycling Targets: Environmental, Economic and Social Impact Assessment

III. Plastics packaging recycling chain in the EU

III.1. Recycling performance in the EU

This section is an overview of the global industry effort necessary to achieve a 55% target by 2025. The table below presents the recycling performance of each Member State, in 2012, 2013 and 2014 as well as the share of plastic packaging waste generation in 2014. As shown in Table 4, in 2014 the collection of plastic packaging waste for recycling at the EU level was 40%. This indicates that significant efforts are required to reach a recycling rate of 55% within approximately 8 years. Given that the current rates refer to collection rates and not recycling, the improvements of the performance should exceed 15%.

Even when considering solely the collection rates, only a few Member States have already achieved or are relatively close in meeting the target (indicated in green). Even in these cases, it is unclear to what extent the targets have been implemented due to uncertainties of the calculation methods (e.g. inclusion of impurities and humidity during the weighting of the collected streams). Four different calculation methods are allowed when Member States calculate the amount of packaging put on the market[7]. Often Member States report data on packaging waste that is collected for recycling instead of stating the amounts that have been recycled. The exact percentage of the tonnages put on the market and used by converters is currently unknown but it can be assumed that it is lower than 40%.

Table 4: Plastic Packaging Collection rates (%) and share of total plastic packaging waste in 28 Member States[8]

Countries	Collection rates			% of EU-28 waste generated in 2014
	2012	2013	2014	
EU-28	**35%**	**37%**	**40%**	**100%**
Belgium	42%	39%	42%	2.1%
Bulgaria	41%	41%	64%	0.7%
Czech Republic	58%	60%	58%	1.4%
Denmark	26%	29%	30%	1.2%
Germany	50%	49%	50%	19.2%
Estonia	30%	28%	29%	0.4%
Ireland	40%	40%	40%	1.3%
Greece	32%	32%	32%	1.2%
Spain	35%	41%	42%	9.3%
France	25%	26%	25%	13.5%
Croatia	45%	45%	38%	0.3%
Italy	38%	37%	38%	13.6%
Cyprus	45%	45%	47%	0.1%
Latvia	24%	25%	36%	0.3%
Lithuania	39%	43%	51%	0.4%
Luxembourg	37%	32%	37%	0.2%
Hungary	28%	31%	37%	1.7%
Malta	33%	23%	33%	0.1%
Netherlands	48%	47%	50%	3.1%
Austria	35%	34%	34%	1.9%
Poland	22%	20%	29%	5.9%
Portugal	30%	35%	40%	2.3%
Romania	51%	52%	44%	2.2%
Slovenia	65%	82%	69%	0.3%
Slovakia	57%	55%	56%	0.6%
Finland	25%	23%	25%	0.8%
Sweden	35%	46%	47%	1.5%
United Kingdom	25%	32%	38%	14.5%

[7] Eunomia (2014), "Impact Assessment on Options Reviewing Targets in the Waste Framework Directive, Landfill Directive and Packaging and Packaging Waste Directive" Final Report

[8] Eurostat

As shown in the table below (Table 5), in 2014 five countries generated approximately 70% of the plastic packaging waste. Therefore, their performance is particularly important in achieving a high recycling rate at the EU level. The table below ranks the five countries according to their recycling performance with respect to the waste generated in 2014. In 2014 all of these countries except Germany were far from reaching the 55% target.

Table 5: Plastic Packaging Collection Rates (%) and share of total plastic packaging waste in the six Member States with the highest waste generation [9]

Countries	Collection rates			% of EU-28 waste generated in 2014
	2012	2013	2014	
Germany	50%	49%	50%	19%
Italy	38%	37%	38%	14%
United Kingdom	25%	32%	38%	14%
France	25%	26%	25%	13%
Spain	35%	41%	42%	9%

Other countries show a significant increase of their performance between 2012 and 2014 due to a more effective structure of their packaging end-of-life management schemes (e.g. UK). Such trends appear to be promising in the mid-term. The schemes in Italy or Spain are maintaining a good level of performance but they do not show a significant improvement over the past years. France, on the other hand, has the lowest performance. Given that the country is responsible for approximately 13% of the total EU generated waste the impact of its performance is very significant at the EU level. However, the ongoing development of new collection guidelines in France is expected to increase the collection and thus the recycling performance in the following years in this country.

III.2. Organisation of the recycling chain

Although not the same, the structure of the recycling chain is similar across different countries. A typical structure of the recycling chain is presented in Figure 4. In the present study the recycling chain refers to the process through which the waste is collected, separated, processed, and put back into the manufacturing process. Therefore, this term does not include only the recycling step, whose effectiveness cannot be assessed in isolation from the other steps.

As shown in Figure 4, plastic packaging waste originates from different streams (i.e. industrial, municipal, commercial or agricultural). These streams are typically, different in terms of resin composition and level of contamination. A separate collection provides purer streams, compared to the collection from mixed waste which contain a higher share of contaminants. Sorting by colour and type can be done either automatically, manually or through a combined process. Automatization in sorting provides the highest quality of outputs and given the high labour costs in the EU, it is also the most cost efficient. The sorted output is directed always towards mechanical recycling as chemical recycling is still an expensive form of treatment.

[9] Eurostat

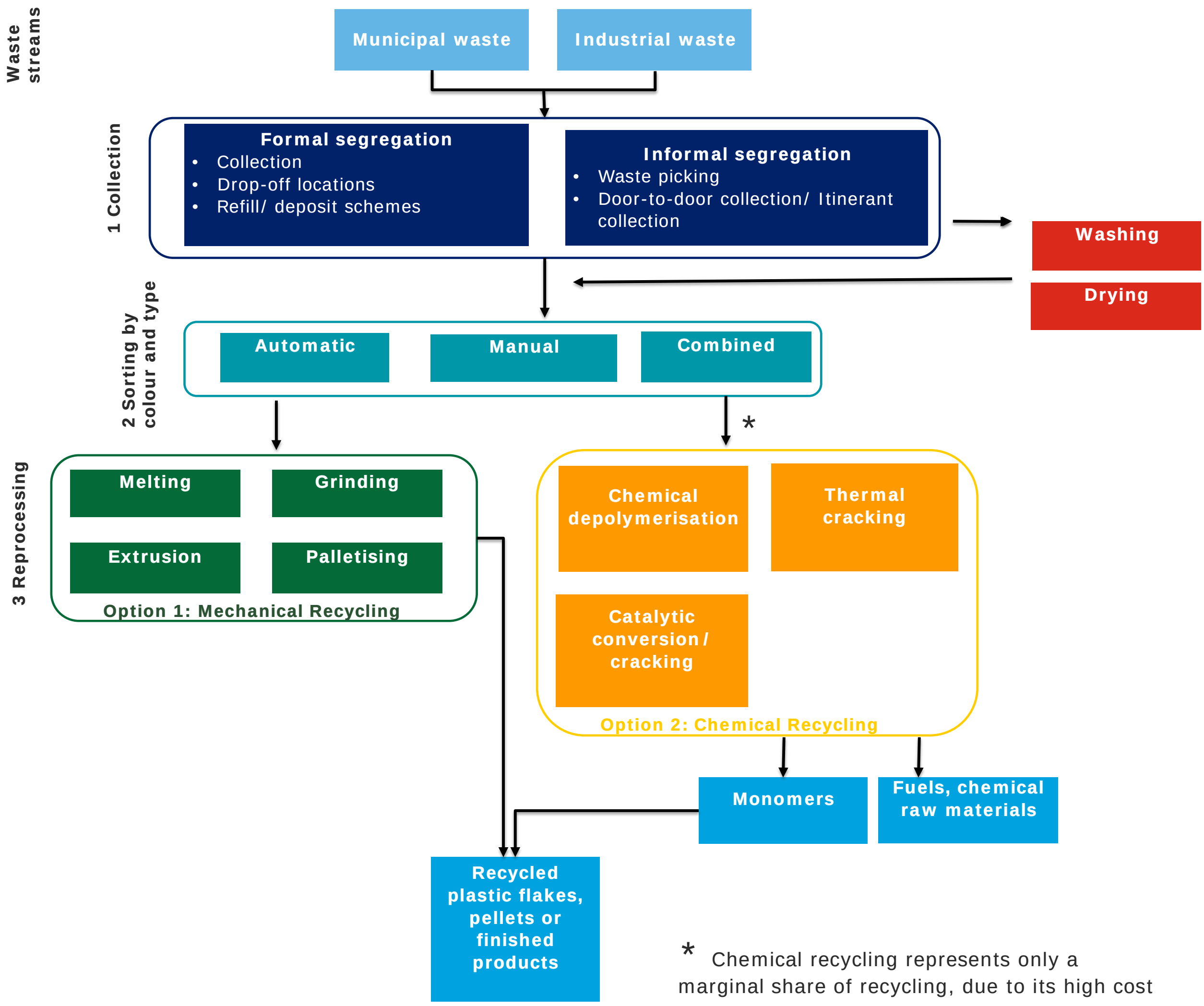


Figure 4: Recycling chain in the EU[10]

III.3. Quantitative overview of the current situation

The country-specific analysis of the situation includes the description of the flows of plastics per resin from the moment they are disposed in bins until they are absorbed by specific sectors, energy recovery plants or landfills. The sections below present an estimate of the current flows of plastics and analyse the performance of waste management throughout the whole recycling chain.

III.3.1. Current situation of the plastics packaging flows

In the Sankey diagram below the flows of plastics for Germany, France, UK, Spain and Italy are aggregated and extrapolated at the EU level.

[10] Deloitte (2015), Increased EU Plastics Recycling Targets: Environmental, Economic and Social Impact Assessment

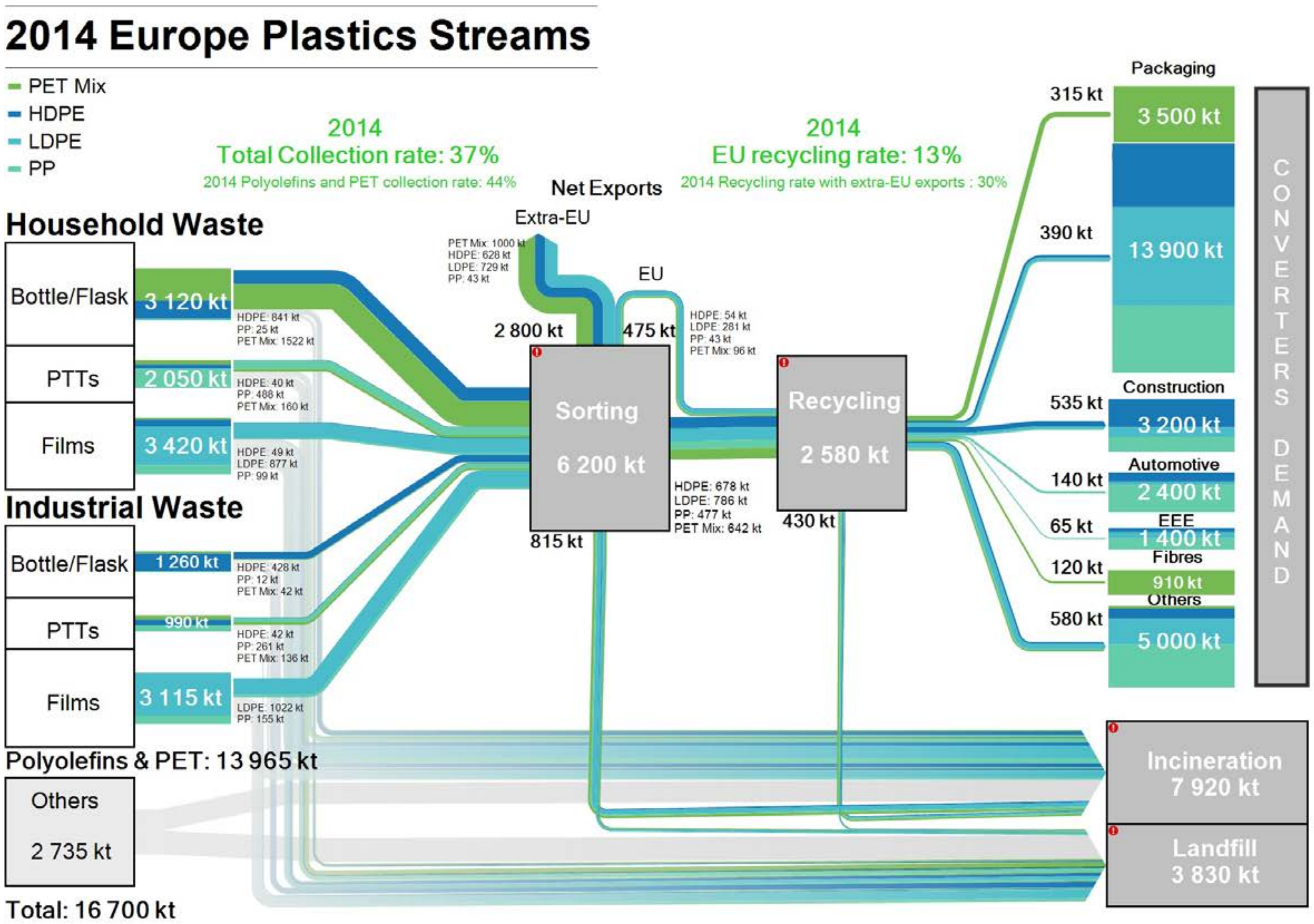


Figure 5: Sankey diagram of the plastics packaging waste flows[11]

[11] The split between household, and industrial and commercial packaging waste is not available for all countries. Therefore, in the diagram the two flows have been merged.

III.3.2. Definitions of products and processes

The following definitions of categories were considered for the estimates presented in the Sankey diagram:

- **Bottle / Flask:** this category includes all kind of packaging considered as "hollow bodies" such as packaging for drinks (water, milk, juices, sauces, etc.), cleaning products (detergents, chemicals, etc.) or hygiene (shampoos, shower gels, etc.). Some bottles, especially for gaseous drinks are made with multilayers of plastics for a more effective maintenance of carbon dioxide.
- **PTTs (pots, tubes and trays):** this category includes all rigid packaging excluding bottles and flasks. Specifically, it includes pots (yogurts, cosmetic creams, etc.), trays (fruits, vegetables, ready-prepared dishes, clamshells containers or consumer goods, etc.), other flat packaging (such as blister pack for unit-dose pharmaceuticals, etc.) and tubes (toothpaste, glue, paints, etc.). In this category, multilayer packaging is also found, especially for trays and containers used in food-contact applications. It also includes industrial canisters and containers (when industrial packaging is concerned).
- **Films:** includes all flexible packaging (mainly multilayer, such as bags (garbage bag, shopping bag, bulk bag, boil-in bag, etc.), complex films (stand up pouch bag for juice, stewed fruits, sugar, detergents, etc.), foils (pellets films, labels, etc.).

Sorting and recycling are the main stages between waste generation and end-use:

- The flows are refined during sorting. Sorting is carried out mostly for household flows which are collected selectively. This step aims in particular to make a first separation of the recyclable materials (e.g. plastics, paper-board, metals, etc.) and in some cases of the main plastic resins (e.g. separation between clear and coloured PET, preparation of a stream of polyolefins to be subsequently separated). The impurities are discarded to landfills or energy recovery facilities.
- Recycling refers to the second refining of the flows. Once the streams composed by one or more resins are received, several successive operations are performed (washing, shredding, identification and classification of plastic and extruding). As in the case of sorting, low quality material is disposed in landfills or energy recovery facilities. The final output is then sold to end-users for reprocessing.

End-users will be of the same as those presented in section II.2:

- Packaging: in bottle-to-bottle applications for clear and transparent PET, but also through the production of sheets used in thermoforming processes;
- Construction: mainly for pipes production, insulation or carpets;
- Automotive: mainly for bumpers, or for hidden parts;
- EEE: used for dark products, and irons, printers, fans, etc.;
- Fibres: this market is one of the major applications of recycled , especially for nonwoven interlining fabric (e.g. chemical suits, protection overalls, etc.) and automotive interiors;
- Others: this category concerns smaller markets, such as furniture and consumer goods (e.g. clothes hangers, boxes); strapping.

III.3.3. Waste generation and collection

According to an extrapolation from 5 countries (see Figure 5), approximately 23% of the plastics packaging waste flows is lost in landfills and 47% is incinerated. The remaining share of plastic packaging waste (approximately 30%) is recycled or exported. Today the amount of plastics exported within EU or out of the EU is included in the recycling rate. When the extra-EU exports are excluded, a 15% recycling rate is estimated for the EU. Due to the uncertainty that characterises the treatment of plastic waste outside the EU (mainly in China), a focus of the study is directed towards the plastics that are recycled in the EU. In addition, the recent ban on the imports of occidental waste to China (see section III.5), of which plastics represents one of the highest shares, provides a tangible argument to focus on the development of recycling within the EU.

Figure 5 is an extrapolation of the data of 2014 from France, Germany, Italy, Spain and the UK, which represent 70% of the waste generated in Europe. The margin error is less than 3% in this extrapolated model. The diagram includes only the PET and polyolefin streams. All other plastics (~16% of the plastic packaging waste generated) are excluded and redirected to landfill and incineration.

Overall 13,960 kt of Polyolefin and PET packaging were consumed in Europe in 2014. A share of 62% is generated from household waste and 38% from commercial and industrial waste.

Table 6 presents average shares by shape and resin **based on the data gathered for the 5 countries.**

Table 6: Share of generated waste per origin, shape and resin in the EU, in 2014

Source	Shape	PET	HDPE	LDPE	PP
Household Waste (100%)	Bottle/Flask (36%)	62%	36%	-	2%
	PTTs (24%)	31%	12%	-	56%
	Films (40%)	3%	12%	69%	16%
Commercial and Industrial Waste (100%)	Bottle/Flask (24%)	9%	86%	-	5%
	PTTs (18%)	27%	32%	0%	41%
	Films (58%)	1%	0%	83%	16%

In Figure 5, we observe that approximatively 37% of this waste was collected in 2014 (44% over total packaging plastics waste) and had entered the recycling chain, of which approximately 2,800 kt are exported. Table 7 presents the collection rate per source, shape and resin.

Table 7: Collection rate of generated waste per origin, shape and resin in the EU, in 2014

Source	Shape	PET	HDPE	LDPE	PP
Household Waste (68%)	Bottle/Flask (76%)	79%	76%	-	32%
	PTTs (34%)	25%	15%	-	42%
	Films (30%)	-	12%	37%	18%
Commercial and Industrial Waste (39%)	Bottle/Flask (38%)	36%	40%	-	18%
	PTTs (44%)	51%	13%	-	65%
	Films (38%)	-	-	39%	32%

The most significant deficiencies on the collection performance are observed on household HDPE PTTs and films, and commercial HDPE PTTs. Overall, the collection rates, indicate a significant room for improvement for most resins and shapes.

III.3.4. Performance of sorting and recycling

The performance of sorting and recycling varies greatly from country to country, as this step is particularly affected by the quality and output of the collection schemes and the level of contamination of the collected waste. The estimation in the Sankey diagram assumes a refusal rate due to impurity of about 10%. There are two main explanations for this significantly low refusal rate. First off, large amounts of refusal volumes are usually exported due to the lower quality. Additionally, only the net weight of resins was considered in the estimates (e.g. low quality PET and polyolefin packaging waste or fractions of them), **excluding the contaminants and moisture**.

The recycling performance is also related to the quality of the flows received, in particular to the nature of the pollutants that can be found in the sorting output **in relation to the final end-use and the quality needed**. Resins used in certain applications, for example HDPE or PP in technical applications, can show high recycling rates. Furthermore, basic moulding applications or very pure waste inputs (clear PET from deposit schemes) allow for higher yields.

Concerning food-compliance processes, there is a need for highly purified plastics. Specific techniques are required to remove particles banned by EFSA. As a result, a higher proportion of resins is discarded compared to non-food applications.

The presence of PVC or complex packaging (e.g. Ethylene Vinyl Alcohol (EVOH), nylon) requires extended refining. Additionally, it can degrade the yield of the process and quality of the recyclates[12].

III.3.5. End use

The recycled flows are absorbed by the end-users and transformed to new products. As shown in the table below, in terms of absolute amounts, the highest amounts of recyclates are absorbed by the packaging, construction and other sectors. In relative terms, construction, and other sectors are

[12] Hopewell et al (2009),

relevant. As shown in the table below, based on an extrapolation of the 5 countries at the EU level, the industry uses only 7.1 % of recyclates.

Table 8: penetration rate of recyclates in end-use demand

Industry	Total demand for plastics raw materials (kt)	Demand of recyclates (kt)	Penetration rate of recyclates
Packaging	17,225	705	4.1%
Construction	3,234	534	16.5%
Automotive	2,386	142	5.5%
EEE	1,381	67	5.8%
Fibres	911	121	4.9%
Others	4,945	584	11.8%
Total	**30,283**	**2,153**	**7.1%**

Regarding the sectoral demand per resin, the highest demand of the recyclates is observed in the following sectors:

- r**PET** is mainly used in **packaging (313 kt), fibres (121 kt)**, **and other**[13] **(80 kt)** industries.
- r**HDPE** is used in **construction (321 kt), packaging (143 kt), and other (107 kt)** industries.
- rPP is mainly used in **the automotive industry (125 kt), packaging (69 kt), construction (63 kt), EEE (53 kt) and other industries (76 kt)**.
- r**LDPE** is mainly used in **packaging (180 kt), construction (150 kt)** and industries and **other end markets (320 kt)**.

As highlighted in section II.4.2, PS and PVC are not in the scope of the study due to the decreasing use of these resins in packaging. Nevertheless, these resins are still collected and recycled, mostly when they come from industrial and commercial waste streams (including production scraps). The PS and PVC collected from households most often are landfilled or incinerated, even if some initiatives (especially for PS) tend to work on more efficient and less costly recycling processes[14].

III.4. Qualitative overview of the current situation

This section analyses the recycling chain's current performance and identifies the key barriers and opportunities in reaching the 55% target.

III.4.1. Product design

High diversity of products

As also highlighted in section II.1, the intrinsic complexity of plastics impacts the quality of recyclates in the following ways:

- **Intrinsic complexity of specific materials (e.g. multilayer packaging) coupled with the high diversity of the composition of the waste flows**: within the same sector of activity and for the same use, the formulation of a packaging material might vary. As a result, the treatment of plastics through the same recovery routes is not possible. For example, it might be difficult to treat clear PET bottles together with clear PET trays if there is no improvement in the process due to a higher diversity of trays compared to bottles (e.g. differences on the additives and forming process)[15]. Other issues relate to the use of small format packaging (e.g. lids and tear-offs), infrequently used resins (e.g. PS, EPS and PVC), multi-material packaging and highly nutrient-contaminated packaging (e.g. fast-food packaging)[16]. Small format and multi-material packaging is difficult to sort,

[13] The category "others" includes smaller markets, such as furniture and consumer goods (e.g. clothes hangers, boxes); strapping (see also section III.3.5)
[14] For example, in the Netherlands a new technology allows the efficient recycling of polystyrene
[15] Each kind of packaging will have its proper reaction to the process, especially, during the grinding steps of the recycling processes: bottles will be shredded in homogenous scraps while trays will tend to explode and produce smallest scraps, more heterogeneous parts and more dust which might not be efficiently recycled.
[16] Ellen MacArthur Foundation (2017), The new plastics economy – Catalysing action

economically unviable to recycle and is usually disposed of. Sorting and recycling of uncommon resins (e.g.; PS, PVC, PLA, multilayers etc.) is in general very difficult due to technical limitations. In addition, their presence in the waste packaging flows results in a contamination of PET and polyolefin recyclates. Similar issues are faced when packaging contains high levels of organic nutrients which degrade the quality of recyclates.

- Another loss of material can occur when it comes to dark and black products. Optical sorting technologies remain particularly effective on several plastics, as long as the rays can react with the surface of the waste. In the case of dark and black plastics, especially those containing specific dyers such as carbon black, rays are absorbed and cannot be identified in the sorting process. The only alternative is to remove these flows and thus they are lost during the process. Research has been carried out in the UK to develop the sorting of black and dark plastics by replacing commonly used carbon black by detectable black dyes, compliant with NIR technology[17].
- **Combination of several resins and grades within a single product** with the use of imbricated (e.g. multilayer) or non-separable plastics (e.g. food bricks, flexible flasks). Multilayer packaging in general contains polyamides or Ethylene Vinyl Alcohol (EVOH). These substances, if present in the recyclates, can result in an unintentional colouring of PET products and change their chemical, physical and mechanical properties.
- **Dispersed nature of the waste flows, which are not integrated into structured collection schemes**. Even in cases where dedicated schemes are well established, the collection process does not always allow an efficient targeting of all resins (e.g. in cases of incomplete sorting guidelines for plastic rigid packaging). This issue is more significant in the commercial and industrial waste.
- **Difficulties to adapt the treatment schemes to a constantly evolving waste stream:** due to differences in the lifetime of products the issues are not necessarily addressed effectively by the ongoing legislation, treatment schemes and recovery technologies. For example, fresh food and drinks packaging or cosmetics packaging are subject to constant changes due to marketing strategies or technological developments. Such changes cannot be always captured by the legislation, even in cases when the latter goes through regular reviews.
- **High level of impurity in some flows caused by the mixing of different waste streams** (e.g. food packaging and organic residues, agriculture waste, packaging in residual waste flows): incompatible resins or grades of resins might have unpredictable effects on the quality of recyclates. Particularly with respect to the grades, the optical brighteners and UV stabilisers can impact sorting process, as these substances affect the functioning of optical beams.

As a result, the achievement of effective collection & sorting, the control of the physical and mechanical properties (e.g. dark spotting, elasticity, etc.) and the identification and treatment of the additives during the recycling process becomes a challenge for the industry. When the recyclates need to comply with strict requirements (e.g. in food-contact packaging), the challenge increases significantly. Overall, many plastics are designed to be thrown away without taking into account any resource efficiency aspects[18].

In general, these technical issues impose a significant challenge to sorting and recycling facilities in delivering more ambitious targets and requirements than those currently applied.

Strong legislative, marketing and technical requirements

The requirements in terms of the quality of recycled resins differ significantly between the various sectors. The key requirements, as well as the sectors mostly affected, are the following:

- **Food contact requirements**, which currently affect mostly the PET bottle-to-bottle schemes even if gradually the uptake of rPET in food-related applications is growing. Other recycled resins (e.g. HDPE and LDPE) which currently have a limited use[19] in food-contact packaging are affected to a larger extent. The requirements are set by the European Food Safety Authority (EFSA) and affect all products put on the EU market. Overall, the EFSA requirements override the environmental concerns of plastics waste treatment. An expert consulted in the present study stated that in general companies avoid taking a risk over aspects that concern safety.
- **Technical requirements, which cover mechanical, colour, physical properties** especially during:
    - The shaping processes (e.g. injection moulding and extrusion) of non-food packaging;

[17] Source : WRAP, recyclability of black plastic packaging, http://www.wrap.org.uk/content/recyclability-black-plastic-packaging-0
[18] European Commission (2017), Strategy on Plastics in a Circular Economy
[19] Multilayers packaging, with an inner layer made of recycled resins.

  - The manufacturing of black products, particularly when it concerns the production of dark black products, a colour that is difficult to achieve with recyclates;
  - The manufacturing of fibres (e.g. to achieve a low level or complete absence of pollutants);
  - The manufacturing of parts used in the automotive and construction industries (e.g. to achieve high durability and other specific mechanical properties).
- In some cases (e.g. the legacy additives issues for long-life products and food contact plastics), end-users are facing legal uncertainty due to the lack of a working system at the EU level[20].

The complexity of resins and the diversity of plastic products often impose difficulties in demonstrating compliance with specific requirements. Technological developments and the improvements of the waste management do not always result in the fulfilment of the requirements as the end-users are continuously demanding better sorting, less odour and optimised colours to satisfy their customers.

III.4.2. Waste collection

High competition with landfilling and incineration

Evidence collected in all 5 studied countries shows that separate collection has increased significantly over the past year. Nevertheless **landfilling (excluding Germany where a landfill ban is in place) as well as incineration with or without energy recovery remain the cheapest treatment methods. In addition, economies of scale of high-quality recycling are prevented by the high fragmentation of collection and sorting**[21].

In parallel, **as demonstrated by the performance in Germany, strict measures, such as landfill bans, have a direct effect on increasing the recycling performance and on limiting the leakage of plastic into the environment**[21]. Landfill does not only act as a key competitor to recycling but is also a direct source of marine pollution[22].

With significant differences between Member States, there is a general trend of diverting waste from landfilling to incineration due to increasingly strict measures concerning landfilling that are imposed by EU legislation. As a result, low quality waste is diverted to energy recovery facilities whose capacity is constantly increasing.

Waste exporting to extra-EU countries is also a cheaper alternative to recycling. As a result, the EU exports of plastics collected for recycling reach almost 50%[23]. As mentioned above, the **new regulations put in place in China (the largest importer of plastic waste)**[24] **is expected to limit the imports of plastic flows.** Nevertheless, new markets in Asia are arising which could absorb these materials.

Pressure from the costs of the schemes and pricing mechanisms

Due to the specificities of plastic packaging, the costs linked to plastics end-of-life treatment tend to be significantly higher than the costs related to the treatment of other materials. For example, in France, plastic packaging corresponds to the highest producer fees (57% of the total contributions) even if it represents **less than a quarter in terms of the tonnage put on the market**[25]. Nevertheless, for the same tonnage of material, plastics will allow the production of a much larger number of items of packaging than other materials such as glass or metal.

Another example where the price mechanisms do not generate the required messages for higher recycling rates are the Packaging Recovery Notes (PRNs) issued in the UK. The PRNs are issued easily for bales that are exported. The bales that are processed in the UK go through a process of sorting and decontamination as well as numerous inspections from the Environment Protection Agency. In general,

[20] EuPC (2017), The usage or rPM by European Plastics Converters
[21] Ellen MacArthour Foundation (2017), The new plastics economy – Catalysing action
[22] European Commission (2017), Our Oceans, Seas and Coasts, Descriptor 10: Marine Litter, available at: http://ec.europa.eu/environment/marine/good-environmental-status/descriptor-10/index_en.htm
[23] European Commission (2017), Strategy on Plastics in a Circular Economy
[24] Plastics News (2017), China to WTO: Scrap plastic imports banned by year end: http://www.plasticsnews.com/article/20170718/NEWS/170719892/china-to-wto-scrap-plastic-imports-banned-by-year-end
[25] Annual report 2014 of Eco-Emballages and Adelphe

waste destined for exports is highly contaminated. Low labour costs in Asian countries make the manual sorting of highly contaminated waste an attractive option.

Overall the relatively low economic value of these materials in relation to the costs generated by their collection and recycling represents an additional obstacle that needs to be tackled to achieve better collection and recovery rates of plastics packaging waste. The **relative price of recyclates as compared to virgin resins is a key driver for an increased performance of the recycling chain**. In general, the fluctuation of the prices of virgin resins is decoupled from the prices of recycled resins. This discount changes according to the market conditions and is also affected by the quality (material properties and colour) of the recyclates. In general, in the EU the prices range between 10% and 75%.

However, the price gap between high-quality recycled resins and virgin materials can be considerably reduced or even reversed. In the short term, significant changes on the demand for a recycled resin and for a certain use can disturb the market. These changes could impact the price of the resins concerned. For example, the price of clear rPET in Europe had sometimes exceeded the price of clear virgin PET over short periods of time.

Besides these market distortions, stakeholders consulted in the context of the present study suggested that the industry is willing to pay for recyclates as much as it does for the supply of virgin resins as long as the quality requirements are met. Therefore, **the current demand could be fulfilled with a higher share of recyclates if the quality set by the end-user is met.**

Issues related to contamination and traceability

A prerequisite for increased performance and investments in the recycling chain is the existence of a demand capable of absorbing the outputs of the recycling facilities. Simultaneously evidence collected through the present study suggests that at least in Germany, the UK and France, the industry is willing to absorb the recyclates if they meet their requirements. The country analysis indicate that the waste collection plays a key role in the recycling performance, as this step impacts the contamination levels of the flows entering recycling facilities and therefore the performance and costs of sorting.

Collection of household waste

Specifically, in countries with an immature household waste management scheme (e.g. Poland), with non-harmonised collection schemes (e.g. UK) or with sorting processes from mixed waste (e.g. Spain), the organic waste can be an important source of contamination in the recycling processes, thus lowering the quality of the output. As a consequence, advanced and costly sorting equipment and technologies are required to decontaminate plastic waste to ensure that recycling of the sorted waste is cost effective and that the output can meet the quality requirements.

On the contrary **in countries where more selective sorting takes place at the source** (e.g. existence of separate bins for plastics, separation by shapes or/and colour, existence of deposit systems, etc.), **the risk of contamination is reduced**. Consequently, the input in the sorting and recycling facilities is of higher quality and the fulfilment of the requirements of the end users becomes more feasible both in technical and economic terms. As also highlighted in the European Commission's strategy on plastics[26], the implementation of the existing acquis, particularly about the separate collection requirements as set by the EU legislation, is a key prerequisite to achieve circular economy for the plastics industry.

The table (Table 9) below shows the collection and recycling rates, as these have been calculated in the context of the present study. It must be noted that the recycling rate refers to actual recycling rates of polyolefin plastics and not to the total amounts of plastics collected for recycling. The collection rates are more commonly reported by Member States (see Table 4). The table shows that the type of collection scheme in place has a significant impact on the overall performance of recycling. Germany, which has developed a deposit scheme for PET bottles and a separate collection for plastics, demonstrates by far the highest performance. Italy demonstrates good recycling performance due to the mature collection scheme in the country. France and Spain have also developed separate schemes, but the recycling performance is rather weak. This can be explained by the fact that in France separate collection is not mature yet for all shapes and resins, whereas in Spain there is a high share of plastics from residual waste that contaminates plastic stream. UK shows the lowest performance, largely due to significant amounts of plastic waste being exported to extra-EU countries.

[26] European commission (2017), Strategy on Plastics in a Circular Economy

Table 9: Collection schemes in France, Germany, UK, Spain and Italy and their performances on the collection and recycling of polyolefin and PET plastics

Country	Type of collection scheme	Collection rate	Recycling rate
France	Separate collection on HH bottles and flasks, and ongoing extension to all packaging	44%	21%
Germany	Deposit scheme for PET bottles and "yellow bins" for all others and separation by colour	76%	36%
UK	Significant non-collected amount of household containers	38%	22%
Spain	A separate collection scheme is in place but high amounts of plastic waste is collected from residual waste	41%	31%
Italy	A good level of separate collection in place	55%	42%

Overall deposit schemes seem to be the most effective for achieving high collection rates, both in terms of quality and quantity. The figure below illustrates the collection rates of PET bottles in Germany, France, Italy, Spain and the UK. The introduction of the deposit scheme in Germany led to significantly higher collection rates compared to the other countries. France demonstrates a higher collection rate than Italy due to higher coverage of separate collection within its territory. UK exports most of its waste due to low collection and sorting qualities.

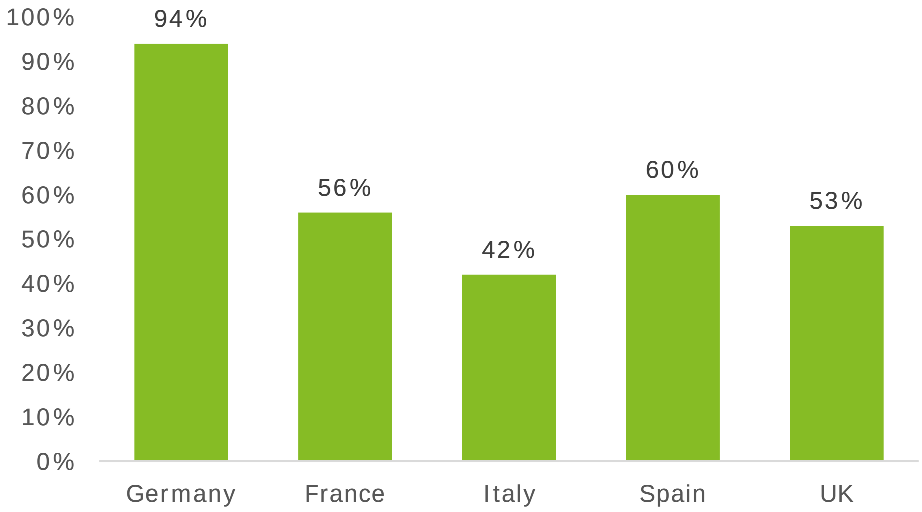


Figure 6: Collection rates of PET bottles in 2015[27]

In terms of quality, as shown in Table 10, the overall content of contaminants in recycled flakes is significantly lower in Germany compared to the other countries for all contaminants except polyamides (PA). The latter is attributed to the collecting sacks used in the automatic return machines as well as due to blended packaging which includes a layer of PA.

Table 10: Content of contaminants in PET flakes[27]

Country	Contaminants		
	PVC (ppm)	PA (ppm)	Other contaminants (ppm)
Germany	16.4	32.1	29.4
France	313.8	4.1	136.2
Italy	387.1	6.5	542.4

This evidence shows that at least for PET bottles, a deposit scheme is the most efficient collection method, both in terms of quantity and quality of the collected material.

[27] Petcore (2015), Post consumer PET Recycling in Europe 2014 and prospects to 2019

Collection of industrial and commercial waste

In all of the studied countries **industrial & commercial waste stream** (including post-industrial) **tends to be of a higher quality compared to household packaging stream**, leading to lower recycling performance for the latter. Indeed, in the EU (as well as in North America) the recycling rates of the post-industrial plastic waste are higher than of household waste. In addition, large packaging items (e.g. pallets and crates) are often reused 20 to 100 times before recycling[28]. The homogeneity and large volumes of industrial waste create economies of scale that allow for a more cost-effective recycling and facilitate the production of purer recyclates. For example, a manufacturer of cosmetic packaging consulted in the present study stated that most of the recyclates used in his plants are absorbed from commercial and industrial waste.

Nevertheless, after having attempted to collect the corresponding data during the present study, one can conclude that the industrial and commercial packaging waste is not adequately monitored. In most cases, this stream is treated directly by the industry and the commercial sectors, and often the packaging is either reused in industrial processes (e.g. in-house melting and reuse in the production process) or sold to third party recyclers **without being properly monitored by a waste management scheme**. This imposes a barrier in the calculation of the targets at the Member State level and imposes risks in ensuring a level playing field within specific Member States or across the EU.

Closer monitoring of these streams would not only reduce above-specified issues but would also allow for the identification of opportunities, particularly with regards to the use of low quality household flows in industrial applications.

III.4.3. Sorting and recycling

Certain quality issues need to be addressed by advanced technologies

In some cases the required quality can be achieved through the application of specific technologies. For example, for the production of rPET, depending on the quality of the collected waste, advanced optical sorters might be required to achieve high quality for food-compliant applications or fibres. Similarly, for HDPE traces of other resins are often present and specific sorters might be needed to sharply separate PP from HDPE. The same issues are faced in LDPE recycling, when removing pollutants (complex films, dyes, biowaste, etc.).

Chemical recycling is still at early stages of development and is not expected to be fully operational before 2025.

The investments required are high

The implementation of advanced sorting technologies requires significant investments which would eventually increase the cost of recycling and affect the whole recycling chain. The average price of a sorting machine is around 300 000 €, and in some cases, several machines are needed to achieve the targeted quality.

Investments often differ depending on the processed resin. For PET bottles for example, the revenues from recycling are higher than the cost of collection, sorting and recycling[29]. Nevertheless, on average the costs are higher than the revenues for the treatment of plastic packaging waste when compared to residual waste (excluding the environmental and social externalities).

III.4.4. End use

Diverse performance per shape and resin

By default, the industry demands a continuous supply of raw materials both in terms of quality and quantity. **A fluctuating supply could lead to disruptions in the production or affect the quality of the products.** A recent survey conducted among 485 converters, showed that the quality and steadiness of supply is a key barrier in the use of recycled plastics with 60% of the respondents stating that finding a satisfactory supply is hard or very hard[30]**.** Fluctuations could also lead to significant changes in the prices of recycled resins and consequently create uncertainty in the market which would act as a barrier to investments. The economic incentives to use recycled plastic materials in products are weak.

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[28] Ellen MacArthur Foundation (2017), The new plastics economy – Catalysing action
[29] European commission (2017), Strategy on Plastics in a Circular Economy
[30] EuPC (2017), The usage or rPM by European Plastics Converters

Nevertheless, some distortions in the supply occur due to limitations imposed by EPR schemes, which do not allow recyclers to have access to multiple sources of household waste.

In addition, as highlighted above, **quality requirements set by end-users impose significant challenges to recyclers due to the high level of contamination of the packaging waste flow** (e.g. inputs containing additives that are not permitted in specific applications and cannot be removed through mechanical recycling). The quality issues are particularly significant when the waste is collected from residual waste. In such cases the outputs are used mostly in rough moulding applications (e.g. pots, buckets, etc.), as they are not suitable for technical applications (e.g. fibres and packaging).

Difficulty in fulfilling the needs of the users

Constant supplies rely on the performance of each step of the recycling chain. If the collection of packaging flows is performant, both in terms of the quality and quantity of the collected waste, the output of the recycling facilities would be also more constant and require lower investment and operational costs.

With the exception of rPET, currently there is no constant high flow of high quality recyclates and no clear horizontal approach on identifying chemicals that shall be eliminated at the design phrase to address the contamination of recyclates.[31]

III.4.5. Lack of communication across the whole value chain

Overall the whole value chain is characterised by lack of communication which prevents the understanding of the needs and constrains. There are several effective and efficient initiatives deployed in specific Member States, but collectively they are not adequate to deliver high quality recycling at the EU level. The scaling up of such initiatives is prevented significantly by inadequate awareness throughout the whole value chain. Communication is inadequate, particularly in the following areas:

- In general **manufacturers and end-users** avoid disclosing information on the share of recycled material in their products, as they could be perceived to have lower quality;
- Despite the increasing awareness of the general public, **consumers** still have limited knowledge on plastic-related aspects (e.g. the importance of separate collection to achieve higher quantity and quality of recyclates);
- The cooperation between **manufacturers, sorting centres and recyclers** can be weak. For example, some of the HDPE bottles were replaced by PET covered with LDPE, or PS which causes problems during sorting process as these items are not detected as PET;x`
- There is limited cooperation between **manufacturers from different sectors** to identify opportunities in standardising the composition of plastics for a cross-sectoral use of recyclates.

The removal of these communication gaps is a prerequisite for achieving a 55% target of high quality recycling. The importance of an increased value chain collaboration was also highlighted in a recent survey among almost 500 converters[32].

III.5. Challenges and opportunities

Based on the analysis of the current situation (sections III.3 and III.4), the main challenges and opportunities for the plastic recycling sector are summarised hereunder.

Challenges

Improvements of the waste management practices and particularly the increased levels of separate collection have led to cleaner yields with smaller levels of contamination from hazardous substances, biowaste and non-plastic materials. Nevertheless, in parallel, the marketing and intrinsic needs of packaging as well as other products are becoming more complex and fragmented under the efforts of manufacturers to differentiate their products by fulfilling specific elements. The **increased complexity of packaging** is often reinforced by higher requirements on the health safety, especially in relation to food-contact applications. The complexity of packaging contributes to a high level of **contamination** of the collected waste that reaches the sorting and recycling facilities.

[31] European commission (2017), Strategy on Plastics in a Circular Economy
[32] EuPC (2017), The usage or rPM by European Plastics Converters

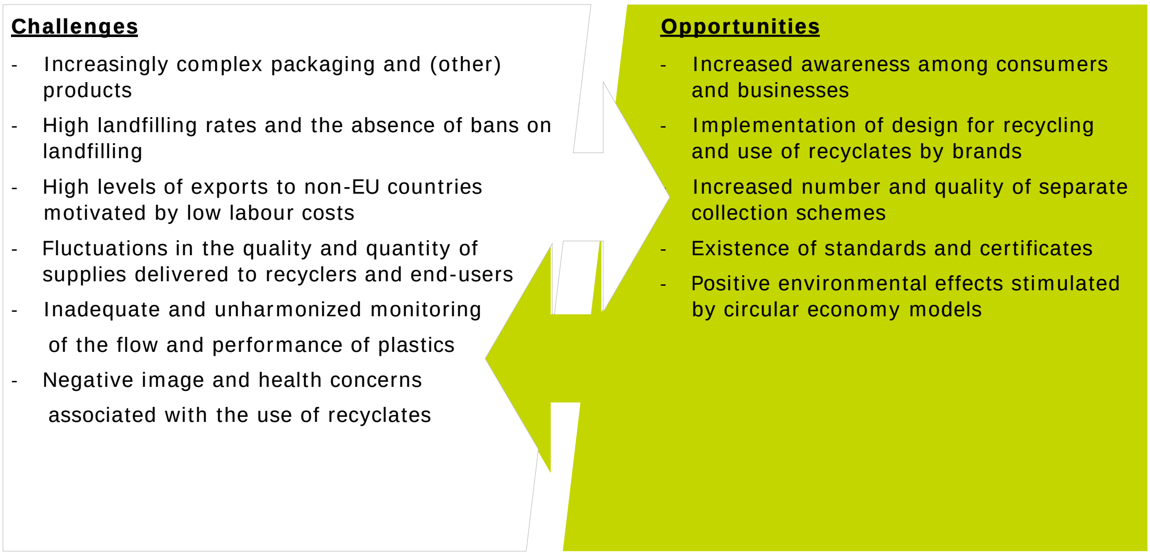

Figure 7: Challenges and opportunities for the recycling sector

Simultaneously the low cost of certain waste treatment methods does not create the necessary signals that would direct the collected packaging waste towards recycling: with some exceptions (e.g. Germany), **landfilling remains a significant treatment method in the absence of bans or high landfill rates**. Under the absence of the necessary price signals, even landfill bans might lead the flows of plastics to incineration or **exports to extra-EU countries** instead of recycling.

In terms of supply of recyclates, the problem is faced both by recyclers and end-users: recyclers can have difficulties related to the **heterogeneous flows** received by their plants (shapes, share of plastics, pollutants, seasonal variation, etc.) and thus have difficulties in ensuring a **constant supply of recyclates** (both in terms of quality and quantity). This lack of vision and assurance on the supply of recycled plastics can divert the **preference of end-users** towards virgin materials. Virgin materials are often preferred due to the **negative image and health concerns** in relation to the use of recyclates, particularly in food-contact applications despite the existence of strict requirements.

The identification of areas of improvements remains a difficult task, as the flows of plastics **often are not monitored adequately** (especially with the commercial and industrial waste).

Opportunities

Nevertheless, there are also several opportunities which could drive improvements in the whole value chain: there is an **increased awareness both from the supply and demand side on plastics related issues** (e.g. marine litter) which can result in the creation of a business case for the achievement of the 55% recycling target. Rising awareness is reflected in the CSR and marketing strategies of companies, together with communication campaigns organised by EPR schemes.

Front-running industries are improving their performance through **better design for recycling** and increased use of recyclates in their products[33]. In terms of implementation, separate collection schemes are increasing in number and quality of output. The EPR schemes have a key role in achieving high effectiveness and creating investment incentives for efficient and **advanced sorting and recycling technologies,** which have been implemented even on smaller scales. The existence **of standards and certificates**, demonstrating compliance with the requirements of end-users, allow a higher intake of recyclates even in applications with high quality standards. Simultaneously, moving from linear to **circular economy models** throughout the whole recycling chain, optimises resource yields through the circulation of plastics and thus reduces the environmental externalities.

[33] Ellen MacArthour Foundation (2017), The new plastics economy – Catalysing action

IV. Solutions to achieve the expected targets

This chapter projects a realistic and effective diversion of the flows to reach the 55% target, identifies a set of measures to achieve this diversion and presents an impact assessment of these measures.

IV.1. The situation in 2025

The quantification of the efforts needed to reach the 55% target is carried out by:

- Estimating the additional quantities of plastics packaging to collect and recycle in order to achieve the 55% target, regardless of the resin type or the origin.
- Assessing the targets by main resins, their origin (i.e. whether these could derive from household or commercial and industrial waste) and the main end-markets that could absorb the collected and recycled resins.

The type of information considered includes, for instance, the origins and amount of HDPE that could be directed towards the construction sector and the additional amount of PET which the packaging sector could absorb for food contact or non-food related packaging.

These potential country-specific flows are aggregated and presented in the Sankey diagram in Figure 8. Thus, this Sankey diagram presents the flows in 2025 under a situation where the 55% target is implemented. In the Sankey diagram the implementation of the target does not take into account the extra-EU exports. If these are to be taken into account, the performance of the recycling is expected to reach 65%. In this context, the performance described in the Sankey diagram below exceeds the target by 10% as the extra-EU exports can be included in the estimation of the recycling performance.

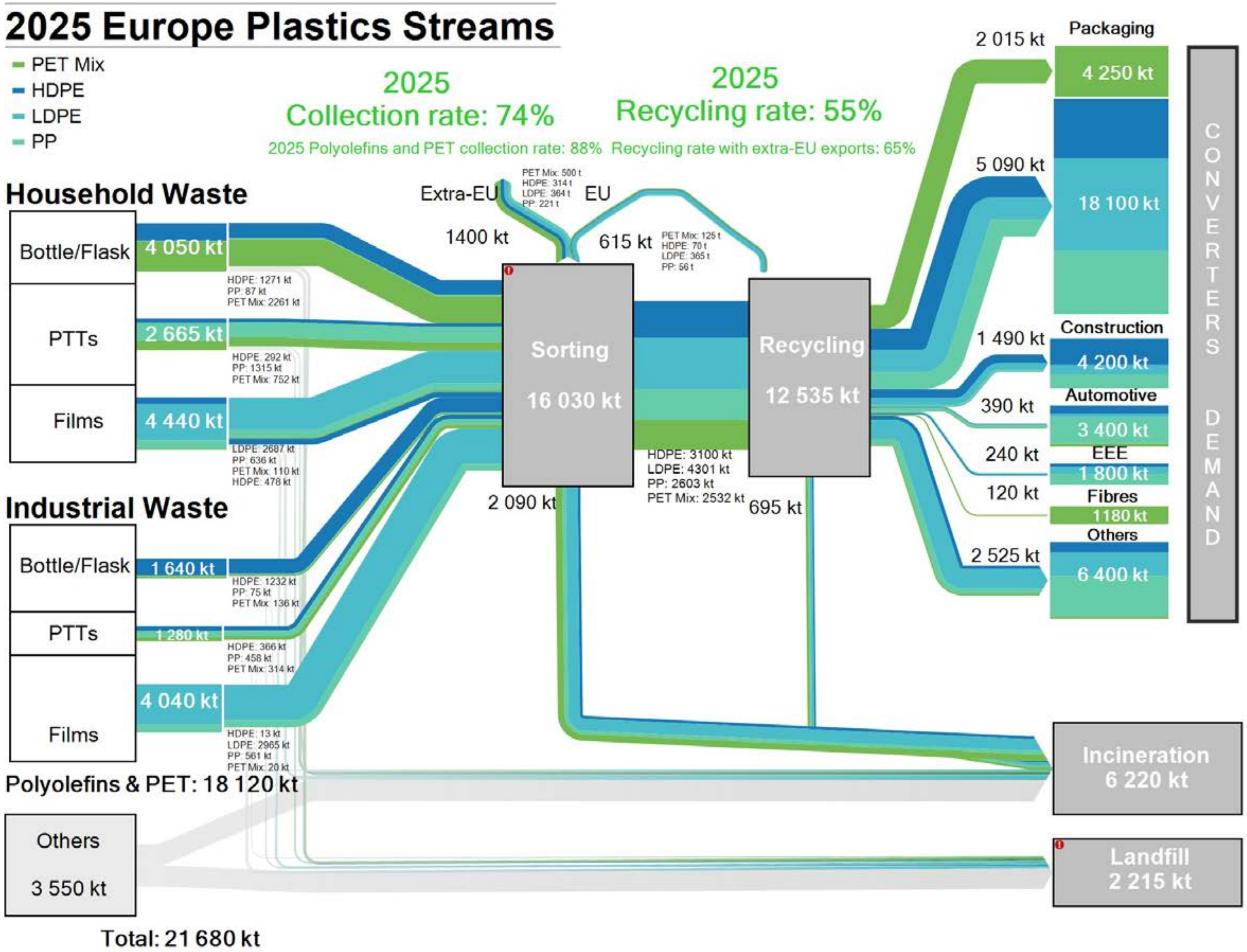

Figure 8: Sankey diagram of the plastics packaging waste flows in 2025

IV.1.1. Waste generation

The 2025 flows assume a 2.4 % increase per year between 2014 and 2025. The share of the waste generation per resin is the same as in 2014. For example, compared to 2014, an additional amount of 577 kt PET bottles will be generated whereas for HDPE films this amount will reach 125 kt. It is assumed that 84% of plastic packaging waste generation originates from polyolefins and PET, and 16% from other resins. The same ratio applies in 2014. In total, 21,680 kt of plastic packaging will be generated in 2025 out of which 18,125kt are PET and polyolefins.

IV.1.2. Collection, sorting and exports

The refusal rate is expected to increase in the following years until 2025 despite the technological developments. This is due to the absorption of lower qualities of plastic waste in the sorting and recycling facilities.

Due to the existing EU legislation on landfilling, which calls for a reduction to less than 10% of landfilling by 2030, the 2,090 kt of plastic packaging refused at the sorting stage is expected to be directed to incineration.

Due to a high share of other resins (16%) used for plastic packaging, the collection rate of PET and polyolefins must reach 88% in 2025 for each source. In the 2025 estimates, a 74% collection rate is applied to all resins and shapes. In this context, important improvements are required for all types of generated waste when compared to 2014 (see Table 6). These efforts should be directed mainly to shapes and resins that had low collection rates in 2014 (e.g. household HDPE bottles, pots and trays).

The ban of the extra-EU exports is expected to lead to a significant reduction of the extra-EU exports. Despite the ban, it is assumed that 50% of the 2014 levels of the exports will remain. These exports will be absorbed by other importing countries, including Malaysia, Indonesia and Vietnam.

Alternatively, if a significant amount of resins under the category “others” is replaced by polyolefins or PET, or if assuming that the effectiveness of the recycling of other resins will be as high as the one for PET and polyolefins, a 67% collection rate for all plastic packaging waste would be adequate. Currently there is no suitable evidence supporting this assumption.

IV.1.3. End-users

Since 2010 the overall plastic raw materials demand in the EU has stabilised at around 30 Mt for the polyolefins and PET. Based on this trend it is assumed that the demand will not increase significantly between 2014 and 2025.

Achieving a 55% recycling target in 2025 means that approximately 12 Mt of recycled material needs to be absorbed by the end-markets. Compared to 2014, this corresponds to more than twice the amount of the total recycled material and to about one third of the plastic used in the different end-markets. As a result, the main sectors that use recycled resins in 2014 will be saturated. This indicates that sectors with low penetration rates will need to increase significantly the use of recyclates. These markets are mainly the sectors with a high demand of plastics and a low use of recycled material.

Table 11 below present the share of recyclates absorbed in 2014 and 2025. As shown in the table, significant improvements are required in all sectors, as the penetration rate needs to increase from approximately 7.1x`% to 30.2%. This rate needs to particularly increase in the packaging sector, but also in building & construction, automotive and other applications. The increase of share of recyclates in building and construction is expected to be less challenging compared to the packaging sector due to more tolerant technical requirements. The EEE and automotive industries can also contribute in the end-use of the additional recyclates but at a smaller extent due to the strict technical requirements.

Table 11: Penetration rate of recyclates per sector

Industry	Resins	Penetration rate of recyclates 2014	Penetration rate of recyclates 2025	Recycled 2025 (t)
Packaging	PET	9.5%	47.0%	2,015
	HDPE	3.7%	35.3%	1,764
	LDPE	3.0%	24.2%	1,887
	PP	1.7%	27.2%	1,438
	Total	**4.1%**	**31.8%**	**7,104**
Construction	HDPE	18.6%	33.0%	740
	LDPE	26.5%	75.0%	550
	PP	6.6%	16.4%	200
	Total	**16.5%**	**35.5%**	**1,490**
Automotive	PET	2.5%	27.0%	70
	HDPE	2.2%	9.8%	70
	LDPE	0.0%	0.0%	0
	PP	7.7%	11.8%	250
	Total	**5.5%**	**11.6%**	**390**
EEE	PET	0.0%	0.0%	0
	HDPE	5.4%	39.3%	112
	LDPE	0.0%	5.7%	30
	PP	7.4%	10.2%	100
	Total	**4.9%**	**13.5%**	**242**
Others	PET	56.6%	69.8%	128
	HDPE	16.6%	37.1%	310
	LDPE	20.6%	80.0%	1,614
	PP	2.9%	14.0%	473
	Total	**11.8%**	**39.3%**	**2,525**
Fibres	PET	13.2%	10.1%	120
	Total	**13.2%**	10.1%	120
Total	**-**	**7.1%**	**30.2%**	**11,871**

IV.2. Measures required to reach the 2025 target

Based on the analysis provided in sections IV.2 (quantitative analysis of the situation), III.4 (qualitative analysis of the situation) and III.4 (key challenges and opportunities), the current section aims at providing concrete measures on how to reach the 2025 target. The identification of the measures is also built on recent reports of plastic-related challenges, particularly the Ellen MacArthur Foundation report[34] and a report carried out by the British Plastics Federation[35].

The measures that are required in each of the main steps of the recycling value chain are summarised below. In addition, the table shows the main actors that need to be involved for the development and implementation of the target. Given the complexity of the challenges and the different actors that are involved in the recycling chain a common solution does not exist.

The analysis reveals measures which are different in nature and whose implementation requires the involvement of different actors.

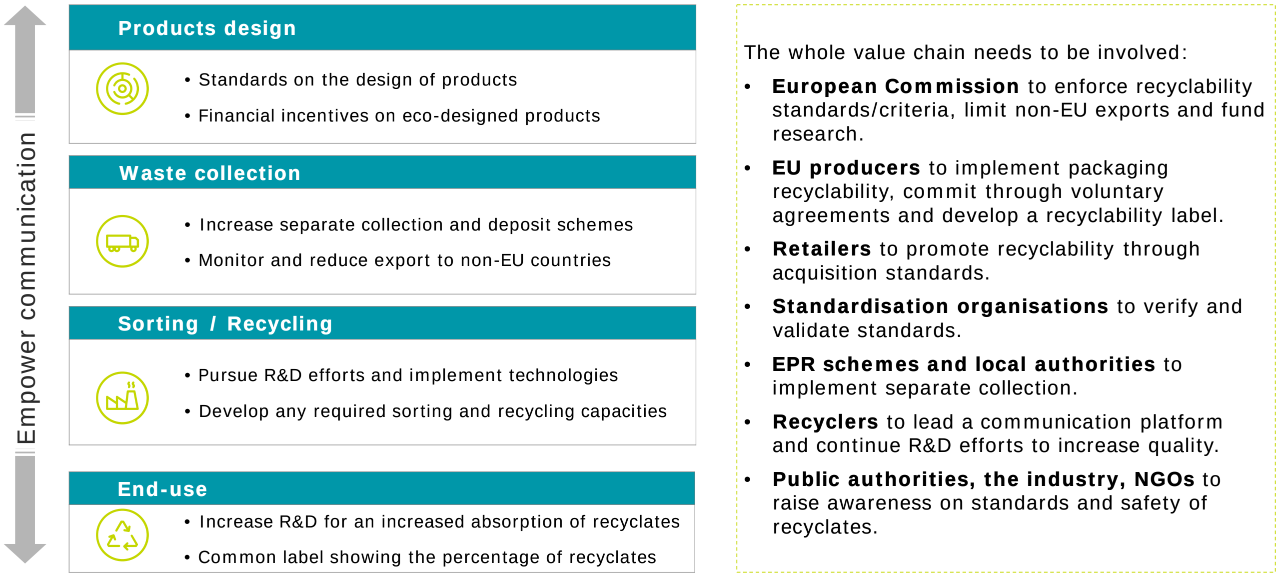

Figure 9: Measures required to achieve the 2025 target

The sections below provide a detailed description of the measures, together with the implementing actors and a suggested timeframe. The enhanced communication is presented as a horizontal measure as it involves all steps of the value chain.

IV.2.1. Measures on product design

Product design is a crucial step in achieving high-quality collection, sorting and recycling. Currently the high levels of complexity and diversity of plastics put on the market lead to the development of highly heterogeneous streams. In this context and as stipulated by the European Commission Strategy on Plastics[36], the design which facilitates recycling is even more important than single-use plastics.

Two main measures on product design would be effective. The first measure puts forward specific design for recycling standards and the second focuses on financial incentives for considering the environmental externalities of plastics.

	Design for Recycling
Description	The definition of mandatory standards by the large retailers in Member States has a great potential in driving an increase of the quality and recyclability of the design in all types of packaging. Specific design for recycling standards needs to be established to: • Avoid small format packaging • Identify alternatives to the unrecyclable multi-material packaging • Set a preference for clear or light-coloured materials over coloured or opaque materials • Develop standards on reusable packaging particularly in the commercial and industrial sectors The standards need to be uniformly imposed at the EU level to ensure a level playing field. Where relevant, Member State specificities need to be taken into account, in particular with regards to the timeline of implementation.
Responsibilities	Existing standards can already be applied at a voluntary basis by manufacturers and promoted by retailers. Retailers could first apply the standards in their own brands and

[34] Ellen MacArthur Foundation (2017), The new plastics economy – Catalysing action
[35] British Plastics Federation (2016), The UK plastics industry: A Strategic Vision for Growth
[36] European commission (2017), Strategy on Plastics in a Circular Economy

	then require the uptake of these standards on other suppliers. Gradually the standards may become compulsory through EU guidelines and regulations. Standardisation organisations will verify and validate the compliance of products with the standards.
Timeframe	3 years

	Financial incentives on products designed for recycling
Description	A bonus/malus system could be established by EPR schemes to ensure lower participation fees per kg for products that meet the standards and higher rates for non-compliant products put on the market.
Responsibilities	EPR schemes are in the best position to set up the bonus/malus system as they have a direct role in setting and collecting the fees. For waste flows that are not covered by the EPR schemes (e.g. the commercial and industrial waste in some Member States) such financial incentives should be provided through national fiscal measures, such as VAT discounts.
Timeframe	3 years

IV.2.2. Measures on waste collection

The quality of the collected plastic waste is highly affected by the performance of the collection schemes that are put in place. A low performance of the collection schemes leads to a degradation of plastic waste from the presence of other materials, such as organic waste or glass. Overall the collection has a particularly important influence on all the subsequent steps of the recycling chain. For example, if all waste is collected in one single stream, the output will have a higher level of contamination, resulting in either a lower quality of recyclates or the need for more expensive sorting equipment.

The two measures presented below focus on improving significantly the collection schemes and keeping the collected plastic waste in the EU to ensure circularity.

	Increase of separate collection and deposit schemes
Description	Separate collection schemes should be implemented in all Member States as required by the existing EU acquis. In certain cases separate collection should be complemented or replaced by deposit schemes. Deposit schemes seem to be the most effective instrument in achieving high quality and quantity of recycling. However, the shift to deposit schemes needs to be assessed at the local level to enable a good understanding of the environmental, social and economic impacts. Simultaneously, landfilling should be phased out or where feasible banned and incineration limited to non-recyclable streams and residues from sorting and recycling.
Responsibilities	The collection schemes should be enforced by the national authorities that are responsible for waste management in the respective countries. The design and implementation of these schemes should be carried out by EPR schemes or municipalities. The effectiveness and cost-efficiency of deposit schemes should be assessed at a Member State level and implemented where their overall impact is positive.
Timeframe	2 years for the assessment of deposit schemes and 5 years for their implementation

	Monitor and reduce exports to extra-EU countries
Description	The option of exporting plastic waste to EU or extra-EU counties is an option that is foreseen and allowed by the existing EU legislation given that there is sound evidence that recovery of materials is taking place under conditions that are equivalent to the EU legislation. Nevertheless, the monitoring of the recycling activities in extra-EU countries remains a difficult task especially since these take place in several countries. An improved monitoring framework is necessary but not completely in line with the objectives of the circular economy. In this context, a closer monitoring should be coupled with significant reductions of extra-EU exports, in order to: • Keep valuable plastic materials in the EU to boost the local economy • Create economies of scale to promote further investments in quality sorting and recycling • Reduce unnecessary environmental impacts that are caused by the long-distance transportation to Asian countries • Make the supply of quality recyclates more stable The reduction of extra-EU exports would also reduce the need of complex and costly monitoring in extra-EU counties. The very recent ban on waste imports in China

	imposes problems but at the same time presents an opportunity to focus on developing the recycling market for low-quality waste inside the EU borders.
Responsibilities	In the short term, extra-EU exports can be reduced through industry voluntary agreements. In the mid-term, the exports of the most valuable resin (e.g. PET) could be banned through an amendment of the EU legislation on the exports of waste.
Timeframe	1 year for the voluntary agreements and 3 years for the legislative amendments.

IV.2.3. Measures on sorting / recycling

Most plastics have different processing requirements. Those contaminated even with small amounts of other types of plastic (i.e. in terms of resin or additives) or other waste streams are difficult to recycle and require intensive treatment to produce high quality recyclates. Sorting plastics from other waste streams and contaminants is therefore essential for efficient reprocessing, and has an impact on both the cost of recycling and the quality (purity) of the recyclates.

Sorting and recycling are highly affected by the design of products and performance of the collection schemes. Even if the performance in these steps is improved, certain technical barriers need to be addressed through increased R&D efforts to allow for the recycling of residual plastic waste. Simultaneously recycling and sorting infrastructure needs to grow in order to allow the processing of larger amounts of waste.

Pursue R&D efforts and implement technologies	
Description	Further R&D efforts are required, particularly for sorting and recycling of the following applications: • LDPE films, Food-contact HDPE and PP, Multi-material packaging. • Sorting of mixed waste and in general waste with high contamination levels In parallel, efforts on the development, scale up and identification of limitations of chemical and thermochemical recycling should continue.
Responsibilities	R&D efforts should be implemented through joint efforts of manufacturers, recyclers and sorting facilities. Such efforts could be co-funded through the EU research funds.
Timeframe	8 years

Develop any required sorting and recycling capacities	
Description	Improvements in the design for recycling of plastic packaging in combination with more efficient and effective collection schemes would increase the quality of recycled plastic packaging waste and thus increase the financial incentives for advancements in recycling. Increased levels of recycling, both in terms of quality and quantity are expected to deploy and scale up advanced and high-quality sorting and recycling practices. To this end the deployment of efficient separate collection methods, including a separate collection bin is particularly important to increase the quality of the waste that enters the facility. Nevertheless, in the short term, direct financial incentives will be required to boost the development of the required capacity, particularly in Member States with low performance. Such incentives include public co-funding (e.g. from European Regional Development Funds), green bonds, tax exempts and contributions from EPR schemes.
Responsibilities	In the short term, the European Commission could fund the required capacities, particularly in areas with inadequate market incentives. The increased target will act as a demand-pull measure and in combination with the improved design for recycling and collection schemes, it is expected to create the necessary market conditions.
Timeframe	Funding mechanisms should be established within 3 years.

IV.2.4. Measures on end-use

End-users often have a limited visibility on the supply of recyclates in terms of both quantity and quality. Acquisition agreements, coupled with design for recycling standards and adequate sorting and recycling infrastructure are expected to guarantee a timely supply of the required materials. In parallel the development of a label will build trust and eventually increase the consumer demand for products with a high content of recyclates.

Promote an increased absorption of recyclates	
Description	More R&D is required to understand the potential use of recyclates in various sectors and applications. Simultaneously a higher demand should be promoted through green public procurement in the public sector and voluntary agreements in the private one.

	The design for recycling standards will act as a verification of the required quality and prevent cases where manufacturers demand unnecessarily strict standards (e.g. food-contact requirements for applications irrelevant with food).
Responsibilities	Public authorities and end-users should commit formally to a minimum content of recyclates in the products which they acquire or produce.
Timeframe	3 years

	Common label showing the percentage of recyclates
Description	A label showing the recycled content of packaging will allow to communicate in a direct manner with consumers the importance of plastic recycling and promote packaging with a high content of recycled plastic. Ideally the appearance of the label and the methodology for calculating the content should be harmonized, in order to increase label awareness and recognition amongst consumers. The uptake of the logo could be done at a voluntary basis in the same manner as is done for other environmental labels (e.g. the European Ecolabel).
Responsibilities	The logo needs to be implemented directly by manufacturers but the responsibility for the design and content should fall on the EPR schemes to ensure a common approach. Standardisation organisations will have the role in verifying the displayed content.
Timeframe	3 years

IV.2.5. Horizontal measures

The implementation of the measures requires a strong and constant communication throughout the whole recycling chain, from packaging designers to end-users. Enhanced communication will complement and support, as well as create synergies amongst the different measures. It will also help in identifying possible areas of improvement.

	Develop a common understanding of needs and constraints
Description	A common understanding could be developed through the development of a communication platform aiming to: • Exchange best practices on the treatment of plastic waste and the absorption of recyclates • Disseminate the technological developments in sorting and recycling and direct the R&D efforts on the most critical areas • Alert when new materials are put on the market and ensure that the required technology for its treatment is in place • Build consumer awareness on the importance of plastic recycling and the safety of recyclates Help in understanding not only the future demand but also the technologies and skills required. Better communication throughout the whole recycling chain could be built on existing initiatives (e.g. the Dialogue Mechanism developed under the Ellen MacArthur Foundation's New Plastics Economy Initiative).
Responsibilities	EPR schemes are in the best position to drive such initiatives as they already act as the link between manufacturers, retailers and sorting and recycling facilities. EPR schemes have also a direct role in developing the collection schemes and monitoring the flows of plastics.
Timeframe	3 years

IV.3. Impacts assessment of measures

The impact assessment performed here consists in an update of the results of the previous study carried out by Deloitte. The model includes the following steps in the waste management chain of the packaging waste stream as defined in the scope of this study:

- Collection of the plastic-containing waste (including transportation to sorting facilities);
- Pre-treatment and sorting of the collected waste into different plastic resins;
- Transportation of the sorted plastic resins to recycling facilities and other management options;
- Recycling by type of resin;

- Final disposal or incineration (with or without energy recovery) of plastic waste not collected for recycling and plastic waste from pre-treatment/sorting and recycling operations.

The model includes a *Baseline* scenario where the current situation (reference year 2014) and all associated parameters are analysed in detail. Using the *Baseline* as a point of departure, 2 possible future scenarios were developed, which refer to the year 2025:

- A “business as usual” (BAU) scenario where no additional effort is made to improve recycling performance and the recycling rates remain the same as the Baseline but with increased waste generation.
- An “EU Targets” (Targets) scenario where a 55% recycling target is achieved.

The section below presents the environmental, economic and social impacts of the Targets scenario compared to the BAU scenario.

IV.3.1. Impact assessment results

The impact assessment shows very positive results in saving considerable amounts of GHG emissions and in creating thousands of indirect and direct jobs within the EU economy. Moreover, the costs of achieving these results are quite moderate and certainly feasible.

Environmental impacts

High environmental benefits, in terms of GHG emissions savings, demonstrate the significant contribution of plastic recycling in improving the sustainability of the EU-28 while at the same time safeguarding precious resources within the EU economy, making it more resilient to external pressures. The figure below presents a comparison of the GHG emissions per activity through the whole value chain.

The overall GHG emissions avoided in a year (2025) are estimated at 14.8 Mt. To give an order of magnitude, these emissions are equal to the carbon footprint of approximately 2.1 million EU citizens[37]. The previous study which addressed sectors other than packaging, estimated the savings at 7.75 Mt. Although the present study considerers only packaging the results are higher as larger amounts of the generation of packaging waste assumed. Additionally, in comparison to the previous study, the present study considers only the impacts the at the EU level, as the amounts recycled in the EU and the extra-EU exports are separated. In this context, the reduction of the extra-EU exports would generate significant environmental benefits as a significantly higher amount of recyclates would substitute the production of virgin plastics. Furthermore, substitution of virgin with recycled plastics would result in saving 80% of CO_2 emissions.

The highest savings will derive from the substitution of virgin by recycled plastics (16.6 Mt) **and reduced incineration** (9.2 Mt) which will be counterbalanced mainly by the increased recycling activity (3.11 tonnes Mt).

[37] According to Eurostat the carbon footprint of a EU citizen in 2014 was 7.2 tonnes

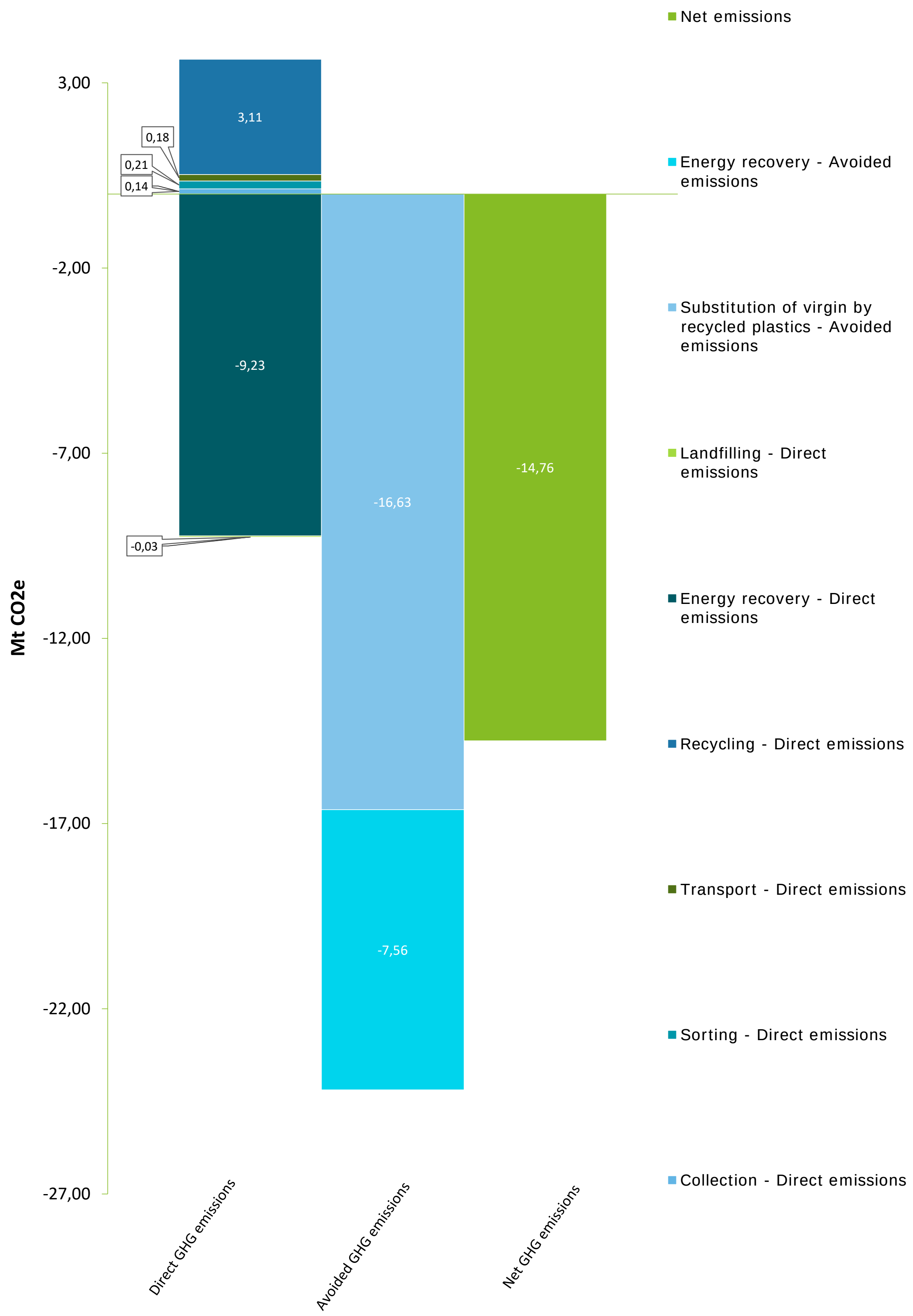

Figure 10: Comparison of annual GHG emissions in the scenarios *Targets*, compared to *BAU* in 2025 (in Mt)

Social impacts

Increasing the recycling of plastics will have a positive effect on EU employment.

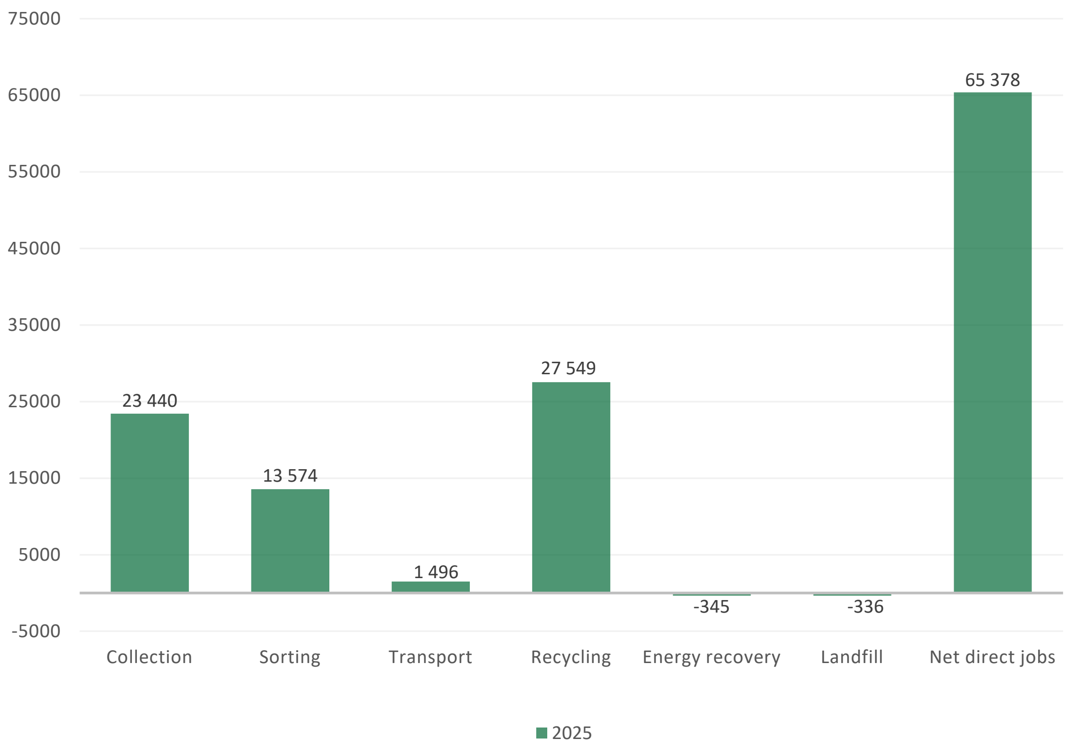

Figure 11: Number of direct jobs created along the plastic recycling value chain in Targets 2025 compared to respective BAU (in FTE)

It is estimated that approximately 65,400 new jobs could be created directly in the plastics packaging recycling value chain by 2025, with over 50,000 additional indirect jobs supporting the sector and its operations. The increase will derive not only from increased sorting and recycling activities but also from the improved collection. In addition, the reduction of extra-EU exports of plastic waste will transfer jobs from Asian countries to the EU.

Economic impacts

The economic impacts of increased EU recycling targets appear positive and will reach 1,049 million EUR by 2025. All sectors will benefit from an increased target except for landfills (losses of 246.8 million EUR) and energy recovery facilities (losses of 255.6 million EUR). Landfilling has particularly high environmental externalities which are not included in the cost estimates. Energy recovery will remain an important method of waste treatment where recycling is technically difficult or cost-inefficient. The moderate loss of about 255.6 million EUR seems to be necessary to achieve a higher circularity of plastics.

The economic benefit for the recycling industry assumes moderate prices of recyclates. If all recycled plastics are sold at the highest prices[38], a possible net benefit of about 1872.4 million EUR will be generated. A marginal benefit of 33.5 million EUR is expected if recycled plastics are sold at low prices.

[38] In the study different ranges of prices were considered for each resin. For example, for PET the prices ranged from 650 EUR/ tonne for PET to 1000 EUR/ tonne

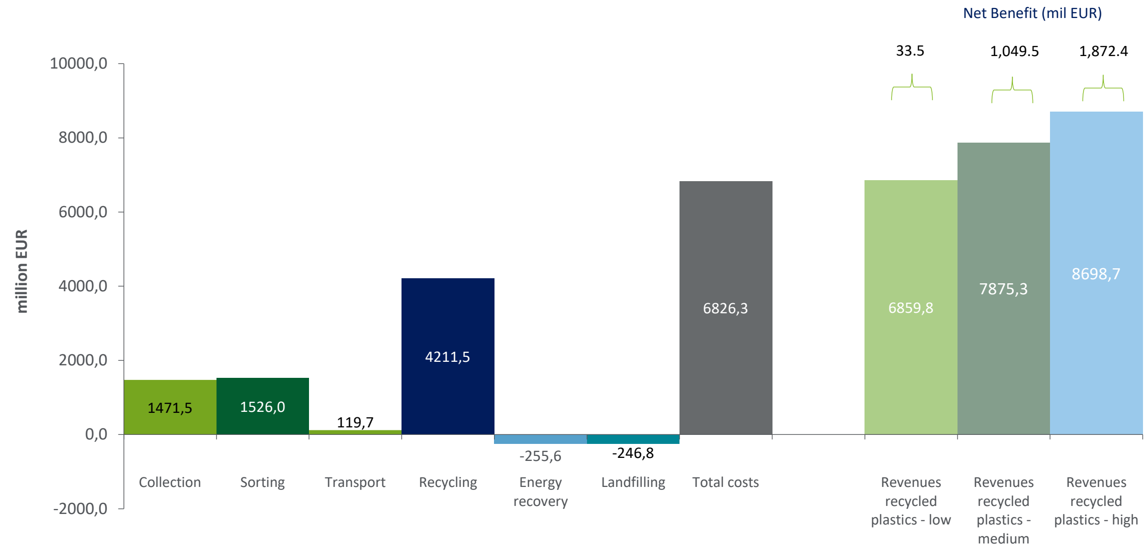

Figure 12: Average operating costs of the plastic recycling value chain and revenues from recycled plastics at the end of the chain in 2025 (comparison of BAU and Targets scenarios in million EUR)

The impact assessment model with the parameters of the previous Deloitte study with a 55% target for all sectors (packaging, WEEE, ELV, building and construction, agricultural and other sectors) lead to an estimated cost of 162 million EUR. In the present study, revenues from plastic recycling are expected due to an assumed higher increase on the generation of packaging waste between 2014 and 2025. In addition, contrary to the previous study, the present one assumes a decrease on the revenues of the energy recovery facilities.

According to the previous Deloitte study, in 2012, there was a lack of recycling and sorting capacity that was required to process the amounts of waste generated in the EU. The treatment of the additional amounts will therefore require an extra capacity in order to cover the current missing one as well to accommodate increasing amounts of plastic waste that will be diverted to recycling in response to the 55% target to be achieved at the EU level including the reduction of the extra-EU exports. The investment required is estimated to range between 4.1 and 6.5 billion EUR. The exact cost will largely depend on the size of the facilities as these can have a substantial impact on the required investment costs. For example, in France the investment costs vary between 500 EUR/t and 800 EUR/t. Similarly, for recycling facilities, the cost can vary between 275 EUR/t and 750 EUR/t depending on the capacity and resin treated.

V. Conclusions

In order to achieve the 55% recycling target by 2025 players from the whole plastics value chain have to be engaged. Furthermore, rather than focusing on one single initiative, collective efforts are necessary in a number of areas. Through the analysis of the collected data and consultations with industry experts, the study points out the below listed measures as possible means of attaining the 55% target (the recycling performance reaches 65% if the extra-EU exports are included).

Design for recycling standards should be made uniform and harmonized across the entire EU, ensuring a level playing field for the stakeholders and enabling an increase in the industry performance. To facilitate and support the implementation of the standards, financial incentives favouring the recyclable products could be introduced.

Improved **collection schemes** are imperative in increasing the quality of the recycled input. Consequently, separate collection or deposit schemes, where feasible and cost-efficient, should be implemented in all Member States. At the same time, Member States should work towards limiting and if possible banning the landfilling operations. If the circularity of plastics is to be achieved, exports of the collected waste should be avoided and the incineration (limited to non-recyclable streams and residues from sorting and recycling) and landfill operations brought to minimum or phased out.

As the design of products and the collection and sorting schemes improves, other areas in the value chain will have to adapt as well. Increased R&D efforts are needed to overcome particular technical barriers when processing the residual waste. Furthermore, the current recycling and sorting infrastructures will have to grow in order to absorb larger amounts of collected waste.

Increased transparency in terms of the quantity and quality of the available supplies would positively affect the demand for recyclates among the end-users. In addition to design for recycling standards and improved sorting and recycling infrastructures, acquisition agreements can help increase the transparency in the supply chain. Developing a standard label will strengthen the trust and boost the consumer demand for products containing high levels of recycled materials.

To complement the mentioned efforts, **strong and constant communication** throughout the entire recycling value chain is vital. Improved communication will facilitate the attainment of the targets and bring light to additional areas that require improvement. Additionally, to foster the compliance with the laid-out means, legislation and policy measure have to be reformed and enforced. Uniform legislation across Member States would encourage a higher uptake of recyclates.

If the 55% target is achieved **significant environmental benefits will be generated, and additional jobs will be created within the EU territory.** In economic terms, **recyclates priced at high and medium levels will create profits, therefore it is essential to focus on quality collection, sorting and recycling and at the same time enable design for recycling.** A 55% recycling rate will result in 12 Mt of recyclates put on the market that have to be absorbed by the converters. Consequently, main sectors that currently consumer recyclates will become saturated, while the sectors with low demand will have to significantly increase the use of recycled materials.