ICIS
Independent Commodity Intelligence Services

PET MARKET IN EUROPE

STATE OF PLAY

PRODUCTION, COLLECTION & RECYCLING DATA 2022

Natural Mineral Waters Europe

PLASTICS RECYCLERS EUROPE

Pioneering PET circularity since 1993
petcore EUROPE

Unesda
Soft Drinks Europe

DISCLAIMER

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GLOSSARY OF TERMS

DFR	Design for Recycling
DRS	Deposit Return Scheme
EFSA	European Food Safety Authority
EPR	Extended Producer Responsibility
EPS	Expanded Polystyrene
EU	European Union
EU27+3	EU member countries, Norway, Switzerland, and the United Kingdom
FD	Free delivered
KT	Thousand Metric Tonnes
MT	Million Metric Tonnes
NWE	North Western Europe
PCR	Post Consumer Recyclate
PET	Polyethylene Terephthalate
PO	Polyolefins
PP	Polypropylene
PS	Polystyrene
PTT	Pots, Tubs, and Trays
PPWD	Packaging and Packaging Waste Directive
PRO	Producer Responsibility Organization
rPET	Recycled PET
RVM	Reverse Vending Machine
SKU	Stock Keeping Unit
SUPD	Single Use Plastics Directive
UK	United Kingdom

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ABOUT PLASTICS RECYCLERS EUROPE

Plastics Recyclers Europe (PRE) is an organisation representing the voice of the European plastics recyclers who reprocess plastic waste into high quality material destined for the production of new articles. Recyclers are important facilitators of the circularity of plastics and the transition towards the circular economy. Plastics recycling in Europe is a rapidly growing sector representing over €10.4 billion in turnover, 12.5 million tonnes of installed recycling capacity, around 850 recycling facilities and over 30,000 employees.
www.plasticsrecyclers.eu

ABOUT NATURAL MINERAL WATERS EUROPE

Natural Mineral Waters Europe (NMWE) represents over 500 natural mineral and spring water producers in Europe, most of them small and medium sized companies, operating in rural areas. NMWE is dedicated to promoting the unique qualities of natural mineral and spring waters as well as sustainable use of water resources and circular economy. The association builds on the long heritage and tradition with environment and source protection at heart. By continuously encouraging its members to reach even more ambitious goals, NMWE plays a leading role in paving the way towards healthy, circular, and sustainable European food systems, while supporting a green recovery.
www.naturalmineralwaterseurope.org

ABOUT PETCORE EUROPE

Petcore Europe is a Brussels-based, not for profit organization, representing the entire PET value chain since 1993. Its membership consists of more than 165 companies (corporations) including PET producers, recyclers, converters, brand owners, technology providers, converters, labels, cap suppliers, masterbatch suppliers, waste management companies, retailers and also includes 9 associations. Petcore Europe's vision is to achieve widespread recognition of the performance of PET as a circular material of choice for packaging and to make sure that PET is collected, sorted, and recycled.
www.petcore-europe.org

ABOUT UNESDA SOFT DRINKS EUROPE

Established in 1958, UNESDA is the Brussels-based trade association representing the European soft drinks sector. Its membership comprises 10 companies and 25 national associations from across Europe. UNESDA members are involved in the production and/or distribution of a wide variety of non-alcoholic beverages including still drinks, carbonated drinks, energy drinks, iced teas, flavoured waters, and sports drinks.
www.unesda.eu

ABOUT ICIS

Independent Commodity Intelligence Services (ICIS) connects data, markets, and customers to create a comprehensive trusted view of global commodities markets, enabling smarter business decisions that help optimise the world's resources.

ICIS helps businesses across the chemical, fertilizer and energy markets make strategic decisions, mitigate risk, and capitalise on new opportunities. A trusted source and benchmark for price information and insight across key commodities markets worldwide. Our independent, transparent market intelligence informs thousands of quality decisions every day, taking the pressure out of negotiations and giving customers space for more innovative thinking.
www.icis.com

INTRODUCTION

This study provides the latest data and trends on the state of the PET market in Europe in 2022, with additional insights on the 2023 market. Including key developments impacting the market and the resultant challenges faced by the supply chain, and potential future scenarios for the PET market.

The study includes data for the EU27+3 region (Austria, Belgium, Bulgaria, Croatia, Cyprus, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, the United Kingdom) and the reference year for the data is 2022. Reference data comparisons are made with 2020, unless otherwise stated. The study uses the best available data sources to present data estimates. The sources used include ICIS PET production, consumption, and trade data, interviews across the European rPET supply chain and results of PRE's Annual PET Recyclers survey and secondary research.

Due to the different methodologies and reporting formats adopted across the region, there can be challenges in the consistency of the data in some areas. The aim of the study is to provide data as reported by nation states, associations, and other industry bodies in a comparable format. The disparity in reporting formats together with gaps in data availability continues to present challenges to provide greater transparency for the rPET value chain.

METHODOLOGY

The ICIS methodologies for production and trade are as follows:

TRADE

Country trade represents the import/export from/to a specific country. The annual import/export volumes refer to the total volumes imported/exported from 1 January to 31 December of every year.

ICIS obtains imports and exports data for the polymers reviewed having access to the trade services provided by all most significant countries of the world through their respective National Statistical Offices. A Harmonised System (HS), used by all countries, has been in place for a number of years to collect and publish statistical trade figures under the same trade codes, so that compilations and comparison among countries are made possible.

Comparisons between country-by-country export and import flows show that polymer data rarely correspond. In the frequent case of inter-trade between two countries where in a given period imports declared by country A from country B do not correspond to exports declared by B to A in the same period, ICIS generally downloads the figures of the importing country. However, different adjustments are possible based on ad-hoc evaluations.

PRODUCTION

"Virgin" production refers to the output of material from polymer plants.

Production is calculated as the sum of "virgin" polymers produced from the respective monomers by the listed capacities and of post-consumer recycled material.

Historical production data of virgin polymers are sourced primarily from documents issued by producers, producer associations and National Statistical Offices. Certain data are obtained when carrying out specific market studies and can include industry publications.

After data collection, the consistency of "virgin" production data is further verified by making comparisons with installed polymer capacities and with key feedstocks' consumption.

Historical polymer production is updated and balanced with consumption country-by-country. In addition, preliminary production assessments are conducted for the major producing countries during the current year, consisting of published official data and ICIS experts' views.

INTRINSIC VISCOSITY VS. VISCOSITY NUMBER OF PET

Intrinsic Viscosity (IV) of PET is a measure of its molecular weight which reflects the melting point, crystallinity, and tensile strength of a material. PET's IV determines its applications as it directly influences its mechanical properties. As an example, bottle applications require higher viscosity PET while polyester fibre applications require low viscosity PET, with other major applications in between the two. This definition is commonly used in the commercial characterisation of the PET products put on the market.

Viscosity Number (VN) of PET is an indication used to classify primary forms of PET in the Harmonised System (HS) codes used to monitor trade volumes. The VN is calculated based on a formula which contains the IV measurement and a correction factor. Therefore, the indication of 78 ml/g in the HS code has a different meaning of an IV of 0.78. The VN of 78 ml/g is close to 0.7 IV.

COLLECTION RATE

To estimate collection rate in the EU27+3 region, ICIS has taken bottom-up approach based on country-level data on waste collected for recycling. Data was obtained via primary research, including surveys and interviews with members of the value-chain as well as via secondary research, leveraging published data by industry participants. There is great discrepancy in the transparency level of information across the countries, so whenever data was not available, estimates have been made based on ICIS's expert's views and knowledge of the market. The results were then cross-checked against estimates based on input for recycling plants estimated by PRE through surveys and secondary research. The collection rate was then calculated by dividing collected waste for recycling by the material placed on the market in the given year.

The volumes of material "sorted for recycling" have been estimated based on the input to recycler's plants and a view of ICIS's market experts on waste trade. The "sorted for recycling rate" was then calculated by dividing the latter by the material placed on the market.

EXECUTIVE SUMMARY

The concerted efforts of the PET recycling stakeholders over the years have resulted in an enhanced recycling value chain and growth in rPET adoption. Mechanical recycling capacity has improved sufficiently to supply current market demand. Focus on product design, collection, and sorting have all factored into the effectiveness of capturing PET packaging into the recycling stream with design for recycle (DfR), deposit-return systems (DRS) and sorting technology developments all forming a part of the solution.

2022 was an unprecedented year for the PET and rPET value chain, with extreme volatility and uncertainty persistent throughout. Regardless of these volatile conditions, demand for virgin and recycled market showed signs of recovery to pre-pandemic levels, with major new recycling capacities and innovative developments announced by the industry.

PET COLLECTION RATE IN 2022 INCREASED TO 60%

A total of 5 million tonnes of PET was utilized in packaging (bottles, sheet (trays), and flexibles) placed on the European market in 2022. Of this, 3 million tonnes were collected, bringing the collection rate to 60%. A vast majority of the collected PET packaging were bottles, accounting for 2.8 million tonnes.

The collection systems in place across Europe include kerbside pick-up, recycling points, bring-to sites, and DRS schemes. 30% of bottle collection volumes was achieved via DRS in 2022. In addition to the implementation of new DRS schemes in the region, efforts directed towards enhancement of existing systems are also underway. While most collection systems in place target PET bottles, only a few countries collected PET thermoformed trays for recycling in 2022, with additional markets setting up collection for 2023.

Almost 2.7 million tonnes of collected PET waste was sorted for recycling. The sorted for recycling rate stood at 54% in 2022, a marginal increase on 2020. The sorted for recycling rate for beverage bottles was 75% in 2022.

EXTRUSION CAPACITY FOR rPET PELLET PRODUCTION DOUBLED TO 1.4 MILLION TONNES IN 2022

European mechanical PET recycling capacity for flakes production stood at 3 million tonnes in 2022. With a capacity of about 630,000 tonnes, Germany accounts for the largest share, followed by Spain & Portugal with more than 500,000 tonnes capacity and then by Italy, France and United Kingdom. The extrusion capacity for rPET pellet production from flakes doubled to 1.4 mil-

lion tonnes in 2022. About 60% of the rPET pellets producers' extrusion capacity in the region is integrated upstream with flakes production, having both washing and extrusion lines. The drive towards reduction in virgin polymer consumption, packaging waste minimization and increasing competition for bottle flake has generated more impetus for the development of tray recycling. In 2022, tray recycling capacity reached 57,000 tonnes/year and is expected to reach over 300,000 tonnes/year by 2025.

Bale input to recyclers in 2022 was 2.6 million tonnes, an increase of 7% on 2020. Average utilization of wash and flake plant capacity was around 87%. The rPET flake production stood at 1.9 million tonnes (for all applications), of which over 1.2 million tonnes were pelletised via extrusion.

Packaging was the dominant end-use for rPET in 2022 with 48% used in bottles, and 25% in sheet (trays). The remainder of rPET was used in non-packaging applications including polyester fibres (15%), strapping (6%) and others (6%). The volume of rPET consumed for bottle production increased 50% in 2022 (as compared to 2020) taking the share of rPET consumption to 48%. New demand areas for PET and rPET are being observed, as some retailers are switching materials for their pots, tubs, and trays (PTT) away from other polymers owing to the high recyclability of PET and wider availability of rPET.

The average recycled content rate for beverage bottles across Europe was 24% in 2022, while for trays (sheet) it was 44%. Depending on the rate of adoption of rPET by producers across the region, the average recycled content rates vary between countries.

DEVELOPMENTS IN LEGISLATIVE FRAMEWORK: NEW RULES AND REGULATIONS IMPACTING PET RECYCLING AND rPET USE IN 2022

Progress was made by EU member states on the implementation of the SUPD, and the EU Commission undertook a review of the Packaging and Packaging Waste directive (PPWD) leading to the announcement of a new regulation proposal – the Packaging and Packaging Waste regulation (PPWR). New regulations for Food Contact Materials 2022/1616 were introduced in October 2022 by the European Commission and replaced Regulation EC 282/2008.

The proposed mandatory and harmonised Extended Producer Responsibility (EPR) Schemes for textiles in all EU member states are expected to accelerate the development of separate collection, sorting, reuse, and recycling of textiles in the EU, in line with the EU strategy for Sustainable and Circular Textiles.

TOTAL REGION RECYCLING CAPACITY TO MEET SHORT-TERM TARGETS BUT STRONG REGIONAL DISPARITIES

Statistics indicate that the existing European recycling capacity is sufficient to meet the short-term targets (around 800,000 tonnes rPET is required to meet the Single Use Plastics Directive (SUPD) mandatory recycled content targets for 2025). This has been achieved through the PET value chain's commitment to circularity and investment since 2020. This shows positive progress by the sector towards achieving targets, however analysis on a country level highlights stark differences in individual country results.

A number of member states hold collection and recycled content rates well below the European average, especially in the southeastern region and in some countries of Central and Western Europe, challenging the ability to achieve the targets without action plans to address this.

An incremental capacity of 3.5 million tonnes will be required to meet the proposed target, under the current draft of PPWR, of 65% recycled content in 2040. Confirming the need for collaboration and planning across the value chain to support growth in collection, sorting and recycling capacities to support the higher demand for rPET supply.

PET VALUE CHAIN OVERVIEW

The PET and rPET value chain operated in unprecedented circumstances and highly fluctuating environment in 2022. The shock caused by the Russia-Ukraine war reverberated through the energy and chemicals markets, majorly altering the macro-economic conditions in Europe. The de-coupling of virgin and recycled PET prices observed in the market in 2021 and the seemingly never-ending price growth of rPET came to an end mid-year 2022 once major stakeholders were no longer willing or able to pay such higher prices.

Regardless of these volatile conditions, demand for virgin and recycled market showed signs of recovery to pre-pandemic levels, with major new recycling capacities and innovative developments announced by the market. Thanks to these the whole PET and rPET system has made progress to improve material circularity and continues to build on these achievements. A snapshot overview of the 2022 material flow is included in Figure 1 below. The following sections of this report discuss in detail the supply and demand, export and import of virgin and recycled resin in Europe – also visualised in Figure 2 in a theoretical manner – finishing with an outlook on future opportunities and challenges.

EUROPEAN PET AND rPET MATERIAL FLOW IN 2022

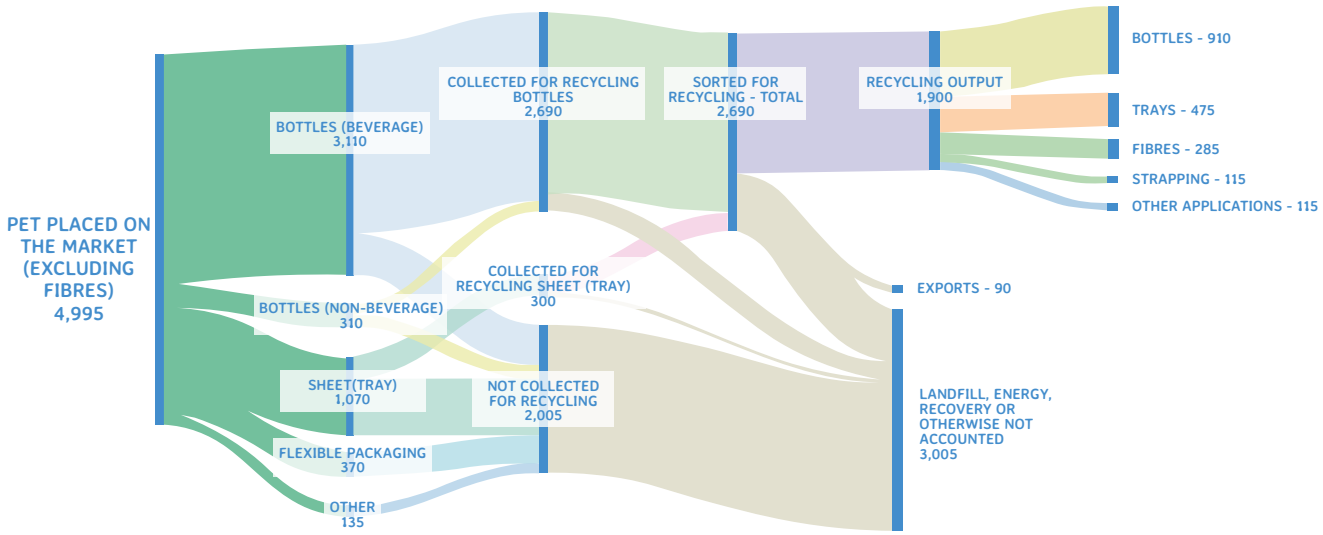


Figure 1: PET and rPET material flow in '000 tonnes (excluding polyester fibres) in the EU27+3 region in 2022.
Source: ICIS Supply Demand Database, ICIS analysis, PRE survey data, Eurostat
Note: At the time of the writing of this report no accurate data for non-beverage bottle collection for recycling was found for 2022. The above material flow is for illustrative purposes only.
The POM bottle volumes also include other non-PET components such as caps and labels that are estimated to account for approximately 10% of the total collected weight.

PET VALUE CHAIN OVERVIEW

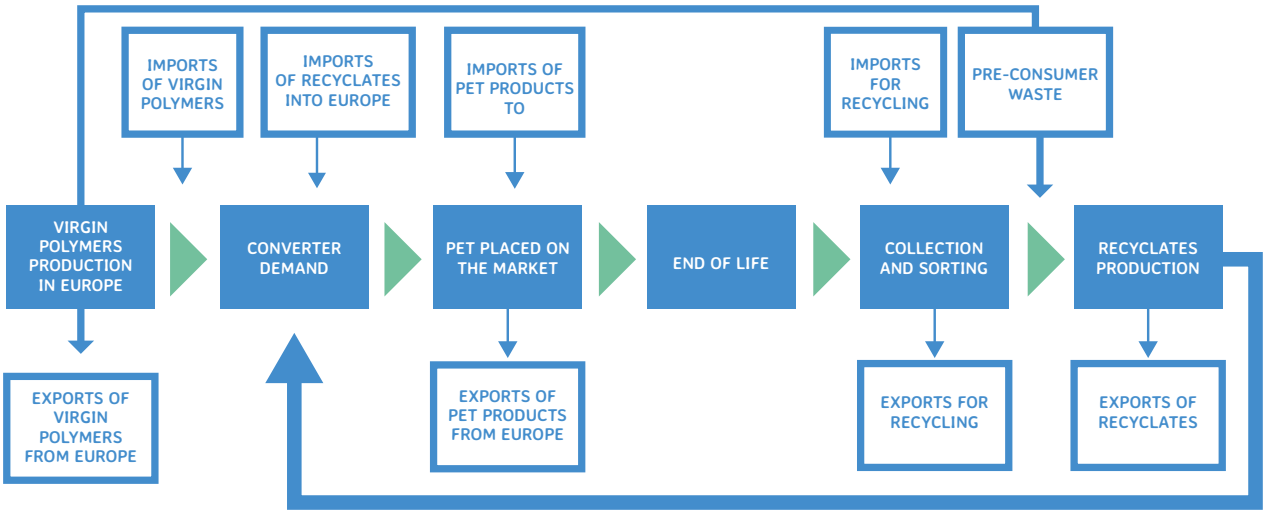


Figure 2: PET value chain overview.
Source: ICIS
Note: There may be additional losses / leakages across each step of the value chain.

PET PRODUCTION AND DEMAND

PET PRODUCTION AND DEMAND

DEMAND

In 2022, polyethylene terephthalate (PET) converter demand for applications such as bottles, films and sheet in the EU27+3 region stood at 5.0 million tonnes. PET production (including virgin and recycled) reached 3.9 million tonnes in the same year, as illustrated in Figure 3, showing a downward trend in relation to previous years. The difference between PET demand and production had to be met with imports, as covered in the subsequent sections.

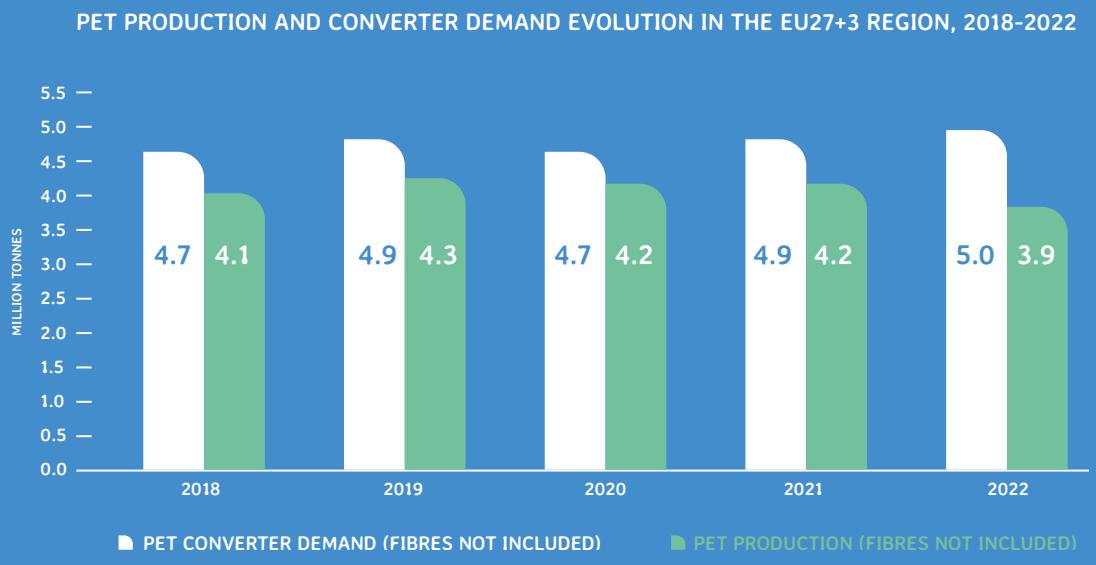


Figure 3: PET total production (virgin and recycled) and converter demand in the EU27+3 region between 2018 and 2022. It only includes PET used in applications such as bottles, films and sheet (trays).
Source: ICIS

Following the years marked by COVID related issues, 2022 saw a converter demand growth of approximately 7% in relation to 2020. In relation to 2019, that change represents 2%, showing recovery and marginal growth compared to pre-pandemic demand levels.

Whilst 2022 started with strong demand, unfavourable economic conditions built up, hindering further demand growth. There was an expectation that the lifting of COVID-related restrictions would boost demand on the back of higher consumer spending on travelling, and a return to typical purchasing patterns, but the summer peak season was lower than expected and converter demand was subject to continued uncertainty. 2022 was impacted by the subsequent rise in inflation and cost-of-living, which put pressure on end-consumer disposable income, as well as the challenging macroeconomic scenario, including recessionary fears towards the end of the year. Compounded by the rise in energy costs, caused by the Russia-Ukraine war, resulting in rapid changes in supply and pricing – affordability was affected for consumers and producers alike.

PRODUCTION

In 2022, European virgin PET production for applications such as bottles, films and sheet (trays), strapping and other reached 2.3 million tonnes while production from recycled material reached 1.6 million tonnes. High energy prices and production costs, set against reduced margins and demand for PET, impacted virgin production output significantly in the EU27+3 region, which decreased in 2022 when compared to previous years, as shown in Figure 4.

rPET production also faced challenges during the year, mainly related to record high energy costs and variable availability of high-quality feedstocks, discussed in more detail further in the rPET section of the report. However, overall production of rPET showed an increase of 0.3 million tonnes in relation to 2020, offsetting the decrease in virgin PET production during the year. In 2022, rPET production represented around 40% of total PET production in the EU27+3 region, an increase in relation to 2020, when rPET represented approx. 30% of total PET production in the region.

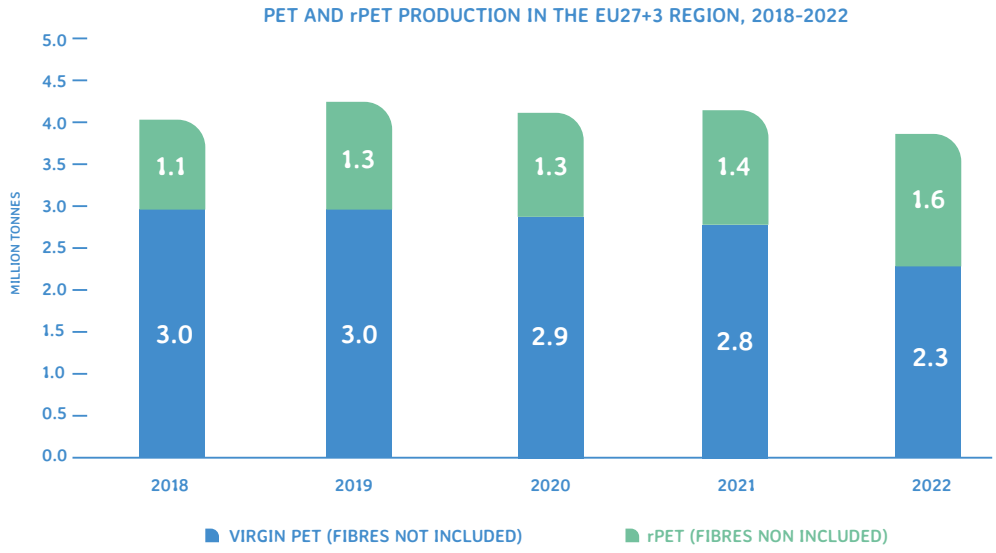


Figure 4: PET virgin and recycled production in the EU27+3 region between 2018 and 2022 (fibres not included).
Source: ICIS

PET IMPORTS AND EXPORTS

EUROPEAN TRADE DATA AND TRADE BALANCE

In 2022, PET imports into Europe (EU27+3) totalled 1.5 million tonnes, while exports from the region came to 0.2 million tonnes, leading to a net trade position (imports minus exports) of 1.3 million tonnes, the highest net trade volume observed since 2018.

As Figure 5 shows, the EU27+3 region has remained a net importer. However, the increase in imports (approximately 24% in relation to 2020) coupled with a decrease in exports (circa 17% in relation to 2020), led to a net import increase of 35% in relation to 2020, rising from 1.0 to 1.3 million tonnes. Whilst the comparison with 2020 numbers alone would suggest an increase in the net importing position of the region, it is important to note that in that year the industry was heavily affected by COVID-19 related freight disruptions. A comparison with pre-pandemic trade numbers from 2019 suggests a smaller increase in imports (8%) and stability in export volumes.

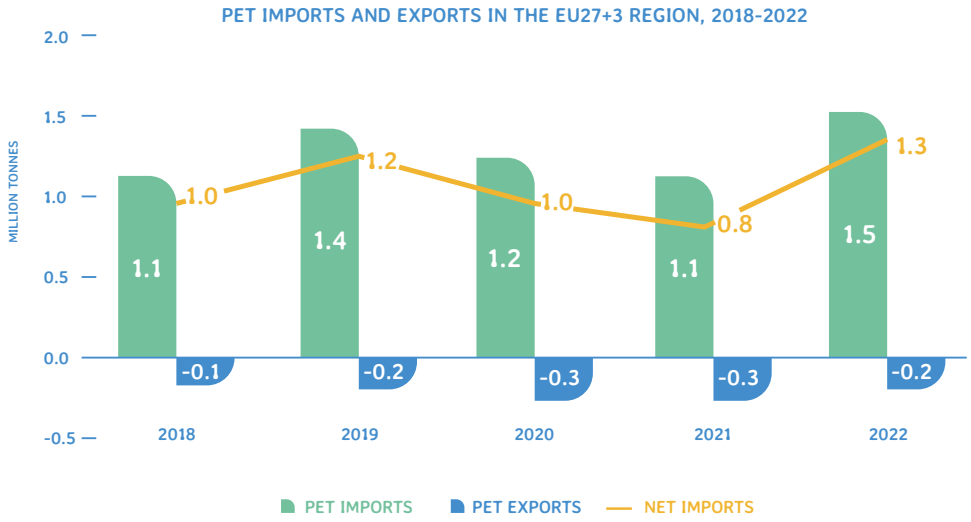


Figure 5: Imports and exports of PET in the EU27+3 region (excluding fibres) between 2018 and 2022.
Source: ICIS Supply & Demand Database and ICIS Research & Analysis.

A breakdown of these trade figures can be seen in Figure 6. The increase in imports was driven mainly by bottle-grade PET imports, a 31% increase compared to 2020, and an increase of 10% comparing with 2019. Sheet imports remained relatively stable at around 0.3 million tonnes during the same period.

The increase in imports observed in 2022 was mainly motivated by soaring production costs which affected domestic PET producers' competitiveness against imports, whilst the stabilisation of freight prices (particularly from Asia), shown in Figure 7, is likely to also have played a role, resulting in an upward trend.

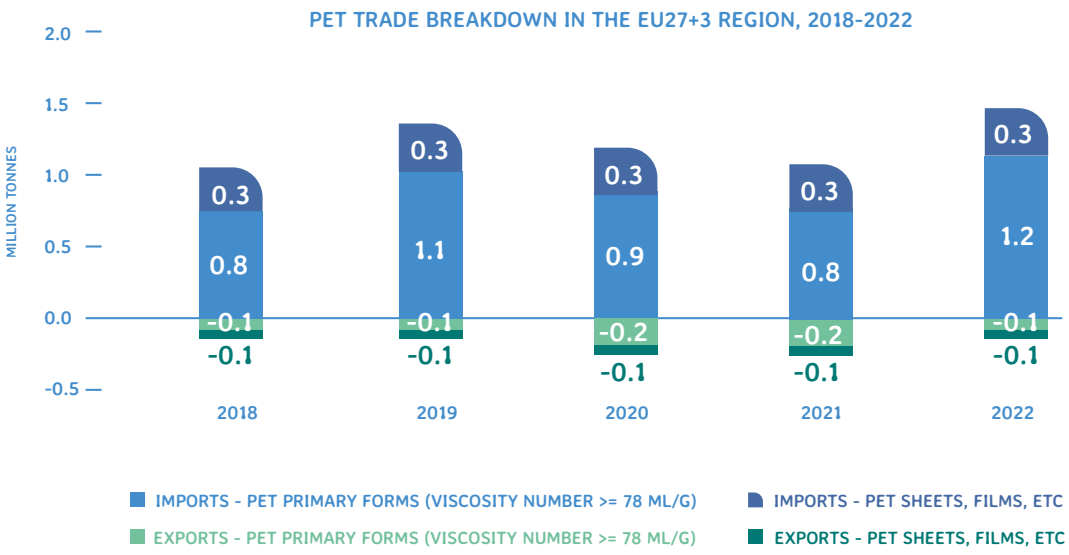


Figure 6: PET trade breakdown in the EU27+3 region between 2018 and 2022.
Source: ICIS Supply & Demand Database and ICIS Research & Analysis.

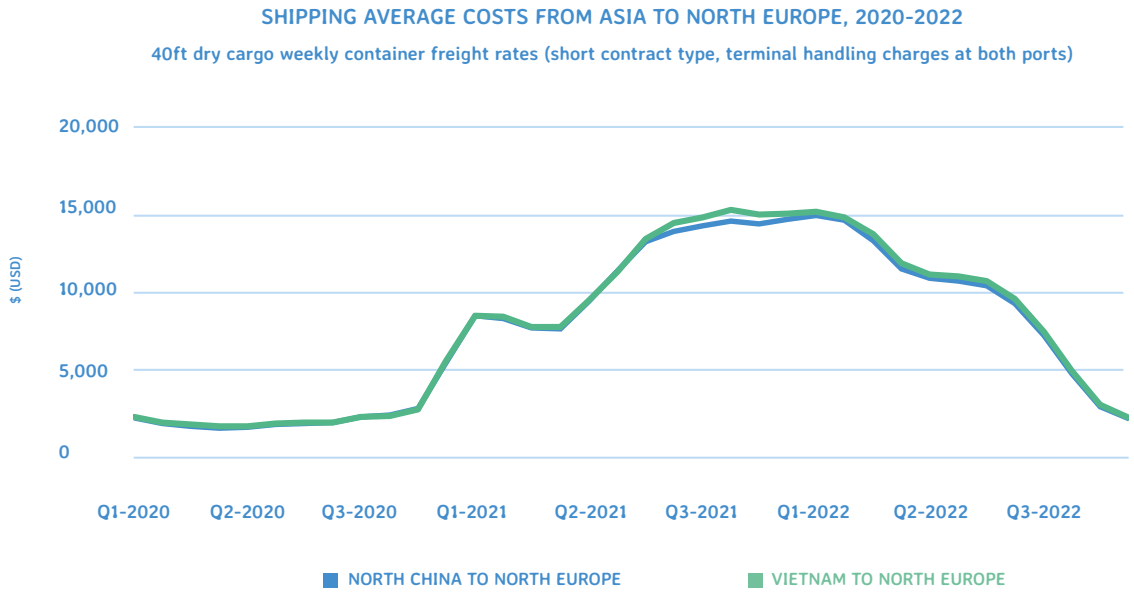


Figure 7: Evolution of freight rates from Asia to North Europe between 2020 and 2022.
Source: Xeneta (mean values used)

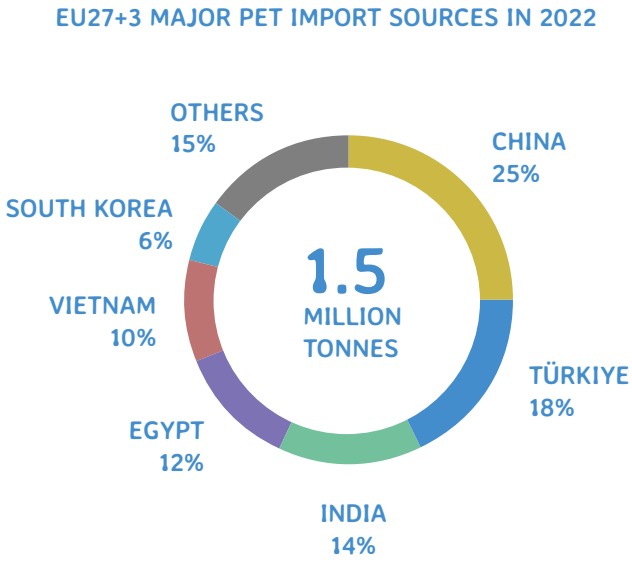


Figure 8: EU27+3 PET import sources in 2022.
Source: ICIS Supply & Demand Database and ICIS Research & Analysis.

As shown in Figure 8, China was the largest PET exporter into the EU27+3 region in 2022, supplying 25% of the import volumes. Türkiye was the second largest source (18%), followed by India (14%), Egypt (12%), Vietnam (10%) and South Korea (6%).

While imports from all key sources increased in 2022, the sharpest increase was seen in imports from China. Figure 9 shows that PET imports from China in 2022 increased circa 178% in relation to 2020 and 58% in relation 2019. This resulted in the launch of discussions on a potential anti-dumping (AD) investigation, and preliminary measures were announced at the end of 2023.

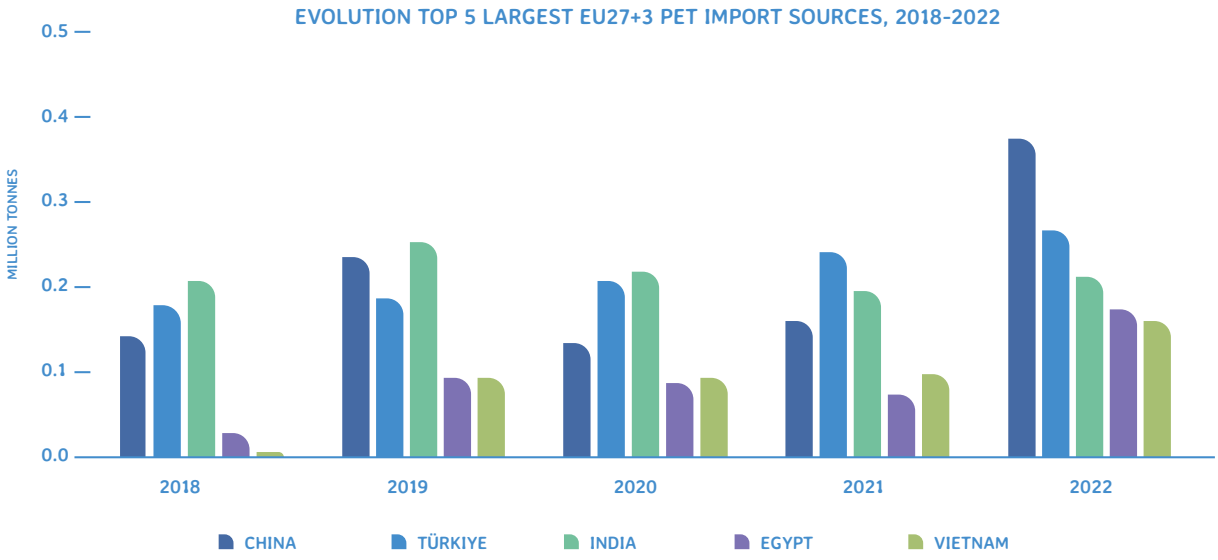


Figure 9: EU27+3 PET imports from top five sources between 2018 and 2022.
Source: ICIS Supply & Demand Database and ICIS Research & Analysis.

PRODUCTS PLACED ON THE MARKET

Packaging accounted for over 97% of the 5 million tonnes of PET products placed on the market in 2022. The vast majority were bottles, at about 3.4 million tonnes, followed by sheet (trays) (circa 1 million tonnes) and films (370,000 tonnes), with strapping as an example of the other products which represented the remaining 3% of the market. Overall consumption of PET packaging has recovered from the impacts of the pandemic and demonstrated a healthy growth in the last 2 years, especially in view of the ongoing market disruptions. Figure 10 below illustrates the breakdown of PET end-applications in the EU27+3 region (excluding polyester fibre/monofilament applications) in 2022.

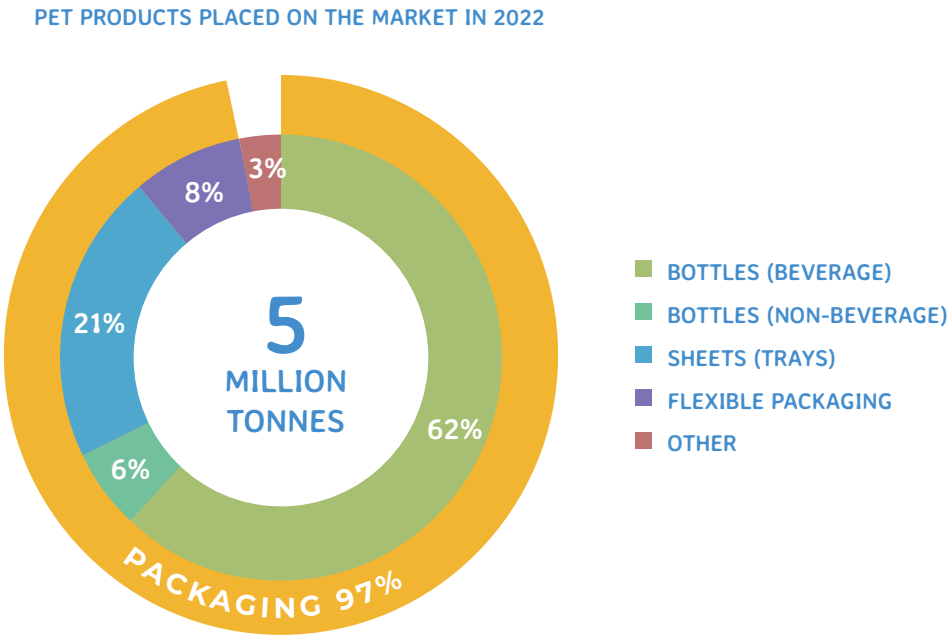


Figure 10: Breakdown of end-applications of PET placed on the market in the EU27+3 region in 2022 (excluding polyester fibres).
Source: ICIS Research & Analysis

POLYESTER FIBRES MARKET OVERVIEW

POLYESTER FIBRES PRODUCTION AND DEMAND

In the EU27+3 region, polyester fibre demand is mainly driven by industrial/technical uses in sectors such as automotive and non-woven production. Due to the macroeconomic environment, marked by increasing inflation and recessionary fears, demand from these downstream markets was negatively affected during 2022. In 2022, polyester fibre demand in the EU27+3 region totalled 1.7 million tonnes while domestic production, including both virgin and recycled material, came to 0.7 million tonnes. Both converter demand and total production showed an overall stable trend in relation to 2020 levels. However, when compared to pre-covid levels, demand in 2022 showed a decrease of approximately 0.2 million tonnes.

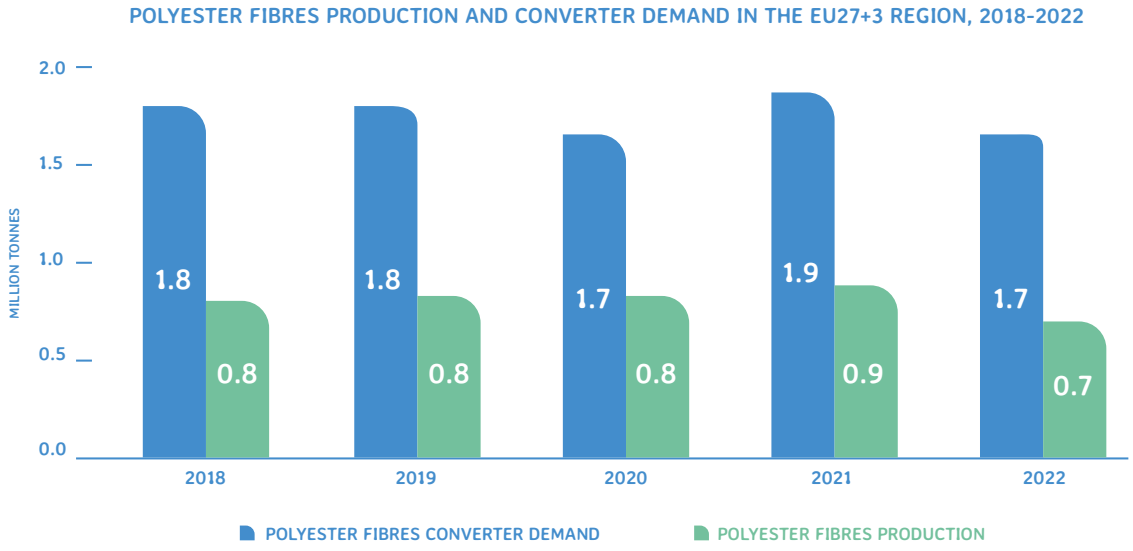


Figure 11: Polyester fibres production and converter demand evolution in the EU27+3 region between 2018 and 2022.
Source: ICIS Supply & Demand Database

While total production of recycled PET increased in 2022 in relation to 2020, production of fibres from recycled material showed a slight downwards trend, shown in Figure 12, as factors such as availability and pricing of recycled PET built up, affecting demand for recycled content in fibre applications during 2022.

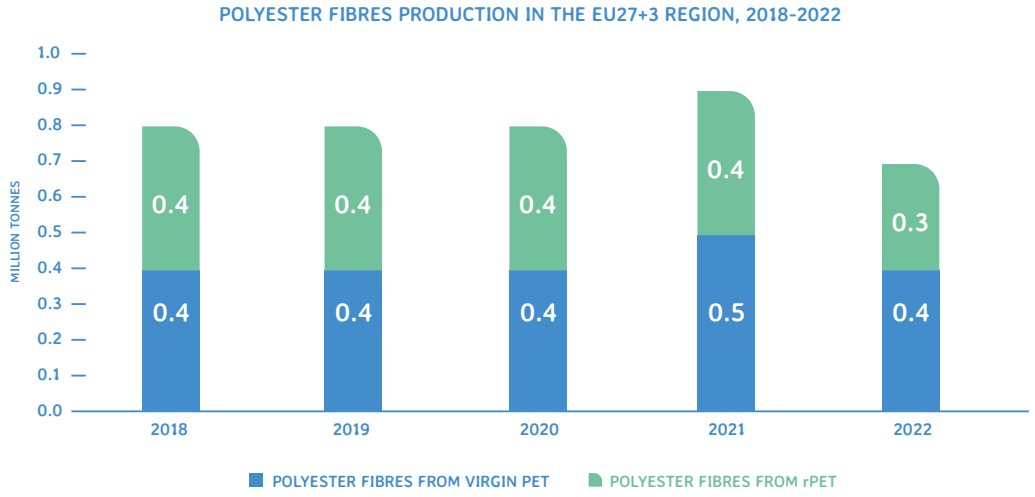


Figure 12: Evolution of the production of polyester fibres by source in the EU27+3 region between 2018 and 2022.
Source: ICIS Supply Demand Database

POLYESTER FIBRE TRADE BALANCE

In 2022, imports of polyester fibre into Europe (EU27+3) totalled 1.2 million tonnes, while exports from the region came to 0.07 million tonnes, leading to a net import position (imports minus exports) of around 1.2 million tonnes as shown in Figure 13.

Similar to PET, the EU27+3 region holds a net importer historic position for polyester fibre. However, in contrast to PET for bottle, sheet (trays) and film applications, polyester fibre imports suggest a trend of stability over the past few years with imports at 1.1-1.2 million tonnes and exports at 0.06-0.07 million tonnes.

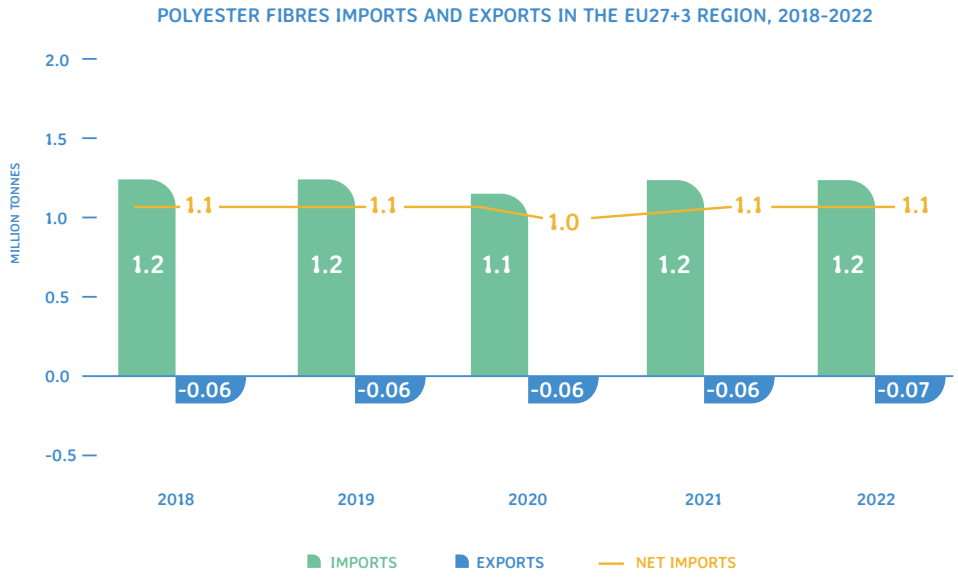


Figure 13: Evolution of the polyester fibre imports and exports including polyester filament yarns, polyester synthetic staple fibres and polyester synthetic filament tow in the EU27+3 region between 2018 and 2022.
Source: ICIS Supply and Demand Database. Numbers have been rounded up.

COLLECTION AND SORTING

WASTE MANAGEMENT OPERATIONS IN PLACE IN EUROPE INCLUDING COLLECTION & SORTING SCHEMES

Of the near 5 million tonnes of PET utilised in bottles, sheet (trays) and films placed on the market in the EU27+3 region, it is estimated that close to 3 million tonnes of PET were collected in 2022 demonstrating a PET waste collection rate of 60%, as shown in Figure 15. Of this, 2.7 million tonnes were sorted for recycling. There were some exports outside of the region with the majority, 2.6 million tonnes, reaching domestic recyclers. This resulted in an estimated rPET output of around 1.9 million tonnes, in which close to 1.6 million tonnes of rPET output was consumed towards bottles, sheet (trays), strapping and other applications with the remaining 0.3 million tonnes going to fibre applications.

The sorted for recycling rate for all PET waste stood at 54% in 2022, a marginal increase on 2020 of 5 percentage points or 180,000 tonnes. As Figure 14 shows, the sorted for recycling rate for PET beverage bottles only, in relation to the volume of PET bottles placed on the market, was 75% in 2022, an increase from 64% in 2020. This shows substantial progress towards the SUPD PET beverage bottle collection target rate of 77% by 2025. However, there is disparity in individual member state's beverage bottle collection rates requiring additional investment in collection systems to progress to the 77% target rate, as will be shown later in the report.

The 3 million collected weight includes a higher contamination rate of around 10% in 2022, compared to 8% in 2020. There is a lack of homogeneous collection systems across the member states, therefore the efficiency of each collection system can vary considerably. This impacts the recycle chain and its ability to also operate with optimal efficiency, therefore the introduction of additional DRS and investment in higher quality sorting is key to improve further advance the recycle supply chain in delivering PET circularity.

The collection systems in place across Europe include kerbside collection, recycling points, bring-to sites, and Deposit Return Systems (DRS) schemes (beverage bottles only).

In most countries PET is collected in a co-mingled manner, together with other lightweight packaging waste. These streams require sorting by material, polymer, and application type in order to produce a PET bale. The resulting quality or grade of PET bales vary dramatically, depending on the infrastructure in place in each municipality, region, and country.

In countries where a DRS is implemented, customers are charged a deposit fee when purchasing beverages, which is refunded upon return of the empty bottle to specified return points. These containers are sorted at dedicated centres, producing a discrete stream of PET bottle bales.

While most collection systems in place target PET bottles, currently only a few countries collect PET trays for recycling, most having started recently, as detailed in the Development in Trays section below. Given this early stage of the market, the sorted for recycling rate for trays was 25% in 2022.

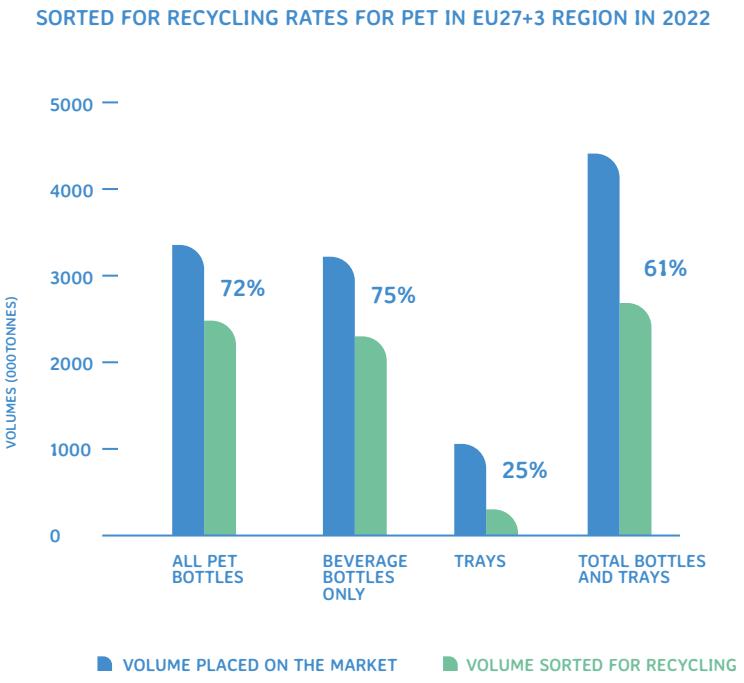


Figure 14: Sorted for recycling rates for PET bottles and trays in the EU27+3 region in 2022.
Source: ICIS research and analysis

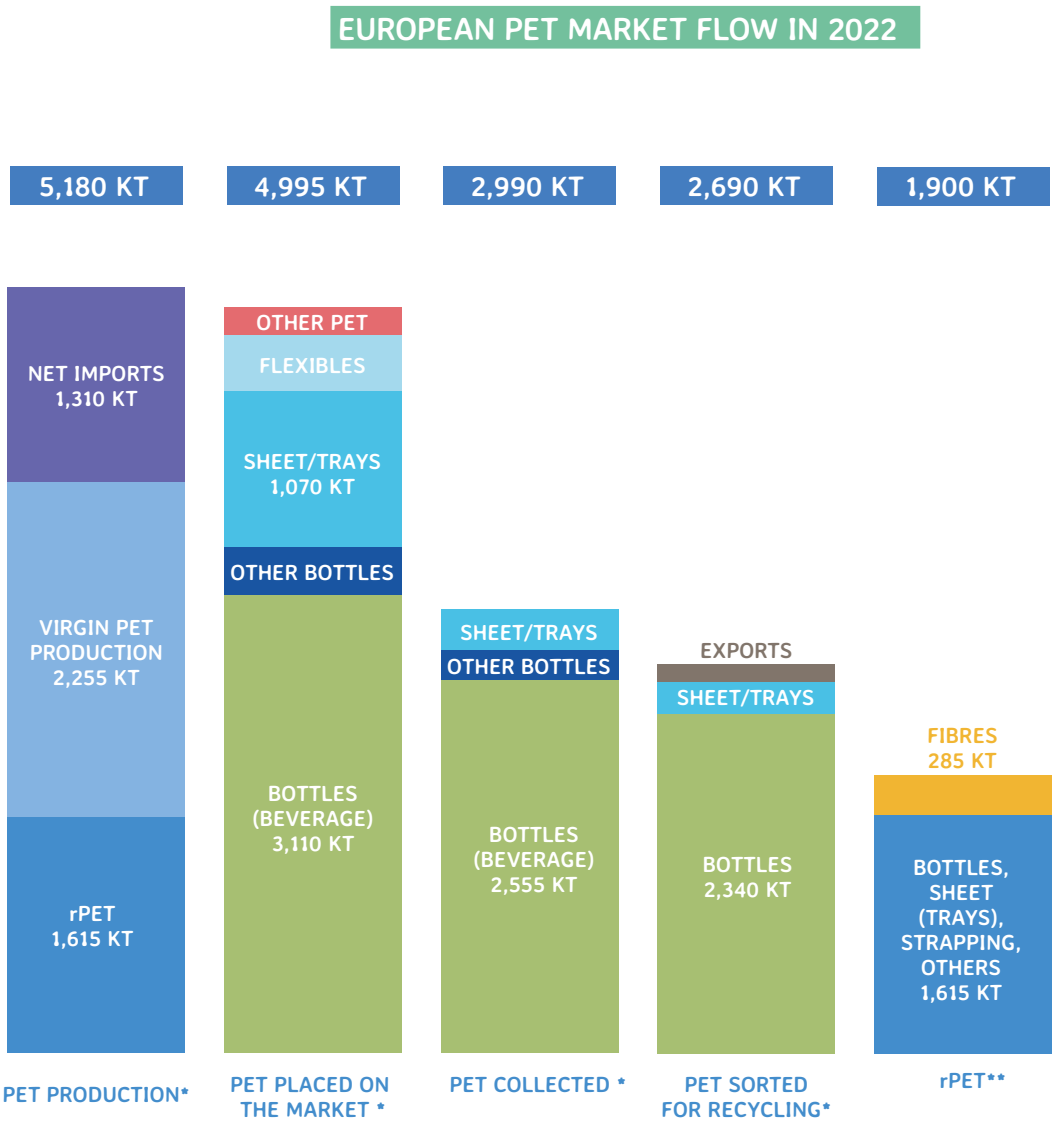


Figure 15: PET material flow in '000 tonnes in the EU27+3 region in 2022.
Source: PRE Surveys, ICIS S&DD and Analysis
**Fibres not included*
***Includes consumption of rPET output by fibres (flakes)*

The proportion of bottle collection via DRS stood at around 30% in 2022. As the new DRS implementations in Slovakia, Malta and Latvia achieve their full impact, the collection is expected to improve. In addition to the implementation of new deposit systems in the region, efforts directed towards enhancement of existing systems were also underway in 2022. In 2021, the Dutch government expanded the system previously covering only large plastic bottles, to also include small plastic bottles resulting in 51% decrease in small bottles found in non-recycle waste streams in 2022. Germany also expanded and modernized its deposit return system in January 2022 to include alcoholic drinks, juices & nectars, with plans to do so again in 2024, with the addition of milk-based drinks in single-use plastic bottles. While the addition of bottle types to the DRS is a positive step towards circularity, this has not yielded the desired results for recyclers. The multi-material design and lack of harmonisation of specifications can result in some bottle types becoming contaminants in previously more homogenous material stream.

The new Blue Bag collection system implemented in Belgium towards the end of 2021 has resulted in a marked increase in tray collection, previously not covered. In 2022, a study commissioned by major industry stakeholders[1] examined the feasibility of a smart deposit system, intended to build further on the strengths of the blue bag. A unique code applied to each piece of packaging scanned by consumers at point of disposal into a blue bag triggers a refund of the deposit, with no need to physically return used packaging to the store. This can be done at home when consumers sort the packaging in the PMD (plastic packaging, metal and drink cartons) bag, and on the go when they throw the packaging in the correct litter bin.

Bar these few positive examples, overall collection activity in the region remained largely stagnant, due to the absence of any major investments in the waste management sector. Governments have not been able to prioritize this sector in their budgetary plans, in view of the ongoing challenges related to rising cost-of-living, the energy crisis, etc.

In addition to improving collection rates for PET packaging, there is also a need for standardisation of specification for bale sorting, which should result in higher quality feedstock being made available in the region. The wide variation in bale quality supplied by collection systems in 2022 put buyers in a challenging position of navigating short availability, competition for supply, unforeseen demand spikes and high fluctuation in bale prices with no guarantee of stable quality.

TEXTILE WASTE

It is estimated that Europe generates about 7 - 7.5 million tonnes of textiles waste annually[2], of which only 30% - 35% is collected. Of the small fraction of textiles waste recycled mechanically, – estimated to be 10% - 15% - most of it is eventually downcycled into low value applications such as fillings, rags, wadding/padding, insulation materials, etc.

While the data on recycling rates for textiles is limited, they are expected to be low due to the absence of a developed recycling value chain for these materials. As a result, the polyester in clothes that is labelled as recycled mostly comes from recycled PET bottles, leading to downcycling of valuable recyclate.

1. Every Packaging Counts – DDRS Blueprint Consolidated report, 2022.
2. EURATEX – Rehubs 2022: circulating textile waste into value, 2022.

RECYCLING

PET RECYCLING INFRASTRUCTURE IN EUROPE

CURRENT CAPACITY

The PET recycling process starts with the arrival of the material (i.e. PET bales) to the recycling facility, where it is shredded and washed, producing flakes. Flakes can be either directly commercialised by recyclers (for applications such as packaging) or be sent to extrusion into pellets.

The first point of the PET recycling value chain where it is possible to measure how much PET can be recycled is the material washing step. The installed washing capacity in the EU27+3 region was around 3 million tonnes in 2022, which accounted for almost 25% of the installed plastics recycling capacity for all polymers. This was an addition of 200,000 tonnes to PET washing capacity in relation to 2020. Figure 16 shows the installed washing capacity per country group, with Germany accounting with the largest share of about 630,000 tonnes, followed by Spain & Portugal with almost 500,000 tonnes capacity. Italy (307,000 tonnes), UK & Ireland (292,000 tonnes) and France (286,000 tonnes) are the next countries with the largest capacities. Together, these 7 countries account for approximately 67% of rPET flake production capacity. Spain, Germany and Romania witnessed the highest capacity growth between 2020 and 2022.

PET polymer recycling capacity for flakes production (washing capacity) has the highest average recycling capacity per plant across all polymers, averaging over 20,000 tonnes per facility, with Benelux, Germany and France having a higher average plant size in terms of geographies.

The extrusion capacity for rPET pellet production from flakes was estimated at around 1.4 million tonnes in 2022, representing a two-fold increase since 2020. This capacity, which absorbs the majority of flakes from the market to extrude into material suitable for food contact applications (mainly food grade pellets), has developed with the demand for rPET materials to comply with mandated targets and voluntary commitments from brand owners and has driven significant investment in this sector of the value chain. As shown in Figure 17, Germany accounts for the largest share at over 270,000 tonnes, followed by France (220,000 tonnes) and Benelux (200,000 tonnes).

Of the 140 companies reprocessing PET waste into flakes in EU27+3 in 2022, about 40 are integrated with downstream extrusion capacity to produce rPET pellets, i.e. the plant has both washing and extrusion processes. Additionally, over 20 companies only produce pellets from flakes procured from external sources. Thus, about 60% of the rPET extrusion capacity in the region is integrated upstream with flake production, having both washing and extrusion lines within the same facilities. As seen in figures below, the geographical areas of Benelux and France have the highest installed extrusion capacity in relation to the washing capacity, indicating sufficient domestic capacity to convert flakes into pellets locally.

Domestic recycling capacity has developed strongly since 2020, with overall available volumes matching demand as set by mandatory recycled content targets for 2025. However, due to the disparity in collection systems across the member states, some capacity was not able to reach its potential due to a lack of available quality feedstocks. Any subsequent gap in supply was met by imports during 2022, with significant increases in rPET flake and pellet imports throughout the year. This displaced domestic supply as the market balance shifted out of typical seasonal patterns, whereby demand spiked early in the year when due to the low season for beverage consumption bale availability was equally low.

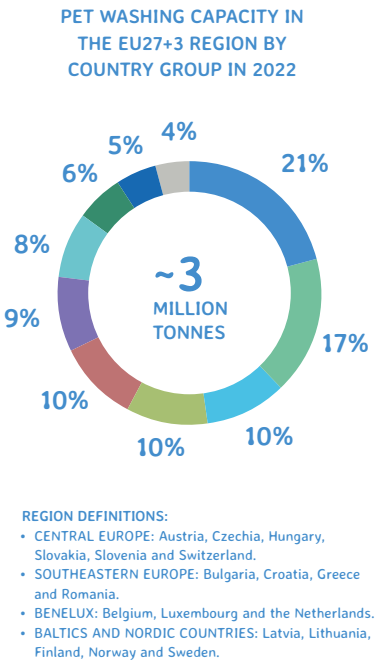


Figure 16: PET washing capacity (for flakes production) in the EU27+3 region by country group in 2022.
Source: PRE Surveys and secondary research.

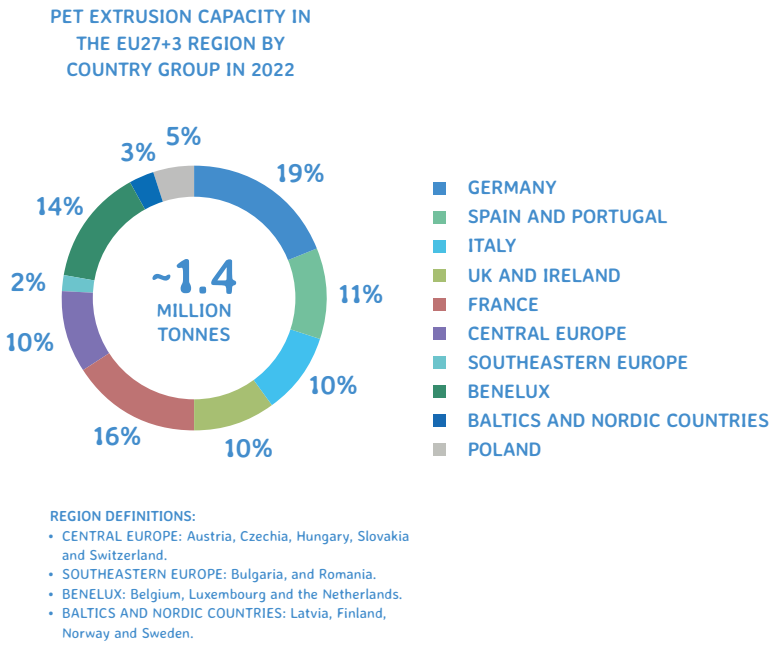


Figure 17: PET extrusion capacity (for pellets production) in the EU27+3 region by country group in 2022.
Source: PRE Surveys and secondary research.

INPUT VOLUME (BALES)

Bale input to recyclers reached 2.6 million tonnes in EU27+3 in 2022. This was an increase of around 7% on 2020, as shown in Figure 18. The PRE surveys found that a substantial share of the input material a recycling plant processes is coming from the same country. The volume of PET collection was 15% higher than the volume input to the recycling chain due to contamination and diversion of the waste to alternative disposal routes such as incineration, storage and landfill, export outside of the region, and leakage into the environment. Product design, collection, and sorting systems all factored into the effectiveness of capturing PET packaging and other PET waste into the recycling stream; with design for recycle, DRS and sorting technology developments all forming a part of the solution as discussed later in this report.

OUTPUT VOLUME AND TYPICAL OUTPUT YIELDS

The average capacity utilization of the washing plants was circa 87%. The rPET flake production stood at about 1.9 million tonnes (for all applications), of which over 1.2 million tonnes were pelletised via extrusion. In terms of applications, 1.6 million tonnes of rPET flake were used in bottles, sheets, strapping, and others, while 0.3 million tonnes were used to produce fibres. As shown in Figure 18, the rPET use in fibres decreased in relation to 2020, going from almost 400,000 tonnes in 2020 to almost 300,000 tonnes in 2022. The ongoing improvements in collection, sorting and recycling processes have resulted in an increased yield of flake production from around 71% in 2020 to approximately 73% in 2022. The yield remains impacted by the challenges in collection and sorting; with process losses including high levels of non-PET materials, leakage, material rejects, higher maintenance activity to clear machinery of such contaminants, amongst others. The yields differ by country, with the highest found in central and north Europe and lower in southern Europe. Consistent high-quality outputs can only be achieved with consistent high-quality inputs, so continued developments across the systems of all member states are required.

EUROPEAN PET RECYCLING CAPACITY, INPUT AND OUTPUT, 2020 AND 2022

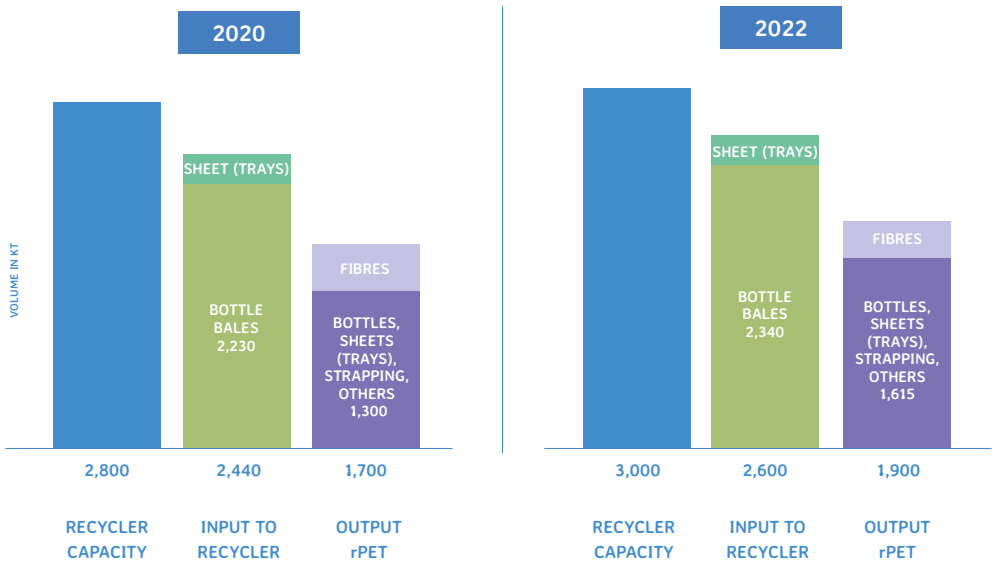


Figure 18: EU27+3 PET recycling capacity, input and output in '000 tonnes, in 2020 and 2022.
Source: PRE Survey and secondary research.

DEVELOPMENTS IN CHEMICAL RECYCLING OF PET

The recycling of polyester and polyester-blend fibres, and specific grades of PET packaging (coloured/multilayer trays, films etc.) continues to be a challenge for mechanical processes. This can be potentially overcome by chemical recycling technologies, such as depolymerization (also known as solvolysis), where polyesters are broken down into molecular building blocks called monomers. Depolymerisation includes methanolysis, glycolysis and hydrolysis technologies which each use particular catalysts to produce monomers. Methanolysis produces DMT and MEG monomers, glycolysis produces BHET monomers and hydrolysis produces PTA and MEG monomers. These monomers can then be used at different steps in the production of PET, and this re-polymerisation of monomers yields virgin-like PET/polyester quality.

In 2022, most of the depolymerisation plants in Europe were in pre-commercial stages with only around 12,000 tonnes/year installed input capacity operating in the region; led by a glycolysis recycling project. Based on publicly announced upcoming commercial plants, it is estimated that over 480,000 tonnes/year of chemical depolymerization capacity will come online by 2027 (Figure 19) including both Financial Investment Decision (FID) and pre-FID projects. Methanolysis and hydrolysis accounting for over a third of total capacity each, with the remainder delivered by glycolysis.

Announced projects are starting with initial testing in pilot or demonstration plants of their process, or by expanding capacities in phases to eventually reach full capacity at a commercial scale. The large proportion of announced plants are operated by the companies developing the respective technologies, with plans to follow a licensing business model moving forward. These pre-commercial plants are a proof of concept and test the process suitability against specific client requirements.

CHEMICAL DEPOLYMERISATION INSTALLED (INPUT) CAPACITY IN 2022 AND 2027

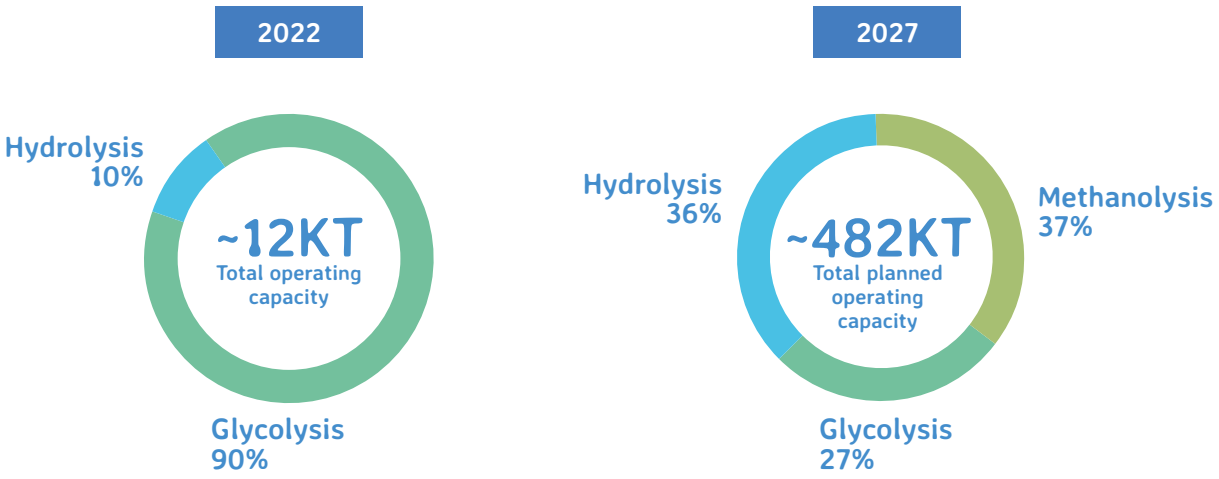


Figure 19: Chemical depolymerisation installed capacity operating in 2022 and planned operating capacity in 2027 (as announced).
Source: ICIS Chemical – Recycling Supply Tracker, 2022

One of the main challenges for chemical depolymerisation is access to feedstock, while simultaneously ensuring that competition with mechanical recyclers for feedstocks is minimised. The average commercial plant input capacity will be larger than a mechanical recycling plant, therefore volumes of waste required are expected to be significant. The value chain is yet to fully develop the infrastructure to provide these volumes to this area of the market. Therefore, players are seeking long term, multi-year contracts to secure PET waste feedstock, not previously seen to the same extent for the mechanical recycling industry. The potential for chemical recycling is to complement the market with the development of streams that mechanical recycling is challenged to reprocess; as seen by the developments in textile recycling. Industry collaboration is proving to be crucial, and projects announced often include partnerships or agreements with technology manufacturers, waste managers to secure feedstock, and off-take agreements with downstream chemical producers or end users to ensure steady demand.

There has been a lack of clarity around regulation for chemical recycling, making it subject to various interpretations, where even market participants and technology developers frequently express different views on how to read the adopted or drafted legislation. The SUP IA 2d (second draft Impact Assessment) draft version does include chemically recycled sources for inclusion in the recycled content calculation which, if passed, should bring greater clarity the sector requires.

Chemical recycling is an umbrella term for a large set of technologies, which inevitably creates additional complexity for creating a regulatory framework for it. PET depolymerisation is not only different from thermal depolymerisation/conversion (pyrolysis and gasification), but also has its own subsets.

For example, with regards to food contact, currently PET depolymerisation into oligomers/BHET and flake injection (mix of depolymerised recycled PET with virgin material) can potentially be considered as novel technologies under the EU 1616/2022 regulation, while depolymerisation to monomers falls beyond this scope.

Overall, lack of legal certitude (including counting towards recycled content goals, using mass balance and food contact regulation) is one of the main challenges for scaling chemical recycling. This alongside other challenges, namely identifying and establishing the appropriate feedstock streams, the multiple technologies being developed, lack of data around commercials of plants

and carbon footprint of the technologies will need to be addressed to encourage further investment into this element of the supply chain.

In Europe, chemical depolymerisation projects are in particular targeting coloured PET, polyester fibre, PET tray waste and waste from mechanical recyclers, while avoiding clear PET bottle waste. While chemical recycling is a solution to more contaminated or hard to recycle waste, the quality of the input waste still determines yield and quality of output from the recycling process. Therefore, recyclers still need to consider a certain level of sorting or pre-sorting activity to be able to maximise output.

Chemical recycling will be critical to closing the loop on polyester polymer recycling and will accompany mechanical recycling on the path to PET circularity. It should play an important role in enhancing PET/polyester circularity by complementing mechanical recycling and enabling recycling of hard to recycle packaging and textile waste into high quality recyclate. The chemical depolymerisation market was for the most part unaffected by the volatile 2022 recycling market due to minimal commercial activity. The planned capacities shall generate higher demand for feedstocks in line with scheduled start-up dates.

DEVELOPMENTS IN TRAY RECYCLING

With the drive towards reduction in virgin polymer consumption and packaging waste minimization, the recycling value chain for PET trays is evolving. The increased competition for bottle flake, prevalent during 2022 as the bottle sector increased recycled content levels, and the subsequent increase in rPET flake prices, has generated more impetus for the development of tray recycling.

PET trays are largely collected with the co-mingled recyclables and separated at sorting centres. PET trays can be included in PET bales, forcing bottle recyclers to run feedstocks through secondary sorting. At present, only a few member states collect and sort PET trays for recycling: Italy, France, Belgium, and the Netherlands. However, there is an increasing interest towards PET trays recycling, and hence collection, in anticipation of market trends resulting from new European regulations. In 2022, new projects started in Belgium[3] and France[4] for the recycling of trays and the development of solutions for tray-to-tray recycling of monolayer PET trays.

In Germany, PET trays are collected via the Dual Systems and sorted into two groups: first, into mixed PET with different mixing ratios of transparent PET bottles and other articles made of PET, such as trays. This fraction is then usually re-sorted to further increase the proportion of bottles. The PET trays are mainly treated as contaminants, and therefore rejected from the bottle stream. The second fraction consists of 75% PET trays. Though PET trays are already recycled in small quantities, they are not primarily used in circular tray-to-tray applications, but rather by the fibre and textile industry. Nonetheless, collection and recycling rates for PET trays have been low, owing to following challenges:

- **High contamination:** In comparison with bottle bales, tray bales have drastically higher levels of impurities. These typically consist of water, organic residuals, labels, lidding film, aluminium, etc. Extensive washing is necessary and yields from tray bales are much lower than bottle bales.
- **Variability in feedstock:** Unlike PET bottles, PET thermoforms have a large variety of packaging types and materials ranging from mono/multi materials to differing colours, lids, labels, etc. It is estimated that almost 60% of trays placed on the market are multi-layer.
- **Insufficient collection & sorting**: Due to the absence of tray recyclate demand, there is insufficient collection and non-standardised sorting activity for PET thermoforms. While the technology to sort out mono-layer trays from multi-layer trays is available, most MRFs are yet to be able to justify the cost of its installation.
- **Lower yields in traditional PET bottle recycling plants:** Due to the brittleness of trays, fines are generated by mechanical friction resulting in lower yield and recyclate quality. To match outputs from bottle recycling, the tray recycling process needs to be technologically improved, ideally with dedicated lines added. Processing trays on recycling lines previously used for bottles results in sub-standard quality not fit for circular applications.

Capacity for separate PET tray recycling has been on the rise over the last few years, with some tray-to-tray projects[5]. As seen in Table 1 below, in 2022 tray recycling capacity reached 57,000 tonnes/year through capacities located in three markets: the Netherlands, Spain and France. Additional projects were announced during 2023, located not only in Spain but also Italy and Belgium.

3. Fostplus
4. Citeo
5. Such as Tray2Tray and TrayRevive

The tray recycling capacity is expected to reach over 300,000 tonnes/year by 2025 – representing close to 30% of the trays placed on the market in 2022 being recycled. Besides separate collection and specific sorting of trays and other thermoformed PET sheet products, design for recycling will be critical to boost circularity.

Country	2022	2025
Belgium		10,500
France	10,000	21,900
Italy		31,100
The Netherlands	25,000	65,000
Romania		10,000
Spain	22,000	167,000
Total	**57,000**	**305,500**

Table 1: Installed recycling (input) capacity for tray recycling (in tonnes per year) operating in 2022 and expected operating in 2025, in the EU27+3 region.
Source: ICIS analysis

The commitment to the use of recycled content in PET thermoforms remained strong with key parties in the sector, but it has not been without its challenges during 2022. The Commission Regulation (EU) 2022/1616 for food contact materials which entered into force on 10 October 2022 classified the functional barrier in food contact trays with recycled content as a novel technology, therefore challenging its use and allowing only for a specific material formation (ABA layer, with A made of virgin plastic). Meanwhile, the Packaging and Packaging Waste Regulation draft published in November 2022 proposed increases to recycled content targets in all packaging. While interest from industry in tray-to-tray projects remained, progress slowed towards the end of 2022 due the lack of clarity around the legislative developments at that time. The intense competition the thermoforming industry faced in H1 in securing rPET material reduced its overall usage during 2022.

Many buyers of thermoforms, particularly retailers, resisted price increases fuelled by higher priced recycled feedstocks preferring to increase the use of the virgin alternative.

Collaboration across the value chain is proving to be key in the development of tray-to-tray recycling. Announced projects largely involve partnerships between recyclers and end users of the rPET material, looking to test this material in existing production processes so it can become a solution applied at scale.

KEY END-MARKETS FOR rPET

From an estimated 1.9 million tonnes of recyclates produced in the EU27+3 region during 2022, packaging was the dominant end-use for rPET with 48% used in bottles (out of this, around 82% were estimated to be consumed for food-contact), and 25% in sheet extrusion (trays), as shown in Figure 19. The remainder of rPET was used in non-packaging applications including polyester fibres (15%), strapping (6%) and others (6%), which includes injection-moulding, PET film and other end-market applications.

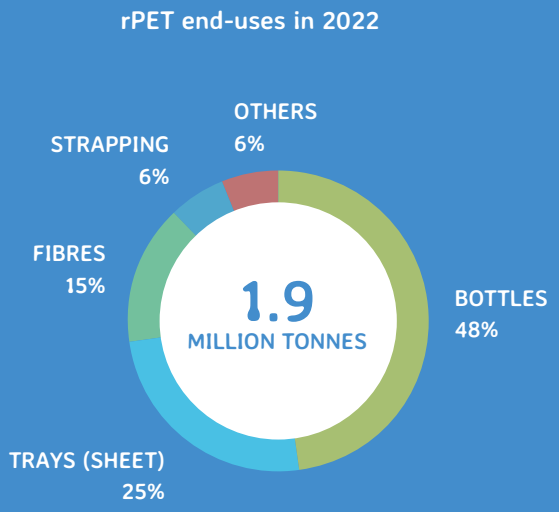


Figure 20: rPET end-uses in the EU27+3 region in 2022.
Source: PRE Survey and secondary research

Over the last decade, the PET end-markets have moved to reduce the use of virgin material towards the adoption of post-consumer recycled content. Within the packaging industry, recycled bottle flake is a key input resource. This changed with the Single Use Plastics Directive (SUPD) mandate for the European bottle industry to include an average 25% recycled content in PET bottles placed on the market by 2025 and 30% by 2030. The competition for rPET supply in 2022 created a shortfall in available supply to non-bottle sectors and resulted in higher prices for the rPET end-product. The premium price became unacceptable and unaffordable for many PET end-users in Europe. The majority of rPET volumes were utilised in the bottle sector, where higher prices were absorbed in production costs. Sheet (trays), polyester fibre, other packaging, and applications such as strapping, were challenged to continue to use domestically produced rPET at rates consistent to previous years.

It is estimated that the volume of rPET consumed for bottle production increased by 50% in 2022 (as compared to 2020) taking the share of rPET consumption to 48%. This was at the expense of volume available for other applications, namely polyester fibre and sheet (trays) which saw a decrease in the share, only 25% of rPET produced was used for sheet (trays) and around 15% for polyester fibre. This trend is expected to prevail, due to the impending SUPD legislation.

RECYCLED CONTENT

The average recycled content rate for beverage bottles in the EU27+3 region was 24% in 2022, while for trays (sheet) it was 44%. Depending on the rate of adoption of rPET by producers across the region, the average recycled content rates could vary within countries, as shown in Figure 21. For instance, in DACH (Germany, Austria, Switzerland), Benelux (Belgium, the Netherlands, Luxembourg) and the Nordic countries (Denmark, Finland, Norway, Sweden) the average rate is estimated to be over 30%, while in Southeastern (Bulgaria, Croatia, Cyprus, Greece, Malta, Romania) and Central Europe (Poland, Czechia, Slovakia, Slovenia, Hungary) and in the Baltics (Estonia, Latvia, Lithuania) the rate is well below 25%. Western Europe (France, Ireland, Italy, Portugal, Spain, United Kingdom) is estimated to be in the range between 8% - 30%. This reflects the lack of harmonisation in collection systems across the region and resulting variation in available feedstocks and rPET product. Greater action is required by those member states that are currently lagging in their progress to recycled content targets as shown below, with substantial growth required in collection as well as adoption of rPET, to meet the obligations of the 25% target by 2025 which is the responsibility of all.

New demand areas for PET and rPET were observed, as some retailers switched materials for their pots, tubs, and trays (PTT) away from other polymers. High recyclability of PET and wide availability of rPET are both attractive features for brand owners and retailers in a bid to meet their sustainability targets. Examples include yoghurt pots previously produced from PS or PP, meat trays previously made from EPS now in clear and opaque PET, and condiment and spread jars previously made

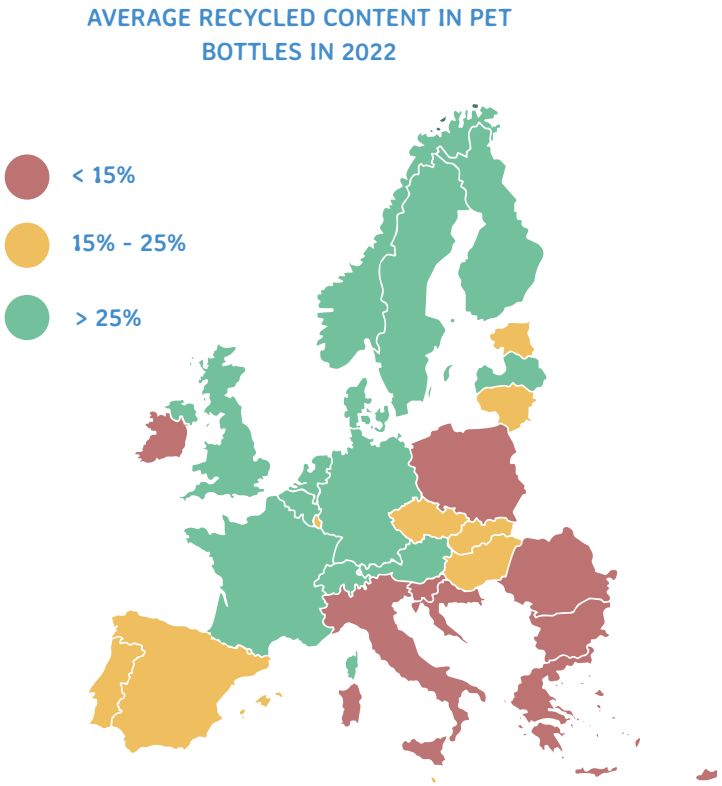


Figure 21: Average recycled content rate (%) in PET bottles by EU27+3 country in 2022.
Source: ICIS analysis and estimates

KEY CHALLENGES FACING THE PET RECYCLING MARKET

QUANTITY: VOLUME FLOW ACROSS THE PET RECYCLING VALUE CHAIN

The trend in movement of bales, flake and pellets within the European Union remained mostly stable. The rate of increase in demand for high quality clear materials in some countries outstripped the growth in domestic collection and rPET production, resulting in imports of bales, flakes and pellets. Significant volumes of rPET were exported from Poland and Romania to meet demand in Northwestern Europe. However, labour shortages and high energy costs (for some 400% increases), directly attributable to the Russia-Ukraine war, put Polish producers under pressure. In other areas of the EU, bales and flakes were transported across borders for processing, utilising washing and extrusion capacity of neighbouring countries where domestic processing was not as accessible.

The extraordinary rise in demand for feedstock during the H1 of 2022 created new trade flows, with competition for supply of high-quality bales rising as buyers ventured into markets further than usual to secure supply. This elevated demand also saw the rise in demand for mixed PET bales as buyers sought to extract as far as possible additional clear and light blue material. The incentive was not only to boost supply for immediate increased production needs, but also to build inventories for the continuation of production throughout the year. The supply chain was building not only stocks of bales, but also producing flake and pellet to support the stock building further through the chain. This also included volumes of non-EU rPET trading into the region during this time. Domestic and import sources combined, escalated the volumes in the market during the year.

Conversely, by the second half of the year, with the sharp downturn in demand, inventory levels across the chain were substantially higher than typical for the industry at any time of the year. The struggle to store all the product and feedstocks became the largest challenge for the value chain in H2, lasting well beyond 2022.

QUALITY

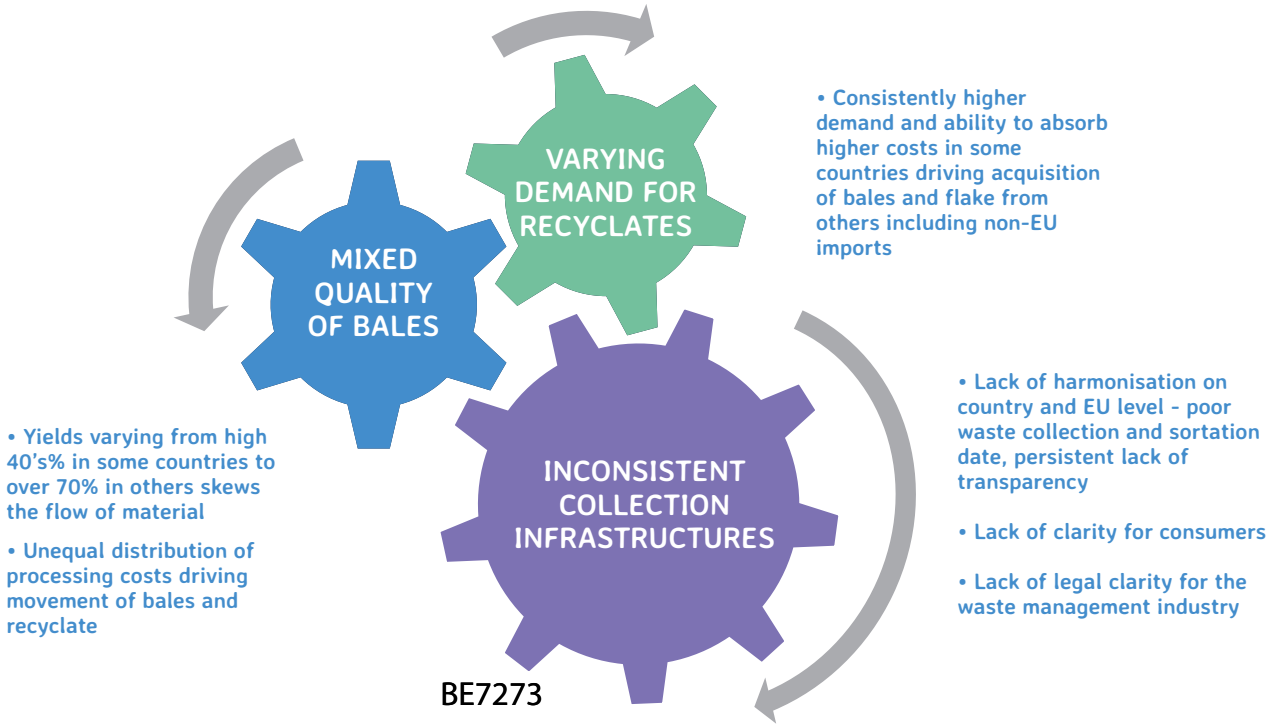
The quality of feedstock throughout the rPET value chain, while high for many suppliers, continued to feature inconsistencies across the region. This stems from the variances in collection infrastructures and sorting capabilities feeding into the recycling market and is further exacerbated by a lack of harmonisation in specifications and calibrated standards: from collection through to final product. This starts with disparity across the European bales market, as most countries do not have a formal bale trading market outside of DRS, with some exceptions such as Italy where bales are sold via regular auction. This is anticipated to improve with the work undertaken by CEN to bring standardisation in the industry alongside other developments, discussed in DfR section below.

Larger scale recyclers form long-standing relationships to ensure feedstock availability, but that does not always result in high quality or full availability as H1 of 2022 proved. Smaller scale operations were dependent on gaining access to sorted raw material by whatever means available, and with no guarantee of quality. For example, bale yields in markets such as UK and Spain are often at around 50%, meaning that recyclers bear the high costs of secondary and tertiary sortation, and appropriate disposal or utilisation of residues/wastes. In H1 of 2022, some recyclers saw a drop in yields due to increased share of trays in bottle bales. The lack of consistency in feedstock quality and purity, but also price and availability, was and continues to be a key driver for inter- and extra-EU bale and recyclate trade. This movement of material has threefold consequences:

- Material circularity in individual countries is impacted.
- Lack of transparency on market balance for recyclates.
- Infrastructure investments required to support further domestic stakeholders are lacking, increasing the focus on non-European sources.

This dissonance between demand and supply of high-grade materials, at consistent volumes across all markets within the region, is also a major driver for extra-EU imports used to fill any supply gap. Long-term independence of Europe for recycled polymers (such as PET) from fossil feedstocks, cannot be achieved without a concerted effort to improve sorting infrastructure, which was over-subscribed in the period of high demand in 2022, and harmonised waste collection and accounting on a national and EU level. In 2022, many member states were still in the process of implementing the Single Use Plastic directive and establishing new Deposit Return Schemes, discussed in more details further in the report.

Figure 22: rPET Circularity Gridlock
Source: ICIS analysis



PRICING DYNAMICS ACROSS THE VALUE CHAIN

The volatility which dominated the European rPET market since the pandemic was never more pronounced than in 2022. The dramatic change when compared to historical pricing fluctuation shown in Figure 23 below highlights the extremes in pricing observed in 2022.

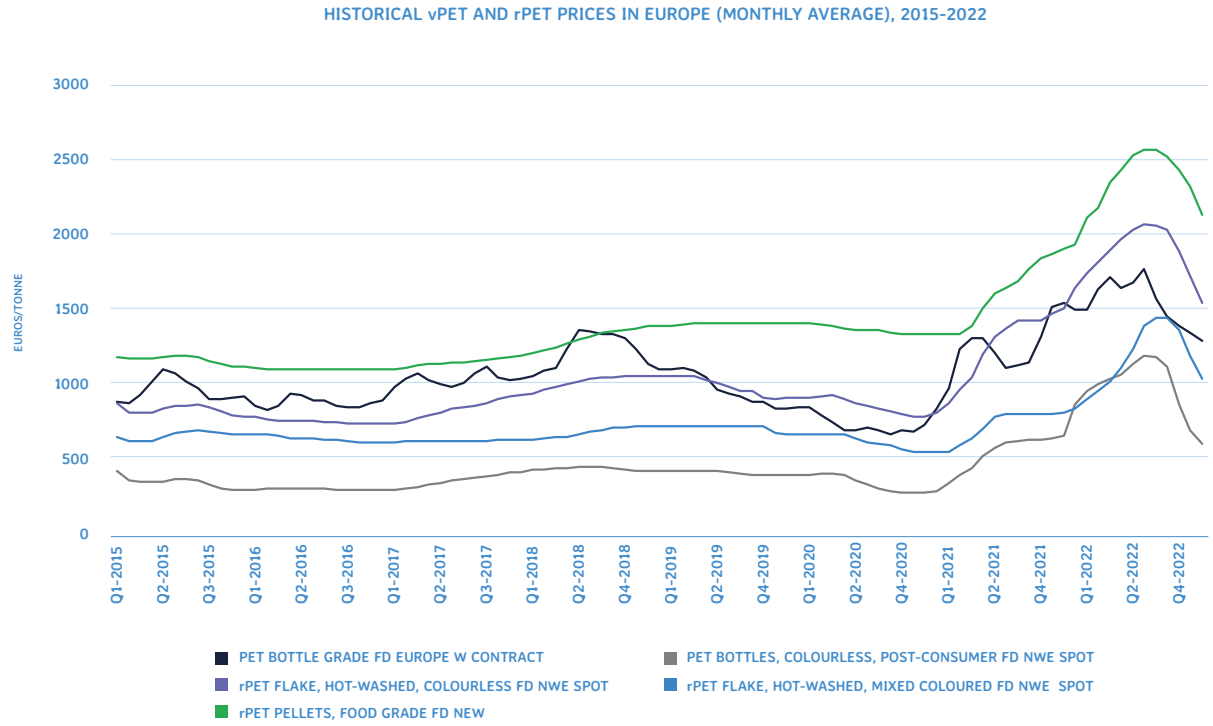


Figure 23: Monthly evolution of the historical pricing for virgin and recycled PET in Europe from 2015 to 2022.
Source: ICIS

The rising demand set against reduced availability of feedstocks in H1 2022 destabilised market prices. Limited improvement in collection rates, coupled with reduced consumption in some markets due to the cost-of-living crisis across the region saw a shortening supply of high-quality bales. However, the tolerance for high bale prices waned by H2, as weak demand for rPET dissipated. Nonetheless, bale price decreases lagged rPET flake prices.

Concerns for meeting commitments, predominantly voluntary targets for individual players, on recycled content levels resulted in speculative activities from buyers; purchasing additional volumes of bales, flakes, and pellets relevant to the operation to ensure security of supply for the immediate and longer term – thus exacerbating the competition for supply, and the subsequent upward trend that prices were trapped into early in 2022.

The rising costs of bales persisted through the year, impacting the margins of many recyclers given the prolonged volatility in the market. The increase in costs was not only from feedstocks, but higher production (energy) and logistic costs, and increases in labour costs driven by shortages and higher wage expectations due to inflation.

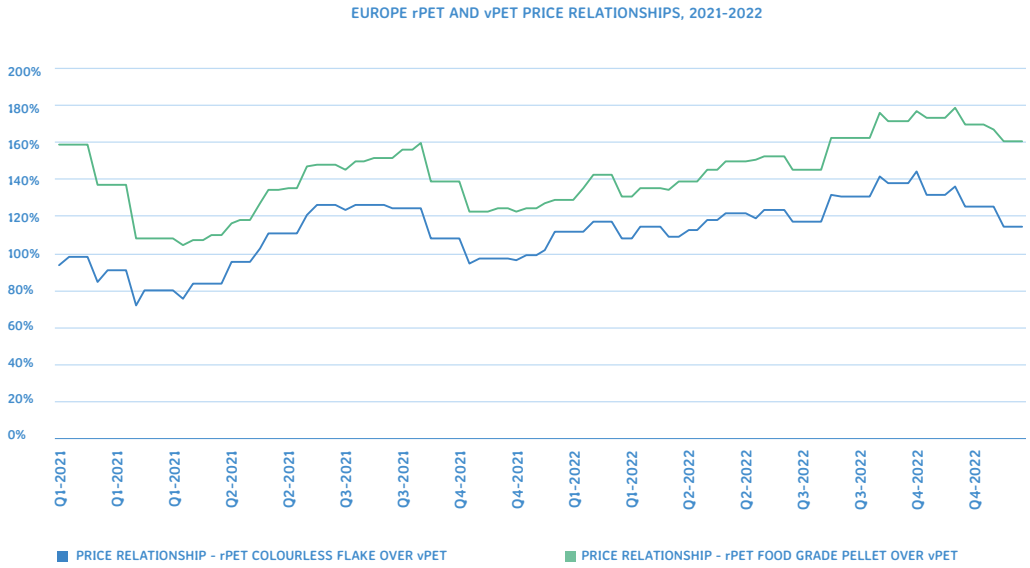


Figure 24: Recycled and virgin PET price relationship (rPET/vPET) in Europe between 2021 and 2022. *Source: ICIS*

A clear sentiment from buyers emerged, as they pushed back on price increases, citing availability of lower cost feedstock from virgin and imported recyclates. A shift in strategy to pull back from current and target recycled content levels crept in during the year, especially as prices continued to rise and consumer demand weakened.

The absence of a typical peak season, for beverage consumption and related preform production, swiftly shifted the pricing dynamics. Weakening consumer demand due to the impact of rising living costs created a strategy shift with brands and retailers focused on pricing strategies and the related cost controls to stimulate consumer spending.

This came at a time where stock levels had built up substantially throughout the supply chain, and those stocks were produced at the height of bale and production costs.

As the market took a sharp turn, rPET suppliers resisted price decreases due to the costs sunk in substantial stocks. Buyers utilised stocks or switched to lower cost feedstocks deepening the weak demand for rPET. Added to the mounting cost was storage, as space became limited due to lack of movement of material through the chain. Sustainability agendas were challenged by economics and the relationship to virgin prices reconnected.

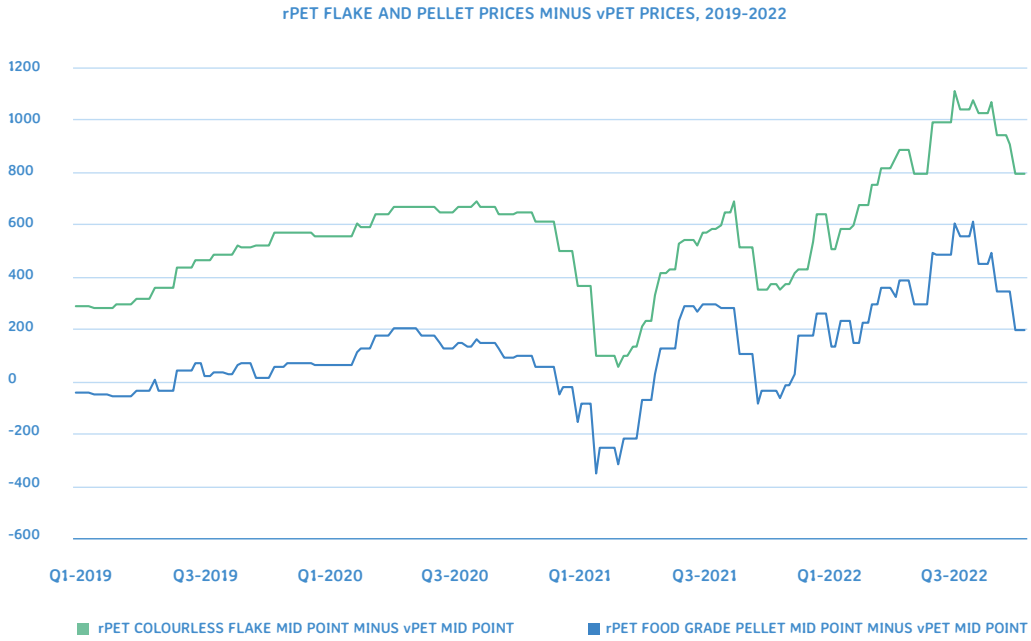


Figure 25: Price differential between recycled and virgin PET in Europe between 2019 and 2022. *Source: ICIS*

PREVAILING TRENDS IN TRADE FLOWS OF rPET

The import and inter-European trade of rPET in 2022 was buoyant in the first half of the year, as the demand and prices were high. India, North Africa, and Southeast Asia (including Indonesia and Malaysia) were popular sources of flake and pellets, both food and non-food grade. Grades of ocean-bound plastic were also imported from these regions, predominantly for use in packaging and consumer goods.

As these commodities are traded under the same code as virgin PET, the opportunity to accurately quantify imports of rPET at a European scale are limited. Overall, the imports of rPET into Europe filled the apparent gap produced from the extraordinary high demand through the first half of the year. However, broad analysis suggests that these imports slowed down in the final quarter of the year, in line with the decline in demand across the wider rPET market. Significant import duties were applied to Indian imports into EU and the UK. This resulted in some exporters being unable to cover production costs and duties, while also remaining competitive on home-markets, leading to reduced volume movement in H2 of 2022.

Overall, imports of rPET from outside of the EU are largely driven by demand for high and consistent quality at competitive prices, which can be lacking for some markets. Meanwhile, the highest grade of recyclate (sourced from bottles) is not being used in countries of origin for circular applications due to a lack of legislation permitting the use of recycled plastics in food contact applications. Given the rise in demand for supply and upward trend in prices during early 2022, Europe became an attractive market for exporters. The flake and pellet were exported to Europe at prices competitive to domestic EU production despite import duties and other costs. These imports are often produced by companies focusing solely on recycling for the European market, operating on EFSA approved lines, with feedstock traceability in place. As PET consumed by the markets of origin is of virgin quality, the rPET properties can often exceed those outputs from domestic recyclers operating the same lines. The continual challenge of inconsistent quality, as described earlier in this section of the report, also links to the overarching limitations posed on the market by the sorting infrastructure. The resulting inconsistency in feedstock qualities and quantities were mirrored in the rPET product availability within individual markets and subsequent demand for materials outside the region.

The challenges of compliance with all regulations and certifications falls to all suppliers, domestic and imports alike. Equity in compliance across all suppliers is required but also necessary so buyers can source with confidence. There was still much confusion during the year, with a lack of transparency on the status of compliance from some areas of the supply base and therefore an area that needs improvement moving forward.

RECYCLABILITY AND CERTIFICATIONS

Ensuring recyclability of plastic packaging placed on the market is not only a legislative target but also a key tool in the process of elimination of waste sent to landfill or incineration. Recyclability is a broad concept, encompassing elements from the whole life cycle of a packaging product. Figure 26 shows the conditions necessary to determine the recyclability of packaging. It includes the product design stage, availability and accessibility of collection and sorting infrastructure, mapping of recycling technologies, as well as end markets for recycled materials.

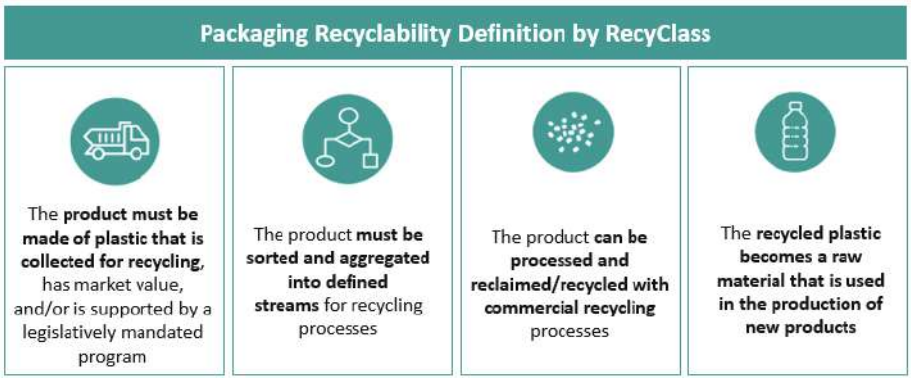


Figure 26: Plastic Packaging Recyclability Definition by RecyClass
Source: RecyClass

Packaging design is a crucial element to achieve recyclability. This determines not only its ability to be collected and sorted into appropriate streams, but also impacts the quality of the recyclate produced. Design also plays a major role in the uptake of recyclate in high value applications. Several industry associations have published Design for Recycling (DfR) guidelines for the PET industry, with new guidelines tailored to specific markets coming out regularly.

Together with guidelines, verification mechanisms are vital to prevent greenwashing, and to bring transparency across the value chain. Reliable certification schemes based on coherent and transparent assessment methodologies, independent audits and testing can be an efficient and effective tool if widely adopted by the value chain.

Packaging producers are expected to provide evidence of the recyclability of the products and packaging placed on the market, from regulators and consumers alike. The recycling value chain has taken initiative to develop schemes to meet these requirements. Some of the systems adopted by the industry include RecyClass, and the European PET Bottle Platform (EPBP).

The key areas of focus vary for certifications, such as RecyClass, are to provide accountability and clarity for the industry. RecyClass offers three third-party audited certification schemes:

- **Recyclability:** packaging features are evaluated regarding their compatibility with recycling infrastructure to ensure limited negative impact on recycling process or recyclate quality.
- **Recycling process:** certifying standardised practices, origin of the plastic waste and traceability in recycling sites, giving suppliers and buyers assurance that a recycler handles material in a responsible and correct manner.
- **Recycled plastic traceability:** certifying the traceability of recycled plastics and its chain of custody along the process and different actors of the value chain via a controlled blending model. The certification gives end-users an opportunity to effectively communicate the use of recycled plastics in a product with buyers and consumers. It allows claims of recycled content to be made in accurate way, following standardised methodologies.

The uptake of these certifications increased throughout 2022, with rPET buyers increasingly making certification a pre-requisite to their supply agreements. Some waste sorters and bale suppliers also began using certifications in order to ensure material is being used for circular applications.

COLLECTION SYSTEMS

As mentioned in Collection and Sorting section, nearly 3 million tonnes of PET waste were collected for recycling in the EU27+3 region in 2022, resulting in a 60% collection rate.

Collection in the EU27+3 region varies significantly from country to country, and internally between regions/municipalities of the same country. The lack of harmonisation on waste collection systems results in several challenges: mainly affecting bales quality, availability, and data transparency.

Collection via DRS (coverage limited to beverage bottles) and bring-to sites generally leads to higher quality bale production, while kerbside collection tends to present risks for higher contamination levels. While the availability and state of sorting infrastructure further influences the quality of bales produced, the way the waste is collected is the first quality indicator. Communication and education of consumers/citizens on what and how to recycle is also key.

With different mechanisms in place, compiling comparable and accurate granular waste data is a complex and challenging task for municipalities and governments. Despite the pressure and expectation to deliver traceability on plastics circularity, the challenges for waste traceability are yet to be resolved. EU's Waste Framework directive, signed into law in 2019, set an expectation of improved transparency and traceability from all members states. EU members are expected to be "prepared for re-use, and the recycling of municipal waste shall be increased to a minimum of 55%, 60% and 65% by weight by 2025, 2030 and 2035 respectively".

The variation of quantitative performance of plastic waste management is strongly linked to the lack of the harmonisation on collection. With a few exceptions (e.g. Belgium), the implementation of DRS systems is associated with higher collection rates for in-scope products and also with cleaner waste streams. Table 2 and Figure 27 below summarises the status of DRS implementation in the region.

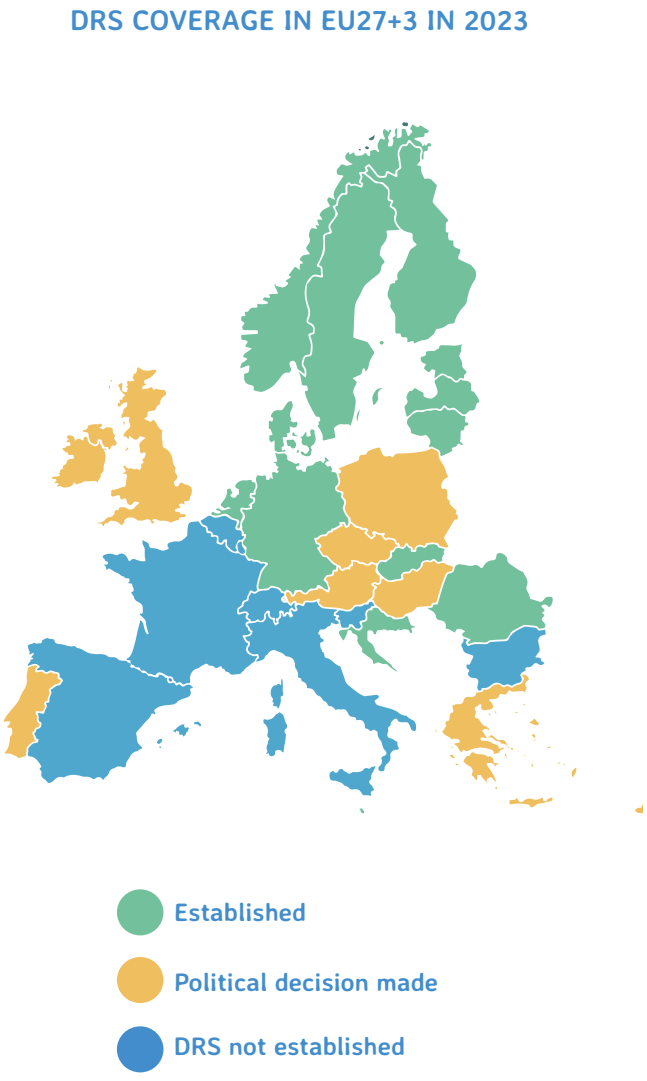


Figure 27: DRS coverage in the EU27+3 region in 2023.
Source: ICIS research and analysis, November 2023.

DRS established		DRS political decision made		DRS not established
Sweden	1984	Greece	2023 (implementation postponed)	Belgium
Norway	1999	Ireland	2024	France
Denmark	2002	Hungary	2024	Spain
Germany	2003	Austria	2025	Italy
Estonia	2005	Cyprus	2025	Slovenia
The Netherlands	2005	Czechia	2025	Bulgaria
Croatia	2006	Poland	2025	Switzerland
Finland	2008	Portugal	2025	Luxembourg
Lithuania	2016	UK	2025	
Slovakia	2022			
Malta	2022			
Latvia	2022			
Romania	2023			

Table 2: DRS implementation status in the EU27+3 region in November 2023.
Source: ICIS Research and Analysis

In 2022, 12 countries in the EU27+3 region had DRS schemes in place, including Malta, Slovakia, and Latvia, which implemented DRS systems during the year. Romania officially launched its system in November 2023, while nine other countries have confirmed implementation in the following years. The remaining eight countries: Belgium, France, Spain, Italy, Slovenia, Bulgaria, Switzerland and Luxembourg are each at a different stage of political discussion. A closer look at these member states reveals that approaches to establishing DRS vary across the EU:

- In **Belgium**, a smart deposit scheme as an alternative to traditional DRS is being analysed and tested – if successful, the technology could be implemented by 2025. In the so called "Digital DRS", customers would be able to redeem deposit fees by scanning 2-D codes on packaging at home and then correctly dispose of it via the Blue Bag collection.
- In **Spain**, the new law on Waste and Contaminated Soil for a Circular Economy which came into effect in April 2022, established separate collection objectives for single use plastic bottles:

- By 2023 at the latest, 70% by weight of that put on market;
- By 2025 at the latest, 77% by weight of that put on market;
- By 2027 at the latest, 85% by weight of that put on market;
- By 2029 at the latest, 90% by weight of that put on market.

If the objectives set in 2023 or 2027 are not met at a national level, DRS will be implemented throughout the territory within two years to guarantee compliance with the objectives in 2025 and 2029 respectively, transposed into national law from the SUPD.

- In **Italy**, a national campaign ("A buon Rendere" – "A Good Yield – Much More Than A Vacuum") led by several municipalities and partner organisations aiming to promote the transition to a circular economy in the packaging sector carried out a survey in March 2022. Results indicated that 83% of Italians are in favour of the establishment of a DRS system. Although no official decision has been made, the campaign aims to speed up the debates and approval of a national law on DRS.
- In **France**, Elipso (an organisation representing plastic packaging manufacturers) as well as other industry bodies (BRF, MEMN & SESEMN) are encouraging policymakers to implement a DRS, however, no legal decision has been made yet.

While some countries have implemented DRS in 2022, the Netherlands expanded the existing system from covering only large plastic bottles, since July 2021, to also include small plastic bottles (below 500ml). Meanwhile, new schemes were also implemented in 2022:

• Malta

The Beverage Container Refund Scheme (BCRS) has been operating a DRS scheme in Malta since November 2022 covering beverage drinks made of PET, metal (steel and aluminium) or glass (clear and non-clear glass) with a capacity between 0.1 and 3 litres. Bottles containing dairy, juices or alcoholic beverages containing more than 5.0% alcohol are not covered by the scheme. The system launched with over 320 Reverse Vending Machines (RVMs) installed in supermarkets/retail shops and public hubs.

Source: BCRS official website: Home - BCRS Malta Ltd

• Slovakia

Správca zálohového systému (officially named Deposit Return System Administrator in English) started the operation of a DRS system in January 2022. The scheme covers beverage containers made of plastic and metal with a volume ranging from 0.1 to 3 L. milk and syrup containers, as well as beverages with more than 15% alcohol content are not covered. The system operates RVMs and manual scanners present in small shops and remote locations.

Source: Deposit return system in Slovakia (spravcazaloh.sk)

• Latvia

Deposita Punkts started operating a DRS scheme in Latvia in 2022. The system covers beverage containers of 0.1 to 3L made of PET, glass and aluminium. Beverage containers of dairy products and wine are not covered by the system, neither are glass bottles for alcoholic spirits (alcohol content above 15% vol).

Source: Beverage Packaging Deposit System in Latvia (depozitapunkts.lv)

• Romania (2023)

In Romania, the DRS system launched in November 2023. The DRS administrator RetuRO managed a system which covers beverage containers of 0.1-3L made of plastic, glass and metal (aluminium). All types of alcoholic drinks are covered, including wine and spirits. However, dairy product bottles are not currently part of the system.

Source: RetuRO official website (returosgr.ro)

Meanwhile, the textile recycling value chain is in its infancy and requires the development of its collection, sorting, and pre-processing infrastructure. Critical mass of collected textiles needs to be achieved to support textiles recycling at scale, and to encourage scaling up of recycling technology. There are some initiatives in Europe[6] working in this direction and using near-infrared (NIR) and visual spectroscopy (VIS) to sort textile waste by fibre type and colour. While no significant developments in collection of textiles for recycling were recorded in 2022, the proposed mandatory and harmonised Extended Producer Responsibility (EPR) Schemes for textiles in all EU member states are expected to accelerate the development of separate collection, sorting, reuse, and recycling of textiles in the EU, in line with the EU strategy for Sustainable and Circular Textiles. Increasing the availability of used textiles is expected to create local jobs and save money for consumers in the EU and beyond, while alleviating the impacts of textile production on natural resources.

SORTING

It is estimated that about 2.7 million tonnes of PET were sorted for recycling during 2022 in the EU27+3 region. The sorting infrastructure remained a bottleneck for processing and creation of quality feedstocks for all polymers, with the exception of PET bottle waste where DRS schemes are present. In countries expanding DRS collection schemes to new bottle grades in 2022 (juices, syrups) the sorting yields were impacted, resulting in lower quality.

Similarly, the growth in opaque PET bottle applications for dairy and "performance" products (e.g. protein shakes), often wrapped in full-sleeve continued to challenge optical-based systems. The sorters struggle to differentiate between food and non-food grade applications where bottles are wrapped in neck to bottom sleeves, lowering yields both at baling and recycling stages of processing. These bottles are currently commonly not included in DRS systems, nonetheless for the sorting of co-mingled lightweight packaging (e.g. in Germany or Poland), their presence in sorted bottle bales increased in 2022. The need for recyclate grade standardisation and design for recycling is discussed further in the report. Belgium is the first market to develop an opaque coloured bottle fraction in their sorting centres, aiming to facilitate new waste streams for recycling.

PET thermoforms (trays) can also continue to be a challenge for sorting facilities. As discussed earlier in the report, the material used to produce thermoforms is more brittle than bottles at the point of recycling, leading to a higher production of fines when processed into flakes. The pre-sorting costs have increased in 2022 for some bottle recyclers, as more trays were found in bottle bales than in previous years.

However, the biggest challenge for the market remained the stagnant investment into sorting infrastructure at country level. With the exception of a few large-scale projects set to launch in 2023 (e.g. sorting plant in Motala, Sweden, with the capacity of 200,000 tonnes/year covering the plastic packaging consumption of the entire country) municipalities struggled to secure the necessary funds. The sorting shortfall will have a directly negative impact on the impending regulatory targets (e.g. SUPD) and cannot be easily enhanced until higher degree of waste harmonisation is implemented.

6. The "Transform Textile Waste into Feedstock (TEXAID)" project is an example.

ENERGY COSTS

The beginning of the Russia-Ukraine war in February 2022 led to energy prices spike in Europe, as shown by Figure 28. The geopolitical tensions heavily impacted the supply of natural gas and left many European nations scrambling to secure energy quotas, with unseasonably cold March exacerbating the shortage fears.

Energy costs play a pivotal role in plastics recycling processes and typically represent 15% - 20% of total operational costs. The energy crisis caused by the war in Ukraine dramatically impacted recyclers' production costs, especially exacerbated in some EU27+3 countries where the recycling industry does not have a status of 'highly energy intensive' and was not eligible for government subsidies (e.g. Poland).

As discussed in the pricing section above, rPET prices increased during H1 of 2022. However, during the latter quarter of the year, recyclers saw rPET prices decline on the back of weakening demand, adding more pressure to margins already affected by increased production costs with little respite. Although key end-markets for PET (e.g. food packaging) tend to be more robust to challenging economic conditions, the cost-of-living crisis led by the record high energy costs affected (and continues to affect) consumer purchasing patterns. The PET recycling industry comprises of many companies with limited cash reserves. A large portion of these recycling companies faced financial difficulties amid squeezed margins without governmental support around rising costs as well as operating in a market with weakening demand, that continued beyond the end of 2022.

Wholesale energy prices did drop in the second half of 2022, but changes are slow to be reflected into retail contracts, creating a prolonged pressure on recyclers' margins. There were concerns in the market that some recyclers, especially those not integrated either into feedstock or end-applications, faced severe financial difficulties and potential closures.

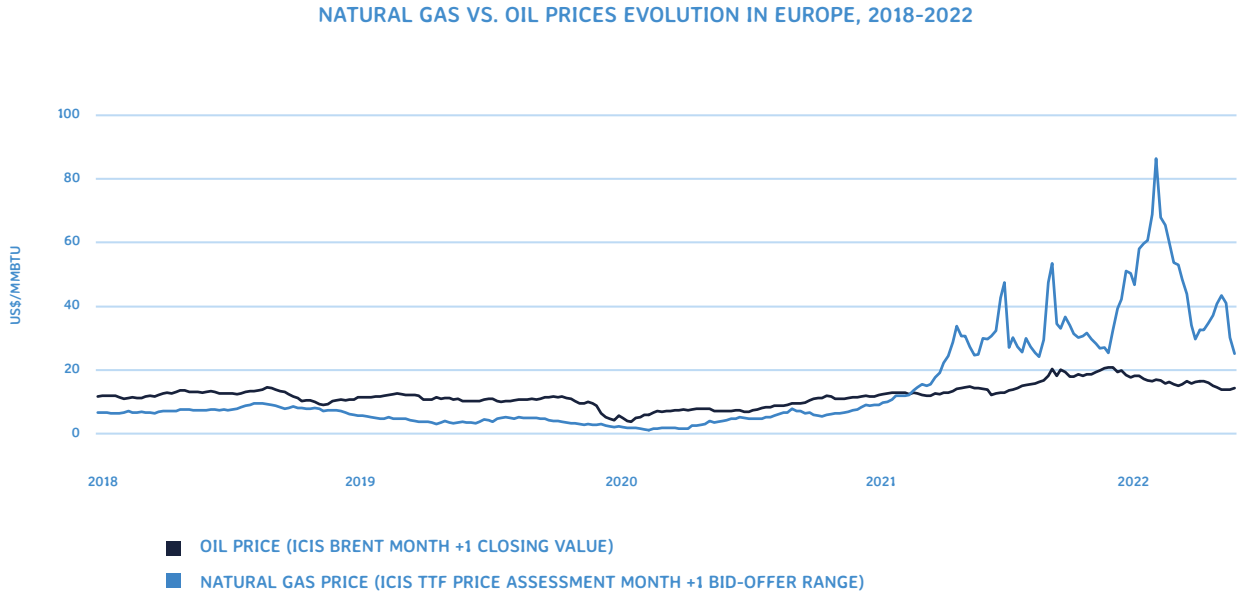


Figure 28: Natural gas prices evolution in Europe in comparison with oil prices between 2018 and 2022.
Source: ICIS LNG Edge

COLLECTION VOLUMES ACROSS EUROPE

The EU27+3 nations continue to find reporting of collection numbers a challenge. Overall lack of harmonisation, both internally on a municipal level and on a Union-level, is a major factor impacting data availability. However, improvements driven by more thorough legislation have been made in recent years. Many member states have already, or are in the process of, implementing and tightening waste data registers, where all waste collectors and processors are liable to report on their volumes.

This analysis presented on Figure 29 uses best available data on PET bottle collection across EU member states.

The methodologies behind individual country data differs from country to country. The accuracy of data (and lack thereof) is one of the major barriers for EU governments and industry to progress the much-needed development of collection infrastructure, especially in countries with low collection rates. The data includes volumes of PCR bottles from Deposit Refund Schemes, separate municipal collection and waste sorted from mixed waste collection.

Across Europe there is a distinct difference in collection rates for countries with established Deposit Return Schemes (with exception of Belgium and Switzerland) and those which are yet to introduce one. The analysis in Figure 30 uses weighted averages to compare regional performance of average collection rates – this means each country in the region was assigned a value proportional to the local PET consumption volume, allowing the average rates to represent the performance more accurately.

The highest average bottle collection rates in 2022 were achieved by DACH (Germany, Austria and Switzerland) at 93% and the Nordic countries (Denmark, Finland, Norway and Sweden) at 87%. These regions have on average surpassed the 2025 goal for separate waste collection of PET bottles (77%) and are ahead of the curve for the 2029 goal of 90% separate collection. The Baltics region (Estonia, Lithuania and Latvia) has seen significant progress with their DRS schemes, averaging 80% collection rate of PET bottles since launching and are well positioned for the 2025 goal. Benelux (Belgium, the Netherlands and Luxembourg) achieved on average 73%, putting the 2025 goal within reach.

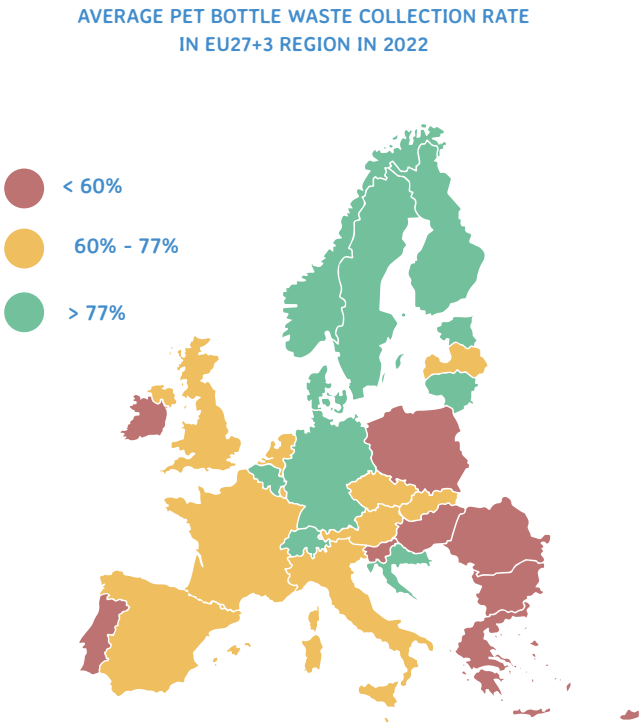


Figure 29: Average collection rate (%) of PET bottles in the EU27+3 region by country in 2022.
Source: ICIS research and analysis.

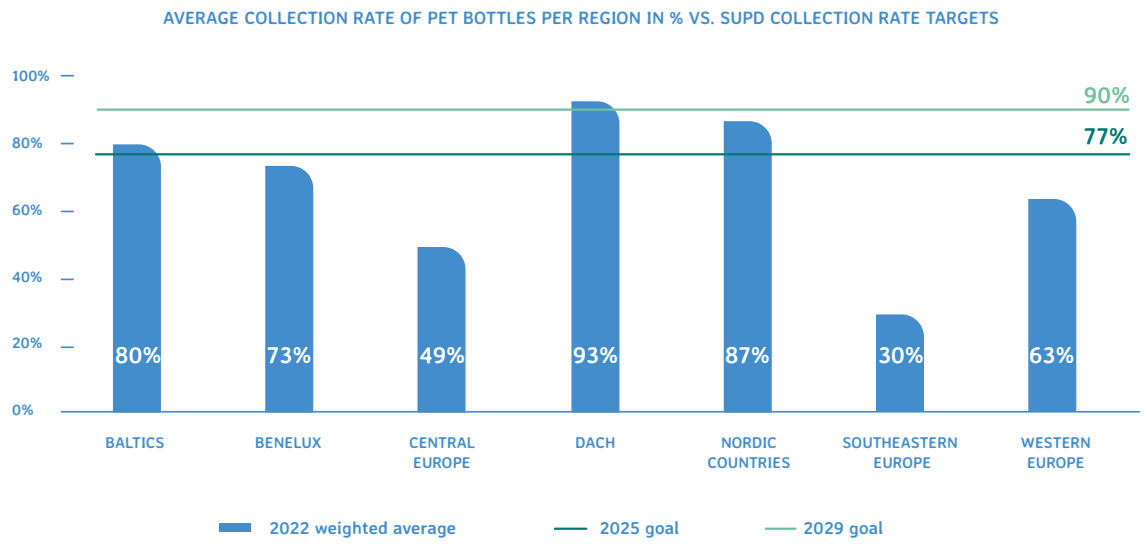


Figure 30: Weighted average collection rate (%) for PET bottle waste in 2022 per EU27+3 region vs 2025 and 2029 SUPD targets.
Source: ICIS Analysis

In DACH and the Nordics, most countries have a long-standing history of DRS and an established consumer culture of returning bottles. An estimated 85% of bottle waste was collected in Switzerland through a mix of separate collection (non-DRS, but separate bins available in public spaces), and secondary sortation targeting PET in household waste. Germany had reported the highest volumes of bottle and tray collection across Europe, with estimated 440,000 tonnes of post-consumer waste, and the average bottle collection rate of 95%. The success with bottle collection in these two regions does not however extend to trays, pots, and tubs. More concerted effort to expand separate collection to drive the overall recycling rates of PET is needed.

In Western Europe (Ireland, United Kingdom, France, Italy, Spain and Portugal) and Central Europe (Poland, Czechia, Slovakia, Slovenia and Hungary) the average collection rate stood at 63% and 49% respectively. Most of new DRS activity took place in Central Europe in 2022 and 2023, with major launches scheduled for 2025 – these new systems are likely to propel the regions' collection rate ahead of Western Europe.

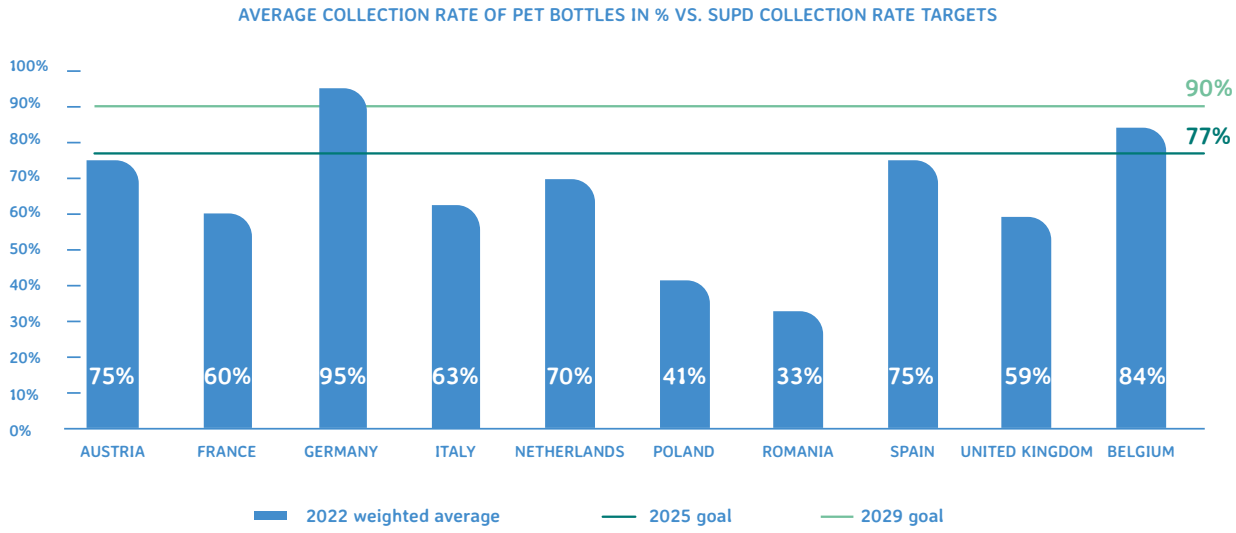


Figure 31: Average collection rate (%) for PET bottle waste for selected EU27+3 countries in 2022.
Source: ICIS Analysis

Meanwhile, the conversations on DRS in Italy, France and UK have stalled in 2022 while bottle collection rates in these countries averaged between 59% - 63%. However, it is important to note that the UK and Spain have some of the highest tray collection average rates in Europe, reporting separation for recycling of over 30%.

Finally, Southeastern Europe (Bulgaria, Croatia, Cyprus, Greece, Malta and Romania) has achieved an average of 30% for bottle collection. Within the region, Croatia showed the highest average bottle collection, estimated at around 87%, having a DRS established since 2006. Significant improvements in bottle collection were also made in Malta since the launch of the DRS. As in Central Europe, a rapid development is expected in this region with further establishment of multiple new DRS systems in coming years (e.g., scheme in Romania launched in November 2023).

Overall, the data indicates that most of EU-members states will need to rapidly improve separate collection rates to meet the 2025 and 2030 targets EU targets. The improved sortation and accurate waste accounting will bring much needed stability and transparency for all stakeholders in the value chain.

KEY DRIVERS FOR RECYCLING

ROLE OF LEGISLATION

New rules and regulations impacting PET recycling and rPET use have come into force in 2022, most notably changes to food-contact applications. Some progress was made by individual EU members states in the implementation of the Single Use Plastic directive, and the EU Commission undertook a review of the Packaging and Packaging Waste directive (PPWD) leading to the announcement of a new regulation proposal – the Packaging and Packaging Waste regulation (PPWR).

SINGLE USE PLASTIC DIRECTIVE

In force since 2019, the Single Use Plastic Directive (SUPD) continued to be the main legislative driver for the EU member states in 2022. Having missed the implementation deadline of July 2021, many members are still in the process of fully transposing the directive into local law. In September 2022, the European Commission announced that it was taking legal action against 11 member states for lack of accurate or complete implementation of the SUPD provisions: this included Belgium, Denmark, Estonia, Ireland, France, Croatia, Latvia, Poland, Portugal, Slovenia, and Finland. Figure 32 representing the state of implementation by November 2023 indicates that eight states continue to work on full transposal, while many already declared ambitious national reduction targets independently of SUPD.

The assessment, and subsequent law-suite from the EU Commission highlighted the gaps in separate collection, Extended Producer Responsibility schemes, effective awareness expansion (citizen education) and overall consumption reduction.

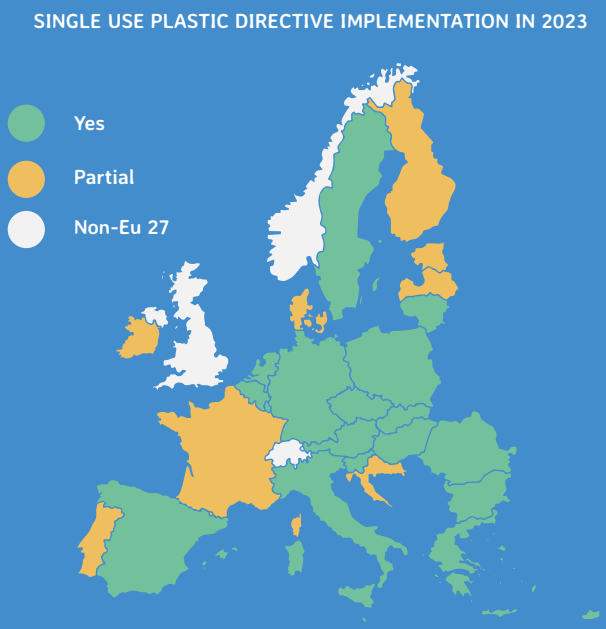


Figure 32: Single Use Plastic Directive implementation in EU27 as of November 2023.
source: ICIS analysis

France continued to grapple with establishing a route for separate collection for PET bottles, with some preliminary discussion of DRS. However, no tangible progress was made in 2022. The country has set additional ambitious targets of 20% plastic packaging reduction, with focus on at least half achieved through reuse and progressive elimination of single-use plastic packaging. A further target of complete elimination of 'unnecessary' single-use plastic packaging (i.e., nonessential technical function such as protection, integrity, transport, or regulatory compliance) was also set, both goals with the aim of deliver before end of 2025.

Other member states also announced ambitious targets, examples include:

- **Portugal**: reduction targets of number of packaging units placed on the market aiming for 80% by 2026 (compared to 2022, exemptions apply).
- **Greece**: a 30% national reduction target by 2024 for all SUP beverage cups and food containers heavily targeting the takeaway sector.
- **Sweden**: 50% reduction by 2026, compared to 2022.
- **Spain:** 50% reduction (by weight) by 2026 compared to 2022. Spain has also announced a plastic tax of 0.45€ per kilogram of non-recycled plastic, levied on manufacturers from January 2023.

Meanwhile, Germany, despite missing the deadline, and only a partial implementation of the ban on single-use plastics in 2022, has taken significant steps in 2023 including the introduction of a new tax[7] originally applicable from 2024 but delayed to 2025.

Meanwhile, the key milestone of 2025 for all EU countries is fast approaching, by when 77% of plastic beverage bottles should be collected via separate systems, and PET beverage bottles placed on the market will have mandatory average 25% recycled content.

FOOD CONTACT REGULATION 2022/1616

New regulations for Food Contact Materials (FCM 2022/1616) were introduced in October 2022 by the European Commission replacing Regulation (EC) 282/2008. It introduces two pathways to obtain approval for food contact materials: the suitable technology addressing already evaluated processes where sufficient data has been generated, and the novel technology addressing processes that have not been assessed yet. The Regulation (EU) No 2022/1616 regulatory package includes among others:

- New registration system for all recycling organisations producing recycled materials for food-contact applications.
- From 10 July 2023, only plastics containing recycled plastic manufactured with a suitable recycling technology may be placed on the market, unless manufactured with a novel technology.
- New rules governing novel technologies, especially applicable to other polymer types (notably for mechanical recycling of PE, PP and PS), or innovative techniques for reprocessing PET.
- New rules governing inclusion of rPET in the ABA structure (B layer containing the rPET). The process is subject to novel technology where further data needs to be generated before an EFSA assessment can define whether the technology can be considered a suitable technology.
- Certification of quality assurance systems for collection, sorting centres and pre-processing operator from October 2024,
- Recycling technologies producing a starting substance provided that it is included in the Union list of Regulation (EU) No 10/2011.
- Changes to the rules governing imports of rPET from outside of the Union. Local competent authorities equivalent to EFSA in exporting countries need to act on behalf of local applicants for technology and production certificates to be awarded.

The primary focus of Regulation (EU) 2022/1616 regulations is food-safety, setting high-quality expectations for the safety of recycled plastics in food contact applications. It also acts in tandem with other regulations governing plastic FCMs, such as the Packaging and Packaging Waste Directive. Since 2022, EFSA continually publish reviews of applications for recycling processes and technologies in the Official Journal on a regular basis. However, industry players have reported delays in processing of applications submitted to EFSA, resulting in operative disruptions since the implementation of the new regulations.

7. EWKFondsG, which translates to Single-Use Plastic Fund Act.

ANNOUNCEMENT OF PACKAGING AND PACKAGING WASTE REGULATION

On 30th November 2022, the European Commission proposed a new legislation package to supersede the existing Packaging and Packaging Waste directive Regulations[8]. These have binding legal force for all Member States and enter into force on a set date simultaneously for every Member State. This will have a greater impact on producing harmonisation, and therefore certainty, across the different EU markets. The proposal for Packaging and Packaging Waste Regulation (PPWR) attempts to tackle multiple interlinked problems:

- The growing generation of packaging waste linked to an increased use of single-use packaging, a high level of unnecessary packaging, and growing share of plastic in packaging.
- Barriers to packaging circularity, including lack of suitable end-of-life design and unclear labelling for consumer sorting.
- Market fragmentation hindering cost-efficient waste management in an internal market.
- Downcycling and low level of uptake of recycled content in packaging, limiting EU's ability to reduce use of virgin materials in new packaging.

These issues are to be addressed at scale through wide range of goals and targets, which include reduction, reuse and refill quotas, design for sustainability and recycling, and collection targets.

The legislative timeline for PPWR was set at a higher than usual pace, to complete the process before the impending general parliamentary elections set for June 2024.

The European Parliament voted 'yes' to an amended version of the draft proposal in November 2023; while the European Council voted 'yes' to a different text of the regulatory package in December 2023. The trialogue will continue into 2024 to reconcile the two versions, with the aim of possible adoption before the last plenary session in April 2024. Final contents of the package, and their direct impacts on the industry, are yet to be known.

LEGISLATION IN OTHER EUROPEAN COUNTRIES

UNITED KINGDOM

The approach in the UK has been focused on the introduction of a tax on plastic packaging. The UK Plastic Packaging Tax came into force on 1 April 2022. It applies at a rate of £210.82/tonne (2023 tax year rate, to further rise to £217.83/tonne in 2024) on plastic packaging components with less than 30% recycled plastic. The tax applies to domestically manufactured and imported goods. Meanwhile, since the implementation of the EU Withdrawal Bill in 2020, the UK has followed REACH regulations for food-contact and aims to continue following EFSA until UK equivalent regulations are developed in the mid-term. However, the introduction of 2022/1616 regulation is yet to be translated into local law. Some progress was made towards the establishment of a DRS in Scotland before collapsing and being withdrawn. However, no legislation was introduced for a national scheme (encompassing England, Wales, and Scotland).

NORWAY

Although not an EU member state, Norway follows European legislation closely. New explicit collection targets were set by the Norwegian Ministry of Climate and Environment: municipalities are to separate at least 50% of recyclable plastic waste by 2028, rising to 60% in 2030 and 70% by 2035. Norway already has a robust and successful DRS with over 90% plastic beverage containers recycled. Norway also follows the EU/EFSA regulations on food-contact materials, and the 2022/1616 is currently undergoing implementation.

SWITZERLAND

No new major legislation was passed in Switzerland in 2022, however, since 2020 the parliament is in the process of reviewing the proposal for 'Strengthening Switzerland's Circular Economy' (20.433). Industry response was mixed, with a suggestion in an opinion letter from a Swiss recycler association that proposed regulations would introduce unnecessary administrative burden on

8.The key difference lies in the functionality of directives vs. regulations. Member states are free to decide how a directive is transposed into national law and goals, providing that certain results are produced (e.g., SUPD discussed above with the target of 25% minimum recycled content in PET bottles placed on the market by 2025). However, regulations are binding.

the collection, sorting, and recycling industry. VSPR also urged legislators to allow greater freedom for individual Cantons to determine their collection needs and work together to harmonise meeting the requirements for material flow transparency.

No indications have been made from the Swiss legislators that an equivalent of SUPD, including product bans or DRS systems, is considered. However, Swiss representatives participate in working groups such as the Plastics Interest Group of the Network of the Heads of European Environmental Protection Agencies (EPA-Network). Switzerland is also one of the signatories of the Basel Convention, subject to the amendments introduced in 2022 governing export of scrap to non-OECD countries.

TEXTILES LEGISLATION

In March 2022 the European Commission published the 'EU strategy for sustainable and circular textiles. The Strategy proposes actions for the entire lifecycle of textiles products, while supporting the ecosystem in the green and digital transitions and works in conjunction to the upcoming review of the Waste Framework Directive. Once the harmonised EU rules on extended producer responsibility for textiles are in place, eco-modulation of fees can be applied to incentivise material circularity and design for sustainability. As a key product value chain, textiles have a strong potential for the transition to sustainable and circular production, consumption, and business models. The Strategy aims to promote fibre to fibre recycling and discourages PET bottle to textile recycling.

VALUE CHAIN COLLABORATION

The persistent challenging conditions of the rPET market (fluctuation of price, quality, and availability) were a key driver behind major new value chain collaborations announced in 2022. Multi-stakeholder partnerships have become commonplace, especially in previously less well-established areas of the market. Examples from 2022 include:

- Project to recycle 50 million PET food trays per year.
- Development of a digital platform to accelerate the development of innovation and sustainable waste recycling methods launched by a pan-European waste management organisation.
- Scale-up of advanced dissolution technology plant for treatment of waste PET.
- Launch of partnership working in a new bio-recycled PET manufacturing plant.
- New recycling project aiming to close the loop on PET-based multilayer products.
- Announcement of a long-term supply agreement delivering significant volumes of hard-to-recycle PET packaging waste for depolymerisation treatment.
- A tray-to-tray recycling project, aiming to increase the use of rPET from post-consumer trays in food packaging.
- Announcement of new partners joining a project aiming to construct a new chemical depolymerisation plant.

Partnerships such as those mentioned above go hand in hand with technological enablers such as design for recycling and sustainability or lightweighting, described in more detail below. For brand owners especially, multistakeholder partnerships are a way to quickly expand knowledge, taking advantage of the expertise and experience of recyclers and machinery suppliers. As brands face an increasing pressure from legislators, lobbyists, and consumers, leveraging knowledge from industry experience and expertise will be key to progressing plastics circularity.

CONSUMER PRESSURE AND COMMITMENTS FROM THE INDUSTRY

As consumer awareness of the environmental impact of plastic pollution continues to grow and influence purchasing decisions, major producers continue to set ambitious sustainability targets.

Transition towards higher recycled content levels differed between producers (based on self-reported data), with some producers already achieving 100% rPET bottles in parts of their portfolio in some European countries. While brand commitments are an intrinsic driver for change, legislation has a pivotal role in progressing the industry towards recycle content targets. Producers reported that in 2022 globally, markets in countries with more developed regulations and support for recycled content in bottled drinks and water saw a higher proportion of recycled content. Meanwhile, some geographies outside Europe where no legal basis for recycled content in food contact materials can be found, inclusion of rPET has been challenging thereby generating interest in export markets for rPET products. The PCR feedstock has been imported into Europe to fill bottle-grade demand.

Some producers explored the potential for improved sustainability through polymer switching to PET and rPET (e.g., away from PS or PE). Weight optimisation (lightweighting) was also deployed and has resulted in a modest reduction of PET and rPET consumption for some producers.

Major lifestyle brand owners in the textile sector, especially those commonly referred to as 'fast fashion' brands, continued to feel the public scrutiny of their lack of sustainability. In 2022, legislation provided limited clarity on the responsibilities of these companies for PET and PET blend textile recycling. However, some businesses have taken steps towards developing new technologies and supply chains to address the issue. Overall, the industry lacks standardisation of efforts, which can be seen by the differences in commitments and progress reporting.

Clothing and household goods retailers announced in 2022 commitments for the coming decades (for 2025, 2030 and 2040) among others:

- to transition to 100% recycled content packaging.
- reduce plastic packaging.
- move towards 100% of materials to be either recycled or made from other more sustainably sourced materials.
- a proportion of commercial goods to be certified recycled.
- to donate, refurbish, or recycled 10x more used or defective products vs. 2021 benchmark.
- to produce at least 90% of offering to be sustainable (i.e., show environmental benefits versus conventional articles due to the materials used, meaning they are – to a significant degree – made with environmentally preferred materials).
- all materials purchased to be renewable, recyclable, and/or recycled.
- reach 100% recycled polyester fibre in textile products.

The ambitions set are high when compared with the speed at which they are to be delivered, while, unlike the packaging sector, the legislative framework is more limited, and the technology is not available at scale.

TECHNOLOGICAL ENABLERS

Major technological and innovation trends continued to develop in 2022 as brands strived to progress towards commitments. These can be broadly defined as design for sustainability, design for recycling or end-of-life, and re-processing innovations.

DESIGN FOR SUSTAINABILITY (DFS)

Weight optimisation, or 'lightweighting' commonly used in the automotive industry, has played a role in the attempts to reduce overall virgin PET consumption by key brand owners. Pre-form lightweighting, especially of the bottle neck, can deliver a reduction of 16% to 52%.

Meanwhile, reuse and refill applications require a more robust and resilient structure. No significant progress of transition to refill/reuse was reported by major players, with the current share of packaging stagnant at 1.2%. At this point it is not clear what proportion of PET and rPET consumption will reuse/refill packaging, with more data needed.

The announcement by EFSA of new food safety regulations in October 2022 (code 2022/1616) introduced rPET food contact provision in tray manufacturing as a novel technology. The ABA sandwiching structure legally allowed manufacturers to replace layer B with recycled PET, ultimately lowering the environmental impact of the product.

DESIGN FOR RECYCLING (DFR) OR END-OF-LIFE

Design for Recycling (DfR) trends in 2022 included material substitutions to PET, especially for pots, tubs and trays previously manufactured from multi-layer PE, or thermoformed PP and PS sheet, increased use of tethered caps and closures, ongoing feasibility work on digital watermarking and deployment of AI for waste sorting.

Retailers and manufacturers are increasingly turning to PET and rPET for their on-the-go ranges (e.g. a UK supermarket brand replacing 25cl wine bottles from glass to PET in the UK). This is due to perceived high recyclability (including food-grade) and decreased environmental footprint when compared to other materials (e.g. glass) or other polymers (e.g. food-contact PP). One such example is the transition from HDPE to opaque white PET bottles for a Swiss dairy company.

Beside substitution, DfR saw some progress from major producers as discussed above. Pilot projects globally tested customer response to re-designed packaging without labels and with new blow-moulded shapes highlighting the brand identity. Other producers tested a new, cold water-dissolvable label adhesive. Such innovations may eventually significantly contribute to more consistent feedstock quality for recycling.

Digital watermarking also gained traction as a technological enabler, aiding the end-of-life management via improved sorting. Validation tests commenced in January 2022 and resulted in 95% purity rates. Another trial at a semi-industrial scale was launched by a partnership in June 2022. The technology has been validated and showed that higher granularity of sorting of packaging waste at scale is possible. If, and when, applied at scale it should improve availability of PET waste feedstock for tray-to-tray and other PTT packaging.

RECYCLING INNOVATIONS

While packaging producers and brand owners focus on the end-use of PET and rPET, machinery producers for the recycling industry also invested heavily in R&D in 2022. Major players all launched new, improved reprocessing lines. PET recycling lines can include integrated granulators for bottle-to-pellet re-processing. As EFSA continues to issue food safe certification, machinery suppliers developed de-contamination and deodorisation units to improve output quality and manage variability of input feedstocks.

The energy crisis which started in 2022 further pushed the need for continual improvement in re-processing efficiencies. Recyclers were particularly impacted by surging energy prices, as in some parts of EU the industry does not have a status of 'energy intensive' and subsidies were not available. Machinery producers introduced products with new efficiencies, simultaneously boosting environmental credentials through lowered footprints.

Finally, machinery producers are working closely with partners and leveraging their experience further in the chain, and for large organisations integration of various stakeholders across the value chain in a group was a key theme; with many major companies strengthening their collaborations and expertise exchange.

FUTURE STATE OF THE MARKET: RECYCLED CONTENT TARGETS OF BOTTLES BY 2025, 2030 AND 2040

The current market balance for the EU27+3 region as a whole shows supply is sufficient to meet the mandatory targets set out in the Single Use Plastics Directive of 25% recycled content in PET bottles, to be met by 2025. In 2022 the average sorted for recycling rate for PET beverage bottles was 75%, while the estimated average recycled content in PET bottles was 24%. This top-level view shows positive progress by the sector towards achieving targets. Further analysis on a country level, however, highlights stark differences in individual country results.

To take this assessment on the total Europe outlook further, the potential scenarios are presented in the figures below, aimed at estimating the input recycling capacity required to meet the recycled content targets – mandated and voluntary - for PET bottles in Europe.

These scenarios assume:

- Average annual growth rate of 2% in beverage bottles placed on the market.
- Output from **mechanical recycling** capacities only.
- Base level of washing capacity of ~3 million tonnes.
- Assuming the percentage of recyclate utilised by the bottle sector from the total input to recyclers remains the same as 2022.
- Reusables target of 10% in 2030 and 25% in 2040.

Other factors such as improvements to collection rates, waste management and sorting technologies, regulations, end-markets etc. are not factored into these assumptions.

SCENARIO 1 – MANDATED TARGETS

- This assumes recycled content targets for beverage bottles, related to SUPD and current proposals under PPWR, of 25% by 2025, 30% by 2030 and 65% by 2040 in PET bottles. Figure 33 indicates the required recycling capacity to meet the mandatory recycled content targets in 2025 and 2030 are circa 800,000 tonnes and 1 million tonnes of rPET respectively. Based on these assumptions, the industry can achieve the 2025 targets for the region total. This is a result of the commitment to improvement in the circularity of PET demonstrated by stakeholders across the PET recycling value chain.
- An incremental capacity of close to 3.5 million tonnes will be required to meet the target of 65% recycled content in 2040. This will require continued commitment from the value chain. Investing in collection to enable improved supply of feedstock that will support development of, and investment in, growth of recycling capacity to the required level.
- The SUPD targets are set at a national level, however current collection rates for individual markets sit across a wide range, with a number falling behind the regional 75% average. For all member states to achieve the targets improvements in collection and sorting, as well as consistent rPET adoption, are essential.
- The markets of focus are in Southeastern and Central Europe, as well as some countries in Western Europe where the levels of both bottle collection and recycled content rates are estimated to be the lowest in the region as shown in Figure 35.

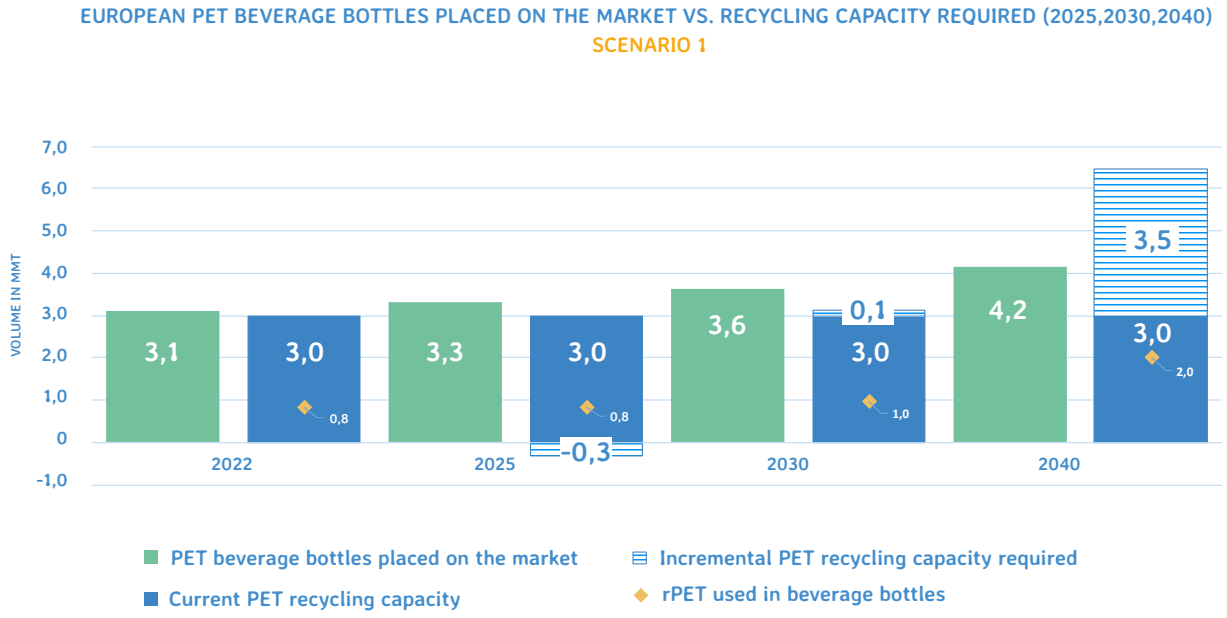


Figure 33: PET beverage bottles placed on the market vs. recycling capacity required in the EU27+3 region by 2022, 2025, 2030 and 2040 under Scenario 1 of mandated targets.
Source: ICIS Analysis

SCENARIO 2 – VOLUNTARY TARGETS

- Recycled content targets of 25% in 2025, 50% in 2030 and 65% in 2040 have been considered, adding in voluntary targets. As industry embarks towards greater circularity and reducing dependency on fossil fuels, beverage bottle brands are setting voluntary targets for recycled content of 50% by 2030. Under this scenario, an additional recycling input capacity of approximately 2.2 million tonnes would be required to meet the recycled content target of 50% in 2030, as Figure 34 shows. Hand in hand with any growth in recycling capacity will be the required increase in PET bottle collection to feed it.
- The available supply to meet any higher ambitions must develop across the region. Not only at an individual level to address the disparity across the region but to prepare for the future demands on the industry. To build the required capacity to meet higher demand, the value chain must plan accordingly and access to consistent high-quality feedstocks is a key driver to investment in new capacities and expansions.

Seasonality of bottle consumption and consequent bale availability is a critical factor to a more balanced market where supply is in line with demand. Bale availability depends on beverage consumption, which is highest in the summer period. Demand for rPET pulling supply before this availability builds will likely result in the price hikes scenario of H1 of 2022.

To support the capacity expansions required, feedstock supply must improve, particularly beyond 2030. Without the development of collection systems across all markets in the region, be those DRS or other systems, supplying the quantity and quality of feedstocks to this capacity will remain a challenge. A shortfall has the potential to be filled by imports, but this cannot be relied upon given the likely change in trade flows of waste, combined with the continued progress to circularity based on utilization of domestic waste sources. Therefore, it is clear the value chain needs to collaborate on the required developments in the first part of the chain – collection and sorting – as early as possible in preparation for the industry needs.

This required investment in infrastructure needs to be mirrored by expansion in capacities for washing as well as extrusion, to deliver the volume of food contact materials to meet the higher targets for 2040, as currently proposed. The feedstock supply must improve in quality as well as quantity, to enable that capacity to build. Developments are in place with the potential to deliver the results, however it is clearly necessary these build from today to prepare the industry for longer term expectations of plastics circularity.

Planned development and industry collaboration will reduce market volatility and uncertainty, as experienced in 2022, ensuring steadier market supply and demand dynamics as recycled content target dates approach.

EUROPEAN PET BEVERAGE BOTTLES PLACED ON THE MARKET VS. RECYCLING CAPACITY REQUIRED (2025,2030,2040)
SCENARIO 2

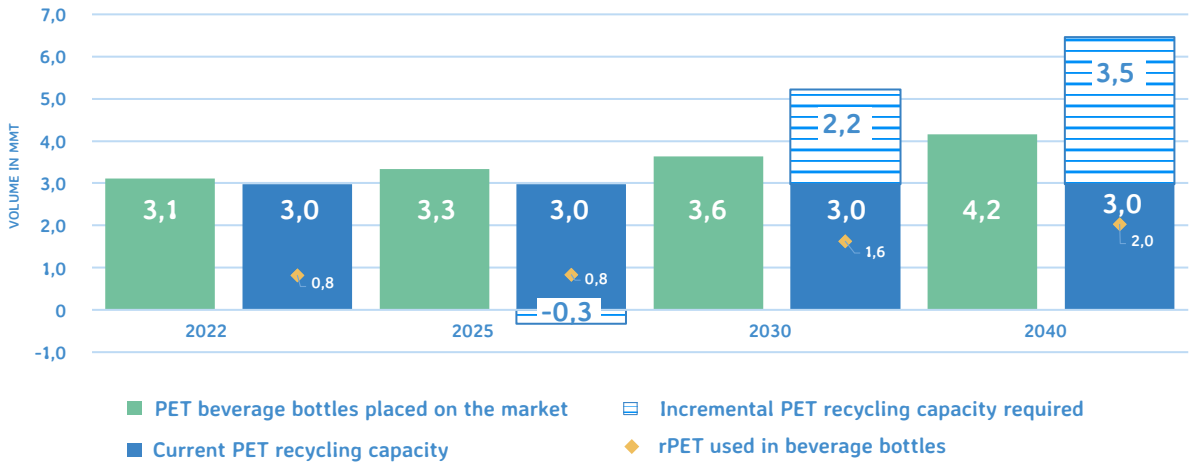


Figure 34: PET beverage bottles placed on the market vs. recycling capacity required in the EU27+3 region by 2022, 2025, 2030 and 2040 under Scenario 2 of voluntary targets.
Source: ICIS Analysis

Seasonality of bottle consumption and consequent bale availability is a critical factor to a more balanced market where supply is in line with demand. Bale availability depends on beverage consumption, which is highest in the summer period. Demand for rPET pulling supply before this availability builds will likely result in the price hikes scenario of H1 of 2022.

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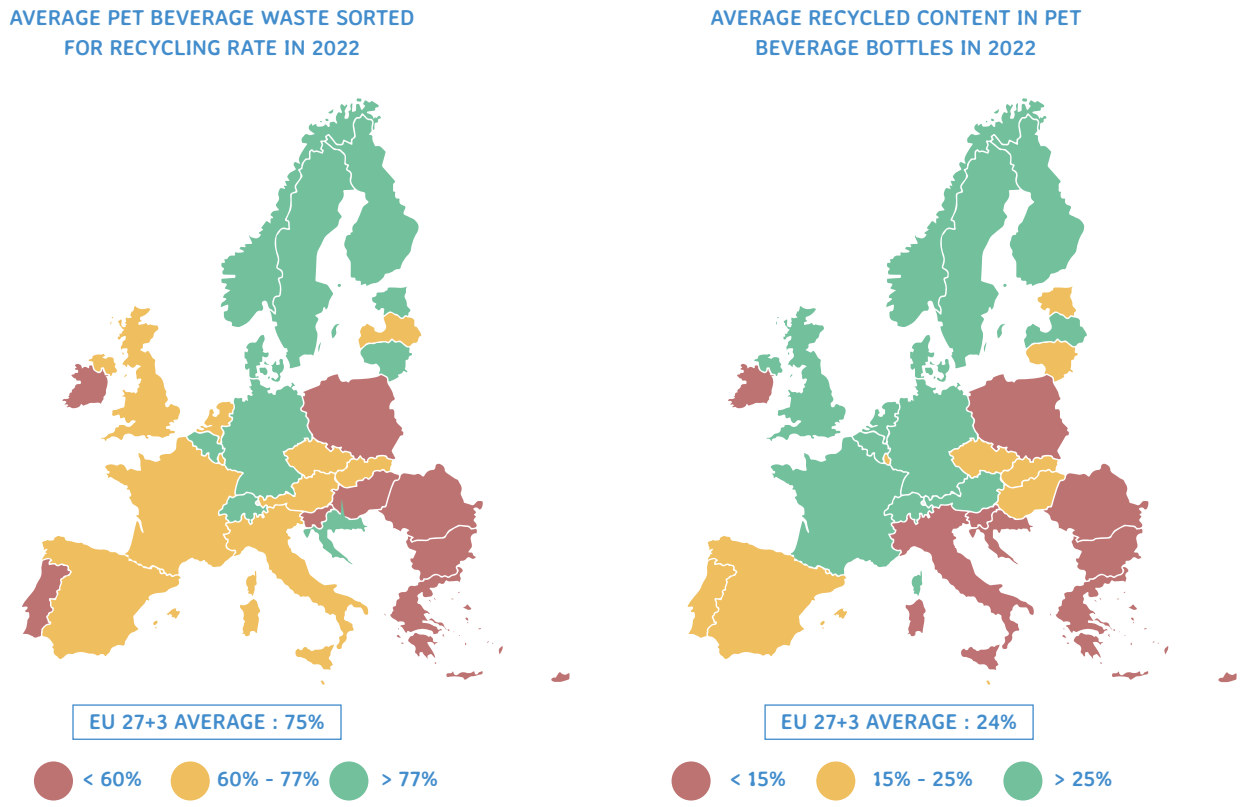

Figure 35: Average PET bottle collection rate and recycled content rate (%) for EU27+3 countries in 2022.
Source: ICIS research and analysis.

CONCLUSION

PET is a strong yet lightweight material with physical properties that allow for great freedom in design and application. PET recycling is a well-established industry in Europe and has achieved much in the areas of sustainability, including light weighting, collection activity and adoption of recycled content across widespread applications. However, vital action by value chain participants in key areas are required to further PET's circularity, set against short- and long-term expectations:

PET'S RECYCLABILITY POTENTIAL YET TO BE FULLY GRASPED

While its high recyclability gives it an edge over other materials in terms of environmental performance, managing the end-of-life of PET packaging, especially the collection and sorting will be a crucial step to strengthen its progress towards circularity. Europe's long-term self-sufficiency for recycled PET can be achieved by a concerted effort to improve sorting infrastructure and harmonised waste collection. DRS, while well advanced in many markets, is seen as one of the key solutions for improving quantity and quality of collection consistently across the region.

DESIGN FOR RECYCLING

Over the years, PET industry has significantly reduced the quantity of PET required for the manufacture of bottles. While the lightweighting of packaging has contributed towards sustainability of packaging, with the proliferation in packaging types and forms other aspects of packaging design such as opaque bottles, full-sleeve labels and multi-material trays continue to challenge existing sorting systems. There is a need of wider adoption of Design for Recycling guidelines to enhance the sorting, reduce contamination and therefore increase volumes and quality of rPET supply, ultimately leading to an increase in uptake of recyclate in high value applications.

DEVELOPMENTS IN TRAY RECYCLING

Value chain collaboration has been instrumental in the development of tray-to-tray recycling. Partnerships support new projects across the chain, with tests in existing production processes aiming to bring this to scale. Besides separate collection and specific sorting of trays and other thermoformed PET sheet products, design for recycling will be critical to boost circularity. This will contribute to tray recycling capacity, expanding tray recycling beyond the 30% of trays placed on the market in 2022.

FUTURE GROWTH FOR CHEMICAL RECYCLING

To progress polyester polymer circularity further, developing chemical recycling capacities will be key. It should play an important role in enhancing PET/polyester circularity by complementing mechanical recycling and enable the recycling of hard to recycle packaging and textile waste into high quality recyclate. The chemical depolymerisation market had minimal commercial activity in 2022 but planned capacities shall generate higher demand for feedstocks in line with scheduled start-up dates. Availability of quality feedstocks will be critical to scaling chemical recycling capacities.

DATA TRANSPARENCY

The disparity in reporting formats together with gaps in data availability continues to present challenges to provide greater data transparency for the rPET value chain. Availability of consistent and reliable data sets across the PET value chain are imperative for the long-term planning and development of collection & sorting infrastructure, recycling technologies and capacities required to achieve circularity.

HARMONISATION IS KEY

Harmonised legislation can advance recovery of PET waste with improved systems that produce higher and consistent quality bales and ultimately rPET materials. The proposed Packaging and Packaging Regulation (PPWR) is a step in this direction with the aim to harmonise implementation across the Member States.

MARKET BALANCE KEY TO SUSTAINABLE RECYCLATE AVAILABILITY

The ambition to increase recycled content levels in packaging needs to build in line with the developments of the value chain to progress towards the goal of circularity in a sustainable manner. For demand to outpace supply at such rates as those seen in early 2022, and the distortion this can create in pricing, creates a risk for the value chain to achieve its goal.

EUROPEAN TARGETS DELIVERED WITH LOCAL ACTION

Disparity in infrastructure and collection systems will continue to detract some member states from achieving the common goal of meeting mandatory targets. Investment and continued collaboration across the value chain to support improved collection, sorting and quality of rPET supply will be required to achieve the short and mid-term goals set by legislators as well as any higher ambitions in the market.

NOTES

NATURAL MINERAL WATERS EUROPE

Place des Barricades 1
1000 Brussels - Belgium
Tel + 32 2 880 20 30
Fax + 32 2 880 20 35
info@nmwe.org
www.naturalmineralwaterseurope.org

PETCORE EUROPE

Avenue de Broqueville 12
1150 Brussels - Belgium
+32 2 315 24 88
info@petcore-europe.org
www.petcore-europe.org

PLASTICS RECYCLERS EUROPE

Avenue de Broqueville 12
1150 Brussels - Belgium
+32 2 315 24 60
info@plasticsrecyclers.eu
www.plasticsrecyclers.eu

UNESDA SOFT DRINKS EUROPE

Rue du Trône 14-16
1000 Brussels - Belgium
+ 32 2 737 0130
mail@unesda.eu
www.unesda.eu