THE CIRCULAR ECONOMY FOR PLASTICS

A European Overview

PLASTICS EUROPE

Enabling a sustainable future

This 2022 edition report is a contribution towards a better understanding of the circular economy of plastics. It provides a European overview of plastics production, conversion into parts and products, consumption, waste collection and treatment, including recycling. It also addresses the production of recycled plastics and their use in different application sectors.

This report focuses on 2020 data. The packaging consumption and waste data used in the report were extrapolated based on 2019 available figures.

CONTENT



2020 KEY FINDINGS

More than
10 million tonnes
of **post-consumer** plastics waste
sent to recycling

65%
of plastics waste
not yet valorised in the circular economy
in the EU27+3

4.6 million tonnes
of **post-consumer** recycled plastics
used in new plastic products

Compared to 2018, the quantity of
recycled plastics used in packaging increased by **43%**

Plastics waste **recycling rates** are
13x higher
when collected separately
compared to mixed collection schemes

Since 2016
plastics waste exports dropped
by almost
50%

The plastics packaging waste data used for the above key findings were extrapolated based on 2019 available figures.

INTRODUCTION

Plastics are essential components of a circular and climate neutral economy. Their durability, resource and energy efficiency, and recyclability facilitate the circularity of products and a climate neutral society. Plastics are also playing a key role in the journey towards a sustainable and climate neutral future, e.g. in electric cars, wind power stations and energy efficient homes. Plastics are key to delivering the sustainable solutions valued by society.

To continue building on this potential, current challenges around plastic products design, collection, sorting and end-of-life management (recycling, energy recovery, landfilling), must be addressed.

A lack of appropriate waste management infrastructure, policy incentives and business models mean that the full value of plastics waste is currently not being captured. Plastics waste that is not disposed of correctly most often ends up into the environment, with unacceptable consequences. Plastics waste sent to landfill and for energy recovery must be kept as a resource in the circular economy.

THE CIRCULAR ECONOMY FOR PLASTICS: PROGRESS SO FAR

The plastics industry is striving to transform the traditional linear economy - where plastics are typically disposed of at the end of their service life - into a plastics circular economy. The plastics circular economy is a sustainable model where plastics remain in circulation longer, and are reused and recycled at the end of their life span.

Two years after the initial report, Plastics Europe is pleased to publish the "Circular Economy for Plastics - A European Overview 2020" report. This new publication outlines the main findings of the "Circular Economy for Plastics 2020 EU27+3" (Norway, Switzerland, and the United Kingdom) study, commissioned to Conversio Market & Strategy GmbH.

This study analysed plastics production, conversion and consumption, recycling processes, production and use of recycled plastics in the EU27+3 in 2020. It tracks the progress made since 2018, to provide a better understanding of the plastics circular economy and identify areas for improvement in this respect. However this study does not investigate other aspects of circularity such as the use of bio-based or carbon-captured feedstock, repair or reuse.

The scope of the study focused on post-consumer plastics. Indeed, the various industry targets (for recycling and recycled plastics uptake) mainly focus on post-consumer plastics waste. However, conscious that pre-consumer plastics waste is part of the circular economy, the "Circular Economy for Plastics 2020 in EU27+3" study provides some estimations, that are presented in this report.

Since 2016, the amount of plastics waste sent to recycling across Europe has more than doubled, while the amount sent to landfill has been reduced to almost 50%.

The 2020 data in this report show that recycling rate increased to nearly 35%. However, 65% of post-consumer plastics waste were still sent for energy recovery or to landfill. Additionally, the study points out that recycled plastics uptake

INTRODUCTION

increased by 15% compared to 2018, reaching 4.6 million tonnes. Despite these encouraging developments, the pace of the progress remains insufficient to meet the various industry targets. Consequently, more needs to be done to increase the circularity of plastics.

COMMITTED TO ACCELERATING CIRCULARITY

The shift towards a circular economy for plastics has already begun. Plastics Europe is striving to be a catalyst for enabling a circular and climate neutral economy for plastics, and prevent plastics waste ending up into the environment.

In order to achieve this collective ambition, collection, sorting and recycling technologies need to be enhanced to obtain higher quality and quantities of recycled plastics, which will facilitate a circular economy for plastics.

The plastics industry is leading the way in this transition, from improved products designs that enable reuse and recycling, to innovation in new technologies such as bio-based and carbon-captured feedstocks and chemical recycling. Emerging technologies also present the opportunity to recycle mixed plastics waste streams that cannot be processed by mechanical recycling, opening up new possibilities for the plastics circular economy.

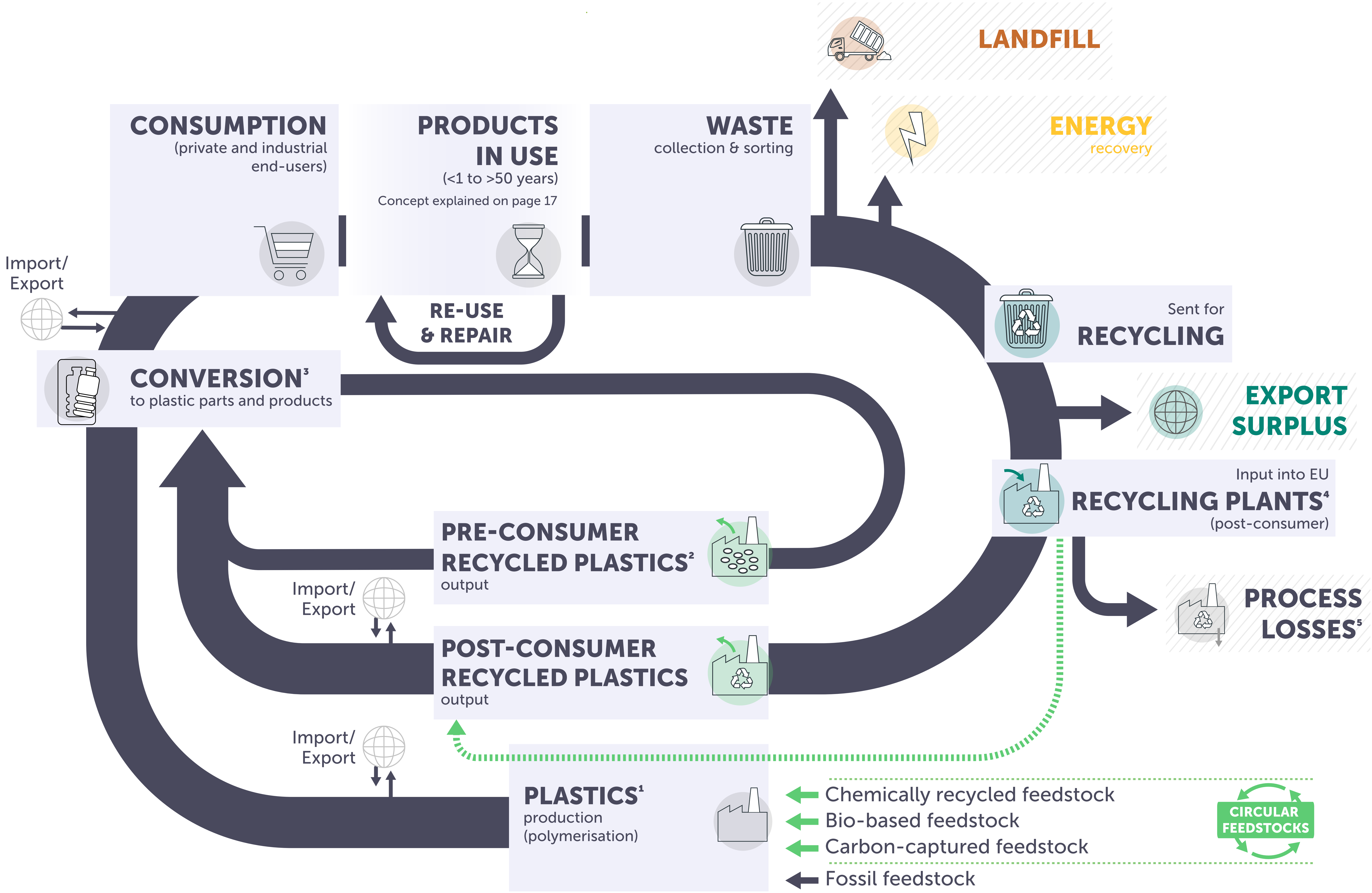
PLASTICS IN A CIRCULAR AND CLIMATE NEUTRAL ECONOMY

INTRODUCTION TO THE PLASTICS CIRCULAR ECONOMY

The circular and climate neutral plastics economy is a system in which plastics are produced, converted, used and managed in a sustainable way.

This means fostering the use of circular feedstocks, creating eco-designed products to increase recycled content, facilitating re-use and repair, and managing plastics waste to convert it into new resources to reduce fossil-based feedstock.

The different service lives of plastic products and parts explain to a large extend the differences between the level of consumption and the collected waste in a single year (e.g. a car lasts for about 13 years, flooring products between 20 to 40 years, and plastic pipes over 100 years).



1. Does not include elastomers, adhesives, coatings and sealants. 2. Pre-consumer plastics waste is mainly originating from the plastics conversion and from plastics production (polymerisation) to a lesser extend. 3. Compounding of recycled plastics and plastics from polymerization may occur prior conversion. 4. Includes chemical recycling. 5. Process losses are usually sent to energy recovery or landfill. Parts of plastics residues could be a potential future source of chemical recycling.

HOW HAS THE PLASTICS CIRCULAR ECONOMY EVOLVED?

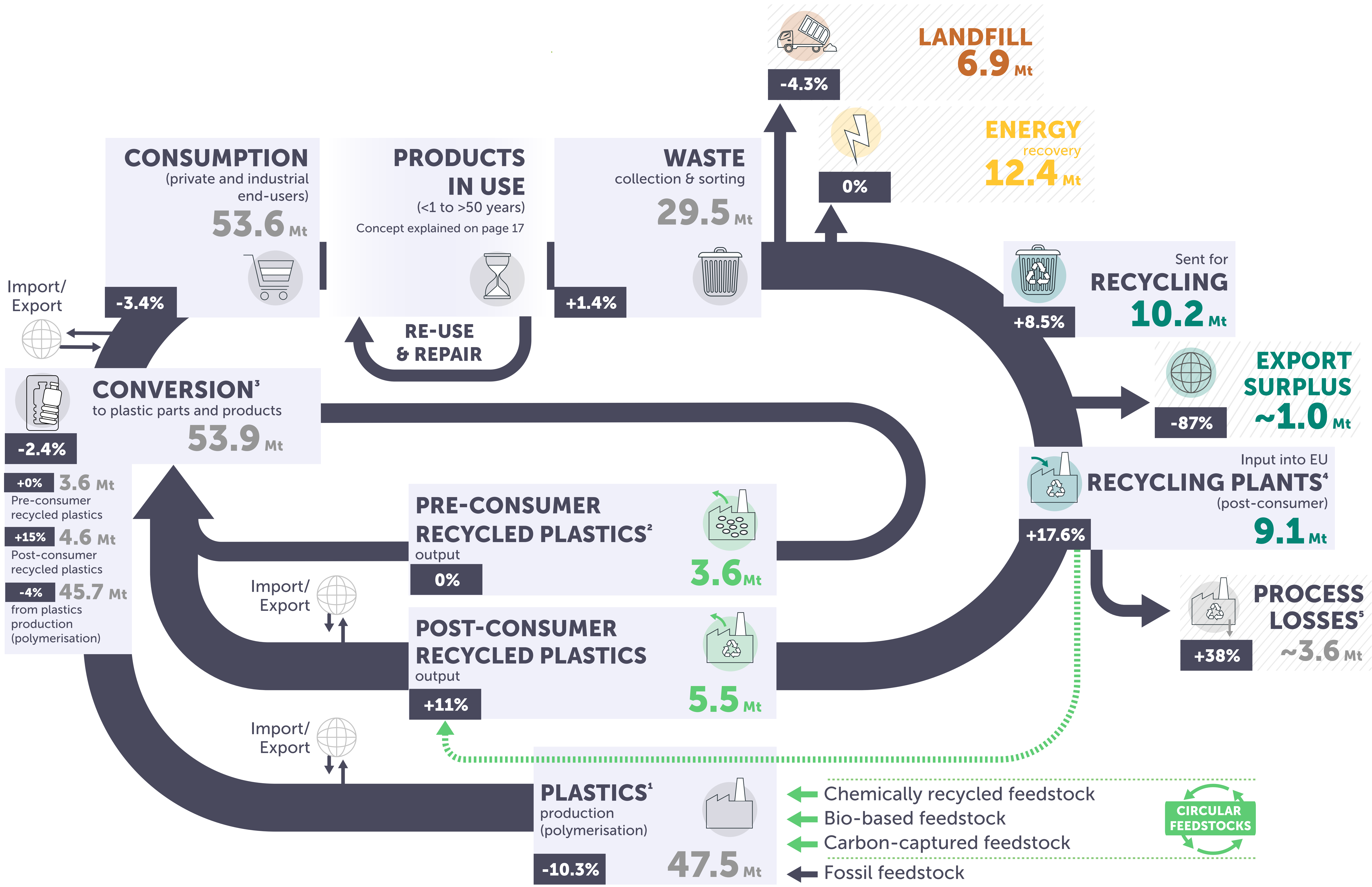
BETWEEN 2018-2020

From 2018 to 2020, a positive trend towards higher circularity emerged.

Plastics production (polymerisation) has decreased by 10.3%.

At the same time, the post-consumer plastics waste quantities sent to recycling have increased by 8.5%. Quantities sent to landfill decreased (-4.3%) and energy recovery remained the same for the first time since 2006. As a consequence, the supply of post-consumer recycled plastics increased by 11% compared to 2018, and their use into new products rose from about 4 million tonnes to 4.6 million tonnes – an increase of 15%.

This demonstrates an initial shift towards a higher share of recycled plastics in the manufacturing of new products (from 7.2% in 2018 to 8.5% in 2020).



% 2018-2020 evolution

The plastics packaging consumption and waste data used for the above graph were extrapolated based on 2019 available figures. The above data were rounded.

1. Does not include elastomers, adhesives, coatings and sealants. 2. Based on interviews with recyclers. Pre-consumer plastics waste is mainly originating from the plastics conversion and from plastics production (polymerisation) to a lesser extend. 3. Compounding of recycled plastics and plastics from polymerization may occur prior conversion. 4. Includes chemical recycling. 5. Process losses are usually sent to energy recovery or landfill. Parts of plastics residues could be a potential future source of chemical recycling.

FEEDSTOCKS FOR A CLIMATE NEUTRAL PLASTICS CIRCULAR ECONOMY

Today, most plastics are still produced from fossil-based feedstock. Transitioning to a circular, climate neutral economy demands special investment and innovation to produce more recycled plastics and develop new feedstocks that are less dependent on fossil-based oil and gas, and contribute to the goals of the Paris and Glasgow Agreements and the EU's 2050 climate-neutral ambition.

Important investments by Plastics Europe's member companies in new recycling technologies have already begun, and are expected to increase the quantity and the quality of recycled plastics.

Feedstock from biological origin, when sustainably sourced and managed, can contribute to an efficient use of resources and to a reduction of GHG emissions. Although today plastics made from bio-based resources account for a very small percentage of the total plastics production, they are steadily taking up and have a huge potential to grow.

Carbon Capture and Use (CCU) is also a promising technology, supported by the plastics industry, to create new feedstock while capturing CO_2 emissions and preventing their release into the environment.

4.6

million tonnes

of post-consumer recycled plastics used in new products

PLASTICS IN OUR DAILY LIVES

PLASTICS CONVERSION AND CONSUMPTION

Plastics conversion in the EU27+3

53.9 Mt*

4.2% AGRICULTURE, FARMING & GARDENING

3.8% HOUSEWARE, LEISURE & SPORTS

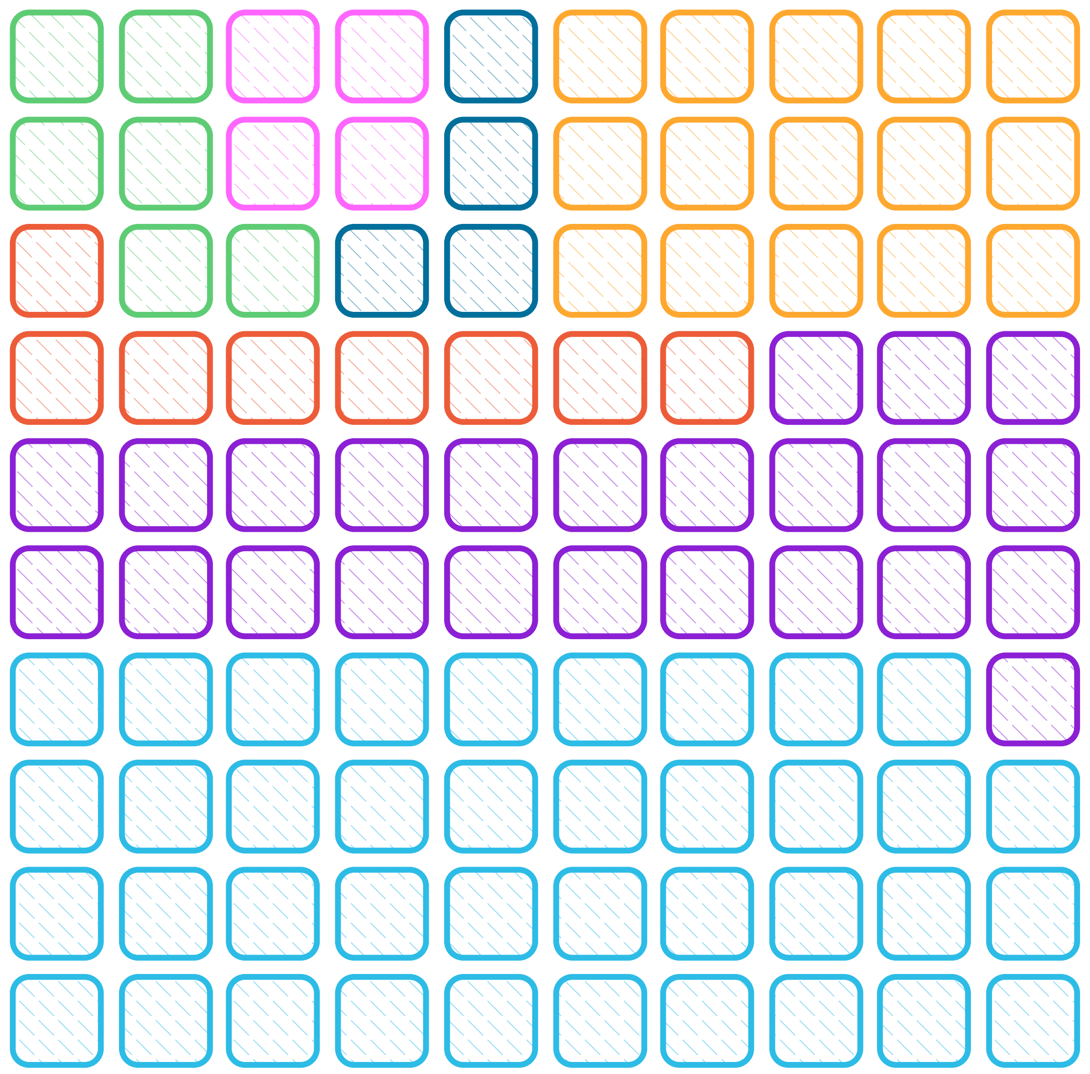
15.3% OTHERS

5.6% ELECTRICAL & ELECTRONICS

8% AUTOMOTIVE

23.6% BUILDING & CONSTRUCTION

39.5% PACKAGING



The conversion refers to the manufacturing of plastic products and parts by plastics converters.

Imports/ Exports

Except for packaging, the EU27+3 is a net importer of plastic products and parts, in tonnage, and mainly in the following sectors: electrical and electronics, automotive, houseware, leisure and sports.

Plastics consumption in the EU27+3

53.6 Mt

16.1% OTHERS

4.4% AGRICULTURE, FARMING & GARDENING

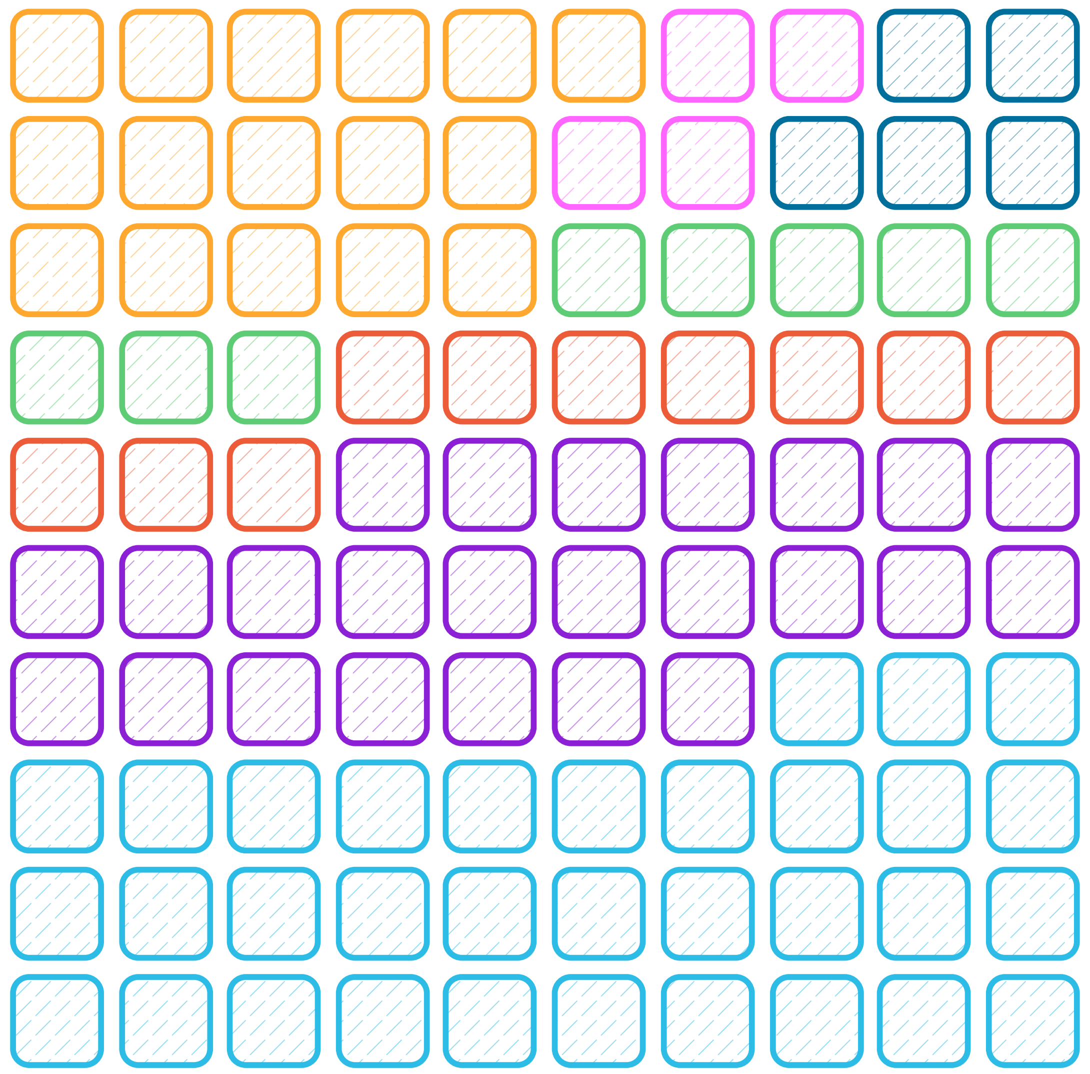
4.9% HOUSEWARE, LEISURE & SPORTS

7.5% ELECTRICAL & ELECTRONICS

9.7% AUTOMOTIVE

23.9% BUILDING & CONSTRUCTION

33.5% PACKAGING



Plastic products and parts sold to end-users.

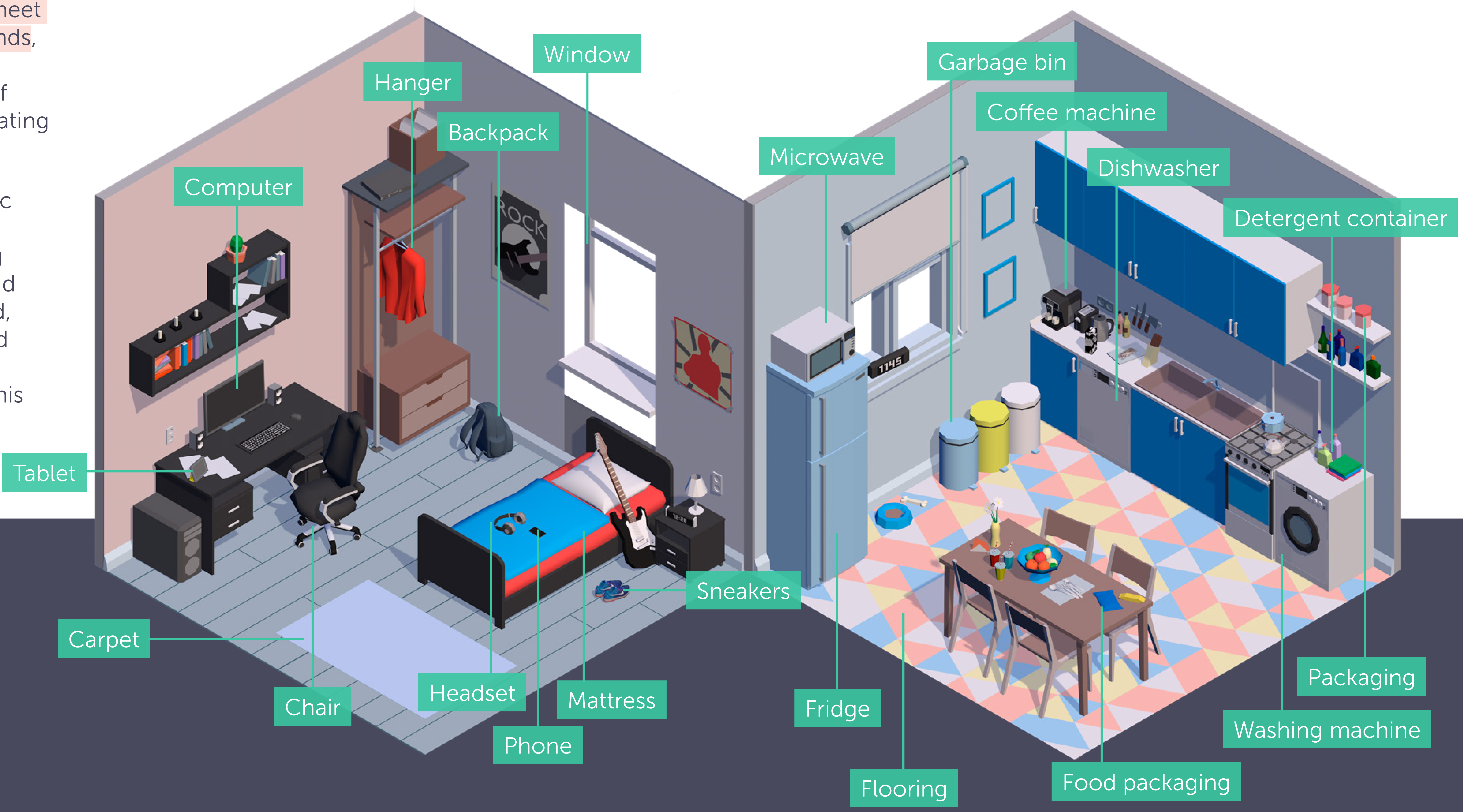
The plastics packaging consumption data used for the above graph were extrapolated based on 2019 available figures. The above data were rounded.

*Comprising 45.7 million tonnes from plastics production (polymerisation), 4.6 million tonnes of post-consumer recycled plastics and 3.6 million tonnes of pre-consumer recycled plastics.

PLASTICS IN OUR DAILY LIVES

Versatile and durable, plastics allow us to meet a myriad of functional and aesthetic demands, from drinking clean water, playing sport, staying connected, enjoying the comfort of home or visiting loved ones near and far, eating fresh food or being treated in hospital.

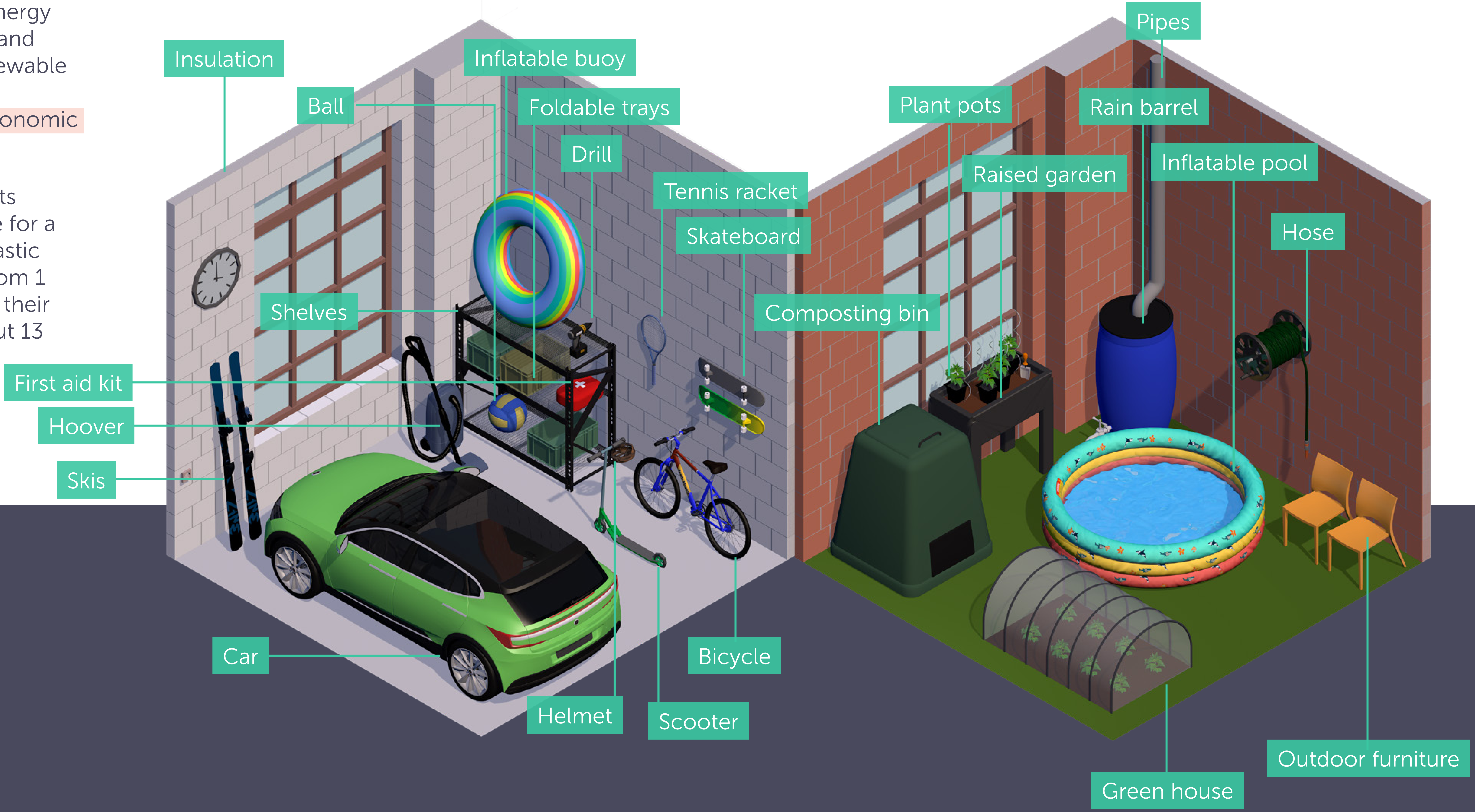
Plastics define the way we live today. Plastic products and parts are used in various applications, such as in packaging, building and construction, automotive, electrical and electronic products, agriculture, household, leisure and sports, medical applications and many others, and thereby making our lives easier, safer, healthier, and more mobile. This graphic illustrates how plastic products, or products with plastic components, are used in our daily lives.



PLASTICS IN OUR DAILY LIVES

By cutting food waste, increasing energy efficiency, lowering CO_2 emissions and supporting the development of renewable energy technologies, plastics also contribute to environmental and economic sustainability.

Although the packaging that protects our food may only stay in our home for a few days, the service life of most plastic products and plastic parts ranges from 1 to 50 years, or more, depending on their applications (e.g. a car lasts for about 13 years, flooring products between 20 to 40 years, and plastic pipes over 100 years).



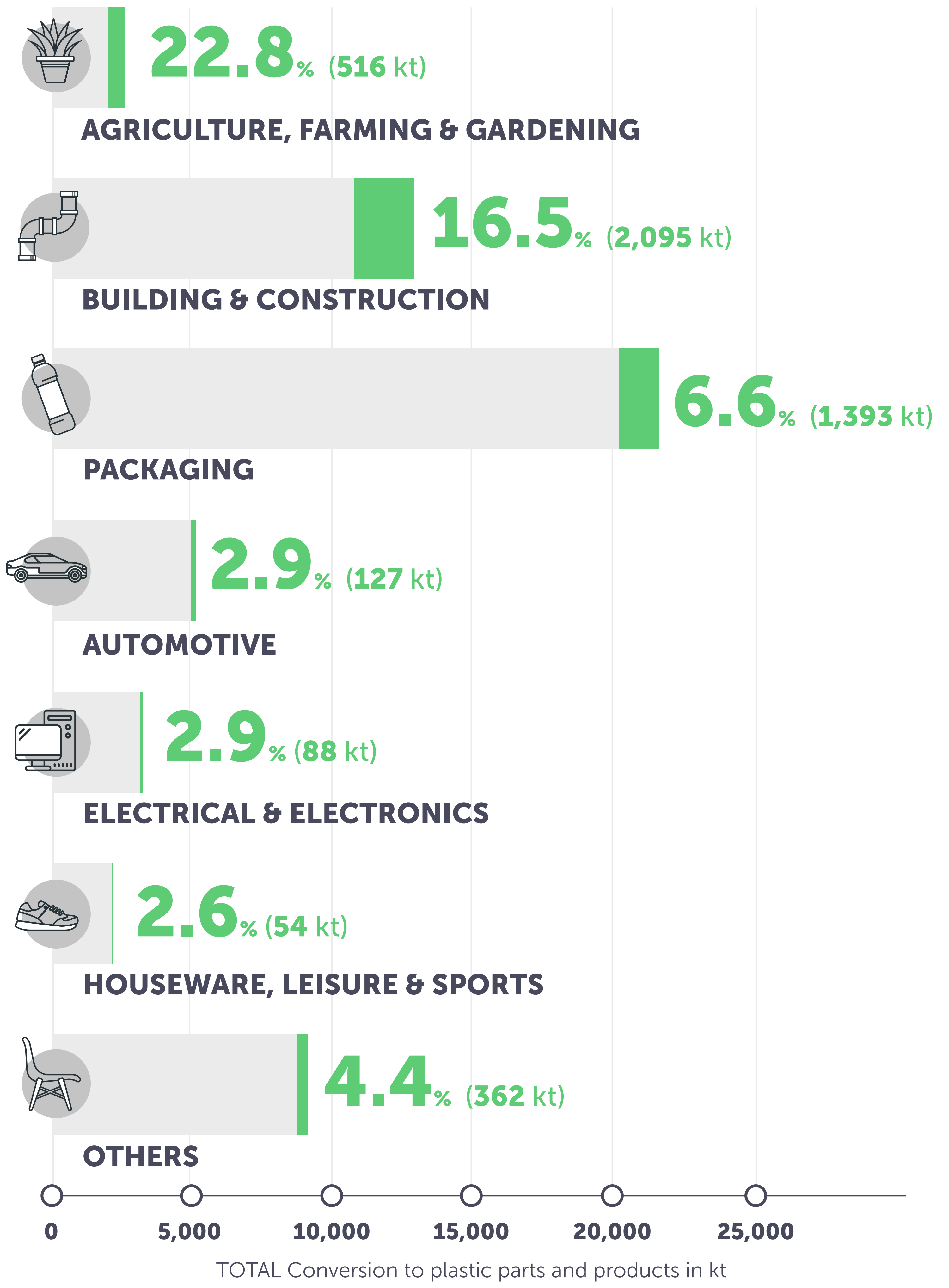
RECYCLED CONTENT RATES IN EACH PLASTICS APPLICATIONS

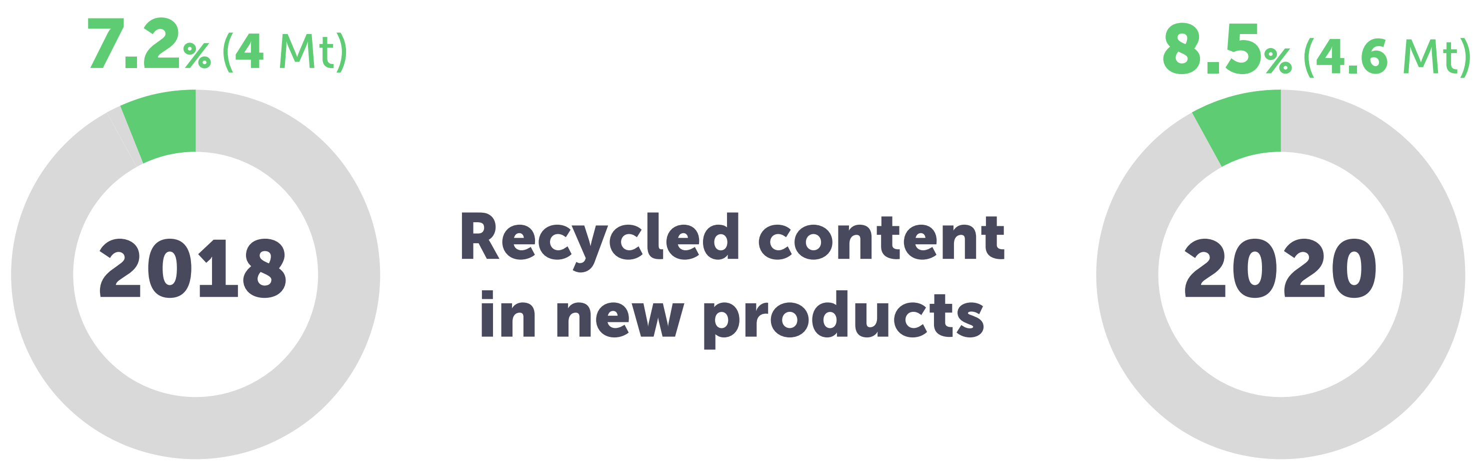
Fostering the use of recycled plastics, and increasing their use in various applications, is essential to accelerate the progress towards a circular and climate neutral economy of plastics.

In 2020, converted plastic parts and products had a post-consumer recycled content of about 8.5%*. This represents an increase of 1.3 percentage points compared to 2018 showing an initial shift towards a higher share of recycled plastics in new products.

The agriculture sector is the one with the highest percentage of recycled content in its products (22.8%), followed by the building and construction sector (16.5%).

Compared to 2018, recycled plastics quantities used in packaging, building and construction, agriculture, farming and gardening respectively increased by 43%, 15% and 3%.





Post-consumer recycled plastics

The above data were rounded.
*53.9 million tonnes of plastic parts and products were converted in 2020, of which 4.6 million tonnes with post-consumer recycled plastics.

PLASTICS IN USE

Plastic products and parts that enter the market have different life spans. Many of them remain in use for years (e.g. insulation boards, cables, cars, electrical and electronics devices, etc.) and therefore do not become waste in the same year that they entered the market.

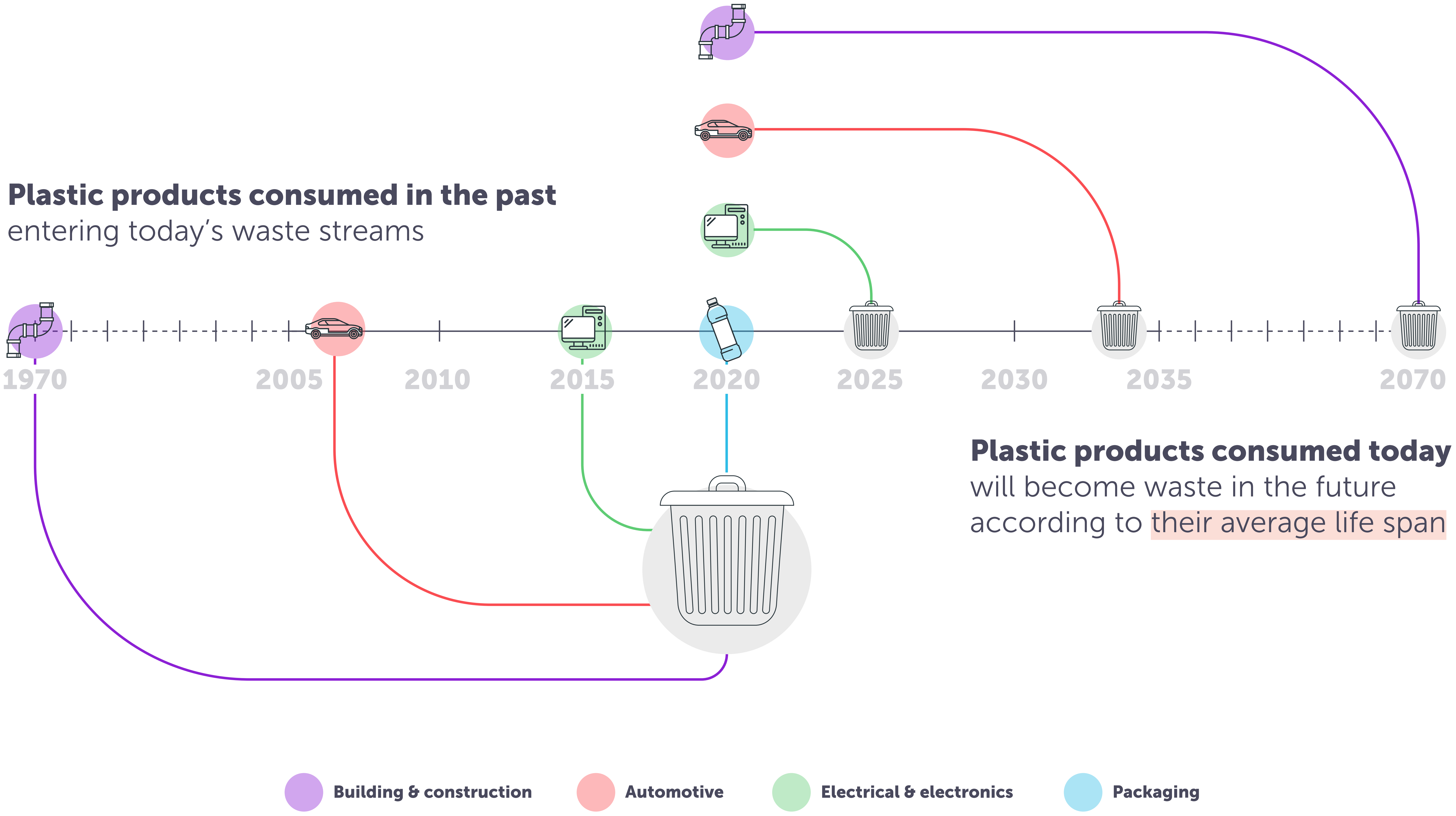
Some plastic products and parts are exported for a second life service, and therefore never become waste in the EU27+3 (e.g. exports of used cars). Other products, such as furniture and toys, may be resold and used second hand, and do not become waste for a very long time.

The variable lifespans of different plastic products and parts helps to explain why waste quantities for a given year (here 2020) are considerably smaller than the total plastic products and parts entering the market for the same year.

Similarly, plastic products and parts collected as waste in 2020 may have entered the market decades beforehand (e.g. old fridge, used mattress, etc.).

However, more research is needed to achieve a higher level of data robustness and a more accurate overview on the quantities of plastic products and parts that are still in use.

When do plastic products become waste?



FROM WASTE TO RECYCLING PLANT

UNDERSTANDING THE DIFFERENT TYPES OF PLASTICS WASTE

Although this report mainly focusses on post-consumer plastics waste, it is important to explain the difference between post-consumer and pre-consumer plastics waste.

PRE-CONSUMER PLASTICS WASTE

Pre-consumer plastics waste arises from the plastics production and converting processes (e.g. faulty production and sprues, edge sections of plastics sheets, production left overs). Pre-consumer plastics waste excludes rework materials, such as regrind or scrap, generated and reclaimed in the same manufacturing process.

POST-CONSUMER PLASTICS WASTE

Post-consumer plastics waste refers to plastic products (plastic packaging, old window frames, used electronics, etc.) that are discarded by final consumers once they have served their purpose and can no longer be used. This category of waste also includes installation waste (e.g. offcuts of insulation boards, flooring or wall cladding when they are installed in a building).

COLLECTION OF POST-CONSUMER PLASTICS WASTE

This study examined all waste streams containing plastics and estimated that 29.5 million tonnes of post-consumer plastics waste were collected in 2020 in EU27+3. This quantity represents about 1% of the total of all types of post-consumer waste generated in the same year in the EU27+3 (e.g. organic waste, metals, wood, glass, paper, cardboard, concrete, etc.).

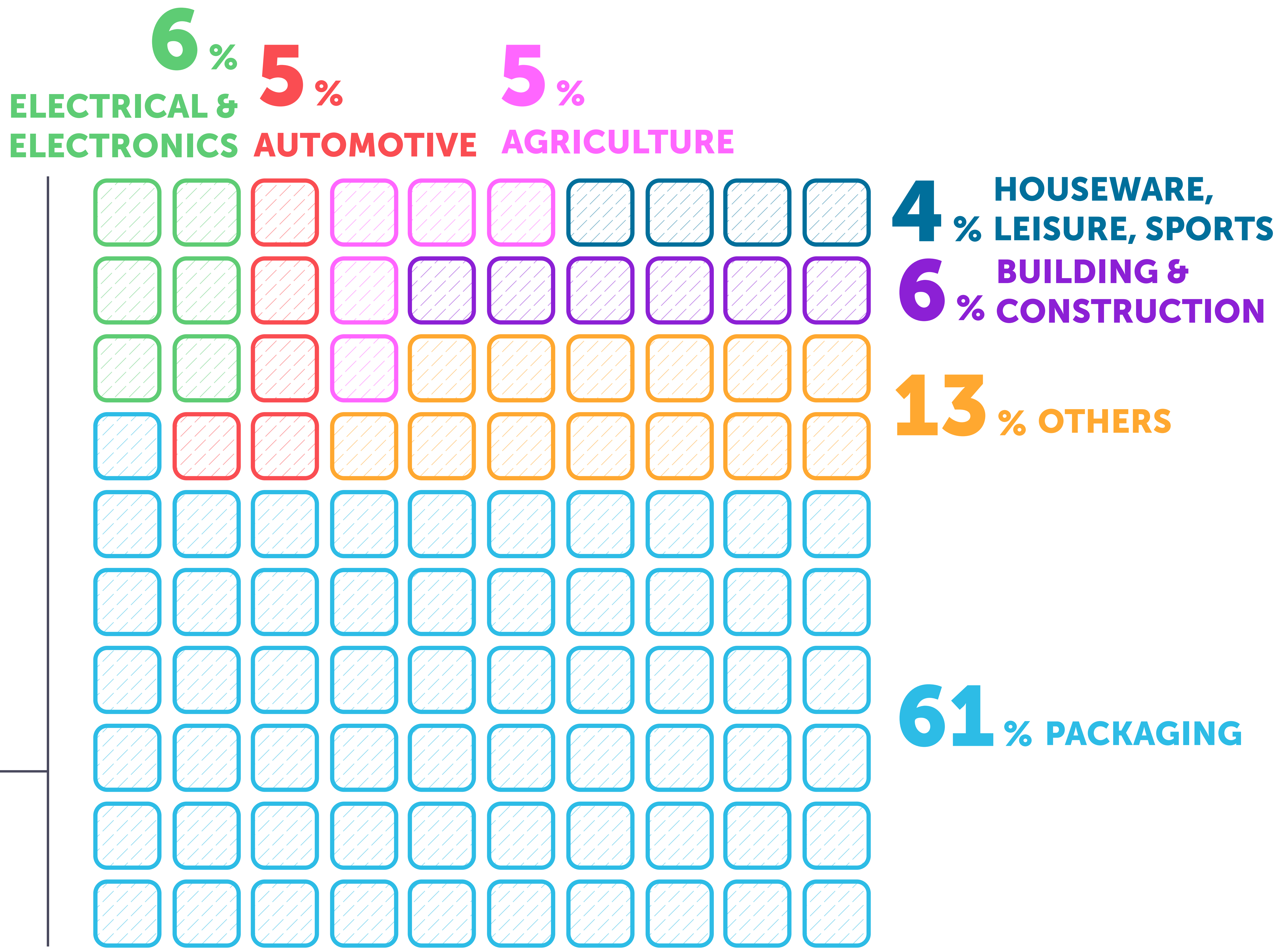
Of the post-consumer plastics waste that was collected in 2020, most originated from packaging applications (61%), followed by building and construction (6%), and electrical and electronic applications (6%).

The study data suggest that on the one hand, in 2020, due to the COVID-19 pandemic, there was an increase in the consumption of household packed goods (e.g. online shopping, takeaway and food delivery). On the other hand, industrial and commercial activities slowed down, and consequently the collection of plastics packaging waste from those sectors decreased. Both trends resulted in a stable share of packaging in the overall post-consumer plastics waste collection in 2020, compared to 2018.

in 2018
29.1 Mt

in 2020
29.5 Mt

of post-consumer plastics waste were collected in the EU27+3



The plastics packaging waste data used for the above graph were extrapolated based on 2019 available figures. The above data were rounded.

WHY IS SEPARATE COLLECTION KEY FOR RECYCLING?

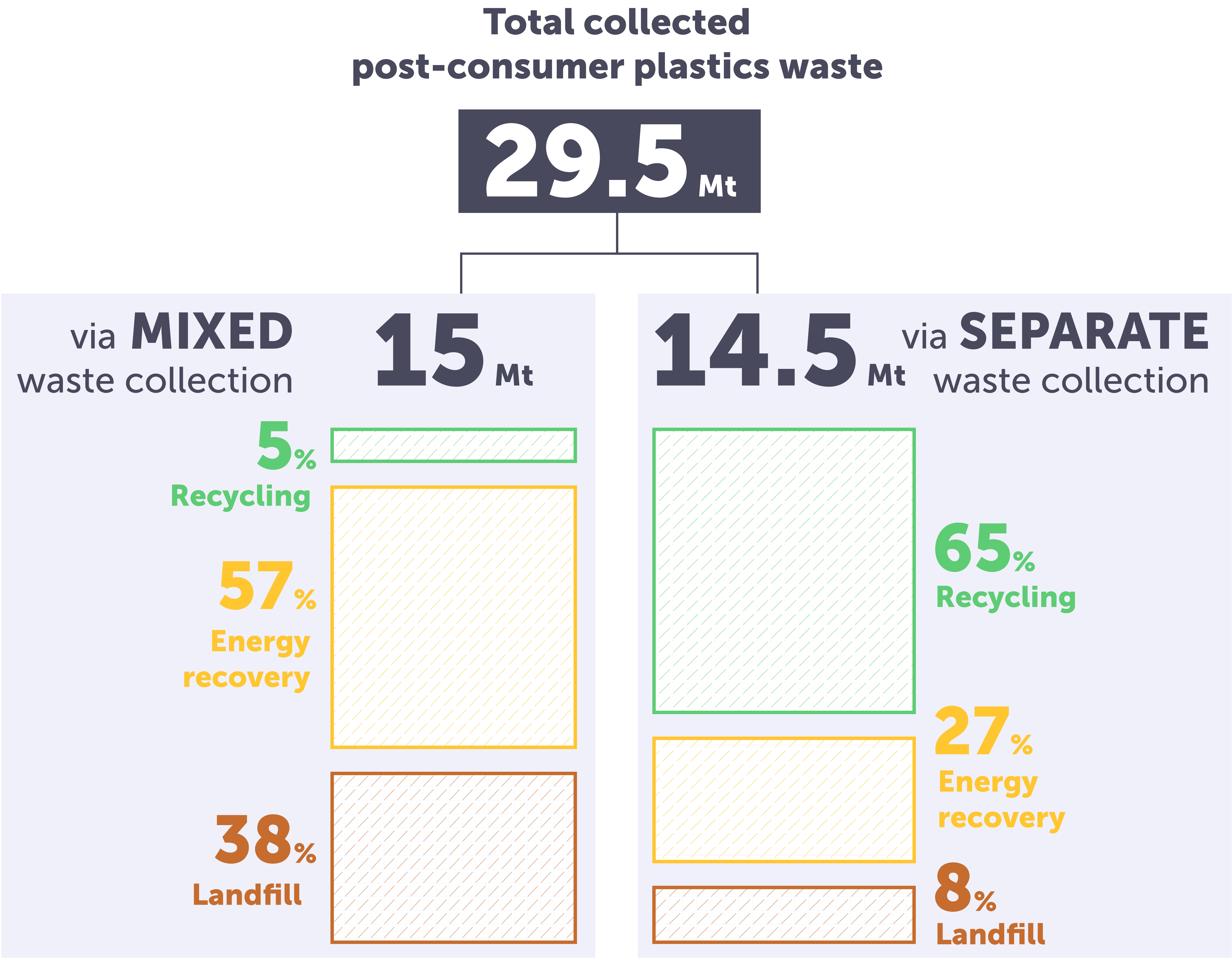
Optimising waste management processes is essential to increase the level of resource efficiency, and thus the level of recycling. Encouraging separate waste collection is key as it leads to a much higher level of recycling rates.

To be able to recycle different waste fractions, they must be carefully separated beforehand. Separate collection helps to pre-sort waste and to ensure that other types of waste are not hindering the process.

However, if plastics waste fractions are collected via mixed waste streams, it would be necessary to add extra sorting steps in the recycling process. These cannot always be performed in the most efficient way, which means that not all plastics waste may be kept for recycling, e.g. if plastics become contaminated with organic waste or other types of waste.

This is why post-consumer plastics waste collected via separate waste collection streams generally has 13 times higher recycling rate.

Plastics waste **recycling rates** are
13x higher
when collected separately
compared to mixed collection schemes.



The plastics packaging waste data used for the above graph were extrapolated based on 2019 available figures. The above data were rounded.
Mixed waste collection: waste collection system in which end-users do not sort the different types of waste (e.g. household residual waste and municipal waste).
Separate waste collection: waste collection system in which end-users sort the different types of waste on a product level (e.g. household lightweight packaging, WEEE collection, container parks).
Separate waste collection streams do not contain 100% plastics, since they may be mixed with other materials (e.g. a computer is composed of different types of materials).

Plastics waste recycling rates are **13x higher** when collected separately

EXTRA EU27 AND UK EXPORTS OF PLASTICS WASTE

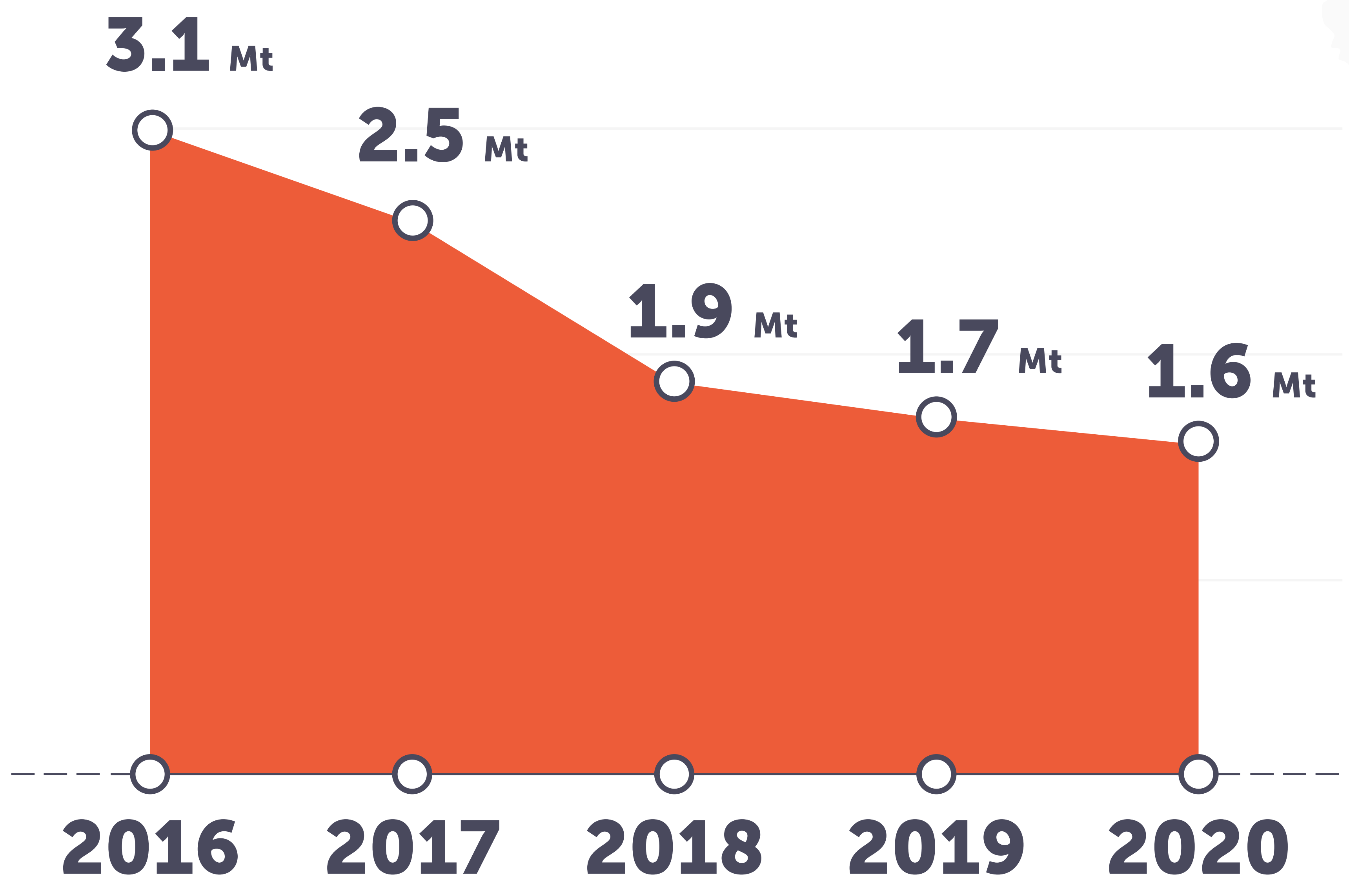
Plastics waste exports outside the EU27 and UK have been reduced by 50%, from 2016 to 2020.

Import bans in destination countries explain this trend, which is expected to accelerate even further with new rules on plastics waste shipments (as of 2021).

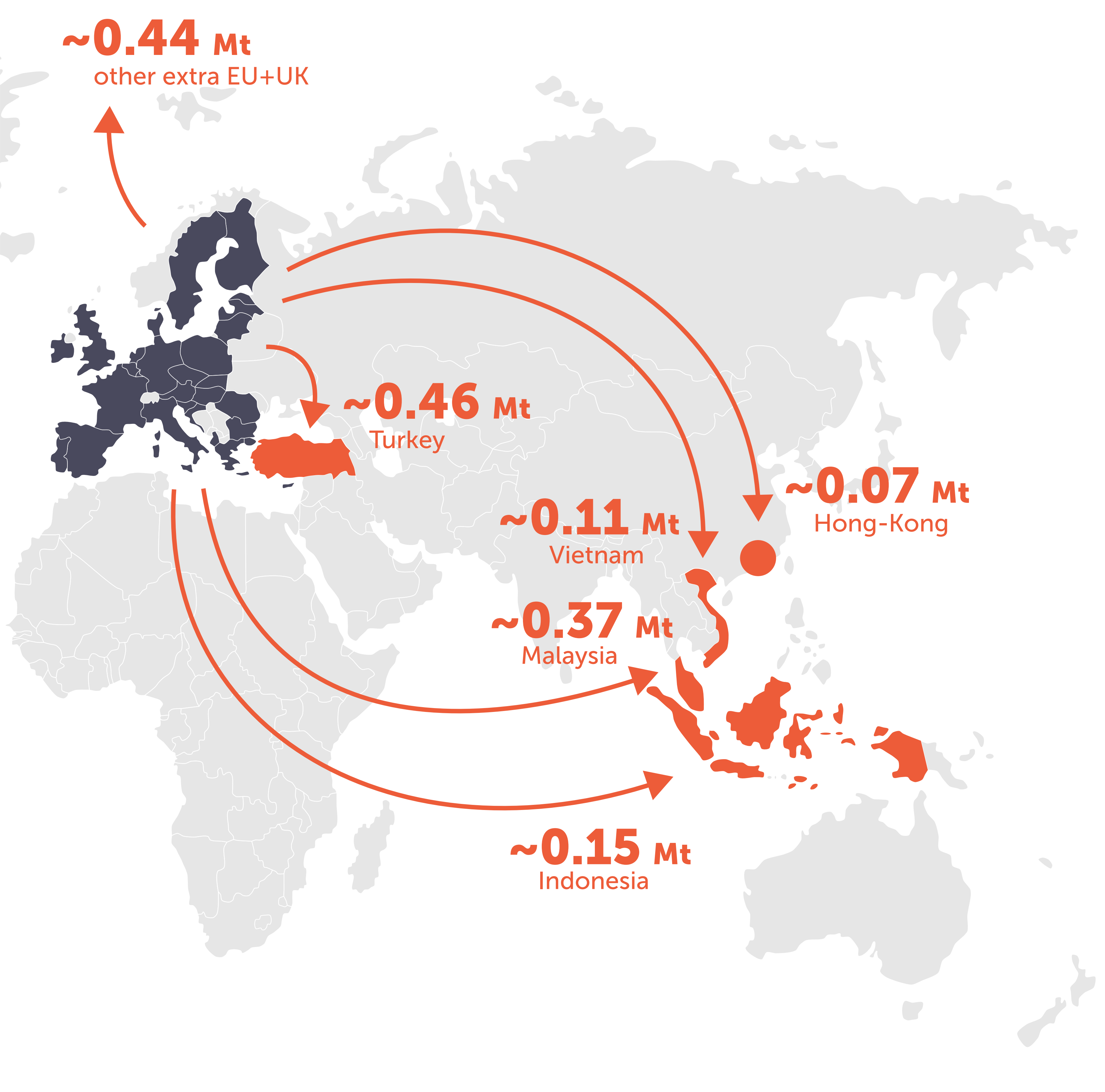
To increase plastics circularity and further decrease plastics waste exports, new recycling capacities need to be built in Europe. Plastics Europe member companies are therefore planning to invest in new capacities for chemical recycling (see page 36), as a complement to mechanical recycling, to offer even more recycling capacity in Europe.

However, investment in new assets requires a sufficient and stable supply of plastics waste. An easy and smooth intra-EU/EEA movement of plastics waste is therefore essential.

EU27+UK plastics waste exports evolution (2016-2020)



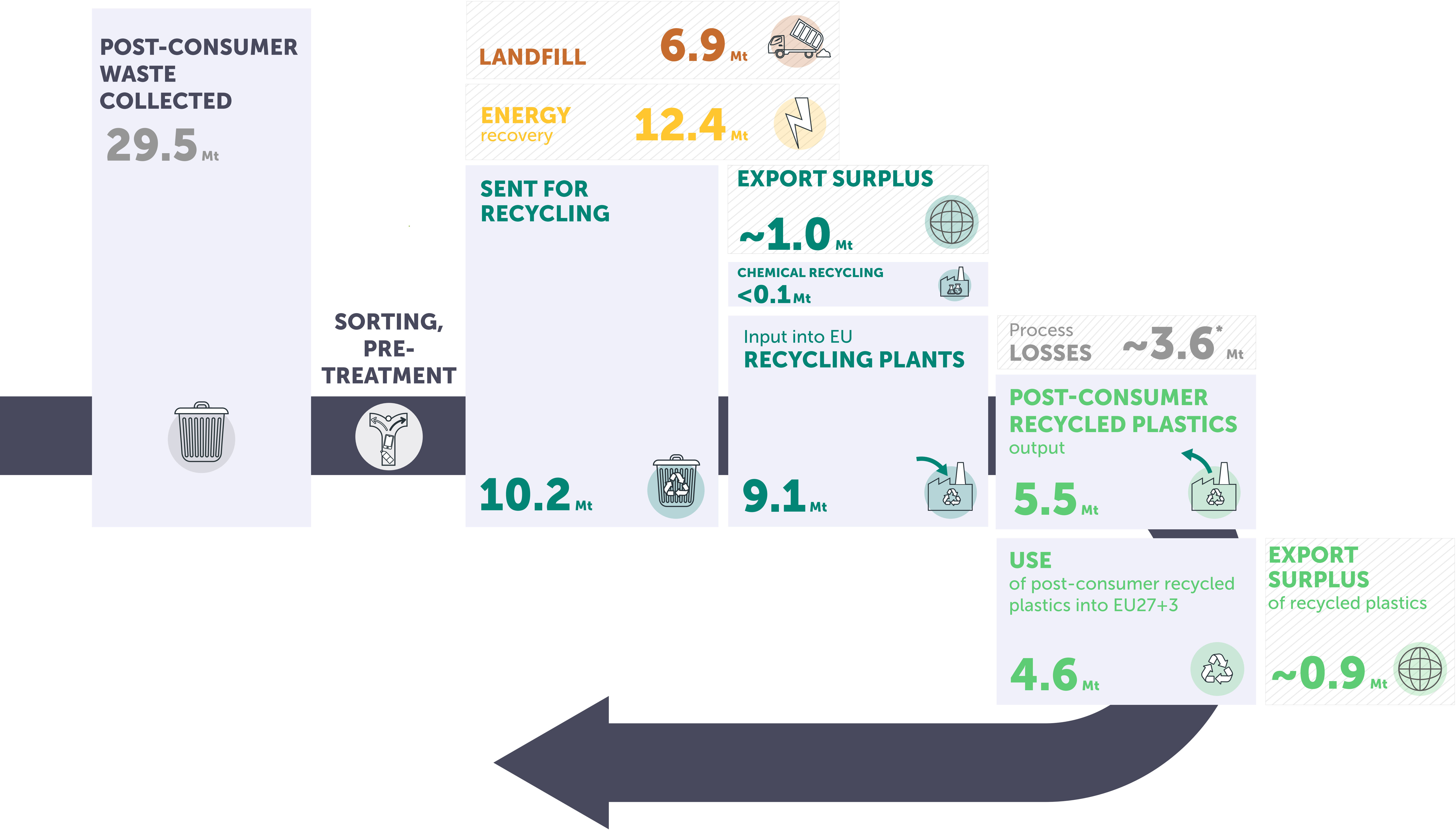
EU27+UK plastics waste exports in 2020



Source: Eurostat
The above data were rounded.
Plastics waste exports data are limited to the EU27+UK for data availability reasons.

TURNING WASTE INTO NEW RESOURCES

OUTPUT FROM POST-CONSUMER PLASTICS WASTE RECYCLING



*Process losses are usually sent to energy recovery or landfill. Parts of plastics residues could be a potential future source of chemical recycling.
The plastics packaging waste data used for the above graph were extrapolated based on 2019 available figures. The above data were rounded.

More than 10 million tonnes of post-consumer plastics waste were sent to recycling in 2020. Close to 90% (9.1 million tonnes) were treated in the EU27+3 to produce 5.5 million tonnes of post-consumer recycled plastics.

When collected plastics waste enters sorting and recycling plants, it first needs to be separated from other types of waste, potential residues that have been jointly collected, and impurities.

These impurities and residues can be organics (e.g. water, milk, yoghurt and any other types of food residues), moistures, paper, adhesives, textiles, composites, metals, etc. Residues also encompass small plastics waste pieces, and collected plastics waste discarded from the recycling process.

Once separated from any dirt, impurities and residues, plastics waste enters the recycling process. As in any other type of industrial activity, losses occur at the different steps of the process. This explains the difference between input and output quantities in plastics waste recycling.

As an effect of the COVID-19 pandemic, there has been a high consumption of household plastics packaging. These often come with higher levels of residues (e.g. mixed with organic residues). This, combined with the increasing market requirements in terms of recycled plastics' quality in 2020, has led to higher process losses.

The plastics value chain is working to improve these processes and achieve the maximum level of recycled plastics yields with the required quality.

POST-CONSUMER PLASTICS WASTE MANAGEMENT

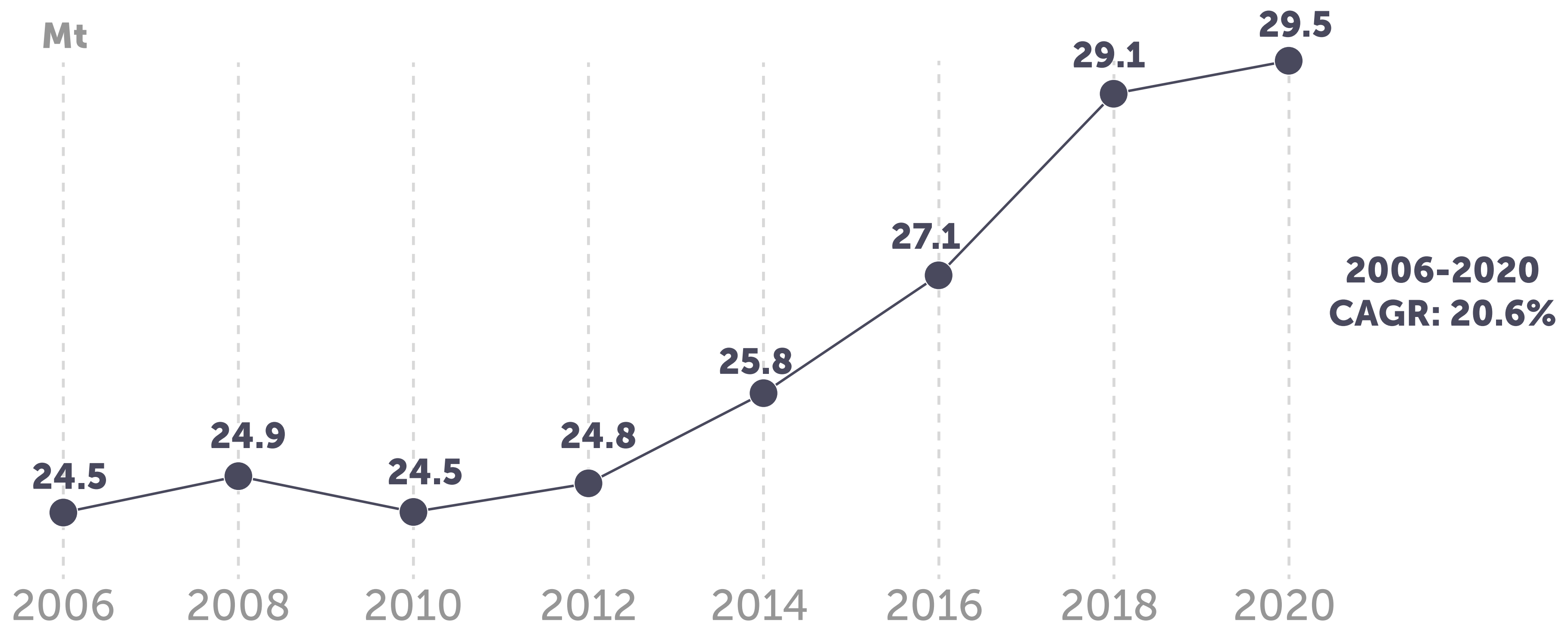
Since 2006, the total quantity of post-consumer plastics waste sent to recycling facilities has more than doubled.

Overall higher recycling quantities are due to: higher volumes of plastics packaging waste separately collected, compared to 2018; more efficient sorting technologies (e.g. also from mixed waste streams); improved waste collection systems and the expansion of recycling initiatives for plastics waste from agricultural, farming and gardening applications.

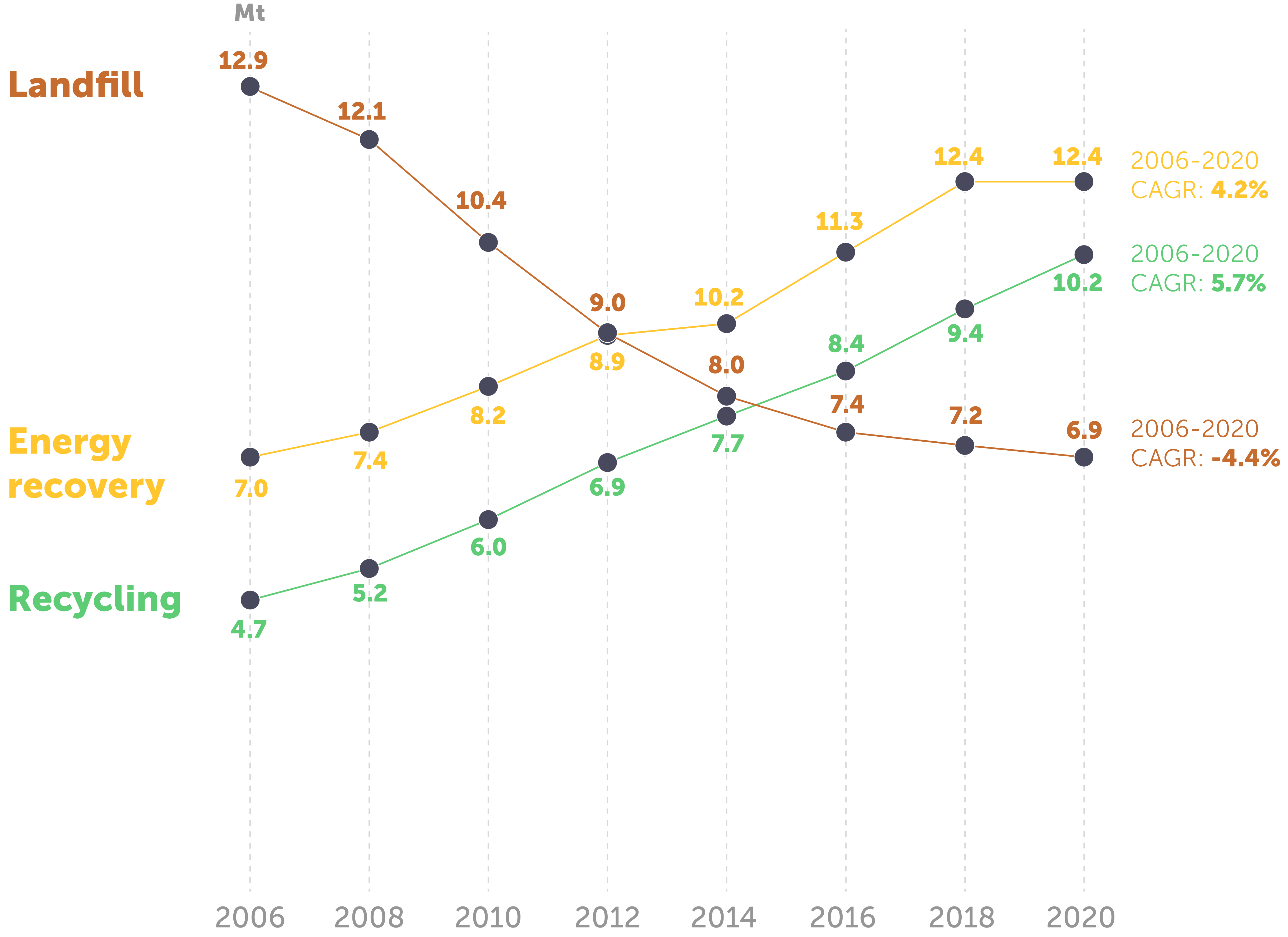
Although landfilled quantities almost halved compared to 2006, 6.9 million tonnes of plastics waste still ended up in landfill in 2020.

For the first time since 2006, however, the quantities of post-consumer plastics waste sent to energy recovery did not increase.

Total plastics waste collected (in Mt)
2006 - 2020, in the EU27+3



Evolution of post-consumer plastics waste treatment (in Mt)
2006 - 2020, in the EU27+3



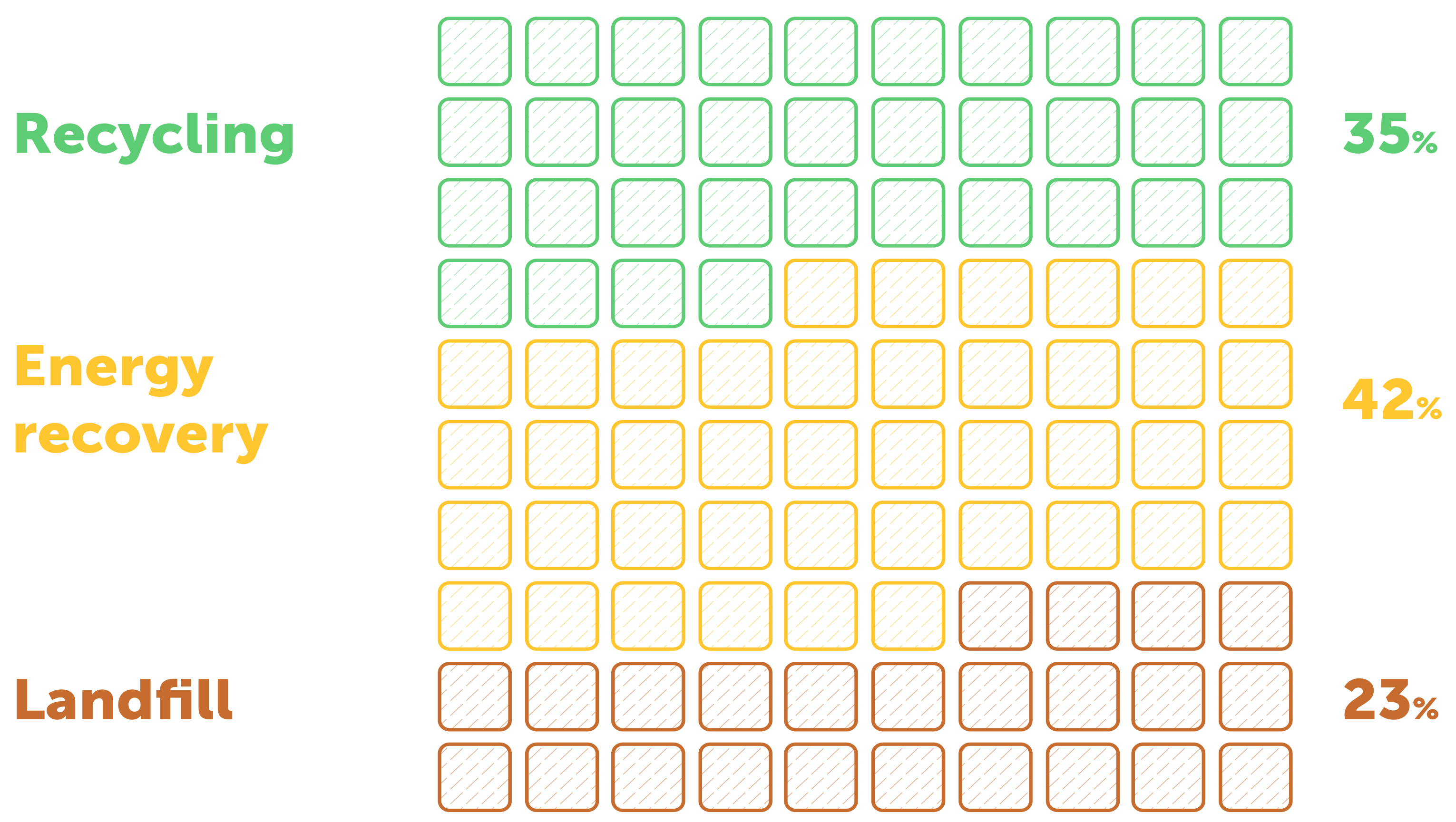
CAGR: Compound Annual Growth Rate
The plastics packaging waste data used for the above graph were extrapolated based on 2019 available figures. The above data were rounded.
Recycling rates for plastic packaging waste are shown under the old plastic packaging recycling calculation methodology.

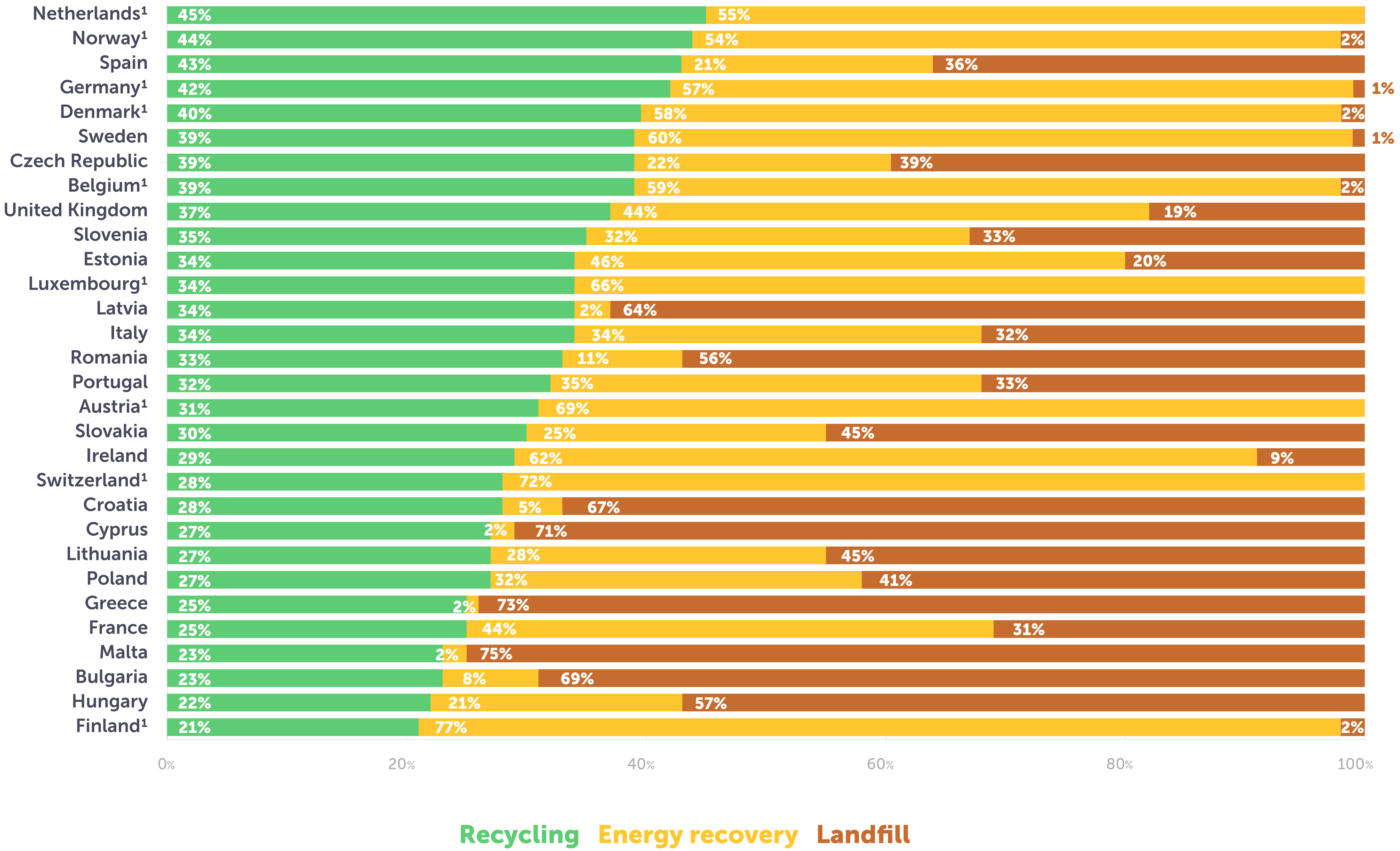
POST-CONSUMER PLASTICS WASTE MANAGEMENT

Post-consumer plastics waste sent to recycling reached 35% in 2020 at a European level.

The countries that are performing best in post-consumer plastics waste sent to recycling are the Netherlands, Norway, Spain and Germany with rates exceeding 40%.

Plastics post-consumer waste management
2020, in EU27+3





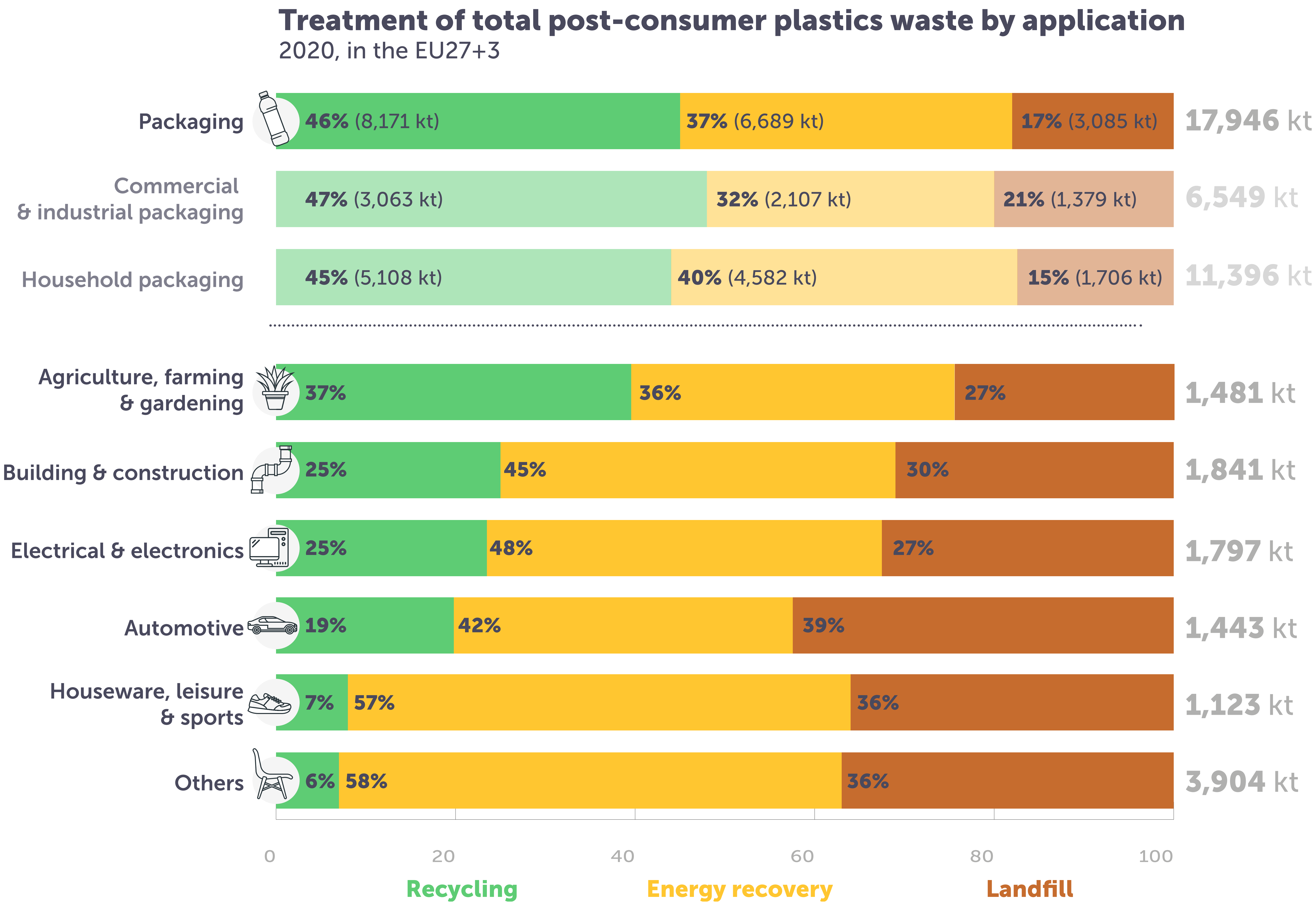
1. Countries with landfill restrictions.
The plastics packaging waste data used for the above graph were extrapolated based on 2019 available figures. The above data were rounded.
Recycling rates for plastic packaging waste are shown under the old plastic packaging recycling calculation methodology.
2020 Dutch plastics recycling included some quantities of plastics packaging waste collected in 2019, due to a fire in a local recycling facility in 2019.

POST-CONSUMER PLASTICS WASTE MANAGEMENT

BY APPLICATION

Plastics packaging waste and waste from agriculture, farming and gardening activities have the highest recycling rates. Since 2018, these applications are also those recording the largest increase in recycling shares: +4 percentage points each. Household plastics packaging waste recycling even increased by 7 percentage points.

This improvement is due to higher quantities of plastics packaging and agriculture, farming and gardening waste being collected separately. This confirms once more that collecting plastics waste separately results in higher rates of recycling.



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Recycling rates for plastic packaging waste are shown under the old plastic packaging recycling calculation methodology.

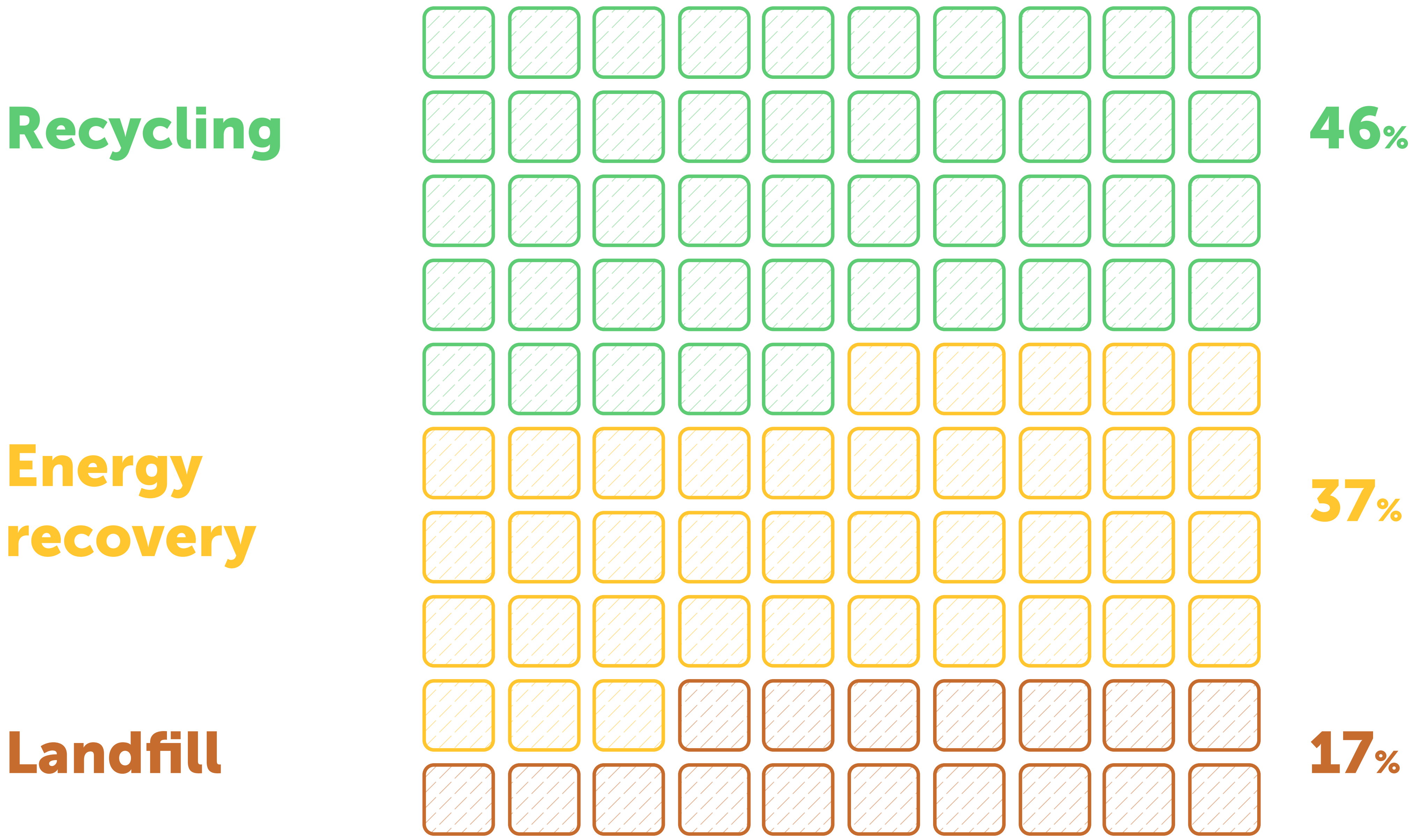
POST-CONSUMER PLASTICS WASTE MANAGEMENT

FOCUS ON PACKAGING

Post-consumer plastics packaging waste sent to recycling reached 46% in 2020 (under the former methodology). 54% are still sent to energy recovery or landfill, which show that there is still a need for significant improvements towards circularity and to reach industry targets.

Plastics packaging post-consumer waste management

2020, in the EU27+3



Post-consumer plastics packaging waste may be generated by household consumption (e.g. food packaging) or through industrial and commercial activities. This may include secondary and tertiary packaging for a wide range of products, such as stretch films around bricks pallets or packs of drink bottles.


Commercial waste


Industrial waste


Household waste

The plastics packaging waste data used for the above graph were extrapolated based on 2019 available figures. The above data were rounded.
Recycling rates for plastic packaging waste are shown under the old plastic packaging recycling calculation methodology.

POST-CONSUMER PLASTICS WASTE MANAGEMENT

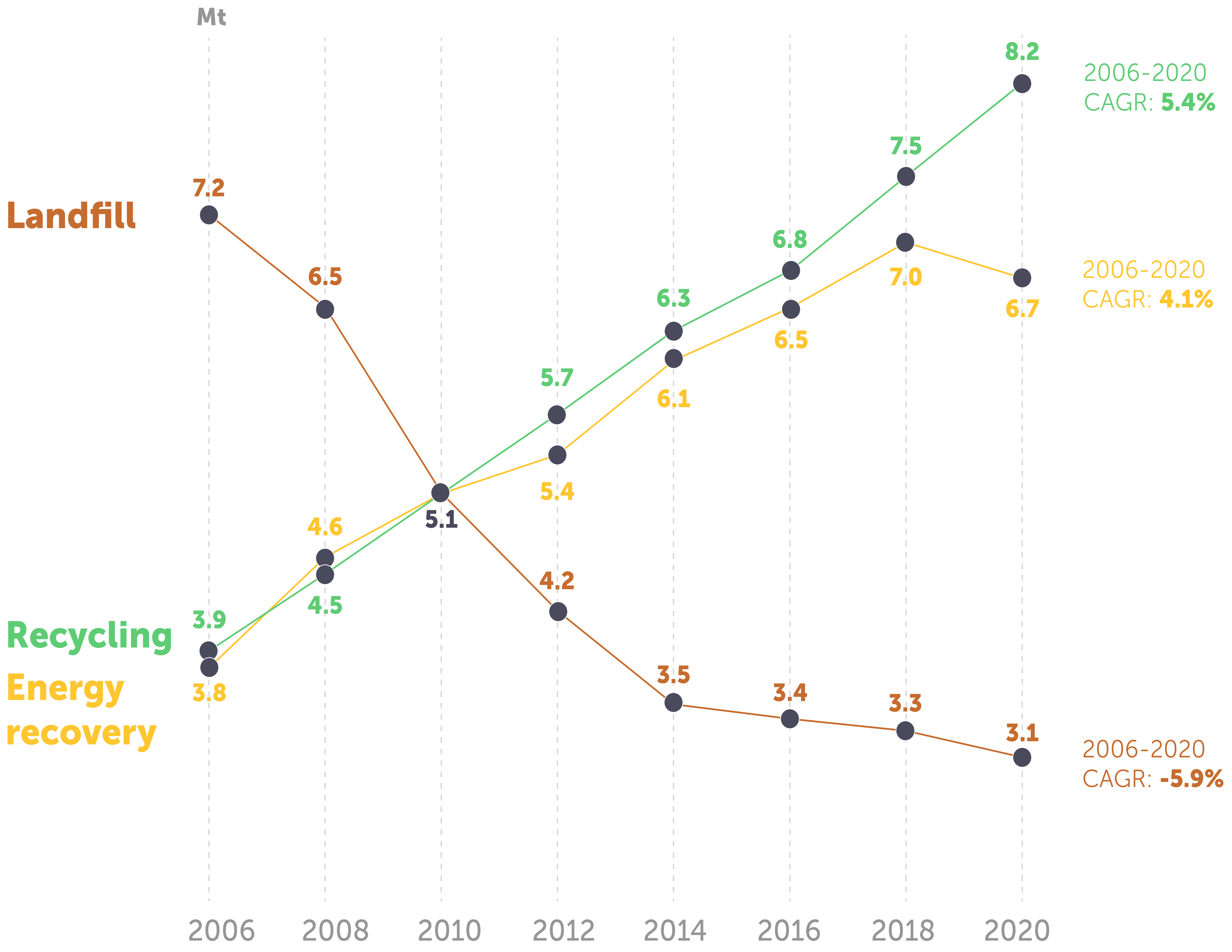
FOCUS ON PACKAGING

The total quantity of post-consumer plastics packaging waste sent to recycling facilities has more than doubled since 2006.

However, 9.8 million tonnes of post-consumer plastics packaging waste were still sent to energy recovery and landfill.

For the first time since 2006, the quantity of plastics packaging waste sent to energy recovery decreased.

Evolution of post-consumer plastics packaging waste treatment (in Mt)
2006 - 2020, in the EU27+3



CAGR: Compound Annual Growth Rate
The plastics packaging waste data used for the above graph were extrapolated based on 2019 available figures. The above data were rounded.
Recycling rates for plastic packaging waste are shown under the old plastic packaging recycling calculation methodology.

POST-CONSUMER PLASTICS WASTE MANAGEMENT

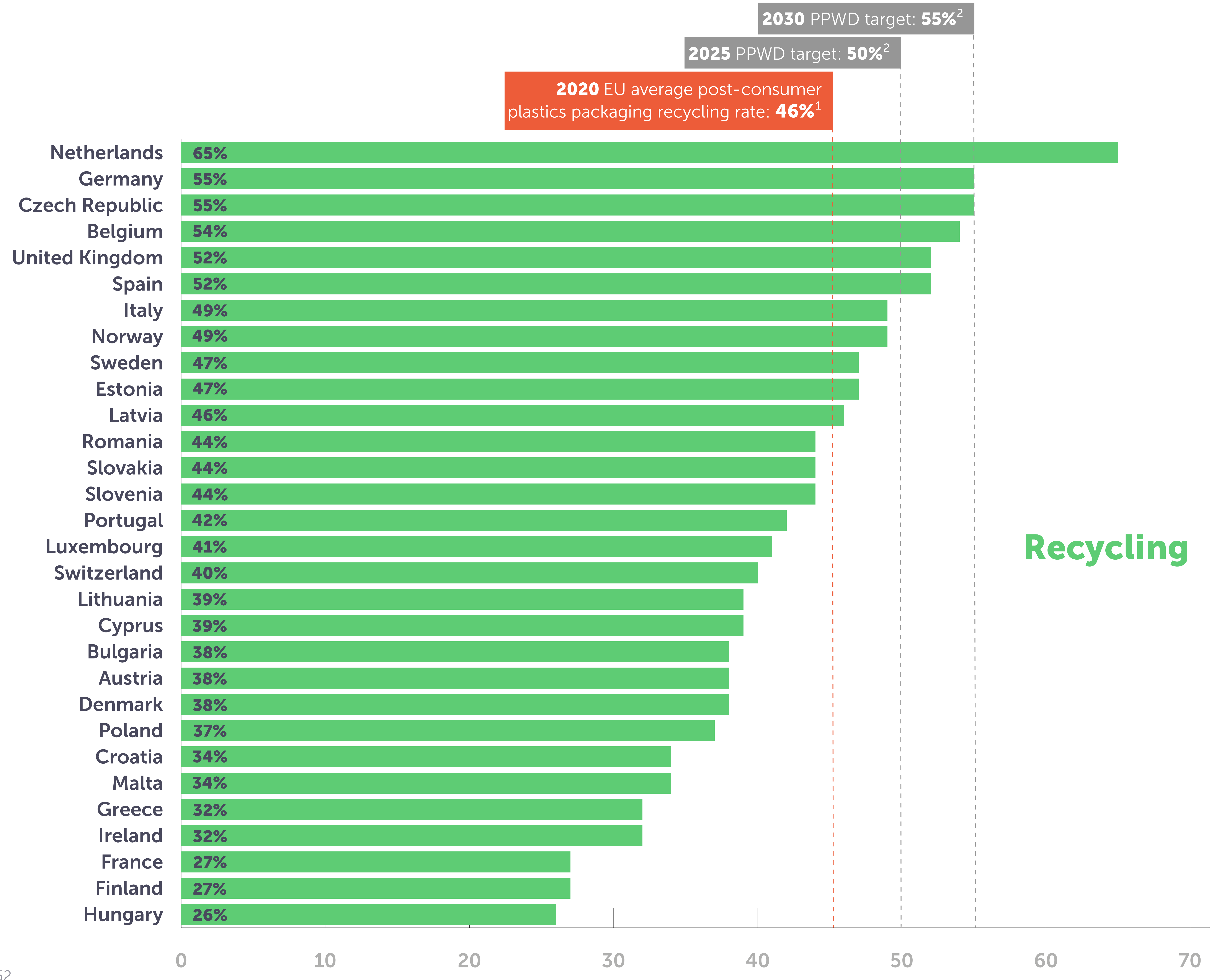
FOCUS ON PACKAGING

In 2020, the overall European recycling rate for plastics packaging reached 46% (under the former methodology), compared to 42% in 2018 - an increase of about 9.5%.

Already six countries do have a recycling rate higher than 50% for post-consumer plastics packaging waste (under the former methodology): the Netherlands, Germany, the Czech Republic, Belgium, the United Kingdom and Spain.

The European Commission's Packaging and Packaging Waste Directive (PPWD) sets a 50% recycling target for plastics packaging waste by 2025, and 55% by 2030. The new point of calculation for plastics packaging recycling adopted in this Directive (materials entering pelletisation, extrusion and moulding processes), will significantly lower current recycling rates.

The analysis of the 2006-2020 recycling evolution showed that the Compound Annual Growth Rate (CAGR) for this period was about 5.4%. Estimates show that in order to meet the PPWD target the rate of packaging recycling needs to grow by almost 10% per year (i.e. almost doubling the current pace).



1. Under the former point of calculation: Materials sent for recycling - Directive (EU) 94/62/EC
2. Under the new point of calculation: Materials entering pelletisation, extrusion and moulding processes - Directive (EU) 2018/852

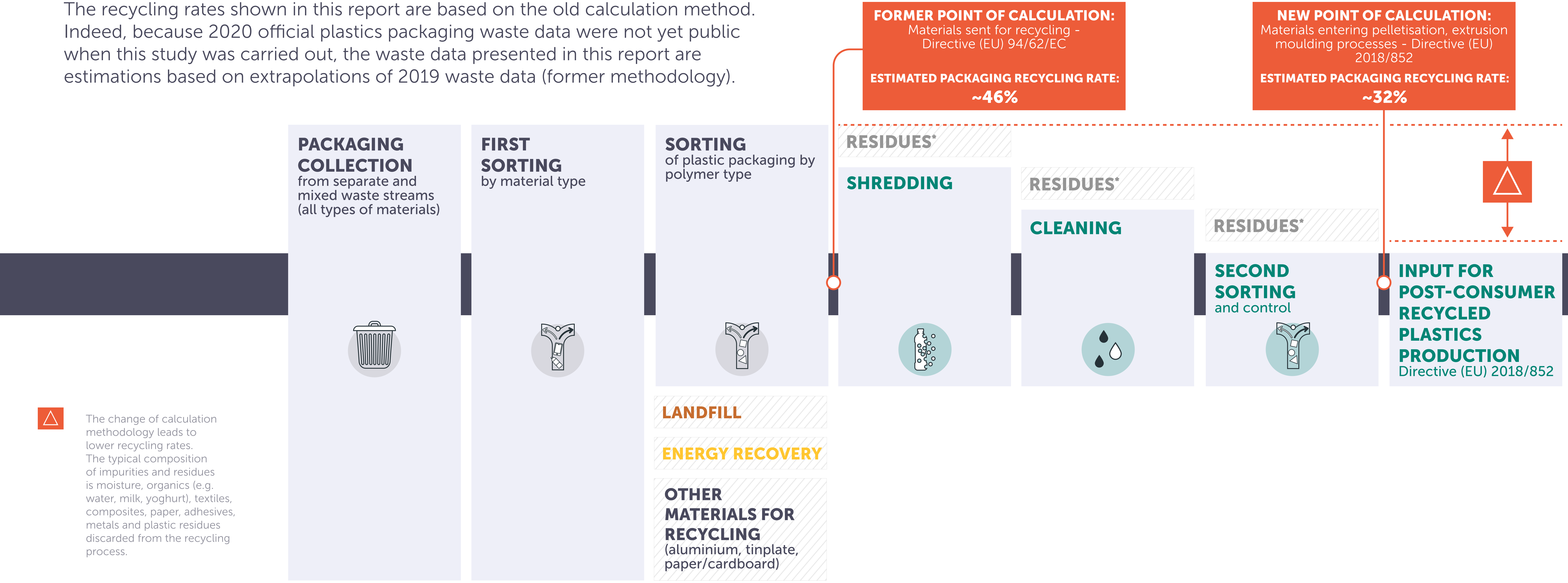
The plastics packaging waste data used for the above graph were extrapolated based on 2019 available figures. The above data were rounded.
Recycling rates for plastic packaging waste are shown under the old plastic packaging recycling calculation methodology.
2020 Dutch plastics recycling included some quantities of plastics packaging waste collected in 2019, due to a fire in a local recycling facility in 2019.

HOW IS POST-CONSUMER PLASTICS PACKAGING WASTE RECYCLED?

In 2018, the PPWD amended the calculation methodology to measure post-consumer plastics packaging recycling rates, as of 2020.

The recycling rates shown in this report are based on the old calculation method. Indeed, because 2020 official plastics packaging waste data were not yet public when this study was carried out, the waste data presented in this report are estimations based on extrapolations of 2019 waste data (former methodology).

As shown by the graph, the current 46% recycling rate for plastics packaging would potentially equal to 32% under the new method. This highlights how much progress is still needed to meet the 55% recycling target for post-consumer plastics packaging waste by 2030.



△ The change of calculation methodology leads to lower recycling rates. The typical composition of impurities and residues is moisture, organics (e.g. water, milk, yoghurt), textiles, composites, paper, adhesives, metals and plastic residues discarded from the recycling process.

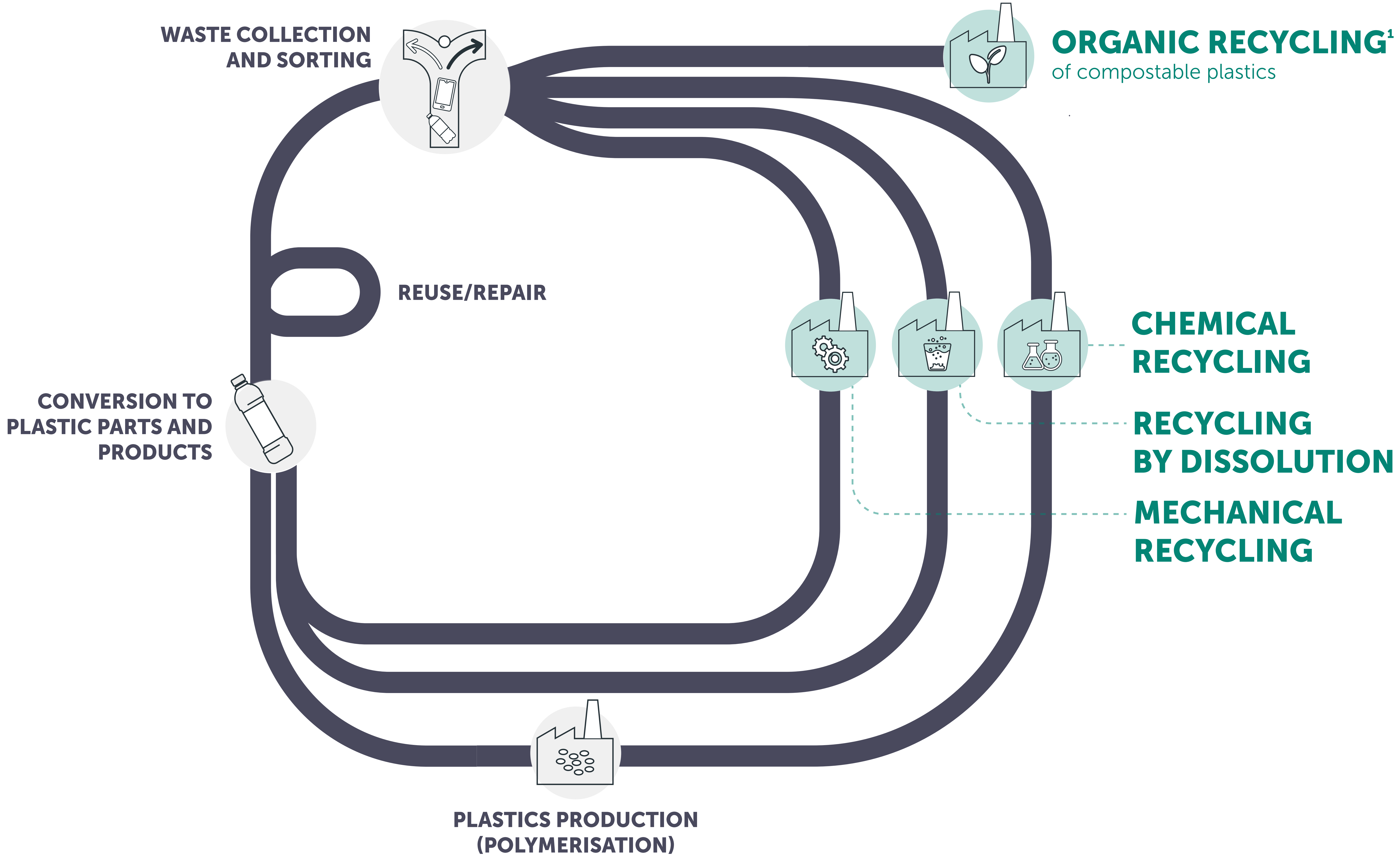
*Process losses are usually sent to energy recovery or landfill. Parts of plastics residues could be a potential source of chemical recycling.
The plastics packaging waste data used for the above graph were extrapolated based on 2019 available figures. The above data were rounded.

RECYCLING TECHNOLOGIES

HOW IS POST-CONSUMER PLASTICS WASTE TREATED TO PRODUCE NEW RESOURCES

Increasing the quantity and the overall quality of recycled plastics is required to accelerate the circularity of plastics. Different technologies are available that maximise the value of plastics at the end of their service life.

Today, mechanical recycling is the recycling process providing the highest quantities of recycled plastics. As a complement, different chemical recycling technologies have also been developed. These technologies are currently running at smaller scale, however, they will be indispensable, not only to reach higher recycled plastics quantities but also to contribute to the transition to a climate neutral circular economy.



1. Organic recycling of compostable plastics is not in the scope of the present study.

EXPLAINING THE MAIN RECYCLING PROCESSES

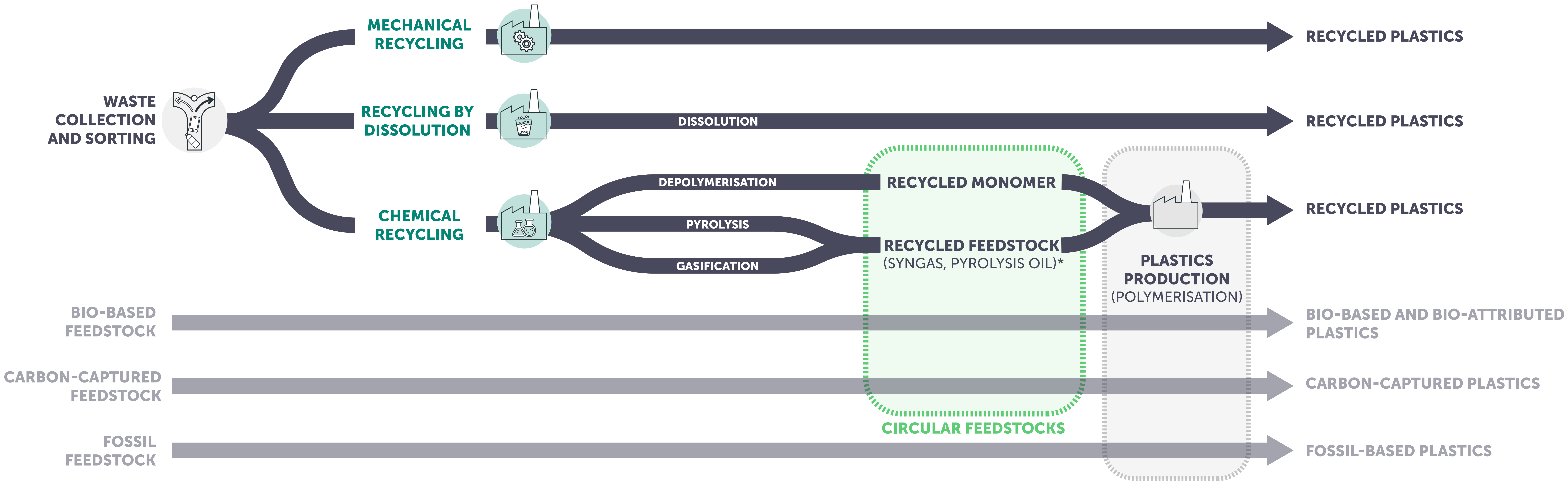
Different complementary recycling processes exist.

Via mechanical recycling, plastics waste is grinded, washed, extruded and pelletised to make recycled plastics. Mechanical recycling allows to recycle plastics waste several times, however, with a progressive loss of properties.

The innovative potential of our industry has enabled the development of new recycling technologies, such as chemical recycling and dissolution. Complementary to mechanical recycling, these technologies offer the possibility to transform difficult to recycle plastics waste into recycled plastics, as if they were produced for the first time, via polymerisation. This prevents this type of waste to be sent to incineration or landfill as they cannot be processed by mechanical recycling.

The dissolution is another physical process to produce recycled plastics from plastics waste by separating polymers from other substances (e.g. additives) with solvents.

Chemical recycling entails three main technologies. The depolymerisation of plastics waste leads back to (constituting) monomers that can be polymerised again to produce recycled plastics. Pyrolysis and gasification create recycled intermediate substances such as pyrolysis oil or syngas to be used as feedstock. In all three cases, the production of recycled plastics takes place in production plants, by polymerisation. These technologies have the capacity to deal with hard to recycle or contaminated plastics waste.



*European legislation does not allow for waste processed for use as fuels by chemical recycling technologies to be considered recycling.

PLASTICS INDUSTRY INVESTMENTS IN CHEMICAL RECYCLING

European plastics manufacturers plan to invest 2.6 billion euros by 2025, and 7.2 billion euros by 2030, in chemical recycling. The production is estimated to increase to 1.2 million tonnes and 3.4 million tonnes of recycled plastics respectively. This investment will support the Circular Plastics Alliance's (CPA) objective of 10 million tonnes of recycled plastics used into new products on the European market by 2025.

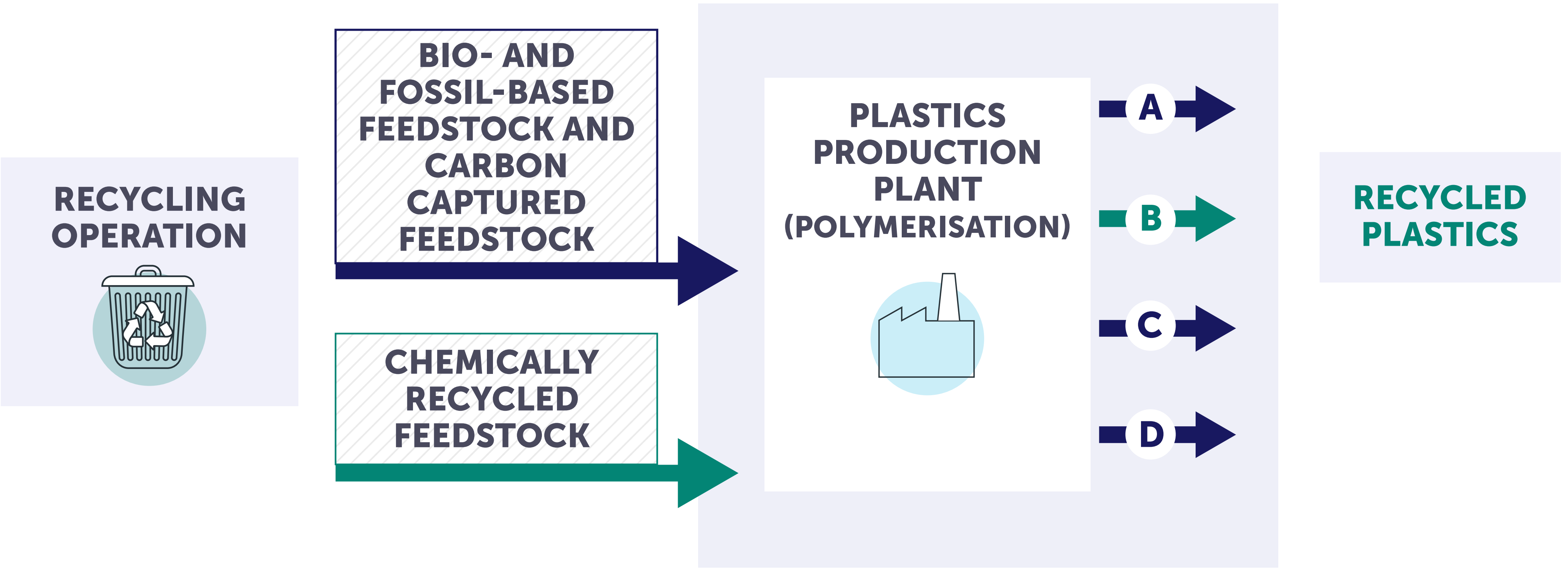
PLANNED RECYCLED PLASTICS PRODUCTION VIA CHEMICAL RECYCLING IN EUROPE

Plastics Europe's member companies are planning 44 chemical recycling projects in 13 different European countries.

What does mass balance mean for chemical recycling?

In most chemical recycling processes, plastics waste is transformed into recycled feedstock that is mixed with other feedstock, in large industrial production units, to produce recycled plastics and possibly other chemicals. The physical traceability or separation between both is therefore not possible, requiring specific methodology/chain-of-custody to evaluate the recycled content in the plastics output. A mass-balance approach with credit (defined in ISO 22095) is then needed to attribute the recycled feedstock input to certain output products, where there is a market demand for recycled content.

APPLICATION OF MASS BALANCE TO CHEMICAL RECYCLING



Mass balance allows the attribution of recycled characteristic, to one or several outputs products.

7.2 billion euros
are planned to be invested by
2030 in chemical recycling

80%
of projects plan to use
waste from the EU

44 planned projects
in 13 EU countries
by 19 companies

3.4 million tonnes
of recycled plastics are estimated to be produced
via chemical recycling
in 2030

Chemical recycling investment data collected via a survey conducted in 2021 by Plastics Europe to its member companies.

RECYCLED PLASTICS

WHERE ARE POST-CONSUMER RECYCLED PLASTICS USED TODAY?

in 2018
4.0 Mt

in 2020
4.6 Mt

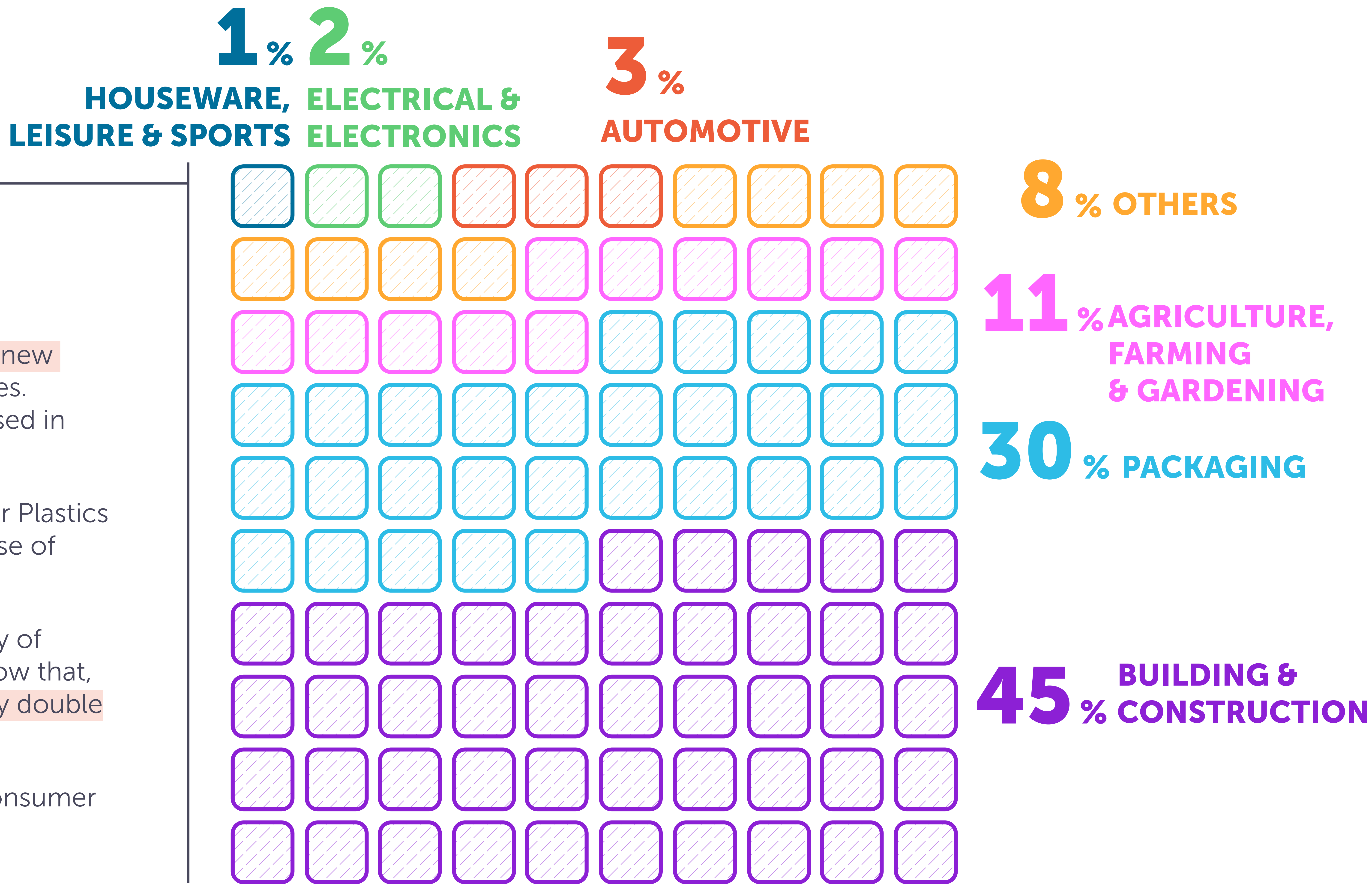
Recycled plastics in new products

Since 2018, the amount of post-consumer recycled plastics used in new products in the EU27+3 increased by 15%, reaching 4.6 million tonnes. Consequently, the proportion of post-consumer recycled plastics used in new products has increased from 7.2% to 8.5% (see page 16).

Individual company pledges, European initiatives such as the Circular Plastics Alliance (CPA), industry initiatives and regulations are fostering the use of recycled plastics in different sectors.

However, more needs to be done to accelerate the overall circularity of plastics. In the specific case of the CPA, the findings of this study show that, amongst other factors, input capacities for recycling need to roughly double to meet target of 10 million tonnes recycled plastics use in Europe.

In addition, this study estimates that about 3.6 million tonnes pre-consumer recycled plastics were used in new products in 2020 in the EU27+3.



The above data were rounded.
Post-consumer recycled plastics only.

45% of post-consumer recycled plastics are used in **building and construction** applications.

Packaging applications represent the **second market** for post-consumer recycled plastics, followed by agriculture, farming and gardening.

FINAL REMARKS

FINAL REMARKS

The challenges of achieving plastics circularity should not overshadow the importance of this shift.

This report, which aims to help stakeholders to better understand the plastics circular economy and the situation in 2020, recognises that progress towards circularity has been done in the past years.

Progress has already been made in the share of post-consumer plastics waste sent for recycling. In 2020, this proportion has almost doubled compared to 2006. Despite the disruption caused by the COVID-19 pandemic, from 2018 to 2020 there was an increase of 2 percentage points in the share of post-consumer plastics waste sent for recycling, reaching now 35% of the collected post-consumer plastics waste. Progress has also more specifically been observed for plastics packaging waste: 46% (approximately 32% under the new calculation methodology) is already recycled. Additionally, the recycled plastics uptake has also increased by 15%, representing 4.6 Mt of circular plastics available for the manufacturing of plastics products and parts.

However, the report also highlights the need to accelerate the pace of progress if the industry wants to meet corporate and EU policy targets and contribute to overall EU climate ambitions.

Plastics Europe supports the targets set to continue and accelerate this progress, such as the Packaging and Packaging Waste Directive (PPWD) and its 50% target of plastics packaging recycling by 2025, increasing to 55% by 2030, as well as the Circular Plastics Alliance (CPA) target of 10 Mt of recycled plastics used in new products made in Europe by 2025. But beyond these goals, we acknowledge that current targets and objectives will probably not be sufficient to achieve a circular system. As identified by the recently published "ReShaping Plastics: Pathways to a Circular, Climate Neutral Plastics System in Europe"[1] report, to transition towards a climate neutral and circular economy for plastics, urgent systemic change is essential at a European level.

Plastics Europe, is striving to be a catalyst for the change needed and recalls that the coordination and involvement of all value chain stakeholders will also be required since transformational decisions and investments have to take place upstream and downstream to achieve climate neutrality, and a faster transition to circular plastics.

Plastics Europe therefore calls for renewed efforts by plastics manufacturers and their value chain partners to intensify progress to achieve the following points:

- To manufacture higher performing products: eco-design innovations will improve the reusability, reparability, recyclability and overall sustainability of plastic products
- To expand provision of separate collection of all types of plastics waste, thereby increasing the amount of plastics waste sent to recycling, since, as of the findings of this report, waste collected separately have 13 times higher recycling rates
- To double capacities for sorting and recycling: increased capacity will enable to soundly manage a higher proportion of plastics waste and will accelerate the availability of recycled plastics. However, building the required new assets and capacities for sorting, mechanical and chemical recycling takes time, thus the decision taken in the next 3 to 5 years will be crucial and will set the level of our ambitions

1. For more information on this report, please go to www.plasticseurope.org/reshaping-plastics.

FINAL REMARKS

- To continue improving sorting and recycling efficiency: more efficient recycling and sorting is vital to improve consistent supply and quantity of recycled plastics
- To foster the uptake of recycled plastics in the manufacturing of new products: increasing examples of innovative products that use recycled plastics can be found on the market. In order to further increase this trend, Plastics Europe has called for a mandatory recycled content of 30% for plastic packaging by 2030

To speed-up progress towards climate neutrality and a circular economy, plastics manufacturers need to pioneer the accelerated production of recycled plastics and development of new feedstocks that are less dependent on fossil-based oil and gas. However, these changes cannot occur in the absence of the necessary policy and regulatory support.

European plastics manufacturers are therefore also determined to play the role of a catalyst towards building a framework that provides certainty and incentivises future investments in collection, sorting and recycling infrastructures and technologies, including chemical recycling. To further stimulate Europe's transformation to a circular economy, Plastics Europe will continue to collaborate with all relevant stakeholders in order to facilitate the development of enabling policies that will ensure:

- A harmonised and consistent regulatory framework throughout Europe that guarantees stability for long-term strategic decisions and investments
- Technology neutrality policies that allow the development of innovative sorting and recycling technologies
- Incentivising and promoting of the use of circular feedstocks, originated from chemical recycling technologies, bio-based or carbon-captured
- Recycling remains the most viable end-of-life option for plastics waste through accelerating landfill bans and the inclusion of incineration of municipal plastics waste in the revised EU Emission Trading System
- The removal of barriers to intra-EU/EEA movement of plastics waste for recycling

Circularity targets will be unattainable without monitoring the progress made towards them, which means reliable data is also needed. Plastics Europe will therefore continue to support initiatives including the CPA monitoring, alongside continuing to improve its own datasets.

Plastics Europe believes that if these steps can be followed and new knowledge and technology can be capitalised on, then the future for a climate neutral circular economy for plastics in Europe is within reach.

DISCLAIMER & METHODOLOGY

The present report draws a European overview of the plastics circular economy, based on the study ‘Plastics Circular Economy 2020’ in the EU27+3 countries commissioned by Plastics Europe to Conversio Market & Strategy GmbH.

The latter provides a detailed analysis of the plastics material flow in the European Union, Switzerland, Norway and the United Kingdom (for the reference year 2020). It looks at the production of plastics, their conversion into parts and products consumption, as well as plastics waste collection and treatment, including recycling. It also covers the production of recycled plastics and their use in different applications. Imports and exports data is also analysed to provide an accurate representation of the circular economy of plastics. Finally, the report did not investigate other aspects of the circularity such as the use of other bio-based and carbon-captured feedstock, repair or reuse.

This study focuses on the following plastic materials: PE-LD/ LLD, PE-HD/MD, PP, PVC, PS, EPS, PA, PET, ABS/SAN, PC, PMMA, other thermoplastics, and other plastics, incl. PUR. The following polymers are not included as the study focuses on plastic materials: elastomers, adhesives, coatings and sealants.

The study was performed from January 2021 until October 2021. The scope of the study focused on post-consumer plastics waste and recycled plastics. Indeed, the various targets (for recycling and recycled plastics uptake) put on the industry mainly focus on post-consumer waste and recycled plastics uptake. However, conscious that pre-consumer plastics waste flux are part of the circular economy, the ”Circular Economy of Plastics 2020 in EU27+3“ study provides some general estimations of pre-consumer waste recycling and pre-consumer recycled plastics uptake, which are shown in the present report. Official data for 2020 plastics packaging consumption and waste not being available at the time of publication, all 2020 plastics packaging consumption and waste in the report are therefore an extrapolation of 2019 available figures. All figures in the report are rounded up. The study has some limitations in so far as it does not include waste that was not officially collected, stored or littered. Plastics waste exports data is limited to the EU27+UK for data availability reasons, and intra-EU shipments of post-consumer recycled plastics are also not shown as no trade statistics are available. Estimates are based on mass balance and market surveys. The report does not show polymer specific data, but only aggregated data.

The multi-methodological approach used for this study – modelisation based on both primary and secondary data research – leads to the best possible estimations data availability and accuracy. The final European data set was reviewed by Plastics Europe and the European Association of Plastics Recycling and Recovery Organisations (EPRO).

Primary research includes data collection from European and national authorities (e.g. Eurostat), EPRO, waste management as well as sector organisations. Plastics Europe’s Market Research Group (PEMRG) also provided input on the demand for plastics by the converters (excluding recycled plastics). Additionally, interviews were conducted with stakeholders along the plastics value chain: 300 in-depth interviews with plastics converters in several European countries – to get a better and more nuanced view of how plastics (including recycled materials) are used to manufacture plastic products and parts – and 100 additional in-depth interviews with plastics producers, compounders, brand owners, extended producer responsibility (EPR) schemes, sector federations, waste management companies, sorting plants and recyclers, ministries and market experts.

The secondary research includes data collection from EPR schemes and other organisations (EPRO, PRE, EuPC, VinylPlus, Petcore, etc.) to analyse existing waste streams at national and European levels. Additionally, Conversio Market & Strategy GmbH used official ELV (end-of-life vehicles) and WEEE (waste from electrical and electronic equipment) data, industry databases and statistics from European associations, private entities, environmental statistical agencies as well as from NGOs and academics.

KEY CONCEPTS

Carbon Capture and Use (CCU)

Process of capturing CO2, CO, or CH4 from potential system emissions streams before it enters the atmosphere. Captured carbon can then be used as a feedstock to produce plastics.

Chemical recycling

Chemical recycling converts e. g. polymeric waste by changing its chemical structure to produce substances that are used as products or as raw materials for the manufacturing of products. Products exclude those used as fuels or means to generate energy.

Circular economy

The circular economy is an economy which is recognising and capturing the value of plastics as a resource, with the least impact on the environment, climate and society.

Circular feedstock

Term encompassing feedstock generated via chemical recycling of plastics waste (chemically recycled feedstock), bio-based feedstock, and carbon-captured feedstock.

Consumption

Every plastic product (e.g. a bottle) or part embedded in larger products (e.g. a plastic component in a car), which is used by the end-user for household, commercial and industrial activities.

Conversion to plastic parts and products

Manufacturing of plastic parts and products.

Depolymerisation

Reversion of a polymer to its monomer(s) or to a polymer of lower relative molecular mass. The process can be mediated by e.g. heating, chemical solvents or enzymatic reactions.

Dissolution

Dissolution recycling is a purification process through which the polymer present in a mixed plastics waste is selectively dissolved in a solvent, allowing it to be separated from the waste and recovered in a pure form without changing its chemical nature.

Eco-design

The integration of environmental aspects at all stages of the development process of a product, striving to generate the lowest possible environmental impact throughout the product life cycle.

Energy recovery

Energy recovery means the use of combustible plastics waste to generate energy through direct incineration, with or without other types of waste, for electricity and/or heat conversion. Energy recovery also includes high-grade energy recovery in industrial facilities, if the main purpose of the operation is to replace fossil fuels (e.g. cement kilns, pulp mills, gasification plants).

Extended producer responsibility (EPR)

Extended producer responsibility means a set of measures taken to ensure that producers of products bear financial responsibility or financial and organisational responsibility for the management of the waste stage of a product’s life cycle, for example deposit systems.

Extrusion moulding process

Manufacturing process that consists of melting plastics into a liquid that is extruded and cooled into various solid shapes.

Feedstock

Raw material that is the principal input for an industrial production process.

Gasification

Gasification is a process where mixed after-use materials are heated in the presence of limited oxygen to primarily produce syngas that can be converted into polymers again.

Landfill

Landfill means a waste disposal site for the deposit of waste onto or into land (i.e. underground).

Mass balance

A set of rules that enables traceability of different types of feedstocks, between their input and the product output, along the value chain to the manufacturer of the final plastic products or parts.

Mechanical recycling

Mechanical recycling is a method by which plastics waste is recycled into recovered plastics without changing the basic structure of the material. Plastics waste undergoes sorting processes in specialised sorting facilities to separate different plastics streams. After cleaning and grinding the sorted plastics waste, the material is generally recovered by melting and re-granulating processes (pellets or powders), to be used in the manufacture of new plastic parts and products.

Mixed waste collection

Collection of waste without pre-sorting of plastics or other materials by the end-user (e.g. household residual waste, municipal waste).

Monomer

Molecule that is used to produce polymers. Monomers are the main building blocks of polymers.

Organic recycling

Organic recycling means composting or anaerobic digestion of biodegradable organic waste including biodegradable plastics under controlled conditions using microorganisms to produce, in the presence of oxygen, stabilised organic residues, carbon dioxide and water or, in the absence of oxygen, stabilised organic residues, methane, carbon dioxide and water.

KEY CONCEPTS

Pelletisation

The action of producing plastics pellets, i.e. granulates. These pellets are then used by plastics converters to manufacture plastic parts and products.

Plastics

Material which contains as an essential ingredient an organic polymer and which at some stage in its processing into finished products can be e.g. shaped by flow or moulding. Elastomeric materials, which also are shaped by flow, are not considered as plastics. Additives or other substances may have been added, and which can function as a main structural component of final products.

Plastics production (polymerisation)

Resin production in a plastics production facility using polymerization. This includes the use of fossil-based, bio-based feedstock, carbon-captured and chemically recycled feedstock.

Polymer

Polymer means a substance consisting of molecules characterised by the sequence of one or more types of monomer units. Such molecules must be distributed over a range of molecular weights wherein differences in the molecular weight are primarily attributable to differences in the number of monomer units. A polymer comprises the following:

a. a simple weight majority of molecules containing at least three monomer units which are covalently bound to at least one other monomer unit, or other reactant.

b. less than a simple weight majority of molecules of the same molecular weight.

Polymerisation

Process in which monomer molecules are combined to form polymers via a chemical reaction.

Post-consumer plastics waste

Post-consumer plastics waste means a material generated by households or by commercial, industrial, and institutional facilities in their role as end-users of the product which can no longer be used for its intended purpose. This includes returns of material from the distribution chain or the installation of plastic products (e.g. cut-offs of insulation, flooring or wall-covering boards).

Pre-consumer plastics waste

Waste arising from the plastics production and converting processes.

Pyrolysis

Pyrolysis is the thermal process of heating up plastics under the absence of oxygen. It converts polymers into a range of simpler hydrocarbon compounds mainly in the form of liquid pyrolysis oil.

Recycled plastics

Recycled plastics are produced from waste via physical (mechanical, dissolution) or chemical process (depolymerisation including solvolysis, pyrolysis, or gasification). Recycled plastics can be used as feedstock in the manufacture of new plastic parts and products. Recycled plastics may be produced either from post-consumer waste or pre-consumer waste.

Recycling

Recycling means any recovery operation by which waste materials are reprocessed into products, materials or substances whether for the original or other purposes. It does not include energy recovery and the reprocessing into materials that are to be used as fuels.

Repair

Operation by which a faulty or broken product or component is returned back to a usable state to fulfil its intended use.

Residues

Together with impurities, residues are material losses in a recycling process. The typical composition of the residues is moisture, organics (e.g. water, milk, yoghurt), textiles, composites, paper, adhesive, metals and plastics residues discarded from the recycling process.

Reuse

Reutilisation of plastic products or parts without undergoing a recycling process or significant modification.

Separate waste collection

Collection of pre-sorted waste on a product level (e.g. household lightweight packaging, WEEE collection, container park).

Service life

The life span of a product.

Sorting

Physical processing techniques and processes to separate materials in waste streams. Sorting is typically performed in Material Recovery Facilities (MRFs) or specific Plastic Recovery Facilities (PRFs). Sorting can be performed automatically with sorting technologies or manually.

Use

The time span during which a product is utilised by the end-user. Every plastic product (or part embedded in larger products) that is still utilised, independently of when it was put on the market.

ACRONYMS

ABS/SAN
Acrylnitril-Butadien-Styrol/Styrol-Acrylnotril

CAGR
Compound Annual Growth Rate

CPA
Circular Plastics Alliance

EEA
European Economic Area

ELV
End-of-Life Vehicles

EPR
Extended Producer Responsibility

EPS
Expanded polystyrene

EU27+3
27 European Member States + Norway + Switzerland + the United Kingdom

kt
kilo tonnes

Mt
million tonnes

OECD
Organisation for Economic Co-operation and Development

PA
Polyamide

PE-LD/LLD
Polyethylen Low Density/Linear Low Density

PE-HD/MD
Polyethylen High Density/Medium Density

PET
Polyethylene Terephthalate

PMMA
Polymethylmethacrylate

PP
Polypropylene

PPWD
Packaging and Packaging Waste Directive

PS
Polystyrene

PUR
Polyurethane

PVC
Polyvinyl Chloride

WEEE
Waste from Electrical and Electronic Equipment

ACKNOWLEDGEMENTS

A special thanks to EPRO (the European Assocation of Plastics Recycling and Recovery Organisations) for its very valuable collaboration and for sharing the data collected among its members. EPRO's knowledge and critical review were key in the development of this study.

European Association Of Plastics Recycling & Recovery Organisations

Thanks to CPME (the Committee of PET Manufacturers in Europe) for its participation in the development of this study.

PET Manufacturers in Europe

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