From Waste to Commodity: DELIVERING ON THE EU'S VISION OF A CIRCULAR PLASTICS ECONOMY

Why an additional EUR 20 billion in investments, modifications to the legislative framework, and brand commitments are needed to reach European Union targets.

MINDEROO FOUNDATION

KPMG

About Minderoo Foundation

Established by Dr. Andrew Forrest AO and Nicola Forrest AO in 2001, Minderoo Foundation is proudly Australian. It is one of Asia Pacific's largest charities, with AUD 2.6 billion committed to a range of global initiatives.

Minderoo Foundation's No Plastic Waste initiative aims to create a world without plastic pollution – a truly circular plastics economy, where fossil fuels are no longer used to produce plastics. A critical step towards this goal is to bring greater transparency to the plastics supply chain – to better understand its material and financial flows and environmental impacts. No Plastic Waste's goal is to deepen the world's understanding of the issue and to better educate and inform companies, policymakers, investors, and consumers. Through Sea the Future, an industry-led consortium pioneered by Minderoo, we are working on solutions to scale up plastic waste recycling.

Learn more at *minderoo.org/no-plastic-waste* **and** *stf.org*
For more information, contact us at *hello@minderoo.org*

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Setting out to contribute positively to both clients' success and society at large, KPMG firms apply their skills, expertise, passion and resources to enable change, and find sustainable solutions to local and global issues such as climate change. For this report, KPMG supported the analysis of plastic materials flows, capacity expansion for improving the management of plastic waste, and the financing of infrastructure necessary to improve the circularity of plastic.

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Cover: A worker presents a final product made from used nylon fishnets at the warehouse of the Fil & Fab company, specialised in the recycling and sale of plastic from nylon fishing nets, in Plougonvelin, western France on November 12, 2020. Photo credit: Fred Tanneau/ AFP via Getty Images.

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FOREWORD

Mark Barnaba,

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For decades, there were no economically viable alternatives to burning or burying an ever-growing volume of plastic waste – the negative environmental and human health impacts of which are increasingly clear.

Thanks to ambitious policy goals to transform the plastics economy from linear to circular – where the EU leads – that is now changing, as evidenced by recent and unprecedented collaboration along the value chain.

Progress on this global issue is rooted in greater consumer concern: their dependency on plastics; how much can accumulate in only a few weeks, let alone a lifetime; and what happens after they are "thrown away". Even petrochemical companies and brand owners that have long relied on virgin plastic made from fossil fuels are moving toward more sustainable approaches.

The first step in resolving the waste crisis is recognising that the way we use fossil fuels to manufacture plastic items, often used for just a moment in time, is completely unsustainable. Plastic stays in the environment for tens, sometimes hundreds of years – unless incinerated, with damaging impacts from burning carbon.

Changing how we produce and use plastics, and how we manage plastic materials after use, must be the focus of effort right now. We urgently need to reduce dependency on virgin plastic and re-imagine plastic "waste" as a valuable commodity. That means re-using and recycling plastics at scale. Smarter infrastructure needs to be built, investments need to be made, and policies introduced to set the conditions for the entire value chain to act.

Plastic is one of history's most successful inventions. Its versatility, light weight, and durability make it a ubiquitous material for products and packaging. Its uses penetrate deep into modern life, offering benefits not only at the household level but also in areas like healthcare and technology. However, the qualities that have made plastic so desirable are now presenting major challenges as we strive for the imperative of a fully circular, sustainable economy. Addressing the lifecycle management and longevity of plastic are amongst this decade's most urgent goals.

Improving the ways plastic is produced and disposed of can help save natural resources, reduce ocean pollution and landfills, and ensure cleaner air. While incremental solutions through innovation are welcome, the pace of change that is required needs bold interventions to rapidly adapt entire value chains. We call on businesses to work together to rise to this challenge, and on policy makers to set clear legislative frameworks that stimulate change in both producer and consumer behaviour.

This picture taken in Beaupreau-en-Mauges, near Nantes, western France, on April 19, 2021 shows blue plastic pellets to make "meduses" (jellyfish) plastic beach sandals at the Humeau-Beaupreau factory. Photo credit: SEBASTIEN SALOM-GOMIS/AFP via Getty Images.

EXECUTIVE SUMMARY

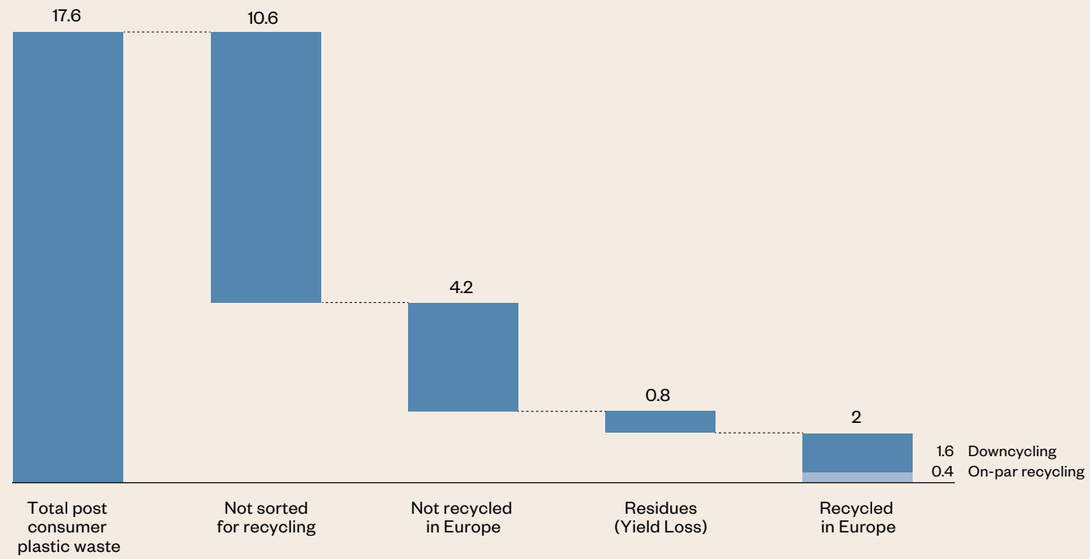
Plastic plays a vital role in the European economy, but the accelerating pressure of plastic pollution on the environment has led the European Union to adopt a range of circularity targets affecting the entire plastic (waste) value chain. These include increasingly ambitious material recycling rates for plastic packaging – 55 per cent by 2030[1] – and recycled content targets announced in the EU Green Deal.[2]

Despite ambitions to be the world's leading circular economy, on the current trajectory the **European Union** will spectacularly underperform against its own plastics recycling goals.

The current recycling rate for post-consumer plastics in the European Union is only around 11 per cent, of which the vast majority involves downcycling to lower-value applications. We estimate that "on-par" (product-to-product) recycling for plastic is limited to 2 to 3 per cent **(Figures 1 and 2)**.

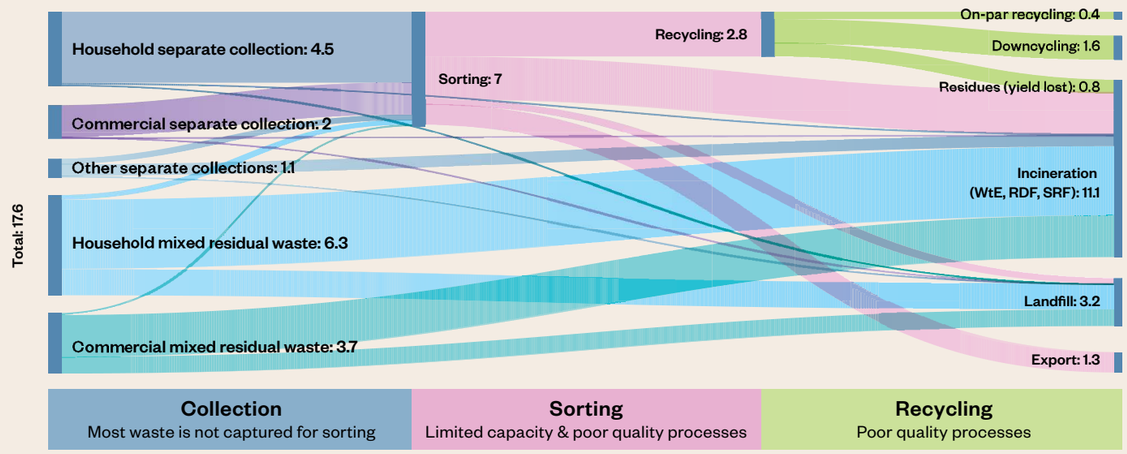
Meanwhile, because of longstanding structural issues across the value chain, current industry initiatives are woefully insufficient to generate a fast rise to a circular plastics economy. These challenges are faced by all types of plastics but are particularly acute for polyolefins, which account for approximately half of plastic waste and nearly two-thirds of all plastic *packaging* waste in the European Union.[3] Of the 20 million metric tons of polyolefin waste generated in the European Union annually, we estimate that between 4 and 7 million metric tons are recycled within the European Union. Roughly 60 per cent of all polyolefin waste – some 12 million tons annually – is incinerated or landfilled.[4]

Figure 1: Status quo of EU plastic recycling (combined average of post-consumer plastic waste recycling in France, Germany, Italy, the Netherlands and Poland in 2018, in million metric tons)[5]



*Note: Total waste figures may be underreported due to plastic lifespan estimates

Figure 2: Where EU waste ends up (combined average of post-consumer plastic waste recycling in France, Germany, Italy, the Netherlands and Poland in 2018, in million metric tons)



Overview of issues along the plastic waste-to-material value chain in Europe

1. COLLECTION

Only half of post-consumer plastic waste is being collected for recycling.

Despite most EU countries having separate collection schemes for plastic waste,[6] about 50 per cent of EU plastic (excluding plastic collected through deposit return systems) ends up as ordinary trash in mixed residual waste streams **(Figure 2).** Even in countries with mature separate collection schemes – like Germany - a significant amount of plastic remains in mixed residual waste, primarily flexible polyolefins.[7] Therefore, there is a significant opportunity to increase plastic volumes available for recycling by sorting these from mixed residual waste.

2. SORTING

Two thirds of the plastic waste that is collected and sorted is not recycled in Europe; rather, it is incinerated, landfilled, or exported.

The quality of sorting plays a crucial role in improving the circularity of plastic. In most EU countries, poor sorting practices result in almost one-third of all collected and sorted plastic being used for refuse-derived fuel (RDF) or incinerated. Another third is exported to non-EU countries **(Figure 2)**, where there is limited transparency on its eventual use. Interviews with global waste management and recycling players indicate that subsequent treatment in those countries would, at best, result in downcycled plastics.[8] None of this is in accordance with the European Union's circular ambition of local waste treatment.[9]

3. RECYCLING

Recycled plastic production in the European Union is limited in both quantity and quality.

The current market penetration of recycled plastic is only around 11 per cent and far from sufficient to meet future EU recycled content targets for plastic, which industry anticipates will range between 15 and 30 per cent.[10],[11] Today, most recycled plastics are of low quality – produced by downcycling plastic waste into lower-value applications – as the sector's profitability and ability to invest are limited.[12] Growth in higher-quality recycling volumes is complicated by a high degree of fragmentation in the recycling sector and high capital requirements.[13] Encouragingly, recent breakthroughs in waste-to-materials recycling technology and business models have enabled industry to overcome these challenges, particularly with regard to those commonly-used plastics, such as polyolefins, that have low recycling rates.

Call to action:

Leveraging the full potential of new sorting and recycling models will require an extensive upgrade and expansion of infrastructure across all steps of the waste-to-recycling chain. We estimate that EUR 20 billion of investments will be needed to put the European Union on a trajectory to achieve its targets. With targeted regulatory interventions and clarifications on how plastics buyers (brands, converters) contribute to the cost through extended producer responsibility (EPR) fees, the right conditions can be created to attract commercial investments.

To unblock the waste-to-material value chain and scale advanced mechanical and chemical recycling seven-fold this decade (from 1 million to 7 million metric tons by 2030), regulatory interventions should focus on:

1 **Increasing mixed waste sorting of plastics to prevent a major share of plastic waste from escaping the recycling system.**

2 **Improving quality of sorted plastics to increase yields of high-quality recycling. EPR schemes should support investments in higher-quality sorting, as opposed to focusing on sorting volumes. Well-defined design for recycling standards can further reduce yield loss in the sorting process and increase the quality of recyclate.**

3 **Introducing mandatory recycled content targets of sufficient magnitude to strengthen demand, especially for polyolefins. An invigorated demand incentive would be a significant driver for investment across the value chain as well as a stimulus for quality improvements.**

Large petrochemical companies may be well-positioned to capture some of the commercial opportunity in chemical recycling, given their expertise and size of balance sheet. Brand owners and retailers also have a role to play in building a future supply of recycled plastics. By committing *now* to buying future recycled plastics, they will give investors and recyclers the confidence needed to scale capacity. This helps reduce the supply imbalance and lower prices in the long term.

To address the ever-increasing plastic debris threatening to engulf our planet, Europe must implement new strategies and adopt the latest technology throughout the waste-to-materials value chain. By acting now and making the necessary improvements to failing infrastructure, the hope remains to hit already ambitious recycling targets.

INTRODUCTION

Plastics are an attractive material for products and packaging as they are lighter, stronger, and more durable than available alternatives. However, how we use and dispose of plastic harms the environment and threatens our future. It depletes natural resources, pollutes oceans, squanders land, and contaminates the air we breathe. This problem is getting worse as time goes by.

The European Union has made plastics a key priority in its 2020 Circular Economy Action Plan and has introduced targets that scale up over time to stimulate plastic recycling **(Insight 1)**. Supported by the Circular Plastic Alliance, an organisation of businesses and other stakeholders from across the plastics value chain, the European Commission aspires to advance a circular plastics economy for recycled plastics to 10 million metric tons by 2025.[14]

Key industry participants are taking steps to advance a circular economy for plastic. Brand owners and retailers such as Henkel, Tesco, and Unilever have developed comprehensive sustainable packaging strategies and targets, including design for recycling, reducing reliance on virgin (fossil-fuel) plastics, and increasing the proportion of recycled plastic content. Waste management companies like PreZero and Veolia, as well as recyclers such as Morssinkhof-Rymoplast and Jayplas, are investing in higher-quality sorting and mechanical recycling of plastic.[15, 16, 17, 18] Petrochemical companies like OMV/Borealis, Dow Chemical, and Lyondellbasell – all large producers of virgin plastics – are starting to invest in chemical recycling.[19, 20, 21]

While these targets and commitments are promising, persistent structural obstacles across the value chain leave them falling well short of what is needed for a rapid rise to a circular plastics economy. Accordingly, the European Union is still far from achieving its circularity goals. Today, only about 11 per cent of all post-consumer plastic waste in the European Union is recycled, with the majority being downcycled into lower-value applications. Only 2 to 3 per cent of plastic waste in the European Union is recycled on-par into products of same or similar value **(Figures 1 and 2)**.

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Large recycled plastic fish sculpture situated infront of the Kronborg Castle in Helsingor in Denmark in July 28th 2017. Photo credit: James D. Morgan via Getty Images.

Challenges are faced by all types of plastics, but are particularly acute for polyolefins, which in the European Union account for approximately half of plastics production and nearly two-thirds of all plastic packaging waste. Of the 20 million metric tons of polyolefin waste generated in the European Union annually, we estimate that between 4 and 7 million metric tons are recycled within the European Union. Roughly 60 per cent of all polyolefin waste – some 12 million tons annually – is incinerated or landfilled.[22]

To meet current and future EU recycling targets, processes and business models will have to be transformed in ways that will generate a rapid ramp-up in the supply of high-quality recycled plastic – and, more broadly, to resolve the existing mismatch between ambition, expected growth in market demand for recycled plastics, and the current market practices that sustain low circularity and recycling rates.

The good news is that the stage has been set for new business models to enter the market and accelerate this transformation by eliminating structural obstacles in the waste-to-material value chain – thereby improving overall EU plastics recycling rates and, in the process, generating significant economic value. **(Figures 1 and 2).**

We are writing this report to demonstrate that a circular plastics economy is possible if the entire value chain – from brand owners and retailers through waste management businesses and recyclers and on to the petrochemical industry – starts cooperating *now* to build future supplies.

Plastic buyers should provide investors and recyclers with the confidence to increase capacity by committing to paying a premium for chemically-recycled plastics, but especially for advanced mechanically-recycled plastics, in the short to medium term. This helps to reduce the supply imbalance and, as a result, lowers prices in the long run. In addition, regulatory measures can help to create the optimal environment for commercial ventures.

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Plastic Waste before shredding and cleaning, in the factory of ExcelRise, dedicated to plastic upcycling, in Montbrison on April 1, 2019. Photo credit: Thierry Zoccolan/AFP via Getty Images

Insight 1

Targets vs Current Recycling Rates

The European Union has introduced a number of targets to encourage plastic recycling. While ambitious, most of them are limited to packaging and do not appear to be on track to be met.

PLASTIC-SPECIFIC TARGETS:

Recycling Targets
The EU Packaging and Packaging Waste Directive sets specific recycling targets for plastic packaging of 50 and 55 per cent by 2025 and 2030 respectively. Currently, the recycling rates for plastic packaging in most EU Member states are well below these targets **(Figure 3).**

Extended Producer Responsibility (EPR) Schemes
Most EU Member states have introduced extended producer responsibility (EPR) schemes to oblige the packaging industry (producers and importers of packaged goods, retailers, and brand owners) to fund the collection, sorting, and recycling of post-consumer plastics and other materials. Optimising EPR performance and investing in infrastructure will be essential for meeting future targets.

Mandatory Recycled Content Targets
These targets are another measure to drive the uptake of recycled plastic in new products. The EU Single-Use Plastic Directive sets a recycled content target of 25 per cent by 2025 for beverage bottles. The European Union is also finalising legislation that will introduce mandatory recycled content targets for other plastic packaging and products. Such targets are expected to range between 15 and 30 per cent. For plastic packaging specifically, the industry has called for a target of 30 per cent.

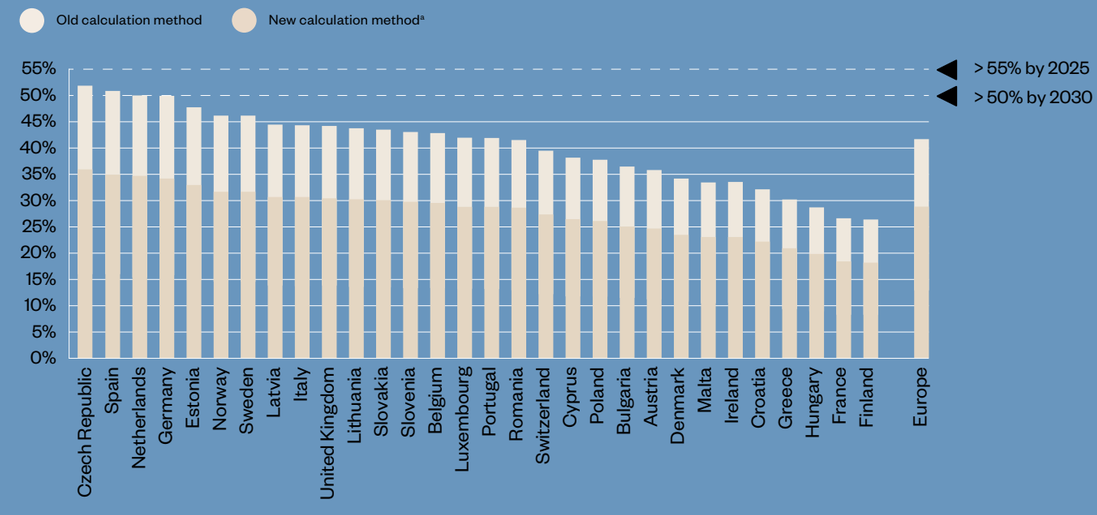
GENERAL WASTE TARGETS:

Residual Household Waste Reduction Targets
These targets as laid down in the EU Waste Framework Directive, require Member states and municipalities to further reduce unsorted plastic waste and thereby increase the proportion that can be recycled.

Carbon Levies
Carbon levies can improve the business case for mixed waste sorting and recycling over incineration. Plastic is the primary component of fossil carbon emissions for incinerators. While waste incinerators are currently excluded from the scope of the EU ETS, EU legislators are contemplating measures to include them. The application of a carbon tax will increase the cost of burning plastic relative to sorting and recycling. However, a carbon tax may also increase the cost of separately collecting of plastics, as waste management companies would have to pay more to deposit non-recyclable materials that end up in separate collection streams at the incinerator. These include non-recyclable plastic items with high calorific value, such as toothbrushes or other non-packaging materials.

Landfill Waste Cap
The EU's Landfilling Directive sets a 10 per cent landfill cap for residual waste by 2035, requiring Member states to drastically reduce the volume of (plastic) waste that goes to landfill. Several Member states have already introduced partial bans and drastically decreased waste going to landfills. However, waste management practices in some south-eastern and south-western European countries will have to undergo a significant transformation, particularly by introducing technology-led waste sorting processes, to meet the landfilling target.

Figure 3: Progress by EU countries towards recycling targets for plastic packaging laid down in the EU Packaging and Packaging Waste Directive EU countries compared with recycling targets (2018)



(a) KPMG estimate based on an average correction from 42 per cent to 29 per cent recycling rate as estimated by Plastics Europe.

Sources: Eurostat, EU Packaging and packaging waste directive (PPWD), Plastics Europe, KPMG analysis.

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Plastic waste is pictured at a recycling site in Berlin on September 21, 2021. Photo credit: Tobias Schwarz/AFP via Getty Images

COLLECTION

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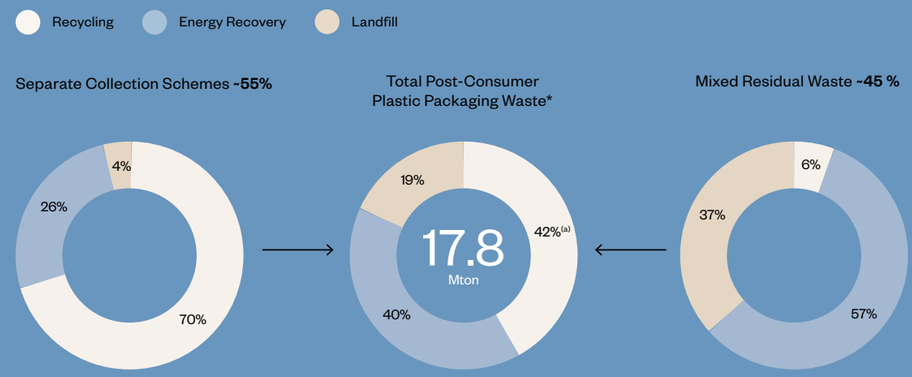
New waste segregation system in Gdansk. The Suez company rubbish collector (dustman) emptying waste container into garbage truck is seen in front of new Scania trucks in Gdansk, Poland on 22 March 2018. Since the April 1st 2018 City of Gdansk implements a new waste segregation system, divided into five factions - paper, glass, metals and plastics, organic waste. Photo credit: Michal Fludra/NurPhoto via Getty Images.

Half of the plastic waste in the European Union ends up as mixed residual waste streams and is mostly incinerated.

Despite well-established separate collection schemes for plastic in most EU countries, approximately 50 per cent of plastic waste (not including plastic bottles subject to deposit return systems) is not collected for sorting and recycling. Instead, it ends as ordinary trash in mixed residual waste and is almost always incinerated or landfilled **(Figure 4)**. For polyolefins specifically, we estimate that approximately 10 million metric tons per year end up in mixed residual waste.[23]

Figure 4: Final processing of post-consumer plastic packaging in 2018 (in million metric tons)



*Note: Total plastic packaging waste figures only represent plastic that is collected, and does not represent plastics lost to the environment

Sources: Plastics Europe (separate collection scheme data); Eurostat (mixed residual waste data); Individual country statistics and interview programmes.

Separate collection schemes for plastics differ widely between, and sometimes even within, EU countries. Some countries and regions use a mixed recyclables scheme that, besides plastic, may contain other materials such as metals and drinking cartons. Others entirely separate plastics from other recyclables. There are also vast differences in what types of plastics are separately collected.

The largest separate collection stream for plastic in most countries is the EPR-backed household waste stream containing plastics and/or other recyclables. As EPR schemes in most countries do not cover commercial waste, source-separation of these plastic waste streams is still limited, especially for most smaller companies and lower-value plastic waste (such as flexible wraps).

Separate collection rates for post-consumer plastic packaging are limited to 60-70 per cent due to a variety of factors, including household understanding and discipline as well as lack of space in urban areas. Even countries with the most established and advanced separate collection schemes, like Germany and the Netherlands, have high shares of plastic waste from households in residual waste. The Netherlands currently has one of the highest source-separated collection rates for plastic packaging, achieving around 70 per cent.[24] Many EU countries are still nowhere near these collection rates, and in many urban areas separate collection rates are very low. As a result, large metropolitan areas like the city of Amsterdam have abandoned separate collection of plastic[25] in favour of mixed waste sorting.

It is doubtful that Member states will be able to reach EU plastic recycling targets if they depend entirely on separate collection of plastic waste without complementary sorting of plastics from mixed residual waste.[26]

Typically, plastics are not sorted from mixed residual waste due to perceived quality issues and unattractive economics. However, new business models and market practice indicate these hurdles can be overcome.

Plastic in mixed residual waste comes into contact with organic materials, leading to higher contamination levels and odour. However, with more extensive treatment involving sufficient cleaning, hot washing, and deodorisation, this type of plastic waste can be just as useable for advanced recycling as any other. One of Europe's largest plastics recyclers, Morssinkhof-Rymoplast,[27] has demonstrated the feasibility of mechanically recycling rigid plastics from mixed residual waste into near-virgin quality output. Flexible plastics are even more contaminated and thus may be suitable primarily for chemical recycling.

In addition to perceived quality concerns, mixed residual waste sorting has been inhibited by economic factors. The business case for sorting plastic from mixed residual waste depends on several factors, including the sorting costs, the revenue gain from freed up capacity in the incinerator – such as the additional gate fees collected for the additional waste volumes[28, 29] – and any additional costs related to marketing or disposing of the low-value mixed plastic residue left over from the sorting process. Often, the costs of sorting and cleaning do not outweigh revenues derived from selling the residue plastic.[30, 31] In this scenario, an EPR scheme could step in and cover the deficit, but so far this is happening only in the Netherlands and Denmark. Most national EPR schemes compensate only separate collection, creating an uneven playing field for mixed waste sorting models.

Sorting plastic from mixed residual waste also faces other obstacles, including a potentially adverse impact on consumer sorting discipline and resistance from some players in the incineration industry. For example, cement manufacturers and power plants rely on the high calorific plastic content in waste to produce refuse-derived fuel (RDF) and solid-recovered fuel (SRF) as energy sources for industrial processes. Therefore, these companies have little incentive to remove plastic from the mixed residual waste they burn..

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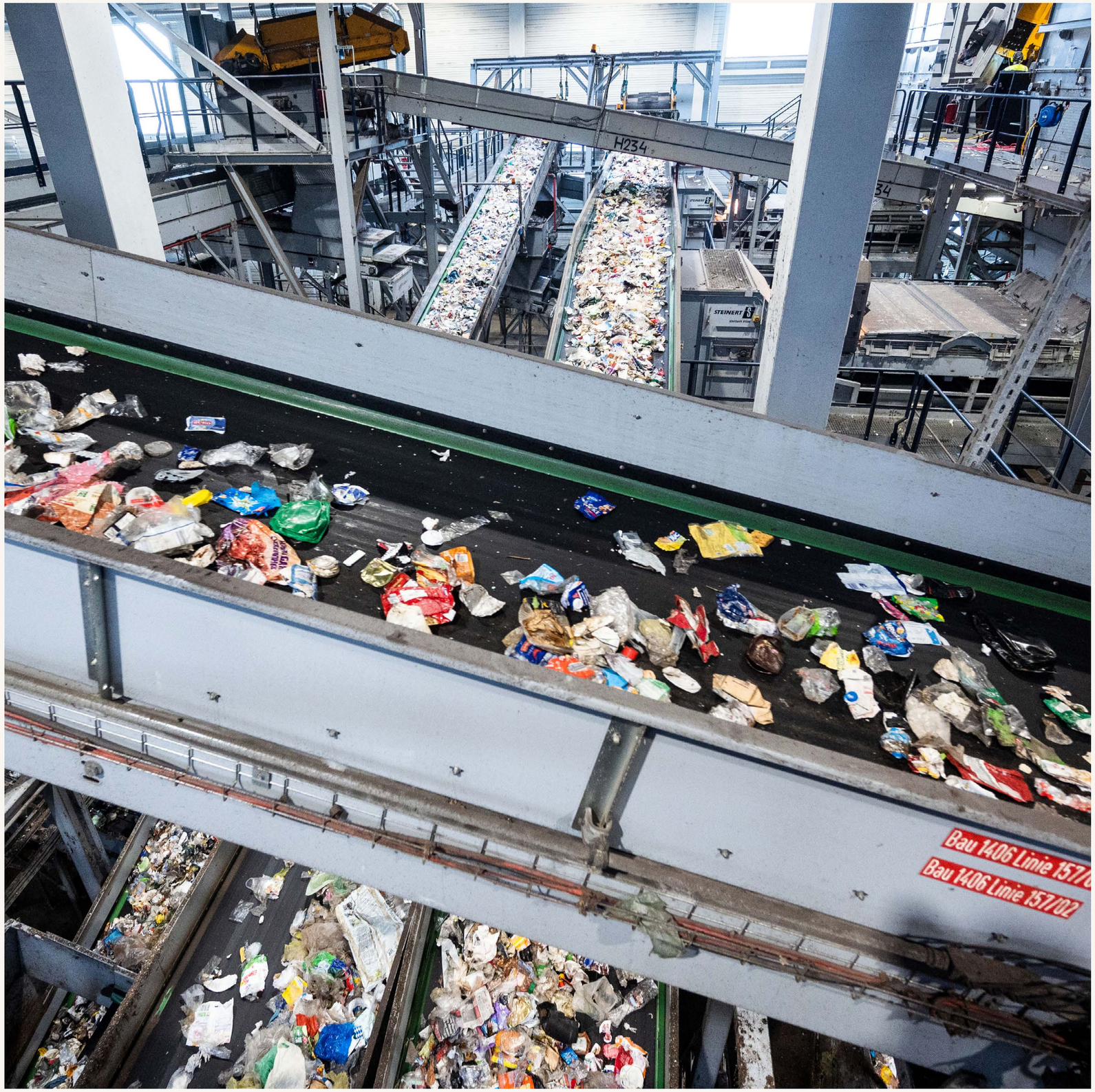
13 June 2022, North Rhine-Westphalia, Marl: Waste sorted by type runs over separate belts in the sorting plant of the new environmental services company Interzero. Photo credit: Bernd Thissen/picture alliance via Getty Images.



EU and national policies must stimulate mixed waste sorting, as this will contribute to achieving recycling targets and reduce the risk of new investments in incineration capacity becoming stranded.

Given the high plastic content in residual waste, mixed waste sorting for plastics (packaging and non-packaging) offers a clear opportunity to boost volumes of plastic waste available for recycling. While for other waste categories like paper, separate collection may work best to maintain feedstock quality, recent market practice shows that this is not necessarily the case for plastics.[32,33]

Leveraging this opportunity requires that EU and national policies improve the business case for mixed waste sorting compared to landfilling or incineration. The EU Waste Framework Directive must shift away from a single focus on separate collection and recognise mixed waste sorting of plastic as an alternative pathway.[34] National EPR schemes must compensate for mixed waste sorting by default, as shown in the examples of Denmark[35] and the Netherlands.[36] Municipalities and/or regional authorities must be able to opt for mixed waste sorting as a complementary scheme or a complete alternative to separate collection. This decision depends on local circumstances such as the presence of well-established separate collection mechanisms, sorting discipline, population density, and collection and transport costs.[37] Some countries, like the Netherlands, have issued national guidelines to support municipalities in making this decision.[38]

Outside the European Union, mixed waste sorting also seems promising as a solution for developing and emerging economies where separate collection mechanisms have not yet taken off **(Insight 2)**.

Insight 2

Mixed waste sorting: A solution for adoption in countries outside the EU?

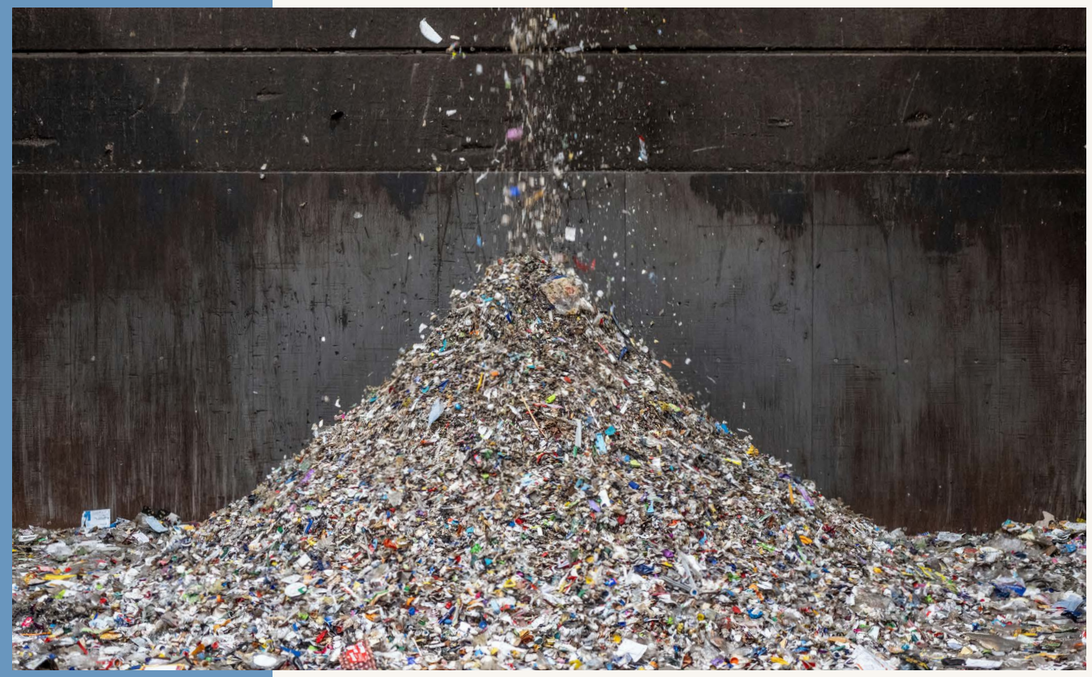
The European Union has invested substantial political capital in separate collection schemes. It has also promoted the development of separate plastics collection systems outside its territory, including in developing and emerging economies with no or limited waste collection infrastructure.[39] In many developing countries, plastics collection depends on informal waste pickers, who segregate the highest value items (such as plastic bottles) at source or at dumpsites. Lower-value plastic waste like multilayer plastics, bags, and flexible packaging is landfilled and littered. Building more comprehensive separate collection schemes for these countries may not be the most efficient way to collect plastics as they require substantial infrastructure investments and major awareness campaigns to steer consumer behaviour. Provided that a just transition is offered to waste pickers, there is an opportunity for them to leapfrog existing solutions for plastics collection by implementing a combination of mixed waste sorting and deposit return systems. This approach would lead to the collection and sorting of all types of plastics, as opposed to the selective collection of high value recyclables in a separate waste stream.

When supported by EPR, there is a clear business case for mixed waste sorting, one that creates an incentive for waste management companies and/or incinerators to sort plastic from mixed residual waste and thereby increase plastic recycling rates.

Further, recent studies have found that sorting residual waste will be key to meeting climate mitigation demands.[40] A recent report estimates the emissions savings resulting from EU-wide mixed waste sorting to range between 39 and 134 million metric tons of CO2 – or 4 per cent of EU-27 total emissions in 2019.[41]

Finally, mixed waste sorting avoids expansion of incineration capacity, which, in some Member states, may be needed to meet the new EU 10 per cent landfill cap by 2035. Preventing near-term investments in expanding incineration capacity will avert the prospect of stranded assets in the medium term.

With the ongoing shift toward a circular economy, the demand for permanent disposal methods such as landfilling and incineration is expected to strongly decline in the medium term.



13 June 2022, North Rhine-Westphalia, Marl: Shredded waste trickles off a belt in the sorting plant for lightweight packaging of the new environmental services company Interzero. Photo credit: Bernd Thissen/picture alliance via Getty Images

SORTING

The majority of plastics collected and sorted end up being incinerated, landfilled, or exported.

More than a third of plastic sorted from waste streams is used for refuse-derived fuel (RDF), solid-recovered-fuel (SRF), or is waste-to-energy. From the post-consumer plastic sorted for recycling, another one-third is exported outside of the European Union **(Figure 2)**, where there is limited transparency on what happens to it. Interviews with industry experts indicate downcycling as a best-case scenario. What is certain is that the current market practices do not correspond to the European Union's ambition for local waste treatment.[42, 43]

Sorting quality is suboptimal for a future in which there is insufficient need for low grade recycling.

It is expected that demand for high quality recycled plastic will increase as a result of more ambitious EU recycling and recycled content targets. Meeting this demand will require high-quality plastic sorting outputs at much higher yields than seen so far.

EPR schemes can anticipate this development by incentivising or setting higher-quality standards for sorting processes to ensure higher-quality recycling. The Belgian EPR scheme, Fost Plus, is a good example of effective collecting, sorting, and recycling of plastic packaging waste. Under this scheme, sorting facilities receive an EPR contribution for sorting 10 different plastic streams for recycling – while most other EPR schemes are limited to 5 or 6 plastic streams for recycling. All sorted plastic fractions, including the mixed plastic fractions and PET trays that are notoriously hard to recycle, are sent to recycling rather than waste-to-energy, RDF, or SRF. Our analysis indicates that by scaling up recycling capacity and introducing new sorting centres, Belgium is already meeting recycling targets that will come into effect in 2025.

Today, EPR systems often set a minimum purity requirement of around 90 per cent.[44] While industry feedback indicates that for high-quality mechanical recycling, a purity level between 98 and 99.5 per cent would be required. Further, in most EU countries, with a few exceptions like Belgium, sorting facilities also receive an EPR contribution based solely on volumes "sent to recycling" up to the required quota. Volumes supplied above the quota are not rewarded, resulting in sorting the easiest fractions up to and no further than the recycling quota. While technically further sorting is still possible, sorting facilities have limited incentive to further improve purity levels (including colour sorting), as additional sorting costs are insufficiently covered by the market price.

As a result, most of the installed plastic sorting capacity in Europe generates low grade outputs. However, demand for these products is largely saturated – further driving down prices as more plastic waste will be sorted. This is especially the case for low-value materials like mixed-coloured, post-consumer LDPE **(Figure 5)**. As supply of these low-quality plastic fractions is much larger than current demand, they are often relegated to cheaper options like RDF or incineration.

As demand for high grade plastics grows, both plastic sorting quality and yields need to improve. In addition to incentivising quality at the level of the sorting facility, yield increases can be achieved through product design-for-recycling standards.

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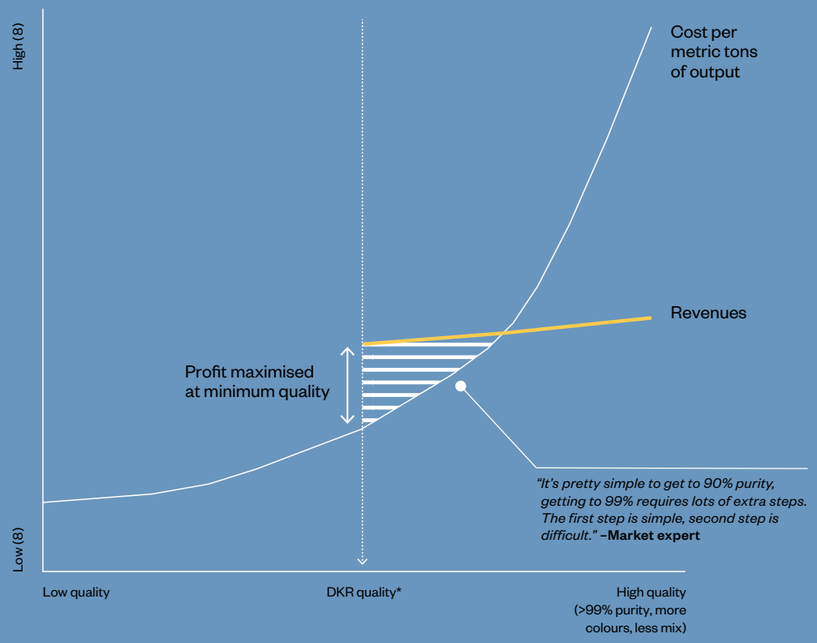
Transforming waste into new products – A worker separates wastes as a company working with a "zero waste" motto, turns wastes such as plastic and packaging into raw materials and then into a new product to contribute to the country's economy in Antalya, Turkey on November 14, 2021. Photo credit: Mustafa Ciftci/Anadolu Agency via Getty Images

This issue is exacerbated for relatively low-value materials like mixed-coloured, post-consumer LDPE, for which demand and market prices are currently limited **(Figure 5)**. As supply of these low-quality plastics fractions is much larger than current demand, they are often relegated to cheaper options like RDF or incineration. The oversupply of low-quality sorted plastics, combined with limited demand, drives down prices to such an extent that incineration, RDF, and SRF become preferred solutions over recycling.

Figure 5: Sorting companies focus on maximising quantity instead of higher quality output as the cost of more extensive processes are not yet profitable



*Deutsche Gesellschaft für Kunststoff-Recycling mbH (DKR)

Another major challenge is yield loss during the sorting process due to the use of multi-layer materials and the lack of capacity of sorting facilities to further separate based on colour and plastics type at scale. This challenge must be addressed in new sorting facilities and at the product design stage **(Insight 3)**.

Sorting facilities have been built for the current recycling targets and past demand for low grade recycled plastics. As the market for high grade plastics grows and recycling targets are much higher, new sorting facilities are necessary. These should have high yields and high purity outputs, and will need greater investments than seen so far. EPR schemes can anticipate this development by rewarding the production of new types of sorting outputs, with new specifications. Developing these specifications will cost time and need input from market players that agree to build new value chains from waste to high grade recycled plastic.

Insight 3

Design for recycling

While we consider the key issues in plastics recycling to be in the waste-to-material value chain (from collection to recycling) – and that they need to be resolved by superior collection, sorting and recycling processes, and technologies within the value chain – other aspects can have a significant influence on this value chain's success. The most important of these is "design for recycling."

Innovative design will improve sorting and recycling yields and qualities. Multilayer, multi-material products (which combine different plastic polymers or other materials into a single product or package) are very difficult to properly recycle on-par and at high quality. Even with technological improvements, many multi-material products remain problematic for on-par recycling.

Consequently, brand owners, plastics manufacturers, converters, and designers must work together to develop and deliver products and packaging that meet the criteria for high-quality recycling.

The upcoming revisions of the EU Packaging and Packaging Waste Directive and the new EU Sustainable Product Initiative are opportunities for EU policymakers to set clear, harmonised design standards that focus on phasing out materials or formats that are difficult to recycle. Under such frameworks, collaboration among brand owners, plastic manufacturers, converters, and product designers is more essential than ever.

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Detail of the giant mosaic of cans and plastic bottles, in Valencia's Parque de Cabecera, on January 8, 2022, in Valencia, Spain. The installation was made by Ecoembes in collaboration with the Valencia City Council. To recognise the commitment of Valencian citizens who recycle cans and plastic beverage bottles through social and environmental rewards. Photo credit: Jorge Gil/Europa Press via Getty Images.

The European Union does not have the capacity to recycle the current volume of plastic sorted from waste, let alone any increases resulting from recent EU legislation.

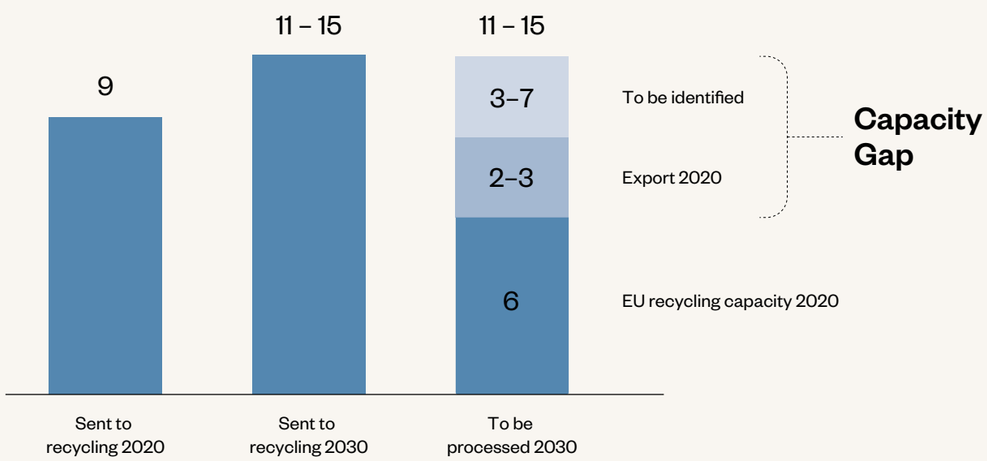
While recycling capacity has increased in recent years, it is still insufficient to absorb even the current volume of materials sorted from waste.

A key reason for this is the historical focus of EU legislation on sorting volume rather than quality.[45] This approach encouraged stakeholders in the European Union's waste-to-material value chain to prioritise sorting at the expense of recycling. Large volumes of sorted plastic waste were subsequently exported outside the European Union, often without any knowledge of whether the material was going to be recycled. It resulted in a significant gap between sorting (which took place in the European Union **Figure 6**) and recycling (most often done in Asia) that has hampered the development of recycling infrastructure in the European Union. Moreover, this has resulted in the supply chain focusing on high-value materials, mostly rigid plastics that are easy to mechanically recycle.

The need for a steep ramp-up of recycling capacity in the European Union is heightened by recent Asian import and European export restrictions. The EU's proposal for a revised EU Waste Shipment Regulation[46] severely restricts the types of plastic waste that can still be shipped outside of Europe, meaning that this will now need to be recycled within. In addition, the EU has adopted a new recycling rate calculation method, which will apply from 2021. This new method calculates the rate at the point of the pelletisation and extrusion moulding process (thus excluding weight of contaminates such as dirt, soil, or non-target materials). The new methodology will require even more plastic waste to be recycled

within the European Union.

Figure 6: Recycling capacity gap for post-consumer polyolefins in Europe.

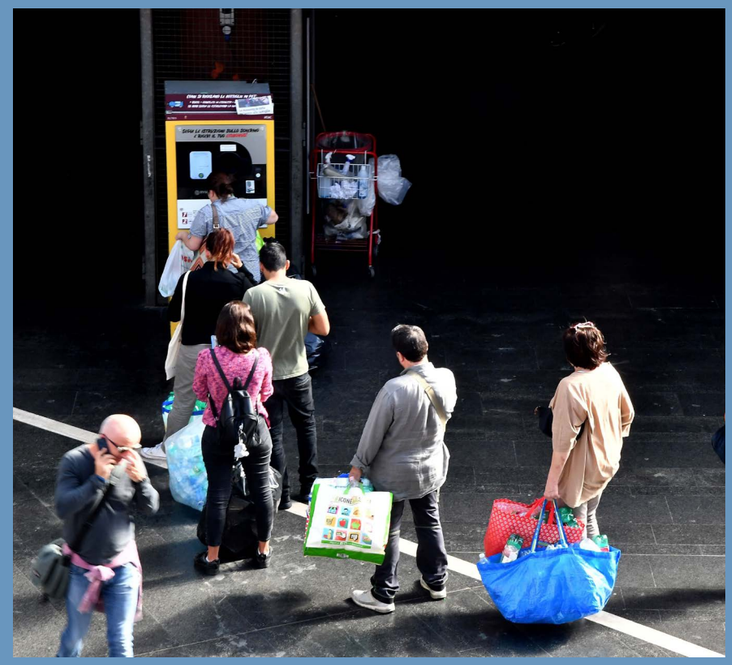


Legislative changes are needed to incentivise investments in sorting performance.

First, the bar should be raised for what counts as "recycling." There has been recent progress on this. As the EU shifted the calculation point from *waste sent to recycling* to *waste entering the extrusion phase*, higher-quality sorting will be required to ensure the sorted plastic can be recycled. The proportion of leftover, non-recyclable mixed plastics will be reduced, resulting in higher overall process yields.

Next, plastic products should be designed for recycling to reduce yield losses from the sorting process. Encouragingly, the revised EU Packaging and Packaging Waste Directive and the EU Sustainable Product Initiative cover this topic.

EPR schemes can incentivise higher-quality recycling by setting higher-quality standards for sorting processes or rewarding the production of higher-quality sorting outputs. Developing these specifications will cost time and need input from market players that agree to build new value chains from waste to high grade plastic.



Commuters line up to trade plastic bottles for transit credits at a reverse vending machine on October 8, 2019 at the Cipro underground metro station on the A line in Rome. Photo credit: Tiziana Fabi/AFP via Getty Image.

RECYCLING

The use of recycled plastic to make new products is well short of anticipated mandatory recycled content targets.

Current usage of recycled plastics as a percentage of total plastic demand is only about 11 per cent, of which the vast majority involves downcycling to lower-value applications. Our market research shows that “on-par” recycling for plastic is limited to 2 to 3 per cent **(Figure 1 and 2)**. Achieving the EU’s 2030 plastic recycling targets and industry-backed ambitions to boost recycled content in plastic packaging by 30 per cent[47] will require a steep ramp-up of existing recycling capacity and improvements in recycling quality.

Investments in high-quality recycled plastics at scale are insufficient due to the challenging business case and characteristics of the plastic recycling industry.

Historically, recycled plastics tended to have inferior characteristics to virgin plastics in terms of purity, colour, smell, and consistency. The focus on poor quality recycling is largely driven by a vicious cycle of low profitability and the sector’s limited ability to invest.

As markets for low-value recycled plastics are currently saturated, additional volumes of plastic waste that can no longer be exported will need to go into higher-quality applications and replace virgin plastics. This is not as far-fetched as it once was, as recent innovations now make it possible to produce near-virgin quality plastic from recycled materials. Advanced mechanical recycling technologies now offer solutions for rigid plastic,[48] while chemical recycling solutions are being developed to process mixed and flexible plastics.

Chemical recycling covers a range of different technologies and processes - including chemical depolymerisation, solvolysis, pyrolysis and gasification - with different outputs and environmental performance. **(Figure 7 shows the example of pyrolysis by way of comparison with mechanical recycling)**

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Piles of plastic bottles before they are recycled at GAMA Recycle factory in the southern Turkish province of Gaziante, November 28, 2020. Photo credit: Yasin Akgul/AFP via Getty Images

Figure 7: Comparison of mechanical post-consumer polyolefin recycling methods with chemical recycling (pyrolysis).

	Standard Mechanical Recycling	**Advanced** Mechanical Recycling	**Chemical** Recycling (Pyrolysis)
Process Steps	1. Sorting 2. Shredding & grinding 3. Cold wash 4. Extrusion	1. Advanced Sorting 2. Shredding & grinding 3. Hot wash 4. Flake sorting (colour & type) 5. Extrusion 6. Compounding 7. Deodorisation	1. Sorting & pre-treatment 2. Shredding & grinding 3. Pyrolysis 4. Hydrogenation 5. Cracking 6. Polymerisation
Indicative Costs (incl. depreciation)	**Low**	**High**	**Very high**
Sustainability for PO Feedstock	1. HDPE from LWP sorting 2. PP from LWP sorting 3. LDPE from LWP sorting 4. Separate LDPE collection 5. Separate mixed rigid collection 6. Mixed plastic	1. HDPE from LWP sorting 2. PP from LWP sorting 3. LDPE from LWP sorting 4. Separate LDPE collection 5. Separate mixed rigid collection	All PO, including mixed plastic
Quality of Output	**Very Low**	**High** (near virgin quality)	**Very high** (virgin quality)
Applications	1. Automotive extrerior 2. Piping 3. Agricultural plastic 4. Filling material	1. Non-food packaging 2. Automotive interior & exterior 3. Electronics 4. Piping 5. Agricultural plastic 6. Filling material	All, including food grade. Focus expected on packaging.
Carbon Footprint (CO2 equivalent per metric tons input)	**-2.3 metric tons**	**-2.3 metric tons**	**-0.5 metric tons**

Note:LWP = Lightweight packaging

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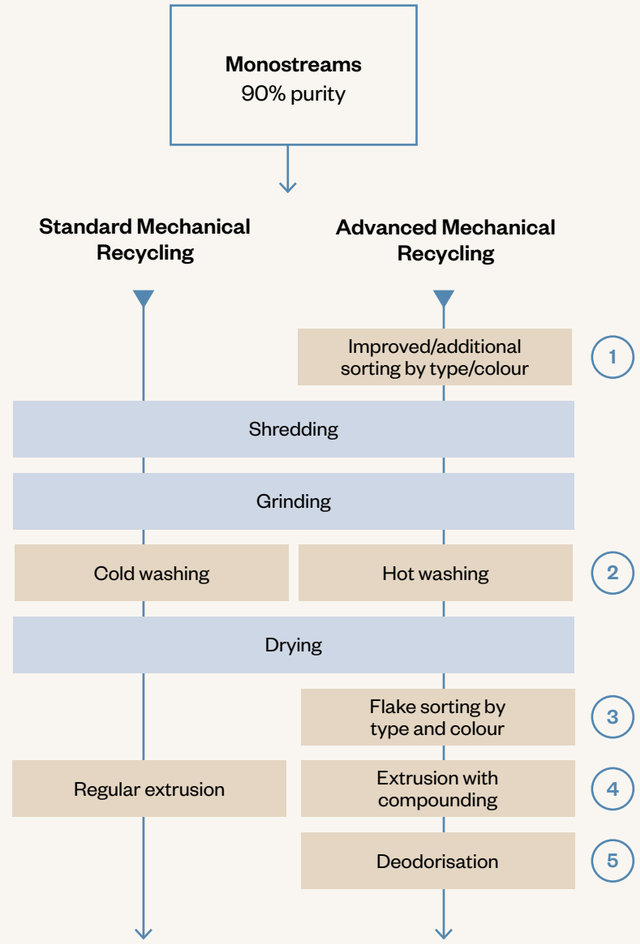
Containers of pellets derived from discarded plastics stand in front of bales of sorted trash at the ALBA sorting center for the recycling of packaging materials on August 15, 2017 in Berlin, Germany. Photo Credit: Sean Gallup via Getty Images

However, advanced mechanical and chemical recycling require significant capital expenditures. Pricing levels **(Figure 8)** for high-quality recycled plastic – which are still strongly linked to the pricing trends for virgin plastic – have historically not been sufficient to justify these expenditures. While recently, several investments into chemical recycling have been announced by the plastics industry,[49] we have not seen the same trend for advanced mechanical recycling. Significant price premiums above the current level will be needed for these technologies to scale.

Figure 8: High-quality recycled polyolefins: differences in mechanical recycling methods[a]



a) generalised regardless of polyolefin type.
Source: Interview feedback, Tomra, KPMG analysis.

Another factor that limits investment in advanced mechanical recycling is the recycling sector's highly fragmented and relatively immature nature. Historic lack of scale and professional expertise in the producing high-quality recycled plastic limit the financial and technical capabilities to invest. This is less an issue in chemical recycling, which primarily falls under the domain of large petrochemical companies. However, these companies tend to have have limited expertise with waste management and, as indicated by delays in previously promised recycling programs, relatively slow decision-making processes.[50]

Brands must initiate stronger demand for recycled plastics, especially polyolefins, and accept higher prices initially to end their reliance on virgin plastic in the longer term.

With the prospect of mandatory recycled content targets for plastic packaging and products by 2030 and voluntary commitments by brand owners,[51] recycled plastic is no longer a price-driven, optional alternative to virgin plastic. It is a separate commodity with distinct market dynamics and significantly different cost drivers than virgin plastic. **(Figures 9 and 10)**

The upcoming establishment of mandatory recycled content targets beyond PET bottles will mean that there will be significant shortages of high-quality recycled plastic in the short and medium terms. This will lead to premium pricing for the limited available volumes of recycled materials, especially for food-grade recycled polyolefins.

As long as recycled polyolefin prices exceed virgin plastic, the non-legislated demand for recycled content appears weak. This weak demand is slowing down the required investments as potential investors see substantial pricing uncertainty.

By committing to pay a higher price for recycled plastics, especially polyolefins, in the medium term, brands reduce the risk of new capacity investment and accelerate its deployment. This approach will lead to a reduction in the supply imbalance and lower prices in the longer term.

Figure 9: Expected demand for recycled polyolefins by quality in 2025 (in million metric tons)

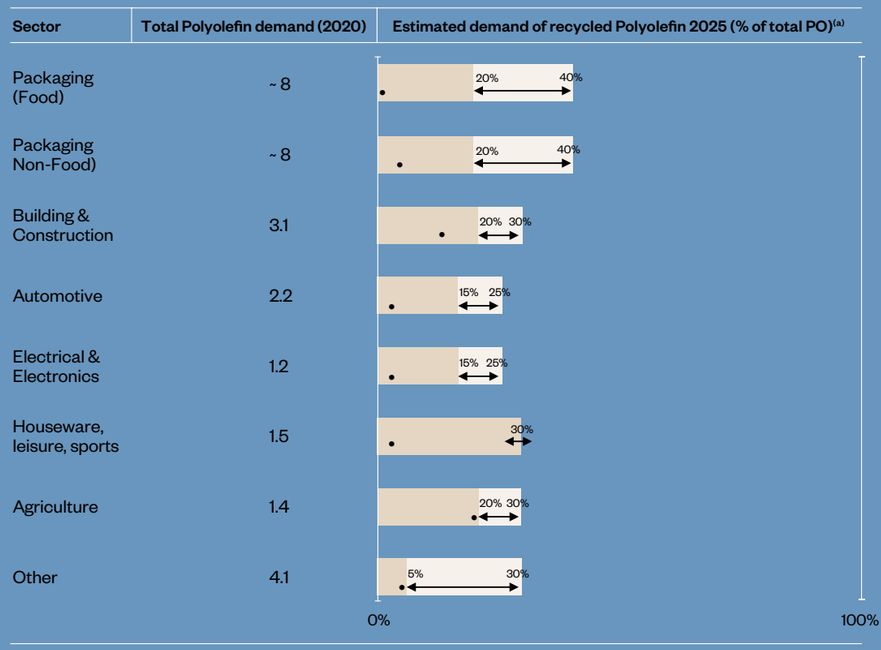
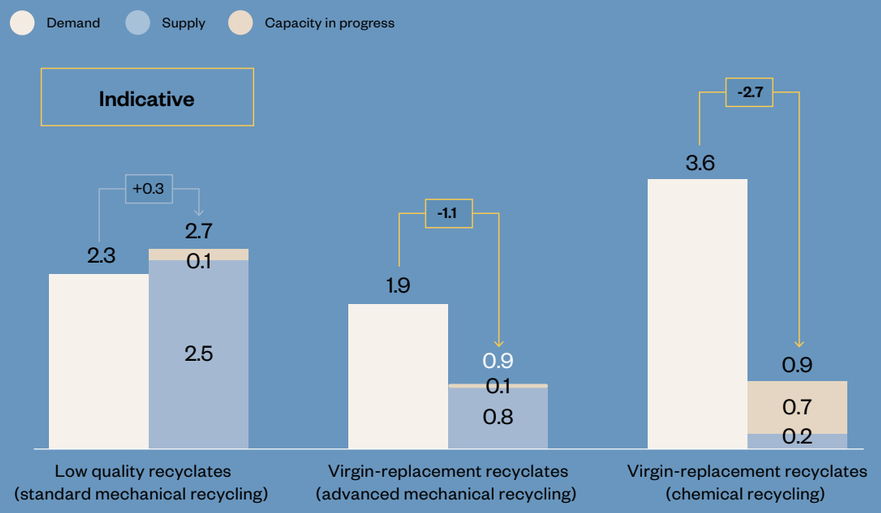


Figure 10: Expected supply-demand gap for recycled polyolefins by quality in 2025 (in million metric tons)



Sources: Ecoprog, Plastics Europe, Plastic Recyclers Europe, Interview feedback, KPMG analysis

EU policymakers should reduce investment risks by introducing ambitious recycled content targets for plastic and by stimulating advanced (mechanical) recycling.

Mandatory recycled content targets must be put in place quickly and be of sufficient magnitude to strengthen demand, especially for recycled polyolefins. By decoupling demand for virgin plastics, mandatory recycled content targets are effective levers to boost the supply and quality of recycled plastic. This is shown by the example of PET, which has been trading at a price premium for several years. Mandatory recycled content targets are therefore an important complement to “supply-side measures” (e.g., waste collection and sorting targets) which address the current shortages of clean plastic waste feedstock.

Next, clarity on the future role of chemical recycling should be provided as soon as possible. While chemical recycling should be considered a viable option, legislators must embrace the complementary nature of chemical and mechanical recycling. Key elements for clarification include:

- The role of chemical recycling in reaching recycling rate targets by 2025 and 2030 (50 and 55 per cent respectively).
- The use of mass balance methods to measure the usage of chemically recycled plastics in products, as well as how ISCC PLUS will certify recycled raw materials for non-regulated markets that fall outside of EU jurisdiction.[52]
- The role of chemical recycling as a legitimate source of recycled plastic to fulfil the mandatory recycled content requirements **(in specific situations only, Figure 7).**

The environmental footprint of certain chemical recycling processes – particularly pyrolysis and gasification – is significantly higher than that of mechanical recycling. These chemical recycling technologies should, therefore, only be allowed for waste feedstock that is not technically feasible for high-quality mechanical recycling, such as post-consumer films and mechanical recycling residues. Also, pyrolysis could be the only method for polyolefins in the short term to fulfil the demanding requirements for applications with high risk from a safety and hygiene perspective, including food packaging.

By stimulating demand for recycling and limiting chemical recycling to areas that add the most societal and environmental value, incentives like these will provide a strong stimulus for advanced mechanical recycling.

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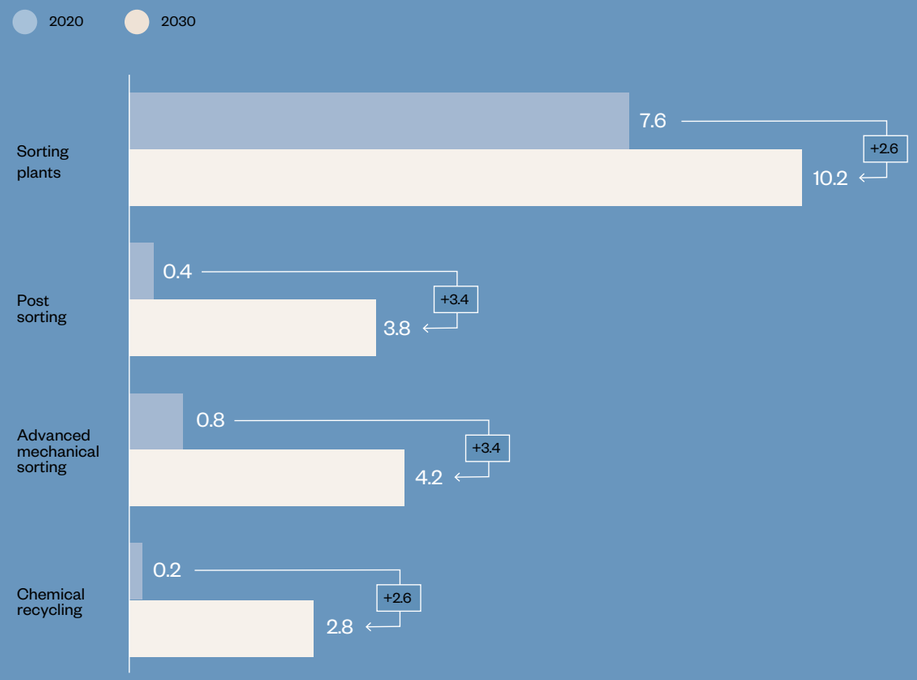
An employee works on November 28, 2020 at GAMA Recycle factory in Gaziantep in southern Turkey. Photo credit: Wang Yasin Akgul/AFP via Getty Images

INVESTMENTS REQUIRED

Extensive additional capacity is required across the entire value chain – collection, sorting, and recycling – to realise mandatory recycled content requirements and achieve full circularity by 2050.

Extensive additional capacity for sorting and recycling needs to enter the market to realise a 55 per cent recycling rate of plastic packaging by 2030 **(Figure 11)**. To meet future mandatory recycled content targets, recycling capacity will also have to be of higher quality.

Figure 11: Indicative analysis of current and required capacity in 2030 (in million metric tons)



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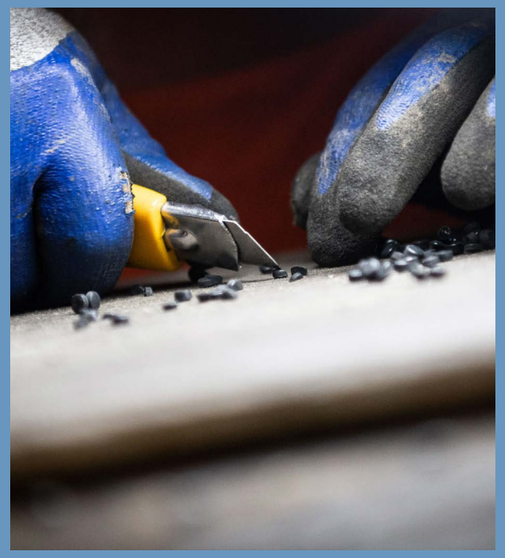
Britain-Waste-Environment-Fashion-Design. A photograph taken on February 2, 2022 shows an installation made of 6,600 plastic bottle caps collected from the beaches of Cornwall and displayed during the exhibition "Waste Age: What can design do?" at Design Museum, in London. Photo credit: Tolga Akmen/AFP via Getty Images

We estimate that approximately EUR 20 billion in overall investment to upgrade the value chain is required to meet the EU targets by 2030.

Nearly 85 per cent of this investment is needed in the advanced mechanical and chemical recycling capacity **(Figure 12)**. Investments should also be directed to the treatment of sorted plastics (after sorting) to upgrade the quality and purity of recyclate sent to advanced mechanical and chemical recycling plants.

By 2030, there needs to be an estimated EUR 8 billion of investments in chemical recycling, EUR 7.8 billion in advanced mechanical recycling, EUR 2.1 billion in mixed waste sorting infrastructure, and EUR 0.8 billion in high-quality sorting infrastructure.



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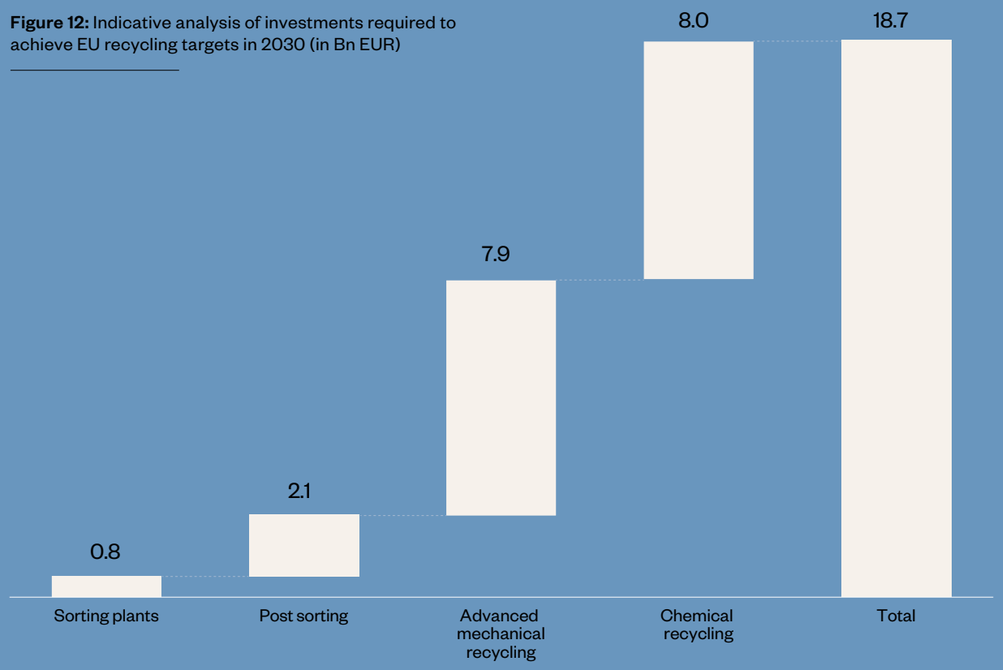
A Suez RV employee controls recycled plastic in a Suez RV recycling plant that recycles agricultural and industrial plastics, in Oree-d'Anjou, western France, on March 26, 2021. Photo credit: Loic Venance/AFP via Getty Images

Figure 12: Indicative analysis of investments required to achieve EU recycling targets in 2030 (in Bn EUR)

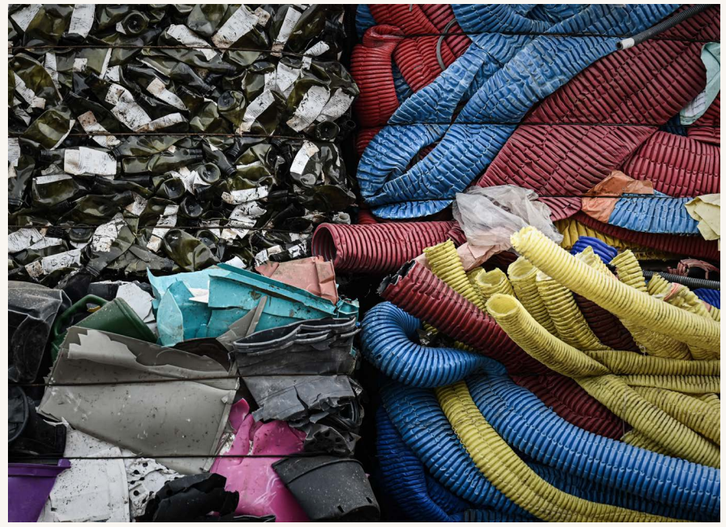


Given the cavernous gap between the current recycling rates and 2030 targets, these investments must come quickly. No investors will, however, move without sufficient expected returns (an IRR between 7 and 10 per cent). With the right regulatory interventions – including mandatory recycled content targets and clarifications on how plastic buyers (brands, converters) will contribute to the cost through EPR fees – the conditions can be created to attract commercial investments.

Large petrochemical companies may be well-positioned to capture some of the commercial opportunity in chemical recycling, given their expertise and size of balance sheet. In a recent positive development, European plastic manufacturers collectively announced an increase in planned chemical recycling investments from EUR 2.6 billion in 2025 to EUR 7.2 billion in 2030.[53] This would increase chemical recycling capacity to 3.4 million metric tons.

While this may be part of the puzzle, significant investments further down the value chain are required as well. First, capacity gaps remain for mixed waste sorting (3.4 million metric tons) and (high-quality) sorting of plastics (2.6 million metric tons), which are also partially required to realise the feedstock for chemical recycling, and second, a capacity gap for advanced mechanical recycling of plastics (3.4 million metric tons) remains.

Awaiting further regulatory interventions, the total value chain – from brand owners and retailers to waste management companies and recyclers and on to the petrochemical industry – should start working together to build future supply. By committing *now* to paying a premium for chemically-recycled but also and especially for advanced mechanically-recycled plastics in the short to medium term, plastic buyers can give investors and recyclers the confidence to scale capacity. This helps reduce the supply imbalance and lower prices in the long term.



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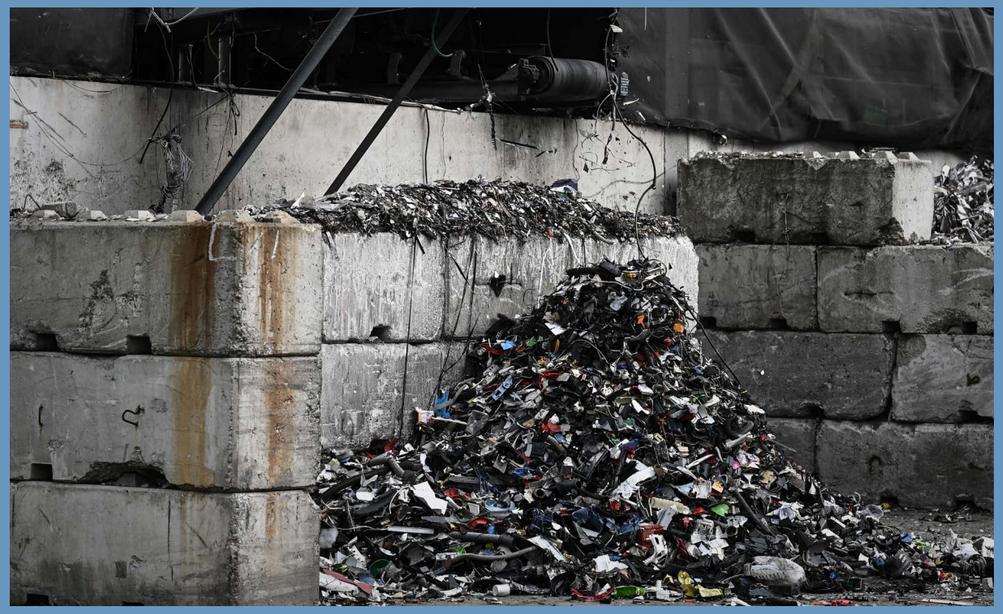
A picture taken on March 18, 2022 during the Global Recycling Day 2022 shows compressed waste at a recycling centre in Merignac in the outskirts of Bordeaux, southwestern France. Photo credit: Philippe Lopez/AFP via Getty Images.

CONCLUSION & RECOMMENDATIONS

There is an apparent mismatch between the EU's circularity goals and the existing reality of low recycling rates for plastic. Approximately half of plastic waste is not sorted for recycling.

The majority of the plastic waste that is collected and sorted is still incinerated, landfilled, or shipped elsewhere. Only 11 per cent of all post-consumer plastic waste in the European Union is recycled into new products. For the European Union to achieve its targets, it is necessary to solve critical value chain challenges.

Establishing systems that enable the collection, sorting, and recycling of multiple types of plastic is essential to meeting EU targets. Extensive additional capacity is required to increase the volume and improve the quality of recycled plastic. Upgrading the end-to-end system will cost EUR 20 billion in new infrastructure.



A picture taken on March 18, 2022 during the Global Recycling Day 2022 shows plastic waste to be recycled piled up at a recycling center in Merignac in the outskirts of Bordeaux, southwestern France. Photo credit: Philippe Lopez/AFP via Getty Images.

Recommendations:

1

A collective effort is needed from the plastics industry to upgrade the entire waste-to-recycling chain.

Achieving a circular economy for plastic will require major investments to build the capacity, quality, and expertise across the entire plastics value chain by 2030.

Investments should be focused on enhancing sorting facilities (2.6 million metric tons additional capacity needed), increasing capacity mixed waste sorting (3.4 million metric tons capacity needed), ramping up advanced mechanical recycling capacity from 0.8 million metric tons today to 4.2 million metric tons, and adding 2.6 million metric tons of chemical recycling capacity.

2

Buyers of plastic should start work with recyclers now to scale the supply of recycled plastic in the mid- to longer-term.

Hundreds of international brand owners have committed to developing comprehensive strategies to reduce their reliance on virgin plastic and increase the proportion of recycled plastic content in their products and packaging.[54]

By committing to paying a premium for recycled polyolefin in the short to medium term, plastic buyers invest in new recycling capacity and, therefore, help reduce the supply imbalance and bring down prices long term.

3

EU and national policymakers should de-risk and incentivise investments.

EU and national policies must level the playing field for mixed waste sorting. EPR schemes must compensate mixed waste sorting for plastics by default, as shown in the examples of Denmark and the Netherlands. Guidelines can be created at the national or even the EU level to help municipalities decide whether mixed waste sorting should be a complement or alternative to separate collection.

EPR schemes should support investments in higher-quality sorting, as opposed to focusing on sorting volumes. Well-defined design for recycling standards can further yield loss in the sorting process and increase the quality of recyclate.

Mandatory recycled content targets for plastic should come quickly and be of sufficient magnitude to strengthen demand, especially for polyolefins. An invigorated demand incentive would be a significant driver for investment across the value chain and a stimulus for quality improvements.

GLOSSARY OF TERMS

Chemical recycling

Operation through which collected plastic waste is reduced into monomers or other basic chemicals.

Contamination

Unwanted content in sorting input, sorting output, and recycled material. The most common impurities in plastic waste streams include metals, paper/cardboard, and organic contamination (food residues), among others.

Downcycling

A term used to describe the recycling processes resulting in low-quality recyclates that cannot be used for the same or similar application. For plastics, downcycling is often due to impurities and combining different types of plastic types. Also known as cascading.

Extended Producer Responsibility

A strategy to impose accountability over the entire lifecycle of products and packaging introduced to the market. This may take the form of legislation that mandates private sector roles, responsibilities, and outcomes for the funding and operating of systems designed to recover post-consumer packaging.

Films

Films are distinguished from sheets in the plastic industry according to their thickness. Films are generally no thicker than 0.030" and made of low density polyethylene (LDPE), a type of polyolefin.

Flexible packaging

Packaging comprised of plastic bags and film such as snack food and pet food bags, also including technologies such as pouches and multilayer film.

Incineration

Industrial burning of recovered waste where thermal energy is captured for heating and electricity.

Incinerator

Facility for combusting waste. In the European Union, energy is typically recovered for heat, steam, and electricity.

Landfill

Specially engineered site for disposal of solid waste on land. The waste is generally spread in thin layers, which are then covered with soil.

Mechanical recycling

Operation aiming to recover plastic waste via mechanical processing, i.e., grinding, washing, separating, drying, re-granulating, and compounding. This produces recyclates that can be converted into new plastic products. This process keeps the polymers intact.

Mixed plastics

Various similar output fractions of sorting centres and recycling companies classified as waste. It represents mainly a mix of PP and PE but also contains PET, PS, and other polymers to some extent. Recycled material is used for substituting concrete and wood.

Mixed residual waste

Waste that has not been separated at the source for recycling/recovery.

Mixed waste sorting

Process of separating recyclable materials (plastic, metals, glass, paper) from mixed residual waste prior to incineration or landfill.

Multilayer plastic

Packaging made with layers of polymer. Multilayer packaging may consist of multiple layers of the same polymer or incorporate different polymers or substances.

On-par recycling

A term used to describe the high-quality recycling processes in which recyclates can be used for the same or similar application. Also known as product-to-product recycling.

Polyolefins

Group of polymer thermoplastics consisting of only polyethylene and polypropylene and PE.

Post-consumer plastic

Plastic generated by households or by commercial, industrial, and institutional facilities in their role as end-users of the product, which can no longer be used for its intended purpose. This includes returns of material from the distribution chain.

Recovery rate

Percentage of usable recycled materials that have been separated from the total amount of waste.

Recyclate

Recycled material resulting from the processing of plastic waste (pellets, granules, flakes, etc.).

Recycling yield

Plastic output volume of a recycling operation as a percentage of its input.

Refuse-derived fuel (RDF)

Fuel from waste that can serve as fuel for energy production and other industrial processes.

Rigid plastic

Rigid plastic keeps its shape when moved or emptied (mostly HDPE and PP). It is the opposite of flexible packaging (mostly LDPE, sometimes PP).

Separate collection

Waste collection system where different materials (metals, paper, plastic) are collected separately. This form of collection ensures lower contamination levels.

Sorting

Process of classification of the mixed plastic waste in multi-material collection schemes. It consists of separating plastic from non-plastic content as well as plastic itself into different colours/polymer categories.

Sorting yield

Recyclable plastic output volume of a sorting operation as a percentage of its input.

Solid recovered fuel (SRF)

Fuel from waste that can serve as fuel for energy production and other industrial processes. Similar to RDF but generally even higher in calorific value.

Virgin plastic

Plastic made from newly extracted fossil fuels.

ENDNOTES

1 EU Directive 94/62/EC on Packaging and packaging waste, Article 6. Available from: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A01994L0062-20180704 [4 July 2022].

2 EU 2020 Circular Economy Action Plan: For a cleaner and more competitive Europe. Available from: https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1583933814386&uri=COM:2020:98:FIN [4 July 2022].

3 KPMG analysis 2021.

4 KPMG analysis.

5 KPMG analysis 2021 of post-consumer plastic waste streams in Germany, Netherlands, France, Italy and Poland (2018 data).

6 EU Directive 94/62/EC on Packaging and packaging waste.

7 KPMG analysis 2021.

8 KPMG analysis 2021; industry interviews.

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Detail of large recycled plastic fish sculpture in Helsingor situated in front of the Kronborg Castle in Helsingor – Denmark, July 28th 2017. Photo credit: Getty Images

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