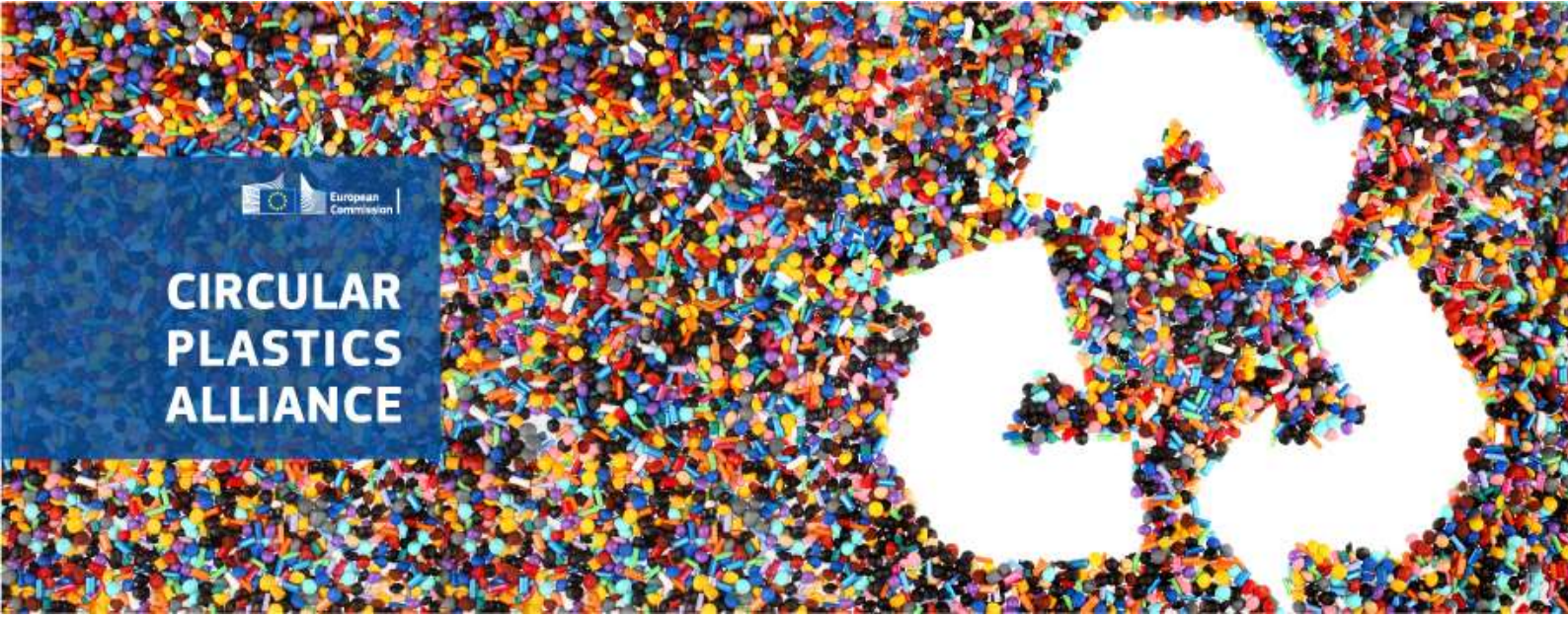

Circular Plastics Alliance – Roadmap to 10 Mt recycled content by 2025

23 September 2021

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List of used abbreviations

10 Mt target	Goal of placing on the EU market each year 10 million tonnes (Mt) of plastic recyclates in final products by 2025
ABS	Acrylonitrile butadiene styrene
AI	Artificial Intelligence
APE	Agriculture Plastics Environment
ASR	Automotive Shredding Residue
ATF	Authorized treatment facility
B€	Billion € (1,000,000,000€)
BTWG	Technical Board Working Group
CEFLEX	Circular Economy for Flexible Packaging
CEN	European Committee for Standardization
CENELEC	European Committee for Electrotechnical Standardization
CPA	Circular Plastics Alliance
DPT	Design Product Team
EC	European Commission
EEE	Electrical and electronic equipment
ELV	End-of-Life Vehicle
EPPA	European Trade Association of PVC Window System Suppliers
EPR	Extended Producer Responsibility
ETP	Engineering Thermoplastics
EU+2	EU28 + Norway, Switzerland
EU+3	EU27 + Norway, Switzerland, and the United Kingdom
EU27	2021 European Union's Member States
EU27+UK	2021 European Union's Member States + United Kingdom
EU28	2018 European Union's Member States
ISO	International Organization for Standardization
JRC	Joint Research Centre
Kt	Kilo tonne (1,000 tonnes)
LDPE	Low-density polyethylene
M€	Million € (1,000,000€)
Mt	Million tonne (1,000,000 tonnes)
NCS	National collection scheme
NIR	Near-Infrared
PCR	Post-consumer recycled
PCS	Polymer-clad silica fiber
PE	Polyethylene
PET	Polyethylene terephthalate
PP	Polypropylene
PPWD	Packaging and Packaging Waste Directive
PRO	Producer Responsibility Organisation
PS	Polystyrene
PST	Post-Shredding Technologies
PU	Polyurethane
PVC	Polyvinyl chloride
R&D	Research and development
rPVC	Recycled Polyvinyl chloride
SWD	Staff Working Document
TRL	Technology Readiness Level
WEEE	Waste electrical and electronic equipment
WFD	Waste Framework Directive
WG	Working Group

Executive Summary

The Circular Plastics Alliance is an initiative under the European Strategy for Plastics.[1] The European Commission (EC) launched[2] the Circular Plastics Alliance (CPA) in December 2018 to help the plastics' value-chain meeting their pledged goal of placing on the EU market each year 10 million tonnes (Mt) of plastic recyclates in final products by 2025[3] (hereafter: "the 10 Mt target"). The Alliance covers the full plastics value chain and to date includes over 290 organisations representing industry, research organisations, and public authorities, while its membership continues to grow.

In 2018, the European Commission has set the 10 Mt target in Annex III of the European Strategy for Plastics, based on the geographical scope of the EU at that time, hence EU28. The CPA, in agreement with the Commission, has kept this geographical scope, hence EU27+UK, for the 10 Mt target and therefore for the present analysis. The monitoring system of the CPA will also cover the production and use of recycled plastics in EU27+UK.

The present report gives an overview on how the CPA estimates that it will get to the 10 Mt target by 2025, showing gaps and investment needs within and across the CPA sectors ("Working Groups - WG), namely: packaging, automotive, construction, electronic and electrical equipment (EEE) and agriculture.

This report is based on the identification of three main obstacles to a higher uptake of recycled plastics in Europe, namely:

A. The adequate quality of recycled plastics, adapted to the requirements of the second life application.
B. The availability and security of supply of recycled plastics.
C. The competitiveness (attractiveness/acceptance) of recycled plastics vs. virgin plastics.

The vision of the CPA, as expressed in its declaration, is that it is possible to lift these three obstacles and reach the 10 Mt target of the EU by 4 action domains:

1) Improving the design of plastic products;
2) Increasing the collection of plastic waste and improving the quality of the sorting;
3) Investing in the development and deployment of better recycling technologies; and
4) Structurally support the demand of recycled content.

The CPA will review and update this report each year, with a particular focus on updating/producing data, including when new product groups are included in the CPA

[1] https://ec.europa.eu/environment/circular-economy/pdf/plastics-strategy-brochure.pdf
[2] https://ec.europa.eu/commission/presscorner/detail/en/IP_18_6728
[3] https://ec.europa.eu/growth/industry/policy/circular-plastics-alliance_en

Design Work Plan,[4] and when feedback is received from non-signatories, in particular public authorities.

The untapped potential report is in this sense a living document for the CPA to have a complete overview of the industry needs and investments required to deliver the 10 Mt target.

The untapped potential report considers the investments' needs of the plastics value chain to overcome the barriers identified to the additional uptake of plastic recyclates. The specific investments needs are addressed in the sectorial subchapters at the end of this document, together with industry-specific untapped potentials (see Table 1).

Table 1. Estimated untapped potentials per sector by 2025.

Sector	Estimated untapped potential: waste collected and sorted for recycling (sent to recyclers) by 2025 (Mt)	Estimated untapped potential: recycling outputs by 2025 (Mt)
Packaging	3.10	2.75
Electronic and electrical equipment (EEE)	0.37	0.29
Construction	0.26	0.05
Automotive	0.14	0.06
Agriculture	0.33	0.22
Total	4.20	3.37

The estimated untapped potential, under a **realistic scenario and considering the current market situation and the expected improvements** is thus **3.4 Mt of additional post-consumer recycling outputs by 2025**, including approximately 2.8 Mt coming from the packaging sector. This has been calculated against a 2020 baseline[5] (i.e., 6.3 Mt of recycling outputs of post-consumer waste origin), hence a total of approx. 9.7 Mt of recycled plastics of post-consumer origin placed on the European market by 2025.

[4] https://ec.europa.eu/growth/industry/policy/circular-plastics-alliance/commitments-and-deliverables_en

[5] Where data for the 2020 baseline was not available at WG level, the estimations are based on the 2018 baseline from PlasticsEurope 2019 study "The Circular Economy for plastics – A European overview". https://www.plasticseurope.org/en/resources/publications/1899-circular-economy-plastics-european-overview

To this should be added approximately 0.5 Mt of pre-consumer PVC waste originating from the construction sector and recycled back into construction products. These quantities are included in the Vinylplus voluntary commitment, which has been accepted in its totality as a valid pledge by the European Commission, and therefore counted in the Commission's assessment report of the pledges of March 2019.[6]

In summary, **the CPA's analysis is that it will ensure the achievement of around 10.2 Mt of recycling outputs in Europe by 2025, under a realistic if not conservative scenario**, assuming for example no advancement of recycled quantities in sectors currently not covered by the CPA (e.g., textiles, furniture, leisure), plus the following assumptions:

1) The priority products listed in the Design Work Plan are recyclable by 2025; this is a commitment of the CPA, which is currently working on design guidelines and standards. It should be noted that improved product design will translate into increased production of recycled plastics by 2025 only for short lifetime products by 2025, i.e., packaging.
2) Coordinated action between the CPA and Member States is taken to substantially improve the collection and sorting-for-recycling of plastic waste in the EU, with a focus on the priority products identified in the Design Work Plan of the CPA, especially packaging by 2025.
3) The necessary investments are done in sorting and recycling capacities (see below)
4) Exports of sorted plastic waste and recycled plastics (recyclates) are significantly reduced by 2025.

The overall investment needs have been estimated for post-consumer recycling in the CPA sectors. Investments in recycling of pre-consumer waste, in sectors not covered by the CPA, or for export, are not included in the below estimates. The baseline year for the investment needs is 2020.

The investment needs have been estimated with two different scenarios: 1) scenario where only existing waste management technologies are addressed with no improvement in product design (**Technology Scenario**); and 2) a scenario addresses improved product design and advancement in sorting and recycling technologies (**Additional design for recycling scenario**).

For both scenarios, the waste management capacity must increase with an additional 3.8 Mt recycling capacity, and additional 4.2 Mt sorting capacity. Combined with that, the scale-up and integration of innovative technologies in the management of plastic waste, will result in an overall ~8.437B€ needed investments by the plastics' value-chain to meet the estimated untapped potential.[7]

[6] The European Commission has counted the Vinylplus pledge for its assessment report of March 2019 (https://ec.europa.eu/docsroom/documents/34267).
[7] Investment needs are calculated on the whole generation of plastic waste at EU level, where 18% is not deriving from CPA industry sectors. The subchapters of the present document, instead, provide for the CPA specific investment needs.

Table 2. Overall investment needs.

Step in the value chain	Estimated capacity in 2025 (Mt)	Estimated investments (B€)	Total (B€)
Technology scenario			
Sorting	16.7	2.52	
Recycling	12.8	5.10	7.62
Additional design for recycling scenario: 100M€+20%[8]			
Total cost for the industry			9.25

The first scenario sets the investments needs to increase the recycling capacity by 2025, the second considers the additional investments for design for recycling and the converters/producers investments required to upgrade the production and investments in advancements in sorting and recycling technologies.

The estimates are calculated **only for recycled plastics used in Europe by 2025, meaning that additional investments would be necessary to cover any increase in the quantities exported**. This exercise, with its limits, has been deemed necessary to provide an estimated best-case scenario. The investments have been calculated by the required installed capacity, per sector, to recycle the amount of additional recyclates required to fill the gap between 2020 and 2025 (Table 6).

For each CPA WG, the sectorial overview is provided at the end of the present document.

Table 3. Overall investment needs, scenario 1 and 2.

	Technology scenario											
	Sorting				Recycling							Tot.
	Capacity		Gap	Invest.	Capacity		Gap	Output			Invest.	Est.
	2020	2025 (Est.)		Est.	2020	2025 (Est.)		2020	2025	Gap	Est.	
	Mt	Mt	Mt	M€	Mt	Mt	Mt	Mt	Mt	Mt	M€	M€
Tot.	12.5	16.7	4.2	2,522	8.0	11.8	3.8	6.26	9.63	3.37	5,104	7,625

	Design for recycling scenario (+100M€+20% on M€ Est.)												
	Sorting				Recycling							Design for recycling	Tot.
	Capacity		Gap	Invest.	Capacity		Gap	Output			Invest.		
	2020	2025 (Est.)		Est.	2020	2025 (Est.)		2020	2025	Gap	Est.	Est.	Est.
	Mt	Mt	Mt	M€	Mt	Mt	Mt	Mt	Mt	Mt	M€	M€	M€
Tot.	12.5	16.7	4.2	2,522	8.0	11.8	3.8	6.26	9.63	3.37	6,629	100	9,251

The investment needs are calculated according to Table 6.

[8] 100M€ and 20% premium to upgrade the production, sorting, and recycling processes with the note that by 2025 max. 1 Mt of "new technology" sorting and recycling capacity can be installed.

1. Baseline: The Circular Economy for plastics – A European overview (2018)

The 2019 report published by PlasticsEurope "The Circular Economy for plastics – A European overview"[9] helps to better understand the overall challenges that must be addressed to increase the quantities of recycled plastic waste in Europe. This report, and the numbers provided in this chapter, focuses only on post-consumer waste, and have 2018 as the reference year, where data at WG level was not available or estimated for 2020. Pre-consumer waste is however an important plastic waste stream that needs to be valorised to contribute to the circular economy for plastics. Together with post-consumer waste, they contribute at recycling plastic waste and producing recycled plastics.

Figure 1 below describes the life cycle of plastics, including plastic products (e.g., a bottle, a pipe, etc.) or plastic parts in larger products (e.g., components and parts in vehicles, insulation for houses, etc.). The use-phase of those products depends on the application, ranging from less than one year to over fifty years. In a growing economy, this explains why collected waste quantities for a given year are considerably smaller than the plastic materials put on the market for the same year. Another reason is that not all plastic waste generated is collected or reported in statistics.

In 2018, 55 Mt of plastic materials were used by plastic converters in Europe to make plastic products or parts.

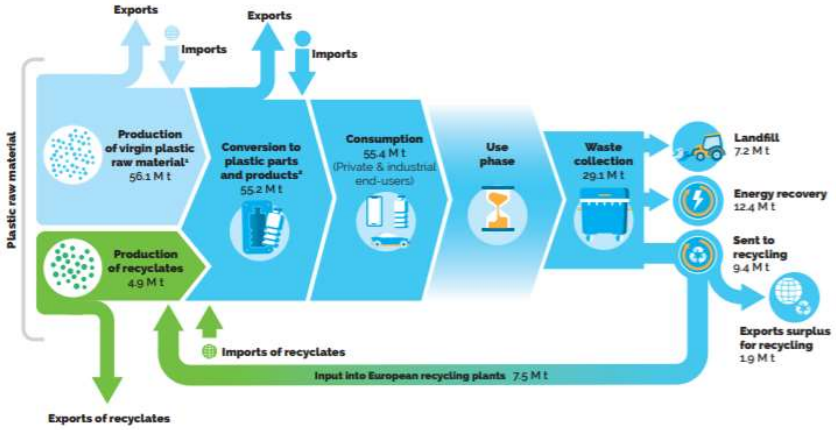


Figure 1. The life cycle of plastics (PlasticsEurope, 2019, p. 10)

In that same year, 29 Mt of plastic waste were collected, out of which close to 10 Mt of post-consumer plastic waste were sent to recycling, 7 Mt to landfills and over 12 Mt to energy recovery. These numbers show the clear untapped potential for more collection and sorting in view of recycling plastic waste currently going to landfills and energy recovery.

[9] https://www.plasticseurope.org/en/resources/publications/1899-circular-economy-plastics-european-overview

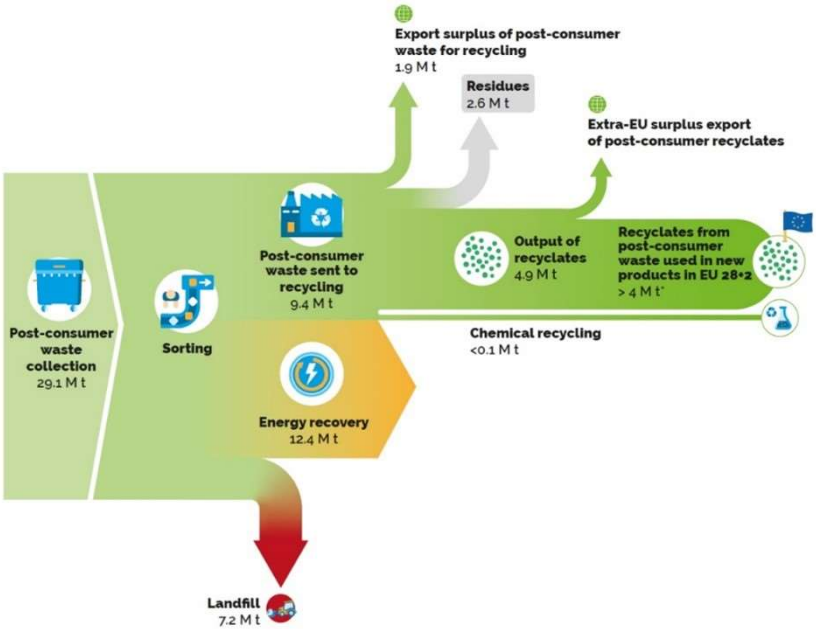


Figure 2. The end-of-life of post-consumer waste plastics. (PlasticsEurope, 2019, p. 17)

An important learning from this study is also that separate waste collection is correlated with higher recycling rates. Plastic waste recycling rates are ten times higher when collected separately compared to mixed residual collection schemes. This may however change in the future due to new technologies to extract plastic waste from the residual fraction, as seen for example in the Netherlands, Norway, and Spain.[10]

Figure 3. Waste collection efficiencies (PlasticsEurope, 2019, p. 15)

[10] https://www.ivar.no/plastic/

Out of the 9.4 Mt of plastic waste going to recyclers in 2018, 7.5 Mt went to European recyclers; the remainder was exported. This resulted in 4.9 Mt of recycled plastics produced in Europe of which 4 Mt were used in EU 27+3 products and packaging in 2018, the remaining 0.9 Mt being exported.

These numbers refer to the overall plastic waste generation and not exclusively resulting from the CPA industry sectors. To show the overall split, Figure 4 and Figure 5 provide also figures for those other industry sectors, including houseware, leisure, and sports.

Over 60% of the collected plastic waste comes from packaging, 6% from construction, 6% from electrical and electronic equipment (EEE), 5% from automotive and 5% from agriculture. The remainder 18% constitute of waste generating from other sectors not in the present scope of the CPA industry segments. The recycled plastics derived from these plastic wastes are used in different sectors with construction being one of the main markets using plastic recyclates with a share of close to 50% followed by packaging at 24%.

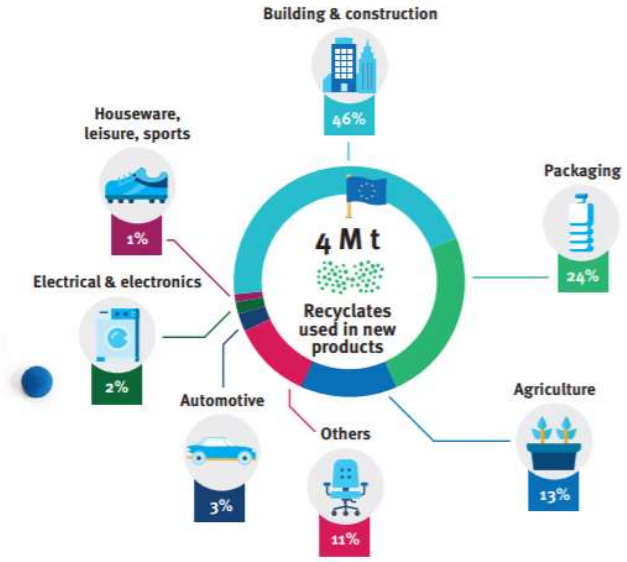


Figure 4. Shares of recyclates use in new products. (PlasticsEurope, 2019, p. 20)

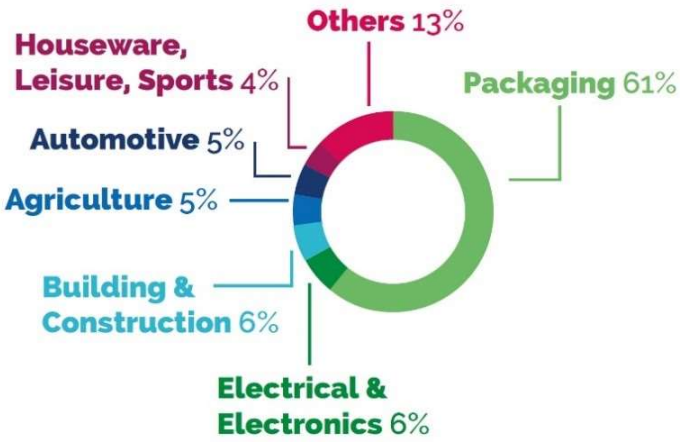


Figure 5. Shares of collected plastic waste. (PlasticsEurope, 2019, p. 14)

2. Untapped potential – The roadmap to 10 Mt

To reach the 10 Mt by 2025 (against 3.98 Mt in 2018), the CPA has analysed the legal, economic, and technical barriers to the uptake of recycled plastics, in the dedicated **CPA recycled content report**. From this research, which has been supported in parallel by other thematic groups, the CPA has built the untapped potential report on collection & sorting, design for recycling, and set out the R&D and investment needs.

a. Current barriers to increased uptake of recycled plastics

The overarching main barriers to more recycled plastics being taken up in European products are derived from the more detailed CPA market sector-based research on legal, economic, and technical barriers to uptake of recycled content and can be summarised along three main elements:

A. The adequate quality of recycled plastics, adapted to the requirements of the second life application.
B. The availability and security of supply of recycled plastics.
C. The competitiveness (attractiveness/acceptance) of recycled plastics vs. virgin plastics.

The CPA declaration proposes a vision and a series of actions to lift these 3 main obstacles to greater uptake of recycled plastics by 2025, including actions to improve collection & sorting, product design for recycling and R&D and investments. The CPA vision is that design for recycling, increased collection and better sorting will provide more reliable feedstock streams to the recyclers and – together with advancements in recycling technology - lead to the quality recycled plastics required by the market at a competitive price.

The CPA roadmap revolves around moving from a push market to a pull market for recycled plastics and putting in place the needed R&D and investments to reach the 10 Mt of recycled plastics in products and packaging.

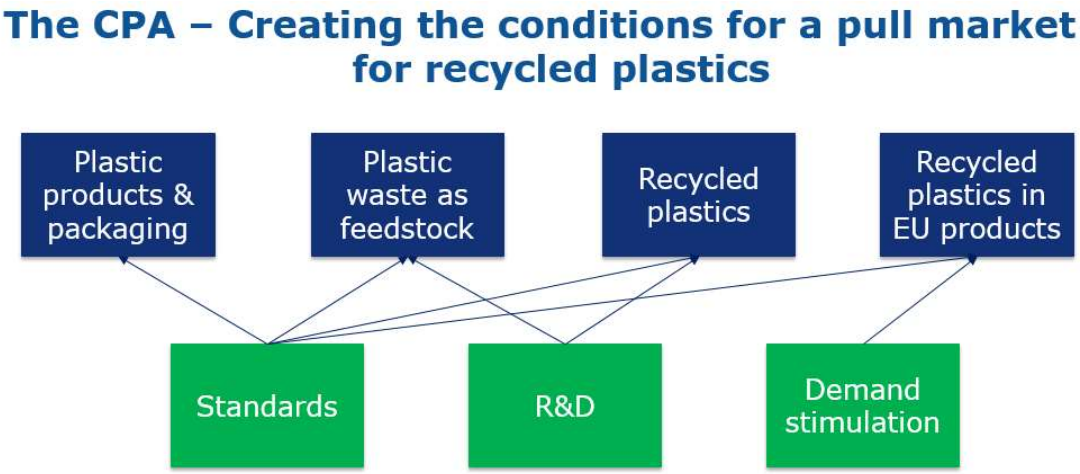


Figure 6. CPA: creating the condition for a pull market for recycled plastics.

b. Untapped potential collection & sorting

The full potential for greater uptake of recycled plastics will be reached by combining greater recyclability with efficient separate collection of plastic products and products containing plastics.

This section looks at the **untapped potential in collection & sorting estimated by the five sectorial Working groups** of the CPA (namely packaging, automotive, construction, electrical and electronic equipment, and agriculture), as each of the sectors have their specific collection and sorting schemes. Based on the research undertaken by the CPA for the state of play for collected and sorted plastic waste, it is estimated that a total of **21 Mt of plastic waste are collected in Europe annually from the sectors represented in the CPA**, which are the biggest plastics-using markets (reference years covering 2016 -2019 depending on sector, see Table 4).

Out of this, **9.2 Mt of plastic waste is sorted for recycling** (sent to recyclers as inputs), **including 7.5 Mt to recyclers located in Europe** (source: The Circular Economy – A European Overview, Plastics Europe 2019). **These 9.2 Mt result in 5.3 Mt of post-consumer recyclates produced in the EU. This reflects a yield of approximately 60%, where exports are considered as yield losses for materials not reaching EU recyclers.**[11]

In its Design Work plan published in November2020, the CPA estimated that to reach the 10 Mt target, assuming a 70% yield, at least 15 Mt of recyclable plastic waste should be sorted for recycling every year in Europe. **The Design work plan has now been updated, with new priority products added to the list, to ensure sufficient feedstock of recyclable plastic waste to realise the untapped potential scenario presented in this report.**[12]

[11] Exported sorted packaging waste represents around 23%.
[12] I.e., at least 16.7 Mt of recyclable plastic waste available for separate collection by 2025, see updated Design Work Plan.

The summary of the current situation is shown in Table 4. Each working group has used different sources to gather the data, as indicated in the footnotes. The table refers to post-consumer waste and is based on estimates.

It should be noted that for construction, automotive and EEE products in particular, the quantities of plastics placed on the market each year do not correspond to the waste generated, as these products have a very long service life, from 3-5 to 100 years in the case of pipes for example. This means that products arising as waste in 2019 were placed on the market several years or decades ago. Besides, not all the waste generated is collected and reported into official statistics.

The figure for plastics demand in construction, the sector which has the longest life products, from 20 to 100 years in some cases, highlights the impact that improved collection and sorting as well as design for recycling could have on future recycling volumes.

The figures in Table 4 are based mainly on estimates. Generally, directly reported data is only available where:

- European directives stipulate the need for recording plastic waste volumes, as it is the case for packaging, and for the whole waste product in which the plastic is one of the materials such as in the automotive and EEE sectors.
- Industry has taken voluntary action and set up collection and recycling schemes, as for PVC in construction (Vinylplus initiative).

Table 4. Overview of collected and sorted waste per sector

	Ref. Year(s)	European Converters Plastic demand	Tonnes of plastic waste collected	Tonnes sorted for recycling	Percentage sorted for recycling	Tonnes of recyclate produced in the EU	Percentage recyclate production out of sorted for recycling	Legislative framework in place
Agriculture[13]	2019	721,500[14]	756,000[15]	756,000[16]	100%	334,000	44%	Waste Framework Directive (WFD)[17] Landfill restrictions depending on Member State
Automotive[18]	2019	5.100.000	1,500,000	350,000	23%	150,000	43%	ELV Directive

[13] Data based on Survey undertaken by APE Europe on behalf of the CPA working group for agriculture EU28+2.
[14] This figure includes only non-packaging plastic products used directly by farmers in their production activities, with agronomic effect.
[15] Including soilage.
[16] This figure includes 40% soilage rate. The plastics content is 443.950 tonnes.
[17] *OJ L 312, 22.11.2008*, p. 3–30.
[18] Data based on Plastics Europe Report "The Circular Economy for Plastics" (2019).

Building & Construction[19]	2018	10,137,600[20]	1,746,000	450,000	26%	340,000	76%	Landfill restrictions depending on Member State National regulations on mandatory pre demolition audits in some countries
Packaging[21]	2016-2019	20,428,800	16,119,000	6,955,000	43%	3,906,000	56%[22]	Packaging and Packaging Waste Directive[23]
WEEE (household only)	2016	1,749,030	752,500	717,589	95%	561,373	78%	WEEE Directive[24]
	Total	33,036,930	20,873,500	9,228,589	58%	5,291,373 [25]	59%	

However, even where Directives require recording of waste volumes, such as the End-of-Life Vehicle (ELV) Directive,[26] as previously mentioned, the producer responsibility is focused on the whole product rather than on the plastic part of the product.

The CPA will take action to address such needs as described in its R& D agenda. Table 5 shows how the specific needs identified in the initial R&D workplan will address the various issues identified in the state of play for collected and sorted waste.

[19] Data based on Plastics Europe Report "The Circular Economy for Plastics" (2019), tonnes of recyclates produced based on estimates and discussion with the consultancy Conversio, experts in this field.
[20] Placed on the market data for a given year, bears no relevance to data for waste collected due to the long service life of the products.
[21] PCEP (LDPE / LLDPE, HDPE, PP): PO Waste Collection and Recycling in European Countries 2016. Conversio for PlasticsEurope; PETCORE: ICIS and PETCORE Europe Annual Survey on the European PET Recycle Industry 2017; SCS: Internal information 2017. EUMEPS: Survey carried out of EUMEP national members. Data relates to 2019.; Data relates to EU+2 (with the UK being within the EU at the time data was collected) other than PETCORE which relates to 28 of the countries in EU+2.
[22] This number considers exports, where around 23% of sorted packaging waste was exported. 73% is the yield of recyclates produced from sorted plastic waste supplied to EU+3 recyclers.
[23] *OJ L 365, 31.12.1994*, p. 10
[24] *OJ L 137, 24.07.2012,* p. 38-71
[25] Difference of 4.9 Mt reported by PlasticsEurope is explained that the 5.3 Mt include pre-consumer materials. This number, combined with the other industry sectors not participating to the CPA, gives the 6.35 Mt 2020 baseline scenario.
[26] *OJ L 269, 21.10.2000*, p. 34

Table 5. Specific R&D needs addressing the collection and sorting challenge (source: CPA R&D agenda)

Sector	Challenges identified in state of play	Specific needs highlighted by the R&D Agenda that will help to tackle these challenges	R&D response
Agriculture	Heavily soiled waste streams. Beyond good practices implemented by the farmer, the agri-plastic waste quality increase depends on technology used at farm to make waste a resource. R&D must be mobilized to provide solutions reducing waste at source such as heavily soiled products.	Need to increase recycled content in their plastic agri-products, increase collection and sorting, and improve the efficiency of the cleaning step to increase the recycling as well as the quality of the recyclates following harsh weather conditions.	CPA5: Improved recycled material properties
Automotive	Automotive shredder residue (ASR) mixed heterogenous material, difficult to sort plastics out of the waste stream.	Specific needs highlighted by the R&D Agenda that will help to tackle these challenges	CPA6: Better separation of different plastics
Construction products	Long service life, potential presence of legacy additives, now restricted under REACH	Construction products have the longest service life of up to 50 or 100 years and therefore are likely to contain substances with legal restriction. To prevent it, there is a need to develop efficient tracking, automated analysis and sorting systems.	CPA4: Develop and standardise methods for traceability CPA7: Detect and separate substances in waste
Packaging and EEE	Heavily contaminated waste streams	The Packaging and EEE groups insist on the need to create more food-contact recycled content by developing detection and separation technologies to remove the contamination from the stream and ensure isolation.	CPA7: Detect and separate substances in waste
Packaging	Laminated mixed polymer products	Packaging group identified a need for delamination technologies to overcome the challenges to recycle multi-materials or multi-layers packaging.	CPA6: Better separation of different plastics

c. Untapped potential addressed through design for recycling

The Design Work Plan of the CPA published in November 2020 identified 19 priority products, that the CPA commits to make more recyclable. The objective has been to generate sufficient recyclable plastic waste streams to contribute to the 10 Mt target, and the work plan has now been updated following the present analysis of the untapped potential[27].

This version of the Untapped Potential Report focuses on the sectorial analysis at industry level, providing the overall untapped potential and investment needs. Objective of upcoming updates on the report is to further extend the level of analysis to the priority products-level, to show the specific impact of design for recycling and collection and sorting improvements to the 10 Mt pledged goals by 2025.

To this regard, and for those priority products that can impact the most the achievement of the goal by 2025, the WGs, with the support of the DPTs, will investigate and populate the mass flow model created for the CPA by the Joint Research Centre of the European Commission (Figure 7). This model establishes the link between the "first life" and the "second life" of the priority products. The data feeding into the model comes from published literature, reviewed and corrected where necessary by the CPA Working groups.

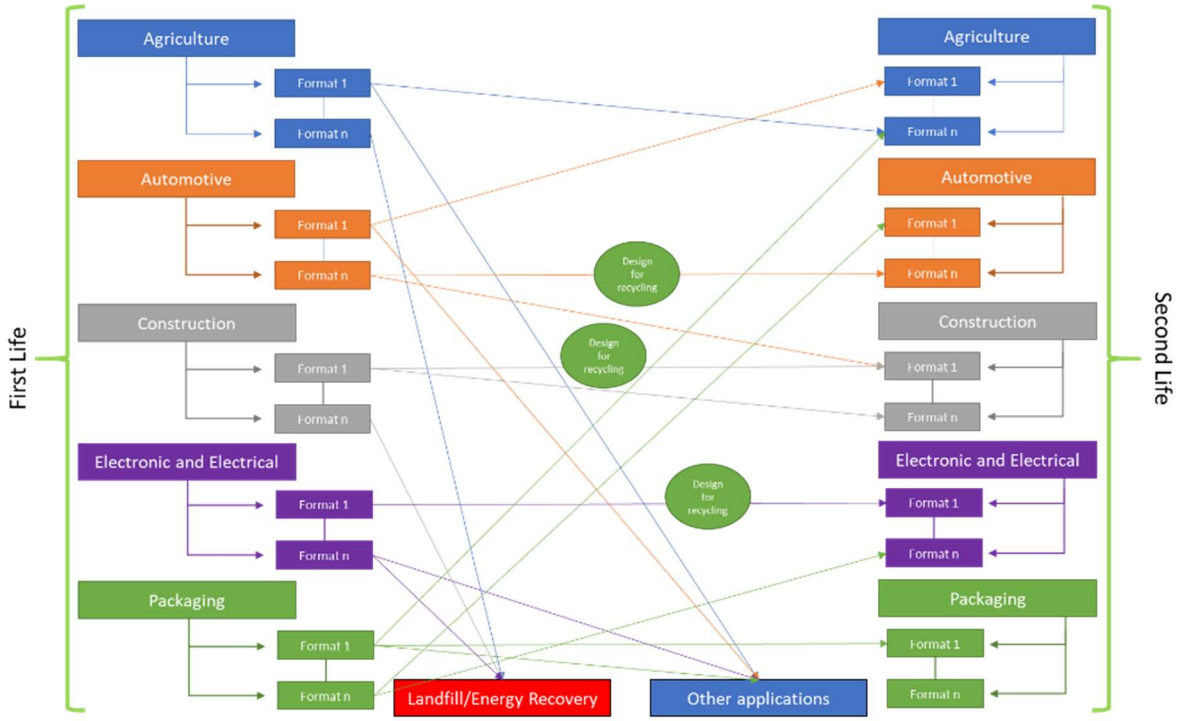


Figure 7. JRC mass flow model

[27] See updated Design Work plan

The Packaging WG, representing the industry sector with the higher untapped potential in terms of Mt of recyclates placed on the market, is currently fine-tuning this work to be published in future updates of the report.

The analysis of untapped potential and investment needs at priority products-level is based on the following assumptions:

- The improved recyclability of products is defined as the result from the implementation of the design guidelines being prepared by the CPA.
- The priority products that have long life cycles (e.g., construction, automotive, EEE products) are excluded in the calculation by 2025, as for these product categories, the products placed on the market today will not become waste available for recycling before 2025.

To operationalise recyclability for the priority products, the CPA will develop design guidelines, and actively contribute to turn these into European standards through the multi-stakeholder process within CEN/CENELEC.

To this regard, the European Commission is expected to issue a Standardisation Request on "recycled plastics and plastics recycling", following up on the report by BTWG 11 under the Preliminary and Ancillary action on Sustainable Chemicals[28] and on the Annual Union Work Programme on European Standardisation for 2019.[29] The Annex gives further details on the Standardisation approach proposed by the CPA.

[28] Grant Agreement n° CEN/000/2017-05 Sustainable Chemicals.
[29] SWD(2018) 434 final.

d. R&D and investment needs

Investments form an integral part in the development and realization of the CPA Plans. Signatories constantly weigh the questions 'what we do have today' vs. 'what is needed tomorrow'. The gap between 'today' and 'tomorrow' will be closed through a smart combination of scenarios.

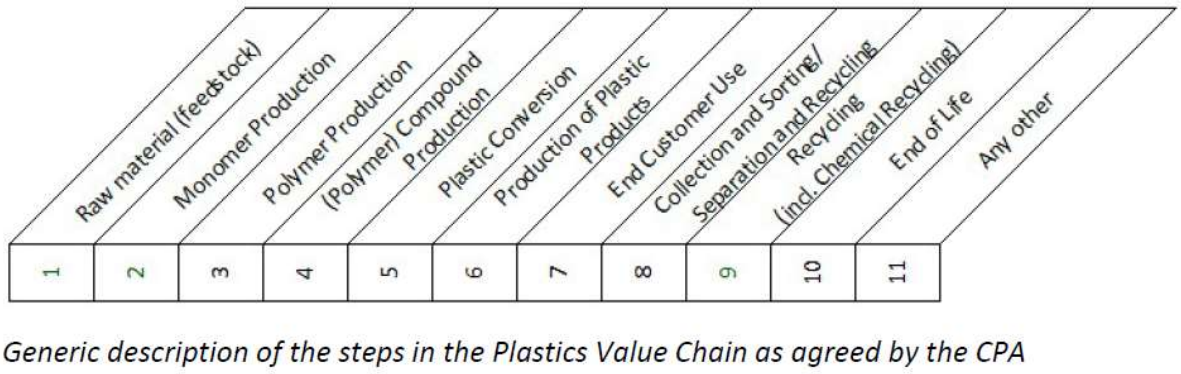
In this section of the untapped potential report the signatories of the CPA looked at the gaps and barriers identified and considered how investments can help to accelerate the closure of gaps and eliminate these barriers. Investment in this report include all three:

1. Investments in capacities and in upgrading existing waste management technologies via R&D programmes, and
2. Additional investments in capabilities.

Investment needs are calculated only on post-consumer waste materials, any investments to increase the uptake from pre-consumer waste materials shall be considered in addition to the estimates provided.

<u>Investments in capacities and in upgrading existing waste management technologies via R&D programmes</u>

Seven strategic R&D projects have been identified by the CPA members. Considering the timeline until 2025, the nature of the identified R&D needs is shorter-term. R&D needs were identified across the steps of the plastics value chain as shown below.



Generic description of the steps in the Plastics Value Chain as agreed by the CPA

Figure 8. Generic description of the steps in the Plastics Value Chain as agreed by the CPA.

CPA1: Recycling (value chain steps 9 - 1 - 2)
CPA2: Polymer-Chain recycling stability (value chain steps 3 – 8+9)
CPA3: Quality control and consistency of recycled plastic (value chain steps 5 – 6)
CPA4: Develop and standardise methods for traceability (value chain steps 5 – 6)
CPA5: Improved recycled material properties (value chain steps 8+9 – 5+6)
CPA6: Better separation of different plastics (value chain steps 8+9)
CPA7: Detect and separate substances in waste (value chain steps 8+9)

CPA1 covers further advancement, scale-up, integration and deployment of recycling technologies to address process yield, ability to handle a broader range of feedstock materials and mixed polymer streams. The scale-up and further integration of both recycling technologies enables a broader range of plastics to be recycled to a consistent high-quality output enabling recycling into demanding applications incl. food contact.

CPA2 addresses the stability of polymer-chain in recycling technologies using advanced stabiliser technologies. These stabilisers may also help to reduce odour problems reported along value chains.

Recycling technologies will need to create procedures to control the consistent quality of the recycled plastics (CPA3) as well as procedures (CPA5) to fulfil the growing demand for recycled content and keeping materials circling in the economy.

The quality of the recycled product can also be verified through the development of smart standardised traceability methods to better understand the origin of the products and substances (CPA4) and prevent some potentially hazardous substances to enter the system (CPA7). To reach this required quality, better technologies to detect, sort, and separate different layers of more complex product composition will also be essential (CPA6).

On top of these overall strategic R&D needs, CPA members also identified specific R&D needs related to each sector.[30]

The CPA estimates 75-100 million Euro will be required for the funding of R&D projects that will deliver a contribution by 2025 to the 10 Mt target. The "shorter-term" nature of these projects requires technologies to be proven and ready for scale-up and implementation. Typically starting at Technology Readiness Level (TRL) 7 and developing via scale-up to a TRL 8/9 level. R&D projects of these nature typically require a 15-20 million Euro investment.

Capex Investment needs in recycling and collection and sorting technologies

A group within the CPA, referred to as the CPA investment group, studied two scenarios to get a handle on qualifying and quantifying CPA investment needs.

Based on these scenario's the estimated capex investment is estimated in the range **of 7.625 to 9.251 B€** and addresses:

- Recycling capacities from 8 Mt → 11.8 Mt as a minimum in 2025
- Sorting capacities +4.2 Mt as a minimum in 2025
- Scale-up and integration of advanced/innovative technologies addressing design for recycling, recycled plastic quality, process yield, energy, sorting, traceability, and separation.

[30] https://ec.europa.eu/docsroom/documents/43693

I. Technology scenario – Upscaling existing waste management facilities by including new technologies (sorting and recycling)

In this scenario the current recycling installed capacities and collection and sorting capacities are identified. The output of these capacities, i.e., the number of recycled plastics available to enter the market is then estimated. The shortfall between what can go to the market today (baseline 2020), vs. what will be required by 2025 (10 Mt) defines capacity increases, i.e., investments in both collection and sorting plants and recycling plants.

- The Recycling capacities would need to be increased by 3.8 Mt.
- The Sorting capacity increase by 2025 is estimated at 4.2 Mt.

The CPA investment group estimates the investment needs to scale up the recycling industry as shown below in Table 6.

Table 6. Calculation method for investment needs

	Untapped potential (Mt)			Investment needs			Averaged total
	2020	2025	Gap		(€/tonne)	(M€)	(M€)
Recycling	**8.00**	**11.78**	**3.78**				
				Min	1200	4,536.60	
				Max	1500	5,670.75	5,103.7
Sorting	**12.50**	**16.70**	**4.20**				
				Min	500	2,101.36	
				Max	700	2,941.90	2,521.6
							Tot. 7,625.3

These numbers identify the necessary investments by the industry to adapt the waste management of plastic waste to the barriers identified in the update of recyclates in final products.

The CPA investment group therefore agreed technology to have a key role in achieving the CPA 10 Mt target while enhancing 'own sector circularity' and enabling 'inter-sector circularity'. The recyclate quality plays a dominant role in these.

Technology scenario investment estimate: **7.625B€**

Table 7. Investment needs: Technology Scenario

	Technology scenario											
	Sorting				Recycling							Tot.
	Capacity		Gap	Invest.	Capacity		Gap	Output			Invest.	Est.
	2020	2025 (Est.)		Est.	2020	2025 (Est.)		2020	2025	Gap	Est.	
	Mt	Mt	Mt	M€	Mt	Mt	Mt	Mt	Mt	Mt	M€	M€
Tot.	12.5	16.7	4.2	2,522	8.0	11.8	3.8	6.26	9.63	3.37	5,104	7,625

These numbers will need to be further validated and refined.

II. Design for Recycling scenario – *Driving gap-closure with design for recycling*

In this scenario the CPA investment group considered whether the gap towards 10 Mt can be closed by adding Design of Recycling.

In this scenario, investments in R&D for design for recycling, investments in the modification of existing plastic conversion equipment, and in sorting and recycling capabilities, are estimated in an additional premium of 100M€ + 20% on the overall technology scenario estimates.

This scenario also includes technology advancements in sorting and recycling to addressing process yield, energy, traceability & sorting capability, separation, and similar aspects.

In the design-for-recycling scenario investment in both collection and sorting capacity and recycling capacity are needed, however versus the technology scenario (see above) the following considerations are considered:

1. Design for Recycling positively contributes to the "yield" of recycling plants (reduction of mixed plastics, ease of recycling improved, ...). In a first estimate the CPA investment group estimates the maximum yield improvement being 10%.
2. Design for Recycling requires the collection and sorting step to be more selective, i.e., identify, sort, and separate the 'designed for recycling' products. New technologies from R&D needs CPA4 and CPA6 may come into play here. In a first pass the CPA investment group estimates a "premium" in the range of 20% to cover these improvements/investments to update production processes.

Under this scenario:

- The Recycling capacities would need to be increased by 3.8 Mt.
- The Sorting capacity increase by 2025 is estimated at 4.2 Mt.
- 100M€ + 20% premium, to upgrade the production, sorting, and recycling processes with the note that by 2025 max. 1 Mt of "new technology" sorting and recycling capacity can be installed.

Design for Recycling investment estimate: **9.251 B€ (+7.625*20% premium+100M€)**

Table 8. Investment needs: Design for Recycling Scenario.

	Design for recycling scenario (+100M€+20% on M€ Est.)												
	Sorting				Recycling							Design for recycling	Tot.
	Capacity		Gap	Invest.	Capacity		Gap	Output			Invest.		
	2020	2025 (Est.)		Est.	2020	2025 (Est.)		2020	2025	Gap	Est.	Est.	Est.
	Mt	Mt	Mt	M€	Mt	Mt	Mt	Mt	Mt	Mt	M€	M€	M€
Tot.	12.5	16.7	4.2	2,522	8.0	11.8	3.8	6.26	9.63	3.37	6,629	100	9,251

These numbers will need to be further validated and refined.

3. Sectorial Untapped Potential

The following section provides the industry-specific untapped potentials and investment needs.

a. Agriculture Working Group

Table 9. Agriculture WG Industry estimates

Baseline 2018

Plastic waste generated	Plastic waste collected to sorting	Plastic waste sent for recycling	Plastic recyclates produced from sector
1,095,000 tonnes	697,000 tonnes	381,000 tonnes	195,000 tonnes

2025 scenario

Untapped recycling capacity	Untapped collection and sorting	Untapped recycled output	Investments for collection and sorting	Investments for recycling	Overall Investment needs
Mt	Mt	Mt	B€	B€	B€
0.413	0.333	0.220	0.200	0.557	0.757

Untapped potential: 0.2 Mt

0.333 Mt of soiled priority products [LDPE films (mulching, silage, stretch, covering) and pipes, HDPE net wraps (horticulture and breeding), PP twines and non-woven films] placed on the market could be collected at +35%, with in addition, a potential extra 0.313 Mt of soiled material to be diverted from energy recovery and landfilling streams.

Untapped potential addressed through design for recycling

Recycling capacity dedicated for plastics in agriculture (0.3 Mt) is working at full capacity (83%) regardless of local and seasonal conditions. Therefore, any additional collected volume should be balanced with additional recycling capacities.

Quality is a prerequisite for better integration. Improvements must be introduced along the value chain, from farm to incorporation. Thanks to existing projects and innovative technologies implemented in certain regions the quality continues to increase. Quality improvements must however be accelerated with a European programme on good practices' dissemination and transfer of technologies.

Untapped potential addressed through collection & sorting

Countries with a landfill ban legislation and/ or having implemented national collection scheme (NCS) achieve the best recycling rate. The Plasticulture industry is already committed in numerous collection scheme, it is however necessary to support the development of new NCS in other countries with all stakeholders (farmers, distributors, industry, and public authorities).

The analysis shows 0.3 Mt of plastic recycled material theoretically available for integration, in addition to the 0.195 Mt already available, i.e., collected for recycling, adding up to almost 0.5 Mt. However, if we exclude energy recovery, the available volume is reduced to 0.35 Mt. The ambition of the agri-sector is to integrate by 2025 0.150 Mt.

R&D and investment needs

Table 10. Agriculture WG Investment estimates

Agriculture WG estimates					
Collection and sorting		Gap	Recycling		Gap
2020	2025 (estimate)		2020	2025 (estimate)	
0.697 Mt	1.030 Mt	0.333 Mt	195 kt/year	415 kt/year	220 kt
			Investments needed by 2025	0.757B€	

The agricultural sector made a detailed analysis by country and focused the untapped potential for films and irrigation pipes (LDPE) representing over 82% of the total waste generated in non-packaging plastics used in agriculture.
63% of quantities put on the market are collected. The maximum untapped potential for collection is estimated at 0.333 Mt. A 0.313 Mt additional volume of soiled plastic currently diverted to energy recovery and landfill is to be considered as a reservoir for recycling in the future.

b. Automotive Working Group

Table 11. Automotive WG Industry estimates

Baseline 2018

Plastic waste generated	Plastic waste collected to sorting	Plastic waste sent for recycling	Plastic recyclates produced from sector
1,500,000 tonnes	958,456 tonnes	350,000 tonnes	150,000 tonnes

2025 scenario

Untapped recycling capacity	Untapped collection and sorting	Untapped recycled output	Investments for collection and sorting	Investments for recycling	Overall Investment needs
Mt	Mt	Mt	B€	B€	B€
-	0.139	0.059	0.083	-	0.083

Untapped potential: 0.06 Mt

By 2025, the untapped potential in the automotive industry relies on extracting a larger additional fraction of plastic waste from End-of-Life Vehicles (ELVs) ending in Automotive Shredding Residue (ASR). By increasing the collection of plastics from sorting operations by 15%, which is a feasible increase by any industrial sector in 5 years, 59,500 extra tonnes of plastic recyclates can be produced from ELVs plastic waste each year. This strategy is not the only one considered by the WG to increase the amount of recyclates from the automotive sector, but it is a first step easily achievable by 2025.

For this reason, the Automotive WG has drafted a standardization request on Post-Shredding Technologies (PST), to increase the uptake of plastic waste for recycling operations.

This is the reason why the Automotive WG has decided to focus on PST to increase the quantities and qualities of recyclates produced from automotive waste rather than on developing better design (incl. recycled content) on specific automotive plastic

Untapped potential addressed through design for recycling

Plastic waste in ELV can either be difficult to recycle, namely, to separate it from the other waste fractions unless the right advanced PST technologies are in place. Furthermore, the recyclates output quality today fits into less demanding applications and high-quality end-applications within automotive remains a challenge. Therefore, the untapped potential for these two present conditions relies on addressing the technologies extracting the plastic waste fraction from ASR. This can be reached by further developing both PST and "design-for-PST", (i.e., R&D). Whereas the first scenario can partly have effects by 2025, design for PST has a longer impact beyond 2025.
In the cases where recyclates quality is not a problem, as shown by current market practices, the need to secure quantity and the need to structurally support the demand of recycled content (e.g., price competition plastic from virgin material vs recycled material), will be further discussed in the recycled content deliverable,

The untapped potential addressed through design for recycling in the Automotive sector, will have actual impact after 2025. Indeed, vehicles placed on the market today will become waste in 15-20 years, hence the effects of design for recycling improvements cannot be measured by 2025.

Untapped potential addressed through collection & sorting

The development of PST across Europe will lead to a market for plastic waste from ELV also capable of addressing the amount of ELV that today does not end-up in official waste management channels (around 4 million vehicles). To further ensure that ELV are treated according to the existing EU legislative framework represents an untapped potential that must be addressed. However, the Automotive WG cannot quantify the exact potential at this stage since this is a broader topic.

The separation of different plastics has made significant progress in recent years and several thousand tonnes (approx. 0.35 Mt) of different polymers (e.g., PP, PE, ABS, PVC...) can be obtained from ASR through advanced PST to generate higher-quality recycled plastics (appr. 0.15 Mt) able to meet the requirements (e.g., legal, technical, and quality) for the automotive market or other sectors (e.g., construction).
Greater effort is needed to widely promote advanced PST recycling technologies currently based on mechanical processing to increase the amount of ELV plastics being extracted from the ASR waste stream and converted back into quality recycled plastics.
By increasing the sorting of plastic waste from ASR by 15%, 138,813 additional tonnes will end in recycling operations, increasing the output of 59,500 additional tonnes of recyclates with present recycling rates.

R&D and investment needs

Table 12. Automotive WG Investments estimates

Automotive WG estimates					
Collection and sorting		Gap	Recycling		Gap
2020	2025 (estimate)		2020	2025 (estimate)	
0.35 Mt	0.49 Mt	0.14 Mt	150 kt/year	209.5 kt/year	59.5 kt/year
			Investments needed by 2025	0.083B€[31]	

The recycling sector still favours PST over dismantling based on the experience for cost/benefit of both approaches. Investment in PST would make more economic sense in terms of improving plastic recovery from the ASR and recycling through advanced PST. ASR represents approx. 90% of plastics present in a car and shows the opportunity to increase the recovery of plastic material from this ASR. In this regard, economic investment will be needed to increase the amount of post-consumer ELV recycled plastics.

To increase the sorting capacity by 59,500 tonnes/year, the Automotive WG calculated an investment need of ca. 83.3 M€.
In addition, a series of measures need to be prioritised for collection and sorting; including increasing the number of collected ELVs through authorized treatment facilities (ATFs), which will be treated in an environmental sound manner compliant with the ELV Directive. Regarding plastics recycling from automotive, mechanical recycling should be complemented where needed with chemical recycling. For polyolefins and other polymers (e.g., ABS) mechanical recycling does a good job. Therefore, to really increase plastic circularity, chemical recycling should focus on the recycling of those polymers (40-50% of those present in a car) with a very low or nonmaterial recovery rate (e.g., PU, PCS, ETP …). Therefore, chemical recycling could contribute to put an end to incineration and landfilling of those polymer types.

[31] Please refer to **Error! Reference source not found.**.

c. Construction Working Group

Table 13. Construction WG Industry estimates

Baseline 2018 (post-consumer only)[32]

Plastic waste generated	Plastic waste collected	Plastic waste sorted for recycling	Plastic recyclates produced from sector
-	1,746,000 tonnes	450,000 tonnes	340,000 tonnes

2025 scenario (post-consumer only)

Untapped recycling capacity	Untapped collection and sorting	Untapped recycled output	Investments for collection and sorting	Investments for recycling	Overall Investment needs
Mt	Mt	Mt	B€	B€	B€
0.068	0.262	0.051	0.157	0.091	0.248

Untapped potential: 0.05 Mt

The Construction WG estimates 51 kt of additional recyclates placed on the market by 2025 thanks to enhanced collection & sorting and increased state of the art mechanical recycling activity, as well as investment into co-extrusion tools at converters' production sites.

Untapped potential addressed through design for recycling

The Construction priority product category most impacting the pledge target of 10Mt by 2025 is represented by PVC Windows and related building products, with 70% of plastic waste for recycling generated from the sector.

Following the vertical DfR work plan and by preparing the design-for-recycling guidelines, the sector **PVC Windows, and related building products** represented by **EPPA ivzw** identified 1st and 2nd wave priority products and incorporated those articles and their nominal rPVC content in its Design-for-recycling guidelines.

As a result, the following can be noted:

- The priority products are defined and technically ready to absorb an additional potential of 75 kT rPVC.
- To broaden the use of recycled materials, recycled PVC tonnages must be untapped by enhanced collection & sorting of used PVC articles.

Note: Capex needed for new articles is mainly determined by investment in tooling and infrastructure (such as co-extrusion technology).

[32] Post-consumer only, PlasticsEurope 2018.

Untapped potential addressed through collection & sorting

1. Increase in separate collection and sorting focusing on products with existing recycling infrastructure and end markets.

The untapped potential for 2025 can only come from post-consumer waste. Pre-consumer waste volumes are estimated to remain stable or decrease due to more efficient production processes and an established waste management across Europe.

Moreover, legislative requirement addressing the need to renovate housing and institutional building could lead to a generation of plastic waste and replacement of older materials with plastics. For example, Europe-wide around 650 million built-in "low energy efficient" PVC windows are candidates for replacement. These products alone provide a source of around 10 Mt of PVC that can be recycled and used for uptake in new products.

It is widely documented that separate collection and sorting of construction products on site leads to cleaner uncontaminated materials. There are several examples of successful collection and sorting schemes for various construction products, including flooring, windows, pipes and insulation as stated in the CPA state of play report.

The EU protocol for demolition and construction recommends pre demolition audits and waste management plans to increase the volumes of material separately collected and pre-sorted at construction sites. 17 countries across the EU have put legislation in place for mandatory pre demolition audits and separation of material at building sites. These are not always strictly enforced and therefore stricter enforcement could lead to higher levels of collection and sorting.

In most cases construction waste is still collected as mixed waste, which makes it more difficult to sort out individual construction plastics. It should be noted that any waste material is only likely to be collected separately or sorted at a waste management facility if there is a significant demand for the sorted material and if it is cheaper to send for recycling than to send to incineration or landfill.

Example window profiles

There are mature systems established across most countries in Europe to collect sort and recycle post-consumer PVC window profiles. In 2019, this amounted to 363,000 tonnes of window frames collected and recycled. EPPA, the European Association for Window Profiles and Associated Building Product aims increase the sorting of windows recycling by at least 15% by 2025 to contribute to the CPA targets. The achievement of this target relies on favourable legislative outcomes regarding the derogation of lead taking a risk-based approach. Furthermore, a pilot project has been initiated in Poland with the aim to capture 2,800 additional tonnes of post-consumer windows by 2025.

2. Unlocking the untapped potential for the collection and sorting where there is either a lack of sorting capacity or a lack of end markets for the resulting recycled plastics.

As identified in the CPA Research and Development Agenda construction products have a very long service life of up to 50, in some cases even 100 years and therefore once they reach the end of their service life, they can contain substances which no longer meet legislative requirements and cannot be used in new products.

As mentioned in the R&D agenda published by the CPA, the development of efficient tracking, automated analysis, and sorting systems, will help to tackle this issue. Although the necessary R&D is still in the early stages, the work being undertaken will contribute significantly to the circularity of plastics beyond 2025.

There are several Horizon 2020 funded projects currently underway in which research institutes, universities, waste management companies and manufacturers are working together to solve these issues.

In summary, the untapped potential for increased sorting of plastic waste from construction contributing to the CPA target for 2025 will come from separate collection and increased sorting of those products for which there are already existing recycling options, such as windows, pipes, insulation, and flooring.

Based on the pledges made from the industry and the efforts being put in place within the various sectors to increase collection and sorting it can be estimated that an additional 15% of plastics from construction will be collected by 2025, resulting in a total collection of post-consumer waste of approximately 2 Mt and sorting for recycling of at least 517 kt .

Sorting will increase once the technologies that are currently being investigated have been further developed. This will result in a significant increase in collection and sorting of plastics from construction beyond 2025.

R&D and investment needs

Table 14. Construction WG Investments estimates

Construction WG estimates					
Collection and sorting		Gap	Recycling		Gap
2020	2025 (estimate)		2020	2025 (estimate)	
1.74 Mt	2.0 Mt	0.262 Mt	450 kt/year	517.5kt/year	67.5 kt
			Investments needed by 2025	0.248B€	

The construction Working Group estimates that by 2025 approximately 1.1 million tonnes of recycled plastics from construction will be used in new products placed on the market in Europe. This entails a 17% increase of recyclates production resulting from at least 566,000 tonnes from post-consumer waste (all plastics) and approximately 500,000 tonnes from PVC pre consumer waste (as estimated under the Vinylplus voluntary commitment).

The quantities of recycled plastics reported under the Vinylplus voluntary commitment have been accepted as a valid pledge by the European Commission (including recycled plastics from both pre-consumer and post-consumer origin), and therefore counted in the Commission's assessment report of the pledges of March 2019.

Using recycled plastics from pre-consumer waste in plastic construction products increases the overall quality of the recycled content of a product and ensures the required product performance criteria can be reached.

It should be noted that the investment needs for the construction sector have been estimated for the recycling of post-consumer waste only, as this is where the growth is expected in the future. Work committed to by the CPA construction Working Group, focusing on design for recycling, research into recycling technologies and increased collection will result in further increases beyond 2025.

d. EEE Working Group

Table 15. EEE WG Industry estimates

Baseline 2018

Plastic waste generated	Plastic waste collected to sorting	Plastic waste sent for recycling	Plastic recyclates produced from sector
-	-	719,981 tonnes	563,231 tonnes

2025 scenario

Untapped recycling capacity	Untapped collection and sorting	Untapped recycled output	Investments for collection and sorting	Investments for recycling	Overall Investment needs
Mt	Mt	Mt	B€	B€	B€
-	0.366	0.286	0.220	-	0.220

Untapped potential: 0.3 Mt

The untapped potential in the EEE sector relies on extracting an increase fraction of plastic waste. If all household WEEE legal requirements were fulfilled by all actors (from the consumers to the recyclers) in all Member States to reach the 65% collection target, 0.384 extra Mt of WEEE plastics could be properly treated and added to what is currently officially reported by the formal channels (0.720 Mt).
This would result in additional 366 kt of plastic waste fraction for recycling, which, at present recycling rates, results in 286 kt of additional recyclates placed on the market from this industry sector.

Untapped potential addressed through collection & sorting

There is a significant gap between WEEE generated and WEEE collected by the formal channels.

To increase the amount of PCR WEEE plastic potentially available in Europe, it is necessary to enforce proper management of WEEE collected through all channels. Increasing the amount of WEEE collected through formal WEEE management channels would automatically enable greater amounts of PCR plastic to be reprocessed and provide a higher share of the European EEE sectors plastic demand and would make it possible to take advantages of economies of scale benefits in logistic as well as WEEE pre-treatment steps.

The entire amount of WEEE collected through formal channels are properly treated. This means additionally that WEEE plastics are mainly recycled (from 65% to 90%) if processed by WEEE treatment plants of the formal channels.

Around 45-55% of WEEE is collected and officially reported compared to the WEEE generated:

- At least 20% of WEEE is in other flows (WEEE mixed in metal scrap, WEEE in waste bins, Used-EEE exported for reuse, illegal WEEE Exports).
- 25% is unknown (13% of WEEE is unmapped and around 12% is unmapped or there is uncertainty arising from the calculation methodology).

If all WEEE legal requirements were fulfilled by all actors (from the consumers to the recyclers) in all Member States to reach the 65% collection target, 0.384 additional Mt of WEEE plastics could be properly treated and added to what is currently (2016 figures) officially reported by the formal channels.
There are no one size fits all solution to reach this objective and a multi-faceted approach is certainly needed.

Table 16. EEE WG Investments estimates

EEE WG estimates		
Collection and sorting		Gap
2020	2025 (estimate)	
0.72 Mt	1.08 Mt	0.366 Mt
	Investments needed by 2025	0.220B€[33]

Investment needs aimed at increasing the share of plastics waste diverted from the household WEEE stream, must tackle the required uptake of waste ending in official streams, where waste is properly treated. These investments include the necessity to increase the recycling capacity of WEEE recyclers to recycle the additional 366 kt estimated to generate from a well-functioning end-of-life management for WEEE household waste.

[33] Please refer to **Error! Reference source not found.**.

e. Packaging Working Group

Table 17. Packaging WG Industry estimates

Baseline 2018

Plastic waste generated	Plastic waste collected to sorting[34]	Plastic waste sent for recycling (in EU+3)	Plastic recyclates produced from sector (EU+3)	Plastic recyclates generated from packaging waste and used by EU plastics industry [35]
16,100,000 tonnes*	7,000,000 tonnes	5,300,000 tonnes	3,900,000 tonnes	3,200,000 tonnes (modelled based on assumed 18% exported)

2020 (Modelled from 2018)

Plastic waste generated	Plastic waste collected to sorting	Plastic waste sent for recycling (in EU+3)	Plastic recyclates produced from sector (EU+3)	Plastic recyclates generated from packaging waste and used by EU plastics industry [36]
16,100,000 tonnes* (assumed no change in model)	7,900,000 tonnes	6,500,000 tonnes	4,700,000 tonnes	4,000,000 tonnes

2025 (Modelled from 2018)

Plastic waste generated	Plastic waste collected to sorting	Plastic waste sent for recycling (in EU+3)	Plastic recyclates produced from sector (EU+3)	Plastic recyclates generated from packaging waste and used by EU plastics industry[37]
16,100,000 tonnes* (assumed no change in model)	11,000,000 tonnes	9,800,000 tonnes	7,500,000 tonnes	6,800,000 tonnes

*Excludes PET trays (estimated to be around 800,000 tonne).

[34] Numbers on the three tables for collected to sorting refers to the output quantities from sorting operations.
[35] All industry sectors.
[36] All industry sectors.
[37] All industry sectors.

Packaging provides the largest untapped potential. Not only is it the largest plastics using market, but it is also creating the highest plastic waste each year due to its short-lived nature.

Modelling was carried out to evaluate how packaging might contribute to the 10 Mt CPA target. This modelling takes into consideration macro environmental drivers, such as legislative targets and changes to waste shipping rules, and then combines these with the potential impact of the work being carried out in the CPA. As the CPA target is for recycled plastic in European products, the impact on exports of sorted waste and recycled plastic are also relevant. The work of the CPA has the potential to impact on these flows also, helping to keep the resource within Europe. For example, by improving the quality of sorted and recycled plastic and through developments in technology and associated investments. The untapped potential figure is based on the difference in recyclates produced by recyclers in the EU+3 in 2020 and 2025 in scenario 3 (see below for assumptions). The 2.754 Mt untapped potential assumes no export of recyclates outside of the EU+3.

Untapped potential: 2.754 Mt

Three different scenarios were developed to show the potential for increased generation of recycled plastic derived from packaging waste for supply to European convertors.

The data provided by CPA signatories in the State of Play Report for packaging was used as a baseline for the analysis[38]. See the Table 1 p. 6, Waste Plastic Packaging Mass Flow, in the State of Play Report for packaging for further details. The baseline year has been assumed to be 2018, although data provided for some polymers / formats in the State of Play Report was for other years. Recycling rates in the scenarios are based on the new measurement point into the recycling operation. The recycling rate for 2018 was adjusted to reflect the new measurement point and the level of collection required to meet the target in the scenario modelled forward to 2025. The level of collection assumes current levels of loss between input to the recycler and input to the recycling operation when considering how much collection is required to meet the recycling target. For simplicity, it has been assumed that there is no change in the packaging placed on the market in the scenarios.

The table below summaries the different scenarios and shows the total tonnage of recycled plastic supplied to European convertors as well as the increase in the tonnage compared to the 2018 baseline (3.21Mt of recycled plastic available to European converters).

[38] https://ec.europa.eu/docsroom/documents/43694

Table 18. Packaging WG Three scenarios

Scenario	Scenario description	Recycled plastic available to European convertors by 2025 (MT)	Additional recycled plastic available to European convertors by 2025 compared to the 2018 baseline (MT)
1	50% recycling rate. Gradual decrease in sorted waste exports. Exports of recycled plastic remain at 2018 levels as a percentage.	5.88	2.68
2	50% recycling rate. Gradual decrease in both sorted waste and recycled plastic exports.	6.56	3.35
3	50% recycling rate. Gradual decrease in both sorted waste and recycled plastic exports. Increased recycler yields from input waste plastic from 2021.	6.83	3.62

A description of each scenario is set out below.

Scenario 1: A 50% recycling rate by is reached by 2025, using the new measurement point. The percentage of exports of sorted plastic reduced by 10% per annum from their level of 23% in 2018 to 11% in 2025. This decrease is due to developments in sorting and recycling technologies that reduce the commercial incentive for export. Changes to shipping regulations, notably the amendment to the Basel Convention, also play a role. Exports of recycled plastic (recyclate) remain at their 2018 level of 18% (PlasticsEurope estimate for all recycled plastic) between now and 2025. This equates to an increased tonnage of recycled plastic exported over the period as volumes of sorted waste grow because of non-EU markets buying more to compensate for lower exports of sorted plastic waste.

Scenario 2: As per scenario one but with the percentage of exports of recycled plastic (recyclate) decreasing by 10% per annum from 18% in 2018 to just over 8.5% by 2025. This is a result of the quality of recycled plastic increasing due to a combination of better design for recycling and advancements in sorting and recycling technologies. The increase in the recycled plastic quality enables European convertors to use recycled plastics in a wider range of products and at higher percentages.

Scenario 3: As per scenario 2 but the yield at recyclers increases. Yield in this context is the output of recycled plastic obtained from the input of waste plastics into the recycler. Yield

loss primarily occurs at recyclers through the removal of non-plastic items and organic residues as well as non-target plastic items. Small percentages of target plastic will also be lost during the washing and extrusion process. In this scenario, the modelling assumes an increased yield from an average of 73% across all polymer and grade types (State of Play Report) to 76%. The modelling uses a 73% yield until the end of 2020. This yield increase is due to improvements in packaging design resulting in less loss during pre-treatment at recyclers, i.e., there are less items that need to be removed due to them reducing recycled plastic output quality. Also, work to develop recycling solutions for some polymer formats that may be currently removed prior to the recycling operation and sent for energy recovery but that in the future may be captured as a by-product and reprocessed by specialist recyclers.

In the most optimum of the three scenarios (scenario 3), the packaging sector could result in 3.6 Mt of extra recycled plastic in European products.

Untapped potential addressed through collection & sorting

The following are identified as areas where there needs to be a particular focus or where there is potential in the collection and sorting element of the plastic recycling supply chain. Those focus areas have been taken up by the design for recycling thematic coordinators group and the R&D and investment thematic coordinators group:

Action for EPR schemes, governments and local authorities.

- Collect all household packaging formats from household collections in Europe, as well as all 'household-like' packaging from 'out of home' locations such as offices, schools, etc…This will increase tonnages of recyclable feedstock for recyclers. For currently difficult to recycle formats, it will make feedstock available for emerging technologies such as physical or chemical recycling solutions, for which legislative certainty is needed.
- Increased separate collection of more packaging types to provide increased feedstock for recyclers. The 2018 average plastic packaging recycling rate is already 41.5%, going beyond 50% in 2025 will support increase collection and recycling. National governments can set higher targets than EU legislation, which should then be applied to EPR schemes.
- Ensure enforcement of separate collection and that consumers are well informed about correct packaging waste disposal. Incentive/disincentive mechanisms for consumers could help, for example reduced cost/free waste bags for recycled waste.
- Increase transparency on the collection and recycling rates of different packaging types, to allow for a clear understanding of the baseline and progress and to identify which plastic materials/packaging types will need dedicated actions. Governments should support this process and ensure oversight on data transparency, accuracy, accessibility, and availability.

Action for EPR schemes and waste management companies. Action for EPR schemes, governments and local authorities.

- Increased scale of sorting centres in countries where there are large numbers of smaller sorting centres. This will increase the commercial viability of capturing polymers / formats that make up a smaller percentage of the plastic waste stream.
- Adjust the output bale specifications, where required, so that they provide recyclers with an optimal feedstock for producing high quality recycled plastics of a type suitable to replace virgin polymer in a wide range of end market applications. This will need to be done in conjunction with changes in recycling processes to maximise recycled plastic output quality.

Action for EPR schemes and waste management companies in conjunction with recyclers.

- Standardisation of bale specifications against key compositional criteria.
- Keeping bale specifications under review to ensure they align with demands of downstream recycling operations and ultimately end users of recycled polymer in terms of the quality of recycled plastic required.
- Regularly review uptake of recycling technologies and packaging formats in line with evolution and innovation in packaging materials

Action for EPR schemes and waste management companies.

Maximising the capture rate of target fractions within the sorting centres. This might be through:

- Use of advanced sorting technologies, for example the latest NIR / optical sorters, digital watermarking, AI and robotics, etc.
- Increasing sorting line numbers.
- Reduced screen sizes to reduce losses of target material.
- Capture of target materials from fines fractions.
- EPR schemes introducing contractual drivers for this to occur. This includes fee modulation that reflects the true net cost of sorting and recycling for different packaging types to enable investments in sorting and recycling.

It is important to note that the collection and sorting of plastic packaging is impacted by decisions taken elsewhere in the supply chain. Also, that actions taken in relation to collection and sorting impact elsewhere in the supply chain. Some key interdependences are shown below:

Action for brand owners.

- Design of packaging products with sorting capabilities in mind.
- Work on the next steps of sorting facilities in partnership PROs

Action for governments to create conditions for investments working with EPR schemes and the waste management sectors.

- Technology development. Investment availability for sorting, collection and recycling technologies and more generally scale up and development of corresponding infrastructure.
- Disincentives for end-of-life options other than recycling for recyclable packaging.
- Allow the shipment of plastic waste that has the potential to be recycled across EU countries.
- Enable smooth and timely transposition of relevant European Regulations into national laws to secure realistic and efficient compliance.

CPA members recognise that separate collection, even with best efforts, may not capture all packaging. Capturing packaging waste from the residual waste has therefore the potential to get additional material. The CPA will also further evaluate this route.

Untapped potential addressed through design for recycling

The main untapped potential for collection and sorting is driven by an expected increase in collections of packaging and improved design on the priority packaging products of the CPA between now and 2025.

The yield improvements provided by design on collection, sorting and recycling yields are already reflected in reported figures to the 7.2 MT of recyclates produced in Europe in 2025. Further untapped potential is available through developments at sorting centres to both maximise the capture of target polymer formats as well as improve sorted bale quality, the latter with associated downstream benefits.

Based on the conclusions of the Design Work Program issued in 2020, if all the waste generated from packaging priority products would be collected, sorted and designed for recycling, an additional 2.9 MT would be added to the 6.6 MT plastic recyclates.

Increases in collection and optimisation of sorting are being driven by a combination of legislative drivers, notably higher packaging targets, and voluntary initiatives, such as CEFLEX,[39] RecyClass,[40] and the various Plastic Pacts in operation in Europe.

EPR schemes, working with supply chain partners and municipalities, are actively working to increase collection rates and optimise sorting. The main polymer platforms are also active in working to increase potential in both sorting and recycling.

R&D and investment needs

[39] https://ceflex.eu/.
[40] https://recyclass.eu.

Table 19. Packaging WG Investments estimates

Packaging WG estimates					
Sorted waste		Gap	Output recyclers		Gap
2020**[41]	2025 (estimate)		2020**	2025 (estimate)	
7.937 Mt	11.040 Mt	3.368Mt/year	4.714 Mt/year	7.468 Mt/year (98% of 10Mt)	2.754 Mt/year
			Investments needed by 2025	6.317B€[42]	

To unlock the untapped potential of recycled content coming from packaging there is a need to invest across all steps of the packaging waste stream. Investments should be directed towards improving collection so that all packaging waste is collected, upgrading sorting technologies to improve the quality of waste, and improve recycling capacity within the EU.

[41] Modelled from 2018 data in the State of Play Report.
[42] Please refer to **Error! Reference source not found.**.

4. Conclusions

The untapped potential report sets the conditions for the plastic industry gathered in the CPA to meet the pledge launched by the European Commission in 2018.

The report bridges between the deliverables of the CPA to investigate the barriers to the uptake of the market for recyclates, the potentials of increasing collection and sorting of plastic waste, design for recycling of products and components, and R&D in the waste management, which all are necessary drives to meet the pledge. Each CPA Working Group (WG) industry sector estimated the investment needs to increase the uptake of recyclates, either generated from or used by their industries. This exercise was deemed necessary to communicate where the industry stands today and what is needed by 2025to meet the pledge.

The untapped potential report is a living document subject to progressive updates that will investigate the granularity of the investment estimated at EU level and for the five industry sectors of the CPA. In the year to the next update of the Untapped Potential Report the CPA plans to work with the EU member states to refine and "localise" its plans. The collaboration should provide a next level of granularity and momentum for addressing the barriers identified in this report and further barriers as identified by member states.

In working towards its 2025 target **the CPA** appreciates input and interaction with stakeholders across plastics value chains and **welcomes any suggestion or input to further advance its work**.

Annex

The CPA considers that, to operationalise the Single Market for recycled plastics and plastics recycling, European Standards need to be updated, revised or created in the four areas shown in the figure below.

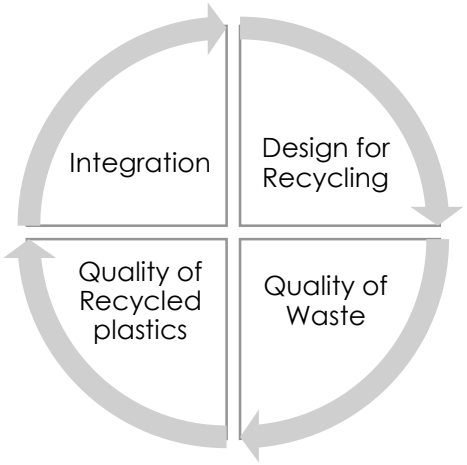


Figure 9. CPA four areas for European Standards.

The CPA product teams have identified needs for their priority product for each of these 4 areas, including for most priority products:

a. **Design for Recycling**
   The standards proposed include:
   - Design for Recycling criteria with regards to
     - the final application
     - possibility to be used as recycled plastic
   - Evaluation of recyclability

   Note: Each sector and priority product have different possibilities and demands to consider. A methodological sector or product specific standard is therefore required to describe the methods to define and assess recyclability and circularity of plastic products. This will enable a common language in the plastics industry on how to manage the evaluation of plastic products' recyclability in general.

b. **Quality of waste**
   The standardisation needs are of a more general nature and could be translated into an umbrella standard stating a methodology to assess and measure the quality of sorted plastic waste.

c. Quality of recycled plastics

The evaluation of the quality of recycled plastics depends not only on the upstream steps in the supply chain but should also take into consideration the demands from the downstream processes and end-applications. This is crucial to enable the uptake of recycled plastics.

Today there is an existing series of standards defining the characterisation of recycled plastics from five materials (PE, PP, PVC, PET and PS). These standards are application and process neutral. This series has been identified by many of the CPA product teams as valuable for the evaluation of quality of recycled plastics.

The standards in the series shall be considered as general (umbrella) standards and should be used to create sector and application related standards according to the input from the DPT's.

As a part of the quality definition there is also a need for demand driven classification of recycled plastics. This is important for two main reasons:

- Simplify the recycled plastic approval process for small and medium-sized enterprises
- Enable purchasing specifications of final products to clearly identify expected properties and quality of recycled plastic content

d. Integration of recycled plastics

Integration of recycled plastics in products contains two main criteria:

- Chain of custody and traceability
- Methodology on recycled content verification in products

When it comes to chain of custody, which is identified as a need from the DPT's, work is ongoing both in European Commission and in ISO to establish calculation methods.

The CPA is committed to actively contribute to the update, revision or development of the necessary standards in the competent Technical Committee within CEN-CENELEC. The objective is to deliver operational standards for the Single Market and provide a basis for presumption of conformity with future EU regulation, whenever appropriate.

The figure below shows how the European Standards developed for each of the four areas are mutually reinforcing.

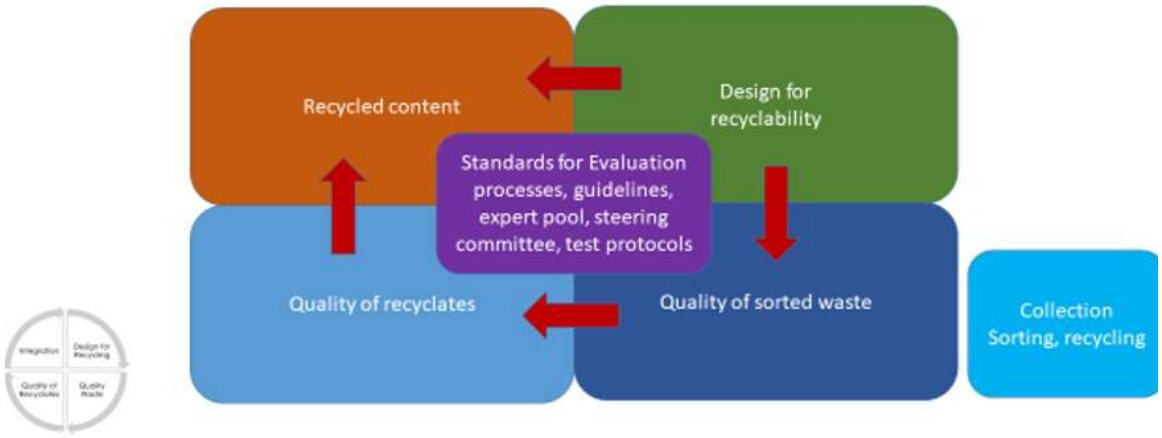


Figure 10. European Standards developed for each of the four areas.