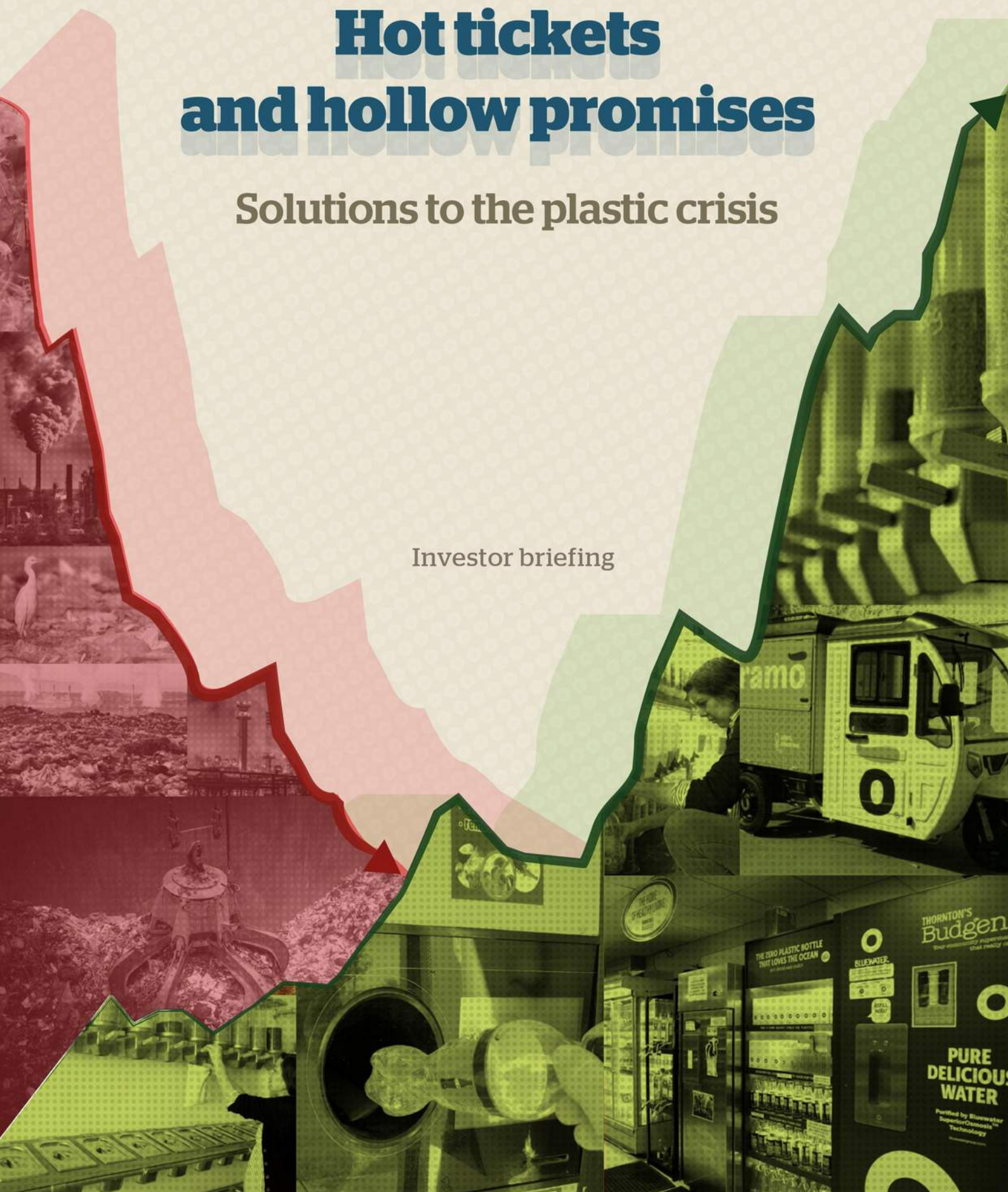


Hot tickets and hollow promises

Solutions to the plastic crisis

Investor briefing



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Executive Summary

Solutions to the plastics crisis come in many forms. However, not all solutions are created equal, and some are more financially and technically viable than others. A concerning level of attention is still being paid to unproven solutions, while major investment institutions lack a full understanding of the policy landscape and its implications.

The following factors will shape the context of the next decade of investor and corporate response to the plastics crisis:



- **Plastic production and pollution** will continue to skyrocket, creating further public backlash and a high risk of stranded assets.



- **Consumer pressure** will create increased scrutiny on corporate action and a mandate for more comprehensive legislation.



- **Regulation** will become an increasingly dominant market force, shaping which technologies win and fail.

Of the technologies covered in this report, we evaluate that:



- Investors should avoid being drawn in by the hype surrounding **chemical recycling** and should steward those they invest in away from reliance on these technologies, which are highly risky and potentially unviable.



- Solutions related to **separate collection and sorting technologies** are a unique opportunity for investment in the short-to-medium term, because regulation indicates they will experience rapid growth.



- Solutions aimed at scaling **reuse and refill** represent a suite of answers to the plastics crisis. Regulations such as all-in deposit-return systems also favour refill enterprises and pave the way for new business opportunities.

Setting the context

Three core trends will shape the operating conditions of the investor response to the plastics crisis in the next decade:

1. Plastic overload + carbon intensity = stranded assets

Plastic production is set to skyrocket; by 2040, the amount of plastic leaking into the environment is set to triple.¹ This will give rise to louder calls to address the problem upstream – either by imposing restrictions on production (such as bans) or by favouring upstream solutions like separate collection, reuse and refill.

Fossil-fuel giants pinning their hopes of future revenue on expanding petrochemical production (a category that includes plastic polymers for uses such as packaging and synthetic fibres)^A defy concerns from every corner of society, as well as governments' decarbonisation agendas, which runs a high risk of stranded assets.

2. Growing consumer pressure will create a mandate for action

With plastic pollution likely to get worse before it gets better, we can expect societal calls for systemic action to become louder. At present, 87% of citizens in the EU are worried about the impact of plastic production on the environment, while 74% are worried about its impact on their health.² This pressure creates a mandate for stronger legislation from policymakers, and will push companies with large plastic footprints to adopt ambitious targets on reuse, plastic reduction, collection and recycled content.

3. Regulation will become an increasingly dominant market force

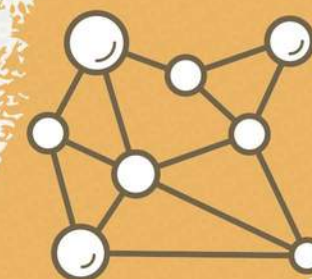
Over the past 20 years, there has been a clear upward trend in both the number of regulatory policies on plastic and their comprehensiveness;³ 25% of policies launched between 2000 and 2005 were comprehensive, compared to 59% in 2018 alone. Such policies increasingly use a combination of binding regulation – both prohibitive (such as plastic-bag bans) and affirmative (such as improvements to infrastructure) – and economic instruments (such as deposit-return systems, extended producer-responsibility schemes and taxes). Good examples of such policies are the EU's Single-Use Plastics Directive and its Waste Directives.

From China's landmark National Sword Policy in 2018 – which upended the waste trade, allowing countries to ship their plastic rubbish to low- and middle-income countries – to the Basel Convention's recent entry into force, restrictions on exports mean plastic waste is piling up within countries, increasing the pressure for it to be dealt with domestically. This means countries will quickly be confronted with the need to rapidly scale separate collection, mechanical-recycling capacity and plastic-waste reduction strategies, such as reuse policies and restrictions on certain (non-recyclable) products and materials. Recent trends, in which recycled PET prices overtook virgin PET prices, makes the case for increasing recycling capacity even stronger.

This unique combination of factors will set the operating context of technologies billeted as tackling plastic pollution.

A According to a study by Pew Charitable Trusts, on its current trajectory, plastic production could use up 19% of our remaining carbon budget. Pew Charitable Trusts (2020) *Breaking the plastic wave* [ONLINE] Available at: https://www.pewtrusts.org/-/media/assets/2020/07/breakingtheplasticwave_report.pdf

Available technologies and recommendations to investors



Chemical recycling

High risk, short-to-medium term

Our analysis finds significant risk exposure for chemical recycling – a suite of technologies ranging from turning plastic into fuel to be burnt to attempts to break down, then reassemble, the molecular building blocks of plastic – from technical and financial viability problems to its dubious environmental performance.

Environmental performance

Chemical recycling is both an energy- and carbon-intensive process, requiring large amounts of external energy input, even when burning some part of the feedstock is accounted for.⁴ To date, there is no comprehensive, independent life-cycle assessment of chemical recycling. With future clampdowns on emissions from all sectors likely, investors should opt for recycling technologies less liable to restrictions in this regard, such as mechanical recycling.⁵

There is also ample evidence that pyrolysis and gasification do not filter out harmful contaminants present in plastic – such as bisphenol A, cadmium, benzene, brominated compounds, phthalates and antimony – and that these processes add further toxic compounds into the mix. The cost of phasing out toxic chemicals is prohibitive, adding to the financial viability issues the technology faces.

Technological and financial viability

The high energy costs and immature technology of chemical recycling mean the vast majority of projects are 'dead in the water',⁶ even after decades of development. Technologies such as pyrolysis and gasification produce low yields and have persistent problems with contamination, while depolymerisation technologies are still only lab-scale, with none able to compete commercially. High-profile failures – such as the drubbing of Loop Industries in 2020, which was backed by companies such as Coca-Cola, Danone and PepsiCo but experienced a significant share-price drop after its lack of viability was exposed⁷ – should serve as a warning to investors of the hollow promise of chemical recycling.

Investor recommendation

Investors should avoid being drawn in by the hype surrounding chemical recycling, and should steward those they invest in away from reliance on this technology. Although there may be a niche role for depolymerisation in the long term, most technologies in the 'chemical recycling' arena are exposed to a number of risks, and are unlikely to bring returns in the short term.

Separate collection

High opportunity, short term

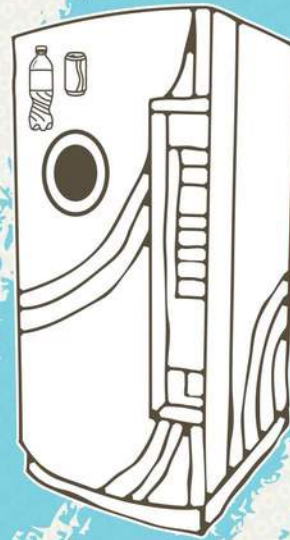
Analysis by the Container Recycling Institute suggests that over a billion people will live in jurisdictions with deposit-return systems^B (DRS) in place by 2030 – up from nearly 300 million people in 2017.⁸ This is driven by governments' growing realisation that DRS are the only way to achieve 90%+ return rates of beverage containers,⁹ with the potential to expand to other types of packaging making them a win-win-win opportunity to reduce littering, increase separate collection rates and guarantee clean streams of recyclable materials. Our assessment of the regulatory landscape is that the growth in container-deposit legislation and minimum recycled-content obligations, and a resulting increase in mechanical recycling, is creating the ideal conditions for companies with reverse vending machine technology, optical sorting and washing facilities, and mechanical-recycling infrastructure.

Our modelling indicates that the progress of container-deposit legislation will lead to growth in the global reverse vending machine market of over 8.4× by 2029, from 84,100 installed machines in 2019 to a potential of 705,257 installed machines in 2029. For this report, we also analysed the growth potential of TOMRA, the market leader in reverse vending machines. From 2021 onward, we expect a four-year 20%+ CAGR for the company, with our models discounting market share by 10% due to increased competition in a maturing market.

Separate collection dovetails neatly with the low-risk, proven technologies in mechanical recycling, which have a strong track record. This allows easier scaling up and building out of additional infrastructure in other parts of the world. Adding carbon pricing when replacing virgin plastics with recycled content will create a further pull market.

Investor recommendation

Investors should consider companies in this space a high-growth opportunity in the short-to-medium term. Market leader TOMRA is a rare and welcome find, exhibiting steady growth and stable margins, while other innovators in the space should also be considered.



Reuse and refill

Good opportunity, both short term and long term

Separate collection and recycling alone will not be enough to solve the plastics crisis, and societal and regulatory pressure is pushing for upstream solutions that reduce our reliance on plastic at source. Refillable containers can be used several times before they are recycled, eliminating the need to manufacture new containers and avoiding many of the environmental impacts associated with both production and waste management.¹⁰ While global data shows a steady decline in refillables, a shift towards both voluntary and mandatory reuse-and-refill quotas is underway, stimulated by societal pressure, investor interest and changes in consumer behaviour. According to the Ellen MacArthur Foundation, this represents an opportunity worth \$10 billion if 20% of single-use plastics are replaced with refillable alternatives.¹¹ Crucially, legislation will also revolutionise reuse and refill. Not only does DRS provide the system to underpin refill systems but reuse-and-refill quotas and policies – such as those adopted in France, parts of Spain and Romania – create further incentives.

There are very good examples of re-usable packaging, like plastic beverages crates, crates for fruit and vegetables, and bulk containers. The majority of such products are made with mono materials which allows 1:1 recycling back into the same applications. The use of refillable bottles in combination with reuseable beverage crates has long existed and now has opportunities in new and developing markets.

In the US, the example of the Oregon Beverage Recycling Cooperative, which has built a successful refillables business model on the state's DRS, shows how DRS is a critical enabling policy to establish such business opportunities. The more regulation continues on this trajectory, the more such opportunities we can expect to arise across the world. In Germany, the German Wells Cooperative has established an economically and environmentally effective pool-reuse system for mineral water, whereby standardised packaging is shared across the system – preventing 5 billion single-use bottles being used each year. Also in Germany, the Hassia Group has invested in bottle washing, optimised its processing infrastructure and increased the outputs of its refill system without compromising on environmental impact – all enabled by the country's best-in-class deposit system.

Promising opportunities and disruptive innovations across packaged goods, food-to-go, beverages and logistics show the breadth of the market's potential for growth. This should be a key area of interest for investors, particularly those looking for equity opportunities.

Investor recommendation

Investors with a view to medium-to-longer-term opportunity should closely watch developments in the reuse-and-refill space, particularly for equity openings. Considered the environmental holy grail, promising reuse-and-refill ventures are still flying under the radar of most investors, but – with increasing pressure on policymakers to enshrine reuse in legislation, and with consumer brands under scrutiny to adopt such systems at scale – investors find themselves in a position to shepherd in a refill revolution in how we consume. With the shift towards all-in DRS, which enable refill at scale, the opportunity for new businesses will only grow stronger.



^B DRS are a highly effective mechanism for collecting large volumes of empty containers in clean waste streams for use in high-quality recycling, or for setting up refill-or-reuse systems. Containers are sold with a small deposit fee, which is refundable upon return of the container to a store or collection point. For more information, see: https://talking-trash.com/wp-content/uploads/2020/08/TalkingTrash_2_DRSExplained.pdf

Conclusion

The findings of our full investor briefing outline in more detail the operating context for investors and businesses in response to the plastics crisis over the next decade. The wider landscape trends are of continued – and even mounting – societal pressure to stem the flow of plastic into the environment, with an increasing focus on upstream solutions. The response from policymakers and government leaders is already taking shape, with more comprehensive policies growing in number and scope. This, in turn, dictates the sorts of solution technologies that will sail or flop in the coming years as businesses, municipalities and investors adapt to the regulatory environment.

Our analysis finds chemical recycling to be exposed to high regulatory and operational risk; separate collection and sorting technologies – particularly reverse vending machine suppliers – to be a welcome opportunity; and businesses specialising in reuse and refill to provide good short-term prospects and longer-term equity opportunities.

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List of abbreviations

ACC	American Chemistry Council
DRS	Deposit Return Systems
EIA	Environmental Investigation Agency
EPR	Extended producer responsibility
ESG	Environmental, social and corporate governance
FMCG	Fast-moving consumer goods
GHG	Green-house gas
HDPE	High-density polyethylene
IEA	International Energy Agency
LCA	Life-cycle assessment
NOK	Norwegian krone
RVM	Reverse vending machine



1. Background and context

1.1. Responses to the plastics crisis

Few environmental crises are more urgent and interconnected than the plastic crisis. Plastic production and pollution pose serious harm to the climate, human health and terrestrial and marine life across the planet. On its current trajectory and without significant, coordinated action, this unprecedented crisis is going to get much worse. Modelling in a recent report by Pew Charitable Trusts, *Breaking The Plastic Wave*, estimates that a business-as-usual scenario could see as much as triple the amount of plastic leaking into the natural environment by 2040 – equating to as much as 50kg of plastic entering the ocean for every metre of shoreline – saddling the world with permanent plastic contamination. The plastic industry will also account for a 19% share of the remaining carbon budget by 2040.¹²

The cost of inaction is high to businesses, communities, and ecosystems; particularly stark is the US\$100 billion annual financial risk that businesses face if governments require them to cover waste management costs at expected volumes and recyclability.¹³

The scramble to respond to the crisis has given rise to a proliferation of solutions from actors across the plastic value chain, seeking to tackle the issue through a combination of upstream measures (such as reduction and redesign) and downstream solutions (such as collection, recycling and clean-ups). Not all solutions are created equal, however, and some are more financially and technologically viable than others.

This briefing will investigate separate-collection solutions, which we consider as precursors to increasing levels of effective mechanical recycling^A and ramping up reuse, including innovative new business models. Reuse and effective recycling are both important solutions to the plastic crisis; they approach the problem from both an upstream reduction and a downstream waste-management perspective. The trajectory of legislation around

A This is sometimes also called *closed-loop recycling*, where, for example, a plastic bottle can be recycled multiple times into a plastic bottle rather than downcycled into fibres for the carpet and fashion industry. Some plastic polymers, such as Polyethylene terephthalate (PET) and high-density polyethylene (HDPE), can be mechanically recycled into new plastic products multiple times, if collected through clean waste streams.

the world increasingly favours this approach, obliging companies to take more responsibility for their plastic use and introducing transformative interventions, such as deposit-return systems (DRS), in tandem with binding reuse targets.

We also analyse chemical recycling, which we consider a false solution – yet the plastic industry and oil companies heavily promote it, and are also investing considerably in new plastic-production capacity. Our previous investigative report, *Talking trash: The corporate playbook of false solutions to the plastic crisis*, showed that the industry has pushed recycling as a silver-bullet solution to the plastic crisis for decades, without simultaneously scaling separate collection.¹⁴ In reality, pushing recycling as a solution allowed the industry to produce plastic in greater (unrecyclable) varieties for an increasing number of uses, which is part of the reason why only 9% of plastic ever produced has been recycled.¹⁵ Now, as pressure to tackle the plastic crisis mounts, the industry is trying to promote chemical recycling as the catch-all solution to the problem of plastic overproduction and the lack of effective separate collection and sorting systems in place.

Chemical recycling is problematic for three reasons:

1. It is technically and financially unviable, as proven by high-profile failures and an estimated \$2 billion in wasted investments up to 2017.¹⁶
2. The energy-intensive process and emissions related to plastics-to-fuel (P2F), and the production of toxic waste and air pollution, have major climate consequences, leaving chemical recycling open to significant risk from emissions targets and other environmental legislation.
3. A variety of technologies – from pyrolysis and solvolysis to depolymerisation – are lumped together under the term ‘chemical recycling’ to deliberately blur the line between what is technically feasible, though unviable (plastic-to-plastic (P2P)), and what is the reality in practice (P2F, which is then burnt).¹⁷
4. In short, chemical recycling operates in a world of economic uncertainty and industry smokescreens, as well as itself being environmentally dubious.



Shell's vast new plastics factory under construction on the Ohio River

Credit: The New York Times

1.2. The risk of stranded assets

As we discover more about the harm of plastic pollution to both human health and the planet, the industry's projections for growth defy concerns from every corner of society. In the US, \$164 billion is expected to be spent on 264 new plastic-production facilities by 2023; in China, \$140 billion on 15 projects; in Saudi Arabia, \$100 billion on new capacity;¹⁸ and in Antwerp, Belgium, €3 billion (\$3.5 billion) on a single new INEOS facility¹⁹ (although this was recently suspended for failing to undertake a full environmental impact assessment).²⁰ This projected growth belies the threat of significant risks; it should not be taken for granted, but rather viewed as potential stranded assets in the making. As Carbon Tracker puts it:

*To have one sector planning on doubling its carbon footprint while the rest of the world plans to phase out emissions clearly makes no sense. This provides a clear driver for policymakers to take action.*²¹

It is important to note that investment in new production capacity is much bigger than investment in waste-management options, such as recycling infrastructure and capacity.

GLOBAL PLASTIC PRODUCTION AND FUTURE TRENDS

(MILLIONS TONNES)

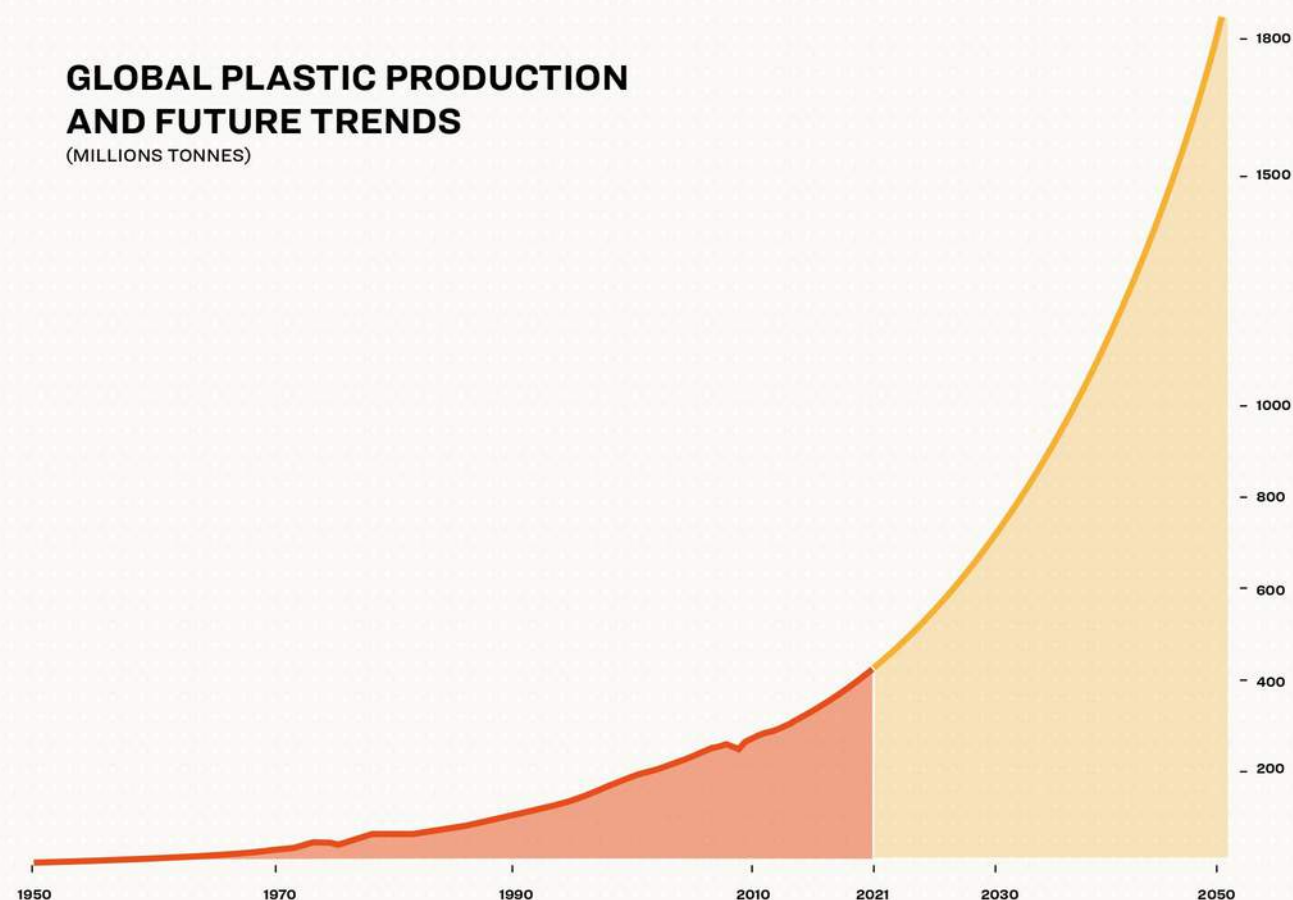


Figure 1.1: The exponential production of plastics

Source: UN Grid-Arenda²²

1.3. Gaps in domestic recycling and collection capacity

China's National Sword Policy in 2018, which turned the global waste trade on its head overnight, revealed the severe shortfall in domestic recycling capacity across the world. Having previously relied on China to process plastic that couldn't be recycled domestically – representing about 50% of all plastic waste for the 30-year period from 1988–2018²³ – plastic is now either piling up domestically or ending up in other countries that are not equipped to deal with the deluge. While some other countries still accept traded waste, under a 2019 amendment to the Basel Convention, which came into force in early 2021,²⁴ they will be allowed to reject *all* plastic waste – not just hazardous types. This will put further pressure on countries to scale up investments into management of plastic within their own borders. For example, in the US, only 7% of recycling capacity is covered by the biggest companies' voluntary commitments and contributions.²⁵

Existing EU legislation already means that recycling capacity in member states will need to rapidly increase. The European Commission's *Strategy for plastics in a circular economy*, published in 2018, envisions a fourfold increase in sorting and recycling capacity for plastics from 2015–2030 to meet current targets.²⁶ Additionally, several member states are including reuse obligations in their transposition of the EU Single-Use Plastics Directive into national law. Meeting this heightened demand for recycling and moving towards greater reuse will need to be underpinned by a rapid growth of collection infrastructure, which provides clean waste streams for effective mechanical recycling, and is a key enabling factor for increased rates of reuse and refill.

1.4. Societal trends and consumer pressure

Civil-society groups, academics, the media, and citizens campaigning and raising awareness of plastic are creating significant pressure on governments and corporates to tackle the plastics issue systemically. In the EU, 87% of citizens are worried about the impact of plastic production on the environment, while 74% are worried about its impact on their health.²⁷ Well-coordinated campaign groups, such as Break Free From Plastic, have succeeded in exposing corporate irresponsibility, fighting attempts to water down legislation and pushing for stricter regulation on plastic around the world. Meanwhile, millions of ordinary citizens sign plastic-related petitions every month, and the growing zero-waste movement is sending a strong signal to consumer brands and retailers to change course. Furthermore, there are strong signs of high consumer demand for reusable and refillable packaging and circular models of consumption.²⁸ During the Covid-19 pandemic, refill-and-reuse systems have become more popular, as consumers have shifted their shopping online and brands ahead of the curve have used the opportunity to experiment with direct-to-consumer models.²⁹

We can expect consumer pressure to intensify and create a strong mandate for action from governments and policymakers. Brands that are more than superficially committed to mitigating their contribution to the plastic crisis should welcome regulation on this issue – particularly where it seems consumer pressure will not wane,



A protest against single-use plastic in Korea

Credit: Zero Waste Europe

and brands are struggling to justify the increase in costs represented by switching to new systems and materials. Simultaneously, companies taking a lead on sustainability can position themselves ahead of government legislation, pre-empting market pressure and gaining from early-adaptors advantage.³⁰ This creates a positive leaders vs laggards dynamic, and is a way for companies to respond directly to societal pressure and distinguish themselves in the market.



Figure 1.2: Polling on plastics¹⁷⁷

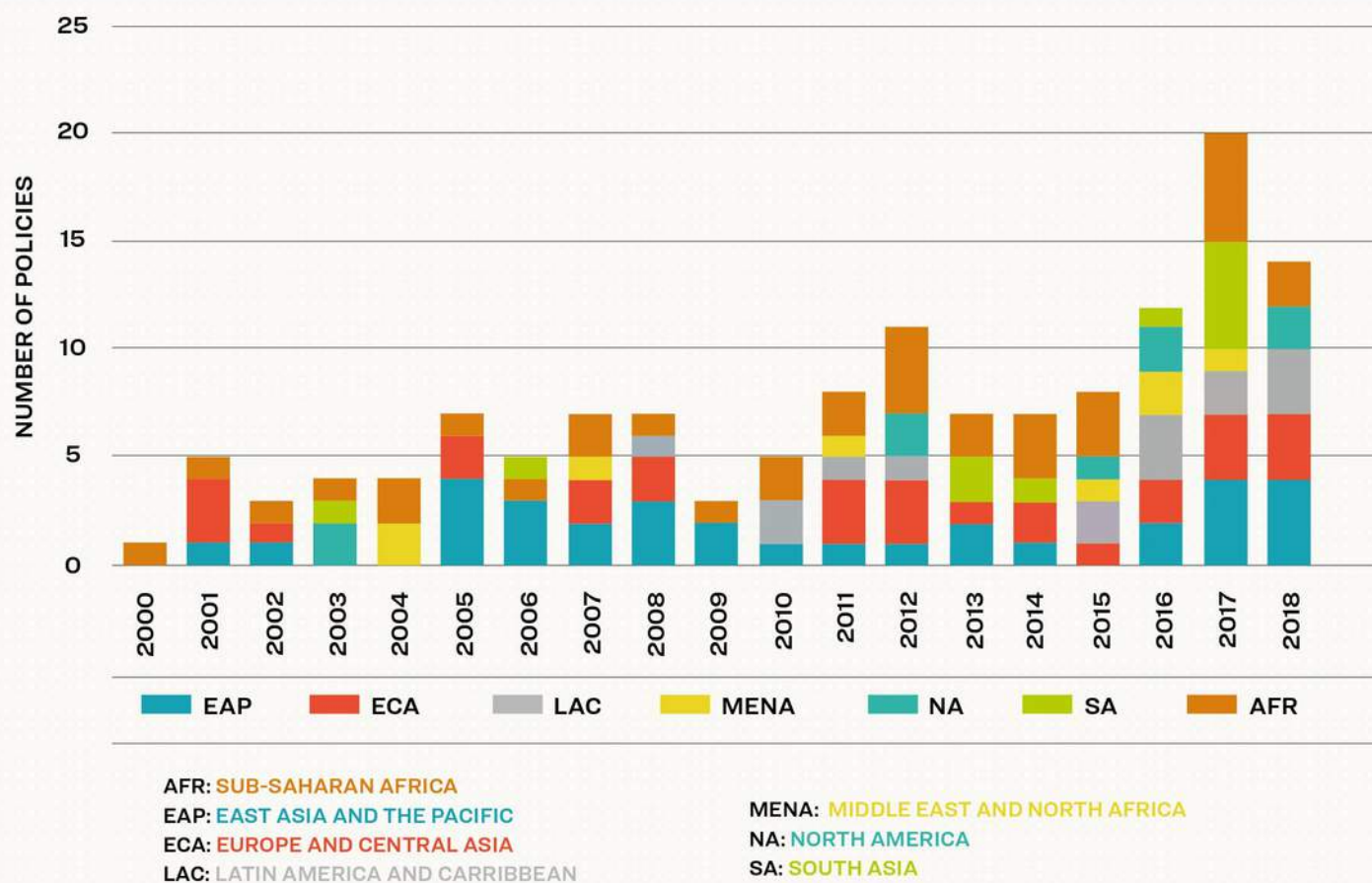
1.5. Regulation as an increasingly dominant market driver

Legislation to tax plastic use, introduce design stipulations, ban problematic plastic products (straws, plastic bags, etc.) and materials (polystyrene, oxodegradable plastics, etc.), increase separate collection and improve infrastructure is now being implemented or considered in major economies across the world.

While a baseline of waste-management legislation has existed for decades at national and subnational levels, there has been a noticeable and accelerating increase in such plastic-specific legislation across the world. A 2020 Duke University analysis of two decades of plastic legislation shows a clear upward trend (Figure 1.3).³¹ These policies

Figure 1.3: Number of national plastics policy documents analysed by region

Source: Duke University Nicholas Institute (2020) 20 Years of Government Responses to the Global Plastic Pollution Problem



are also increasingly comprehensive, seeking to address plastic at all stages of its life cycle, with 25% of policies from 2000–2005 being comprehensive compared to 59% in 2018 alone. Such policies also increasingly use a combination of regulation – both prohibitive (such as plastic-bag bans) and affirmative (such as improvements to infrastructure) – and economic instruments (such as DRS and taxes).

Examples include the EU’s €800/tonne levy on non-recycled plastic waste (the equivalent of 2.4 cents per standard PET bottle);³² UK legislation for a £200/tonne plastic-packaging tax on packaging with less than 30% recycled content, effective from April 2022; the pioneering EU Single-Use Plastics Directive;⁸ China’s legislation to cut down single-use plastic, which threatens demand of 4 million tonnes of plastic per year;³³ California’s recent recycled-content law, effective from 2022 and the first US state to enact such a bill;³⁴ and the ambitious proposal for the Break Free From Plastic Pollution Act in the US, which recommends banning certain items, bringing in a nationwide deposit-return system and introducing a moratorium on new plastic refineries.³⁵ Legislation and legislative proposals highlight the primacy of separate collection by creating large demand for recycled content that current mechanical-recycling capacity is unable to meet, and therefore represents a significant opportunity for investment.³⁶ Analysis by the Container Recycling Institute suggests that, by 2030, at least 1 billion people will be covered by deposit laws – up from 300 million in 2017.³⁷

A growing number of policies aims to tackle the problem further upstream, in particular by seeking to stimulate reuse and refill. The European Commission is currently reviewing the Packaging and Packaging Waste Directive, with a goal that all packaging on the EU market will be reusable or recyclable in an economically viable way by 2030.³⁸ Crucially, this goes hand in hand with the EU Single-Use Plastics Directive, which mandates the separate collection of beverage bottles at 90% by 2029 and refers to DRS as a way to achieve this rate. Mandatory DRS is an essential precursor to reuse because it establishes an highly effective mechanism for the return of bottles and containers. National and regional governments are also increasingly enacting regulation to boost reuse; for example, in France, Romania and the Balearic Islands (see page 46). Pressure from environmental groups and public campaigns, such as Break Free From Plastic’s We Choose Reuse campaign, increasingly encourages legislators to deploy a range of policy instruments in tandem – mandatory DRS, green levies and binding reuse quotas – to boost refill and reuse.³⁹ The mounting pressure from environmental groups is due to the effectiveness of reuse in tackling plastic pollution at source.⁴⁰

Nevertheless, analysis in *Breaking The Plastic Wave* also concludes that, even if all current legislation was fully implemented, it would only lead to a 7% greater reduction in plastic flows into the ocean than under a business-as-usual scenario – and that, even if the EU’s ambitious Single-Use Plastics Directive were rolled out across the world, it would only lead to a 15% greater reduction. Far from showing that regulation is not the tool for the job, what this shows is that regulation will have to increase in scope and ambition, and seek to address reduction, reuse and collection in far more ambitious ways, while also encouraging new innovative business models. This is the single most important factor in setting the operating context for the solutions analysed in this briefing. The plastics crisis is similar to the climate crisis in its complexity and gravity; therefore, there is a clear trajectory for regulation to increase in both quantity and stringency.

B Adopted in 2019, with measures including banning problematic single-use items, mandatory inclusion of 30% recycled content in plastic bottles and 90% separate collection by 2029.



EU SINGLE-USE PLASTICS DIRECTIVE

BAN ON SINGLE-USE ITEMS BY 2021



WASTE FRAMEWORK DIRECTIVES

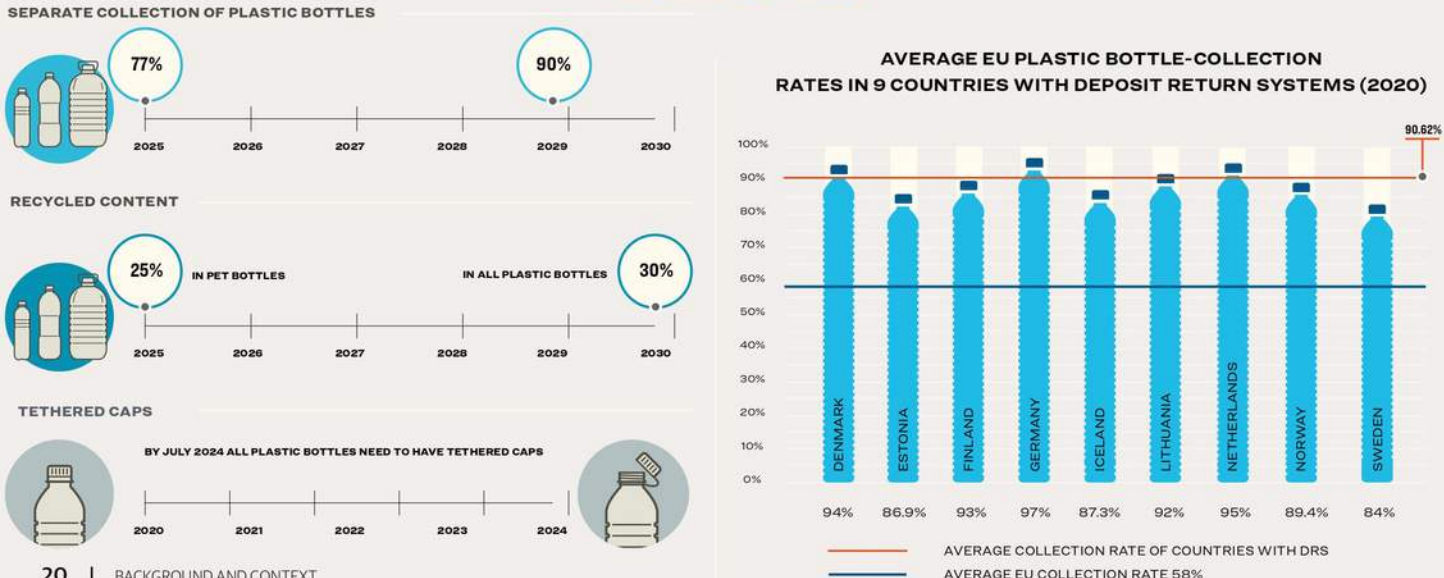


EXTENDED PRODUCER RESPONSIBILITY SCHEMES FOR CERTAIN PRODUCTS

COVERING COLLECTION, TRANSPORT, TREATMENT, CLEAN-UP AND AWARENESS-RAISING MEASURES



PLASTIC BOTTLES



BOX 1: Weak voluntary corporate action is not enough

As a result of the combined landscape-level pressure from legislators and grassroots action, corporates responsible for the plastic crisis – such as plastic producers, consumer brands and retailers – are increasingly seeking to mitigate their reputational fallout through voluntary commitments to tackle plastic pollution. The majority of these commitments fall far short of what is necessary for system change, and – as revealed by our September 2020 report *Talking trash: The corporate playbook of false solutions to the plastic crisis* – are primarily being used for greenwashing purposes, while the same companies seek to undermine governments' attempts to introduce binding legislative measures.⁴¹

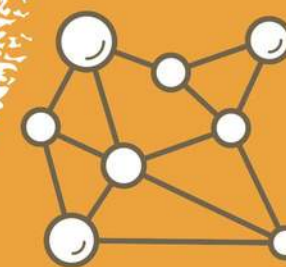
In its quest for quick fixes, the industry has a tendency to jump to voluntary false solutions that fit with the incumbent business model of take-make-dispose. These range from relatively benign projects that unhelpfully distract from systemic solutions – such as making products from marine plastics and running ocean clean-ups – to more environmentally questionable technologies, such as chemical recycling. The oil, gas and petrochemicals industry's protracted use of voluntary initiatives to stave off stricter plastic regulation is well documented. The effectiveness of any voluntary initiatives they are part of must be considered in light of the vast amounts of capital being poured into new capacity. For example, the combined funding of industry initiative, the Alliance to End Plastic Waste, (\$1.5 billion) pales in comparison to the hundreds of billions of dollars invested in new plastic-production capacity.

We have analysed three technology areas regularly held up as solutions to the plastic crisis but with vastly different track records and prospects for actually doing so.

First, we look at chemical recycling, highlighting why this is a high-risk area for investors to avoid. Here, our research has revealed companies are putting all their eggs in one basket, banking on a small number of chemical-recycling technology providers, few of which have shown results – and some of which have experienced significant failures and losses. Second, we look at separate collection and the growth of the reverse vending machine market, using modelling to show the wide opportunity for growth for such solutions presented by the current trajectory of legislation. Finally, we look at the blossoming area of refill and reuse – a rapidly growing area, ripe for investment to shepherd it to maturity, with the potential to disrupt and revolutionise how we consume within environmental boundaries.

For each of these technologies, we look at how the factors previously presented play out to favour or diminish the market opportunities for related companies, in turn affecting their likelihood to scale, as well as data and case studies demonstrating the risks and opportunities in each area.

Figure 1.4: The European Union Single-Use Plastics Directive



2. The hollow promise of chemical recycling

2.1. Papering over the cracks: The reality of chemical recycling

Behind its innocuous-sounding name, 'chemical recycling' features a range of processes and technologies to convert waste plastic into new plastic or fuel by dissolving plastic with chemicals, or using heat to break it down into monomers, naphtha, fuels or other by-products.⁴² In theory, these new materials can go through a process of 'repolymerisation' to create new plastic products; in practice, however, this technology is still uneconomical and technically challenging.⁴³ For example, out of the 37 facilities proposed in the US since 2000, only 3 are currently operational, and none have been able to achieve commercial-scale P2P recycling.⁴⁴

The reality for the majority of plastics undergoing 'chemical recycling' is P2F, whereby the liquid and gas products from the process are turned into fuel, such as diesel or kerosene, and then burnt just like any other fossil fuels. When these fuels are burnt, all the carbon originally extracted as fossil fuels is released back into the atmosphere as greenhouse gas (GHG) emissions, contributing to climate change. Far from being part of the circular economy (as touted by the industry), P2F should be considered worse than landfill – and on par with incineration.⁴⁵ A life-cycle assessment (LCA) conducted by BASF even suggests that pyrolysis of plastic waste performed worse than incineration in ten out of 19 impact categories – although this was conveniently sidelined in the study's findings.⁴⁶

Chemical recycling is far from a techno-fix to the plastics crisis – and it isn't new, either. Gasification and pyrolysis were invented over 100 years ago for use with biomass and coal,⁴⁷ and efforts to apply the technology to P2P have continued for over 50 years under different names – all without success.

2.2. Technology rundown

While it is important to note that there is no universal consensus on the definition of chemical recycling, the technology falls into two broad categories: Those using heat to break down polymers in an oxygen-depleted environment (thermolysis), and those using solvent-based processes to strip out impurities or depolymerise the plastic (solvolysis). Gasification and pyrolysis are thermolysis processes, and purification, liquefaction and solvolysis are solvent-based.

The result of gasification and pyrolysis is a mixture of liquid, gas and solid hydrocarbons – which, in theory, can be used as the building blocks for new plastics. In practice, this mixture is often of such poor quality that it is unsuitable for new plastic production without carbon-intensive chemical reprocessing and, often, the input of virgin feedstock to reduce the low-yield, contaminated pyrolysis oil.⁴⁸ The destination for most of this yield is either a feedstock of petroleum refining (into fuels to then be combusted) or burnt on site through flaring or for electricity generation.⁴⁹ The majority of chemical-recycling plants are P2F rather than P2P. Greenpeace analysis of an American Chemistry Council (ACC) list of chemical-recycling projects found that much of the reported \$5.2 billion in investments in 62 such projects is going to P2F projects.⁵⁰ Since 2017, \$560 million of this funding was from taxpayers, of which 90% is going to P2F projects – in other words, turning plastic into fuel for the petrochemicals industry, rather than recycling any plastic.

Solvent-based processes seek to create the building blocks for new plastic, either by liquefying plastic feedstock but retaining the polymer chains intact, (purification) or by breaking them down into monomers and oligomers (depolymerisation). The former results in some product degradation and does not remove toxic contaminants,⁵¹ the latter is the more innovative solution but exists within a haze of uncertainty and unproven credentials. Due to its energy intensiveness and associated costs, it is likely to only ever be a niche chemical-recycling option for specific applications, and it results in a similar degradation of material to mechanical recycling, meaning it cannot recycle plastic in an infinite loop – in contrast to what is often suggested.⁵²

Even this is an immature industry that, according to sector specialists the Bureau of International Recyclers, is still ten years away from viability – too long to be useful in addressing the urgent problem of plastic waste and climate change.⁵³

2.3. Environmental problems

The primary criticism of chemical recycling, specifically of processes such as gasification and pyrolysis, is its adverse environmental impacts. As we shall see, the risk associated with this should be viewed from not only an environmental, social and corporate governance (ESG) angle but also from the perspective of an increasingly strict environmental regulatory landscape.

The environmental impact of such technologies is predominantly assessed through LCAs, which are studies determining the relative sustainability impacts of certain products or technologies. When it comes to chemical-recycling proponents of such technologies, the industry will frequently point to various LCAs to highlight the environmental credentials of chemical recycling. However, LCAs have serious limitations as tools, and their results vary hugely according to the scope, data and assumptions used.⁵⁴ As such, they are notoriously susceptible to being manipulated and misinterpreted, or used to paint certain technologies as environmentally benign.⁵⁵ Such is the case with chemical recycling. To date, there exists no comprehensive, independent LCA on chemical recycling.

2.3.1. Toxicity

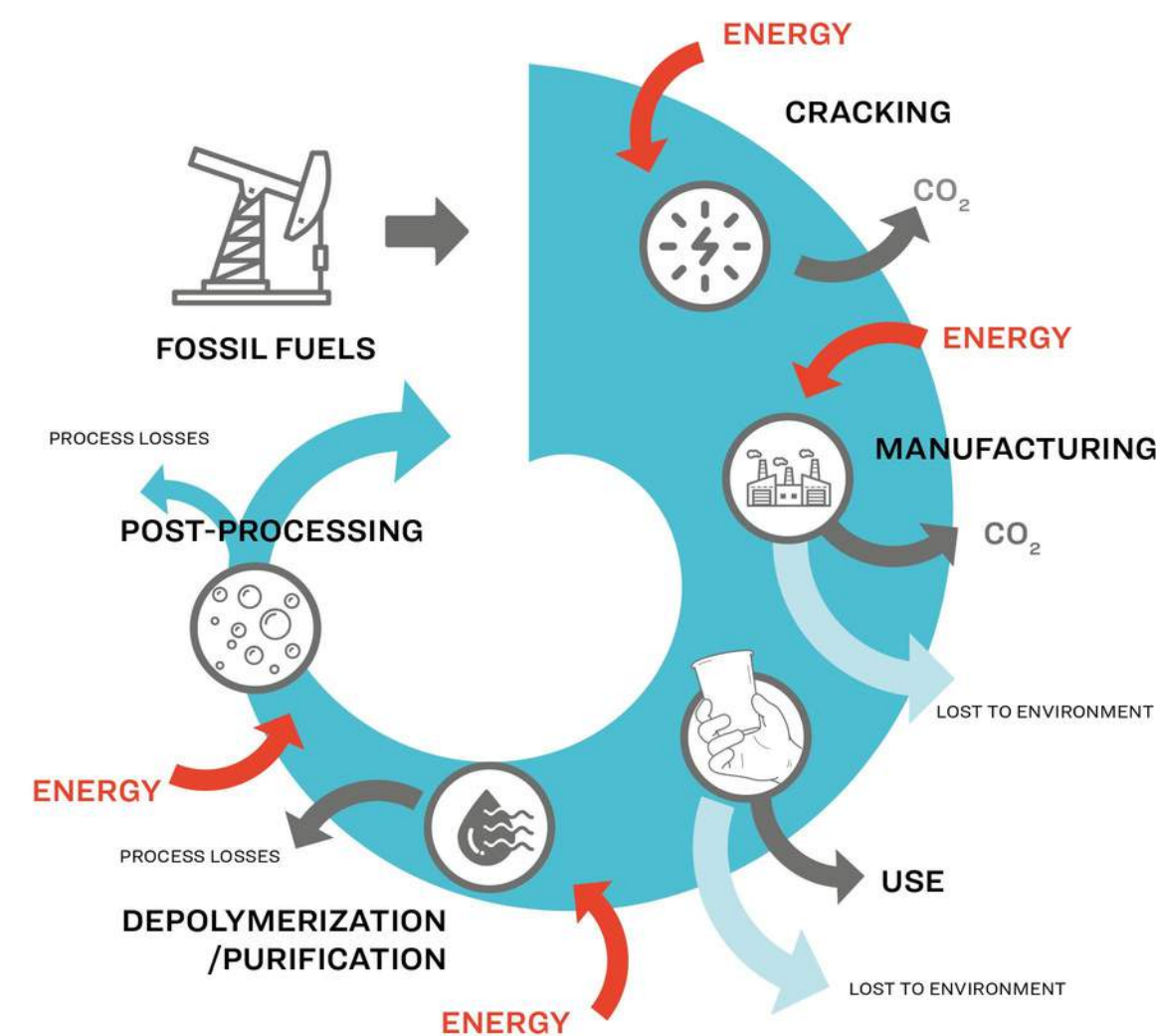
There is low transparency on the levels of toxicity of all chemical-recycling technologies (such as early-stage solvent-based processes), but studies of pyrolysis and gasification show they produce toxic substances. First, they do not filter out chemical additives and contaminants often found in plastic, such as BPA (bisphenol A), cadmium, benzene, brominated compounds, phthalates, lead, tin, antimony and volatile organic compounds. Second, the high-intensive processes themselves produce additional toxic compounds, such as toluene, formaldehyde, vinyl chloride, hydrogen cyanide, PBDEs (Polybrominated diphenyl ethers), PAHs (Polycyclic aromatic hydrocarbons) and tars.⁵⁶ Not only are these toxics problematic in and of themselves, with many

being regulated out of use, but filtering and cleaning the product and by-products (including any effluent and emissions) is also costly and energy intensive – and, even then, results in further outputs of toxic waste. This factor alone serves as a major barrier to viability in its financial burden and regulatory risk.^{57,58,59}

An example of the business risk of toxicity is provided by Solvay's VinyLoop technology for chemically recycling soft PVC – the plastic found in cable coatings and films, as well as a variety of other products, such as carpet backing and vinyl flooring.⁶⁰ Remnant phthalate contaminants in the recycling PVC were found to be hazardous and in breach of EU REACH regulation. Sorting newer, uncontaminated PVC feedstock from legacy material containing the harmful plasticisers was economically unviable, and the plant was forced to close after 15 years of operation, during which it was continuously loss-making.⁶¹

2.3.2. Energy

Chemical recycling is both an energy- and carbon-intensive process and requires large amounts of external energy input, even when burning some part of the feedstock is accounted for.⁶² For P2P, for every tonne of new plastic output, roughly 1 tonne of additional feedstock must be burnt as fuel.⁶³ Even when powered using a more renewable energy mix, the chemical-recycling process itself – particularly in the case of gasification – produces significant GHG emissions, as do refining new plastics during the reprocessing stage and burning resulting fuels in a P2F scenario.⁶⁴



BOX 2: Loop Industries: From hype to high-profile failure



Of the 54 companies whose investments we analysed, ten have invested in Loop Industries. These are predominantly consumer brands, including Coca-Cola, Danone, PepsiCo and L'Oréal;⁸² petrochemical, oil and gas companies have shown little investment interest. Loop Industries is a PET depolymerisation start-up promising to fundamentally reimagine plastic recycling, reaching the holy grail of P2P recycling without adverse water, energy or emissions impacts.

Listed on NASDAQ in 2015, its founder was touted as a 'legendary tech innovator' and the technology heralded as 'becoming the "Intel Inside" of the circular plastic economy' in a 2018 *Forbes* article.⁸³ In May 2019, the company received a capital injection of \$45 million to finance its next stage of growth.⁸⁴ However, the case of Loop Industries reveals a cautionary tale, and underlines how the hollow promise of chemical recycling can fall flat.

Too good to be true? Loop Industries' concept for a proposed recycling factory in partnership with Suez

Credit: Loop Industries

A report by financial research organisation and short-seller, Hindenburg Research, in October 2020 – which included interviews with former employees, industry experts and company partners – accused the company of running a 'smoke and mirrors show'.⁸⁵ Among the allegations levelled against Loop were that it has never turned a profit or generated any revenue, that the 'science' behind the technology is 'technically and industrially impossible', and that its high-profile partnerships with Danone, Coca-Cola, PepsiCo and Indorama have not resulted in a single unit of recycled plastic being supplied.⁸⁶ The report even cast aspersions on Loop's senior-management team, finding that Loop's CEO, Daniel Solomita, had hired into senior management two individuals previously convicted of securities fraud and stock manipulation. This damning research concluded that, 'with a market cap of ~\$515 million, we see 100% downside to Loop once it burns through its ~\$48 million in balance sheet cash'. These revelations from Hindenburg came just after Loop Industries announced it would be building a large recycling factory in Europe, in partnership with French waste-management company, Suez.⁸⁷

The findings were picked up by several media outlets, including *The Wall Street Journal*, contributing to a fall in stock price of more than 39% the same day.⁸⁸ The company continues to exhibit share-price volatility, and recent shareholder dilution adds to its financial uncertainty.⁸⁹ The revelation has led to two separate class-action lawsuits, filed in the Southern District of New York and the Superior Court of Quebec, on the basis that Loop's scientists were encouraged to misrepresent the viability of Loop's process; that the company did not have technology capable of breaking down PET and recovering it at a rate of 100%; that it would not, therefore, realise its commitments to its clients; and that positive statements about Loop's prospects were misleading.⁹⁰ An update from Loop in response to Hindenburg's findings has done little to reassure investors, and has not presented any additional information to suggest the technology has become viable.⁹¹ The status of Loop's project with Suez – to build a recycling factory, due to commence operation in 2023 – remains unknown, and Coca-Cola has terminated its agreement with the company.⁹²

The case study of Loop Industries demonstrates three points. First, that the outsized allure of chemical recycling as a fix-all solution can lead to red-herring companies that capitalise on investor appetite for solutions that fit within the current system. Second, that companies investing in these solutions – such as Danone, Coca-Cola and PepsiCo – are not conducting due diligence but instead leaping on quick-fix opportunities, begging the question: If Loop can pull wool over the eyes of leading consumer brands and outfits, such as the Ellen MacArthur Foundation (of which they are members) which other companies are being misled in a similar way? Finally, the drubbing of Loop Industries is another high-profile failure of chemical recycling, entailing a significant financial risk to investors and raising serious questions about the viability of similar technology.

Chemical recycling is technological unproven, with substantial questions around operational output, energy intensity and technical viability, – making it an investment risk in the short and medium term. Not only that, but its dubious environmental report card also places it against the grain of regulatory developments, which will likely tighten around chemicals and emissions.

At this critical juncture in addressing the plastic crisis, chemical recycling represents a costly distraction from the real issues, and is exposed to considerable risk due to low viability and exposure to regulatory threat.

An assessment of industry-sponsored or -aligned LCAs (including those by BASF, CE Delft and Plastic Energy)⁶⁵ by Zero Waste Europe, Deutsche Umwelthilfe and Naturschutzbund Deutschland found energy and emissions to be a notable weak point, selectively ignored to buoy up the green credentials of the technology by:

- claiming the technologies result in net-negative GHGs by claiming credits from avoided emissions associated with other end-of-life options, such as incineration;
- ignoring or underplaying the significant external energy requirements and associated emissions of the process itself, and of pre-treatment (sorting, cleaning) and post-process clean-up and purification; and
- selectively reporting emissions conclusions (such as those that found chemical recycling to be worse than incineration).
- The result of this energy-intensive system is that the technologies' claims of circularity are unfounded. While mechanical recycling also requires energy input, it requires far less than chemical recycling.⁶⁶

2.4. Viability problems

A recent Greenpeace report analysed the ACC's list of \$5.2 billion of investments in 62 recycling projects – many of them touted as so-called advanced or chemical recycling – and concluded that more than half were not actually true recycling but rather P2F projects, and that about one-third of the proposed projects were unlikely to be viable.⁶⁷ *Plastics Today*, a plastics-industry news outlet, states that even that one-third was likely to be optimistic, and that most chemical-recycling projects announced with such fanfare are in fact '*dead in the water*'.⁶⁸ A 2021 Reuters investigation dug up similar results, with all 30 projects assessed closed down, operating at a fraction of the promised capacity or behind schedule, and three that went public witnessing ever-sinking stock prices.⁶⁹

In parallel to the adverse environmental impacts of chemical recycling are concerns over the viability of the technology as a way of recycling waste plastic. We have broadly grouped these into technical viability concerns and financial viability concerns.

2.4.1. Technical viability

Chemical recycling is beset with problems around yield, scalability and operational failures. Pyrolysis and gasification for biomass, such as wood and coal, are established – if dirty – processes. But for plastic-waste feedstock, the outputs are heavily contaminated, of low quality and require extensive chemical reprocessing to become usable.⁷⁰ For solvolysis, very few are able to scale beyond lab level or become commercially viable due to high operating costs and energy intensity; even then, they must contend with toxic contaminants, the presence of which caused the closure of *VinyLoop*. Rollinson and Oladejo's review of current chemical-recycling technologies found: '*No evidence [...] to support the current claims of technological efficacy of chemical recycling*'.⁷¹

The report also cites industry expert, Rob de Ruiter, in his assessment that it is '*optimistic to consider that chemical recycling of waste plastics will be viable inside the next decade*',⁷² and investment firm Closed Loop Partners' predictions of a full 17 years until growth can be achieved.⁷³

Indeed, an analysis of chemical-recycling projects in the US by the Global Alliance for Incinerator Alternatives found that no plants were turning plastic back into plastic at a commercial scale. Of the 37 plants planned since the early 2000s, only three are operational – and they focus largely on P2F. There is also a lack of yield information across the board from chemical recyclers, leading to uncertainty about how much plastic these plants are actually able to process. Companies such as Brightmark and Agylix, strongly backed by petrochemical and oil companies,

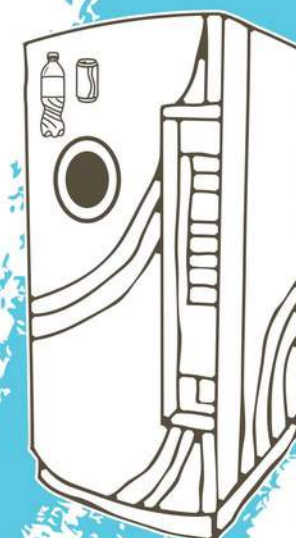
are pushing pyrolysis as a solution to plastic waste.⁷⁴ However, the resultant pyrolysis oil from these processes is highly contaminated, and would have to go through another round of cracking to produce new plastics, or even fuels.⁷⁵ At scale, this is unlikely to meet the strict purity standards for steam crackers.⁷⁶ A Greenpeace report analysing US projects on chemical recycling also found that one-third of the projects were unlikely to be viable and that none of the P2P projects showed promise of viability, with it remaining questionable as to whether they would ever be operational.⁷⁷

2.4.2. Financial viability

Partnerships and investments in chemical-recycling technology have ramped up in the last two years. However, many of the projections made by the petrochemical industry backers of chemical recycling are intended to bolster investor confidence in the technology, rather than being backed up by operational output. Our research showed the fossil-fuel industry's preference for pyrolysis and gasification over P2P, suggesting it is concerned with backing technologies that are merely *perceived* to mitigate the issue of waste management and plastic pollution in the environment – without actually stymying plastic production.

Our research showed 19 fast-moving consumer-goods (FMCG) companies heavily investing in waste-to-energy and/or chemical-recycling companies, the biggest players being Coca-Cola, Nestlé, Unilever and L'Oreal. Yet consumer brands' shows of support should also be viewed with caution. Faced with increasing consumer and regulatory pressure to act on plastic, many are looking to chemical recycling as a silver-bullet solution to deal with hard-to-recycle plastics, and to shift responsibility onto the waste-management sector, rather than investing in redesigning packaging to move away from single-use, non-recyclable packaging and materials. For example, Unilever invested in CreaCycle, which claims to use pyrolysis to convert difficult-to-recycle plastic-sachet waste into industrial fuel;⁷⁸ but a Reuters investigation could not confirm whether this project produces any yield, or is even operating.⁷⁹ Consumer-goods companies are also scrambling to find enough post-consumer recycled feedstock to meet their recycled-content commitments, and the lurch towards chemical recycling to provide the necessary feedstock appears to be a somewhat knee-jerk reaction.⁸⁰ The hype surrounding chemical recycling has already resulted in high-profile, costly failures, which demonstrate the lack of due diligence conducted by even high-profile consumer-goods companies (see Box 2). Indeed, our research reveals a flurry of investment activity and interest in various recycling technologies over the past 18 months, with brands backing multiple horses and focusing more on generating positive headlines in the media than on properly checking the technology behind some of these 'promising' start-ups (see Box 2).

From a regulatory perspective (as presented in Chapter 1), the trajectory is towards more regulation that looks at the intersection of plastics and climate, such as the EU Sustainable Finance Taxonomy and the Just Transition Fund, which pose an existential threat to chemical recycling, particularly P2F (although the latter does not classify as recycling in the EU).⁸¹ Chemical-recycling plants are at risk of becoming the next generation of stranded assets for the plastic industry, if legislators decide to tighten GHG emission standards or best-available-technology requirements. Additionally, EU legislation, such as the Circular Economy Action Plan and the Sustainable Chemicals Strategy, refers to the importance of fully understanding the GHG impacts of chemical recycling – something current LCAs do not provide, while countries like Germany do not allow chemically recycled content to count towards national recycling targets.



3. The primacy of separate collection

3.1. Opportunities for investors in separate collection

While the industry pins its hopes on the development of viable chemical-recycling technologies or other marginal solutions, a clear trajectory towards high levels of separate collection and an increase in effective mechanical recycling is emerging. Coupled with systems of reuse and refill, these techniques have the potential to significantly reduce upstream plastic production and leakage of waste plastic into the environment. Given the current regulatory trajectory and the outlook towards 2030, there are significant opportunities for investors who engage with companies providing solutions to underpin separate collection and mechanical recycling.

The primacy of mandatory separate collection is often underrepresented in discussions around mitigating the plastics crisis, whether from citizens, businesses or governments. Plastic packaging leaks into the natural world because the systems in place to collect it are not fit for purpose. For example, kerbside collection results in mixed and contaminated waste streams need costly sorting and cleaning, with little guarantee that the target materials for recycling will be effectively collected. However, in response to citizen awareness and civil-society campaigning, governments are increasingly looking to introduce mandatory separate collection of different waste streams of plastic to ensure the value of packaging is retained in the system and does not end up landfilled, burnt or leaking into the environment.

Our analysis of global waste legislation shows that combining separate-collection legislation – such as container-deposit legislation (see Box 3) and minimum recycled-content requirements – creates favourable market conditions for high levels of effective recycling and reuse for beverage containers. DRS is the most cost-effective and reliable way to achieve high collection rates for beverage containers, with most systems reaching 90%+ return rates within a few years.⁹³ It also supplies clean waste streams of high-quality recyclables compared to kerbside collection, where items are mixed together, leading to contamination and higher losses during conversion process. Clean recyclables from DRS can be easily and effectively recycled into new materials, reducing overall virgin plastic, aluminium and glass production and improving closed-loop recycling. Beyond stimulating recycling markets, DRS has well-established benefits for the environment. By collecting materials consumed out

A reverse vending machine
for the separate collection
of bottles

Credit: Shutterstock

of the home, studies in the US show that litter from drinks containers is reduced by 70–84%, as consumers are incentivised to return empty containers.⁹⁴ Furthermore, mechanical recycling has been shown to create more jobs than disposal and, when coupled with DRS, creates 11–38 times more jobs than kerbside recycling – another factor making it an attractive policy for governments in uncertain economic times.⁹⁵

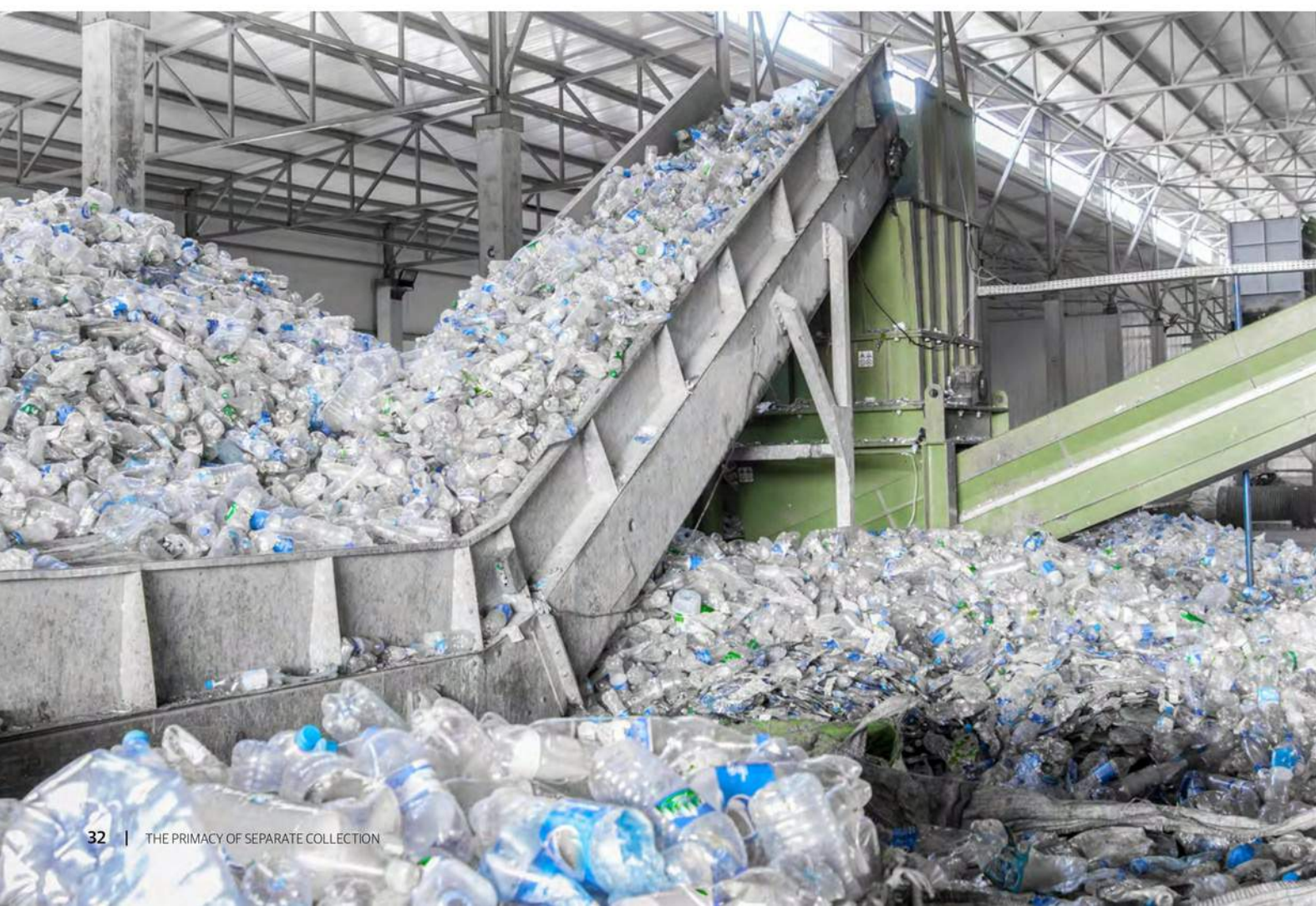
A holistic approach to other forms of packaging and plastic waste is also necessary, requiring high-functioning separate collection and mixed-waste systems to be prioritised alongside mechanisms such as DRS. In such a system, efficient sorting is also required, alongside recycling-and-reuse infrastructure, and mandated through extended producer responsibility (EPR) legislation.

While it is important to recognise that the plastics crisis will not be overcome without mechanisms to significantly reduce virgin-plastics requirements (for example, through a virgin-plastic tax and a modulated EPR fees system) and to adopt widespread reuse and refill (see Chapter 4), policymakers and civil society alike recognise that, in the short to medium term, capacity for collection and effective mechanical recycling will need to be boosted.

Our assessment of the regulatory landscape is that we will see a greater number of government policies on container-deposit legislation, recycling rates and minimum recycled content, and a resulting increase in mechanical recycling. Several factors explain this trend.

First, there is increasing pressure for countries to deal with their own plastic waste domestically, rather than exporting it abroad. New EU rules prohibit the exporting of waste to non-OECD countries from 1 January 2021,⁹⁶ adding to the pressure created by China's National Sword Policy in 2018, which banned the import of waste materials for recycling and turned the global waste trade upside down overnight. Sustained societal pressure to end the plastic-waste trade will continue to mount pressure on governments to improve their own ability to manage waste, rather than relying on being able to ship it out of sight, out of mind.

Credit: Shutterstock

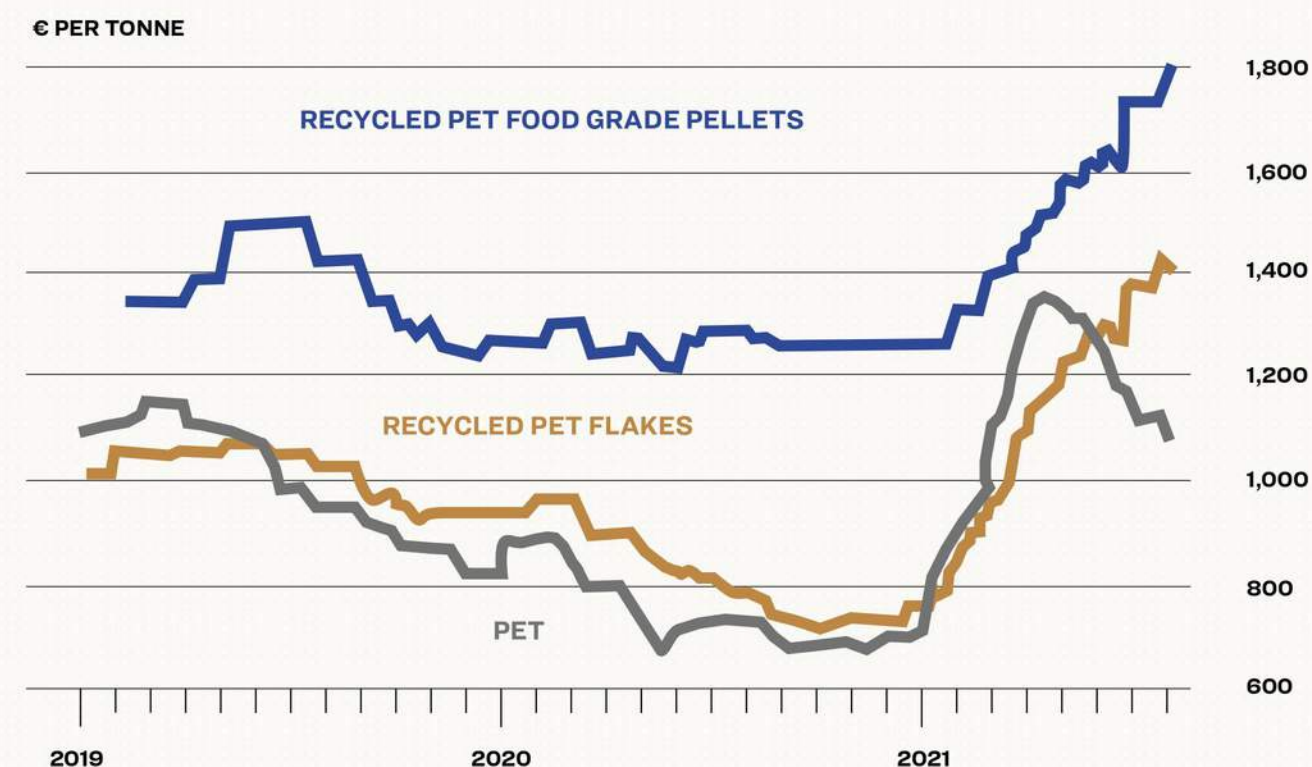


Second, to meet the increasing demand for recycled content and to decrease reliance on the waste trade, domestic capacity for effective mechanical recycling will have to rapidly expand. Effective mechanical recycling refers to the sorting, shredding, cleaning and reprocessing of plastics like PET and HDPE, which can be mechanically recycled and easily constituted into new plastics multiple times. Critically, it is more energy efficient and economical than chemical recycling, with lower resultant emissions.⁹⁷ According to business-as-usual projections from the International Energy Agency, at current trajectories, recycling will increase from 20% to 25% of plastics by 2050 – but that plastic consumption will be 70% higher.⁹⁸ A scenario that sees recycling rates of 60% and collection averaging at 75%, as modelled by the Overseas Development Institute, indicates the level of growth that recycling could experience in the coming years.⁹⁹ Indeed, the quantities of plastics sent to recycling have almost doubled since 2006, suggesting the world is already on a trajectory to meeting this capacity.¹⁰⁰ Modelling by Reloop suggests that 2.78 million tonnes of PET will be available for recycling by 2025 and 3.23 million tonnes by 2030 as new DRS systems come online, offering a significant argument for investment in mechanical recycling.

Third, policy moves to increase recycled content in packaging have gained traction around the world; for example, California's recent recycled-content law, effective from 2022 and the first US state to enact such a bill;¹⁰¹ the UK's £200/tonne plastic-packaging tax on packaging with less than 30% recycled content; and the EU's Single-Use Plastics Directive, featuring a 30% recycled-content obligation for plastic bottles. Coupled with voluntary commitments by companies to match – or even exceed – such targets, it is estimated that recycled PET demand could represent as much as 55% of total PET demand by 2030.¹⁰² The price of recycled PET has already exceeded the price of virgin PET, which will further incentivise the building of new recycling capacity.¹⁰³ Indeed, the combination of legislative pushes for recycled content and business's response have created a very competitive market for recycled materials, especially for food-grade PET. Fashion brands have also already committed to introducing recycled polyester – the majority of which comes from PET bottles – into clothing lines, creating competition and driving price increases.

Figure 3.1 Price of recycled PET overtakes that of virgin

Source: S&P Global Platt



BOX 3: Deposit-return systems and container-deposit legislation

DRS are a highly effective mechanism for collecting large volumes of empty beverage containers in clean waste streams for use in high-quality recycling, or for setting up refill or reuse systems. Container-deposit legislation refers to waste-management legislation that establishes a DRS across a country or state. As of the end of 2020, over 40 jurisdictions have implemented DRS, with many others in preliminary discussions. When these come into force over the next 5–10 years, it is estimated that around half a billion people will have access to DRS worldwide.¹⁰⁴

How it works

First, a retailer buys the product from a distributor, paying for the product plus a fully refundable deposit. This deposit is forwarded to a system administrator – usually a nonprofit organisation, composed of stakeholders from retail and industry, which is responsible for managing the system.

When a customer buys the product, they pay a small deposit – usually around 10c, in addition to the product price – as an incentive to return it later. The retailer sends this deposit to the system administrator. When the customer returns their empty container to the retailer, their deposit is refunded at a counter or reverse vending machine (RVM). The system administrator refunds the retailer’s original deposit plus a handling fee to cover any costs the retailer incurred. The system administrator then arranges for the returned containers to be sent on to recyclers and turned into new material – or, in the case of refill systems, returned to a bottler to be reused.

The system is paid for by three channels: first, by unredeemed deposits; second, from the revenues of the sales of the recyclable materials; and third, by licensing fees that beverage producers pay as part of an EPR policy. DRS can be tailored for different contexts, such as for recycling or to optimise refill and reuse, for low-tech systems without the need for RVMs, or as decentralised systems that retailers operate.¹⁰⁵

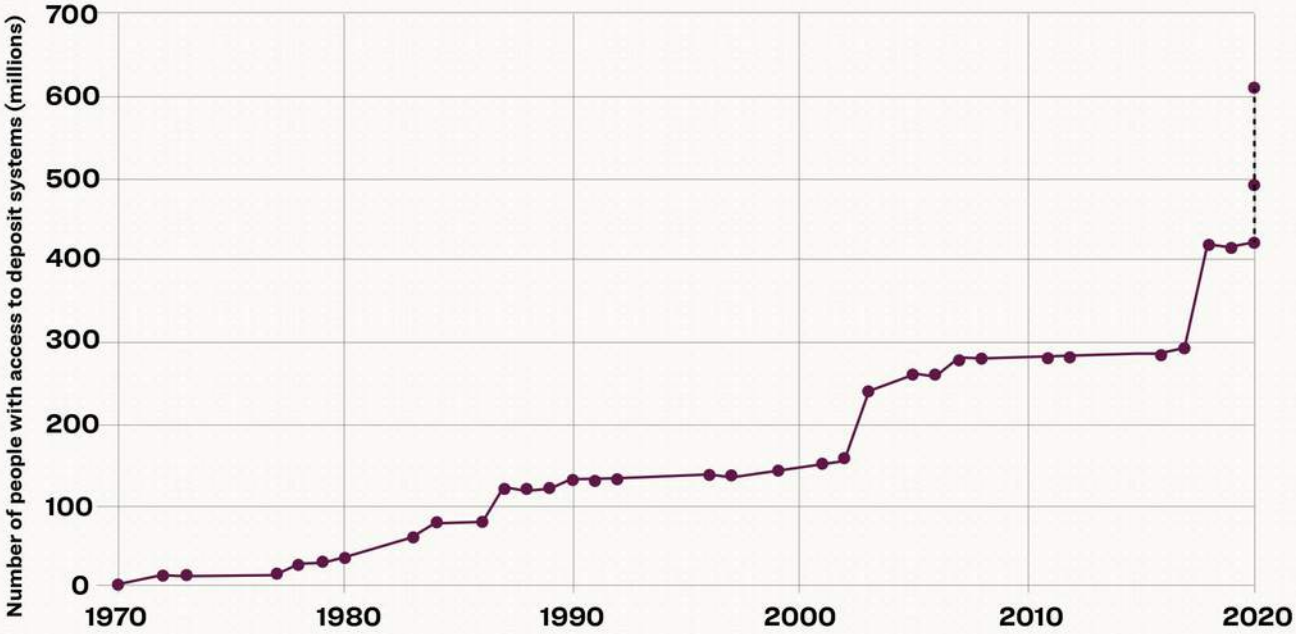
DRS is primarily used for drink containers in the beverage sector, but it could – and should – be expanded to other sectors, such as beauty and personal care, shipment and delivery, and other forms of packaging, such as glass or refillable.¹⁰⁶ Finally, well-implemented DRS is an essential precursor to refill-and-reuse systems, providing investment opportunities for companies in the refill business.

3.2. The winners in a world of separate collection

These wider trends and projections are creating significant opportunities for companies providing the infrastructure for separate collection. Once favourable legislation – such as deposit legislation and recycled-content mandates – have been adopted, the conditions are in place for the market to respond, increasing capacity for infrastructure such as reverse vending machines, optical sorting and washing facilities, and mechanical-recycling plants.

To illustrate this opportunity, Changing Markets researched the market for reverse vending machines and sorting technology in 2020. We looked at global market developments in the coming ten years, including country-specific beverage-container waste generation, and grassroots and NGO willingness to maintain pressure on legislators to act.

To illustrate the market’s potential for growth, in 2017, nearly 300 million people had access to a deposit system. By 2020, a further 15 programmes had been announced for implementation over the next 2–3 years. Analysis by the Container Recycling Institute suggests this will add another 313 million users – more than double the 2017 figure. Deposit systems under consideration elsewhere have the potential to bring this coverage to over a billion people by 2030.¹⁰⁷



After decades of steady growth since 1970, use of container deposit laws across the globe is now expanding rapidly. With new programs coming on-line, in two years these laws will cover 613 million people worldwide – double the number of people covered in 2017.

Figure 3.2: Container-deposit laws: A growing global trend
Source: Container Recycling Institute (2019)

The majority of these deposit systems will be operated through reverse vending machine (RVM) technology, used to collect separated waste streams of empty beverage containers for recycling or processing into rPET, or for recycling cans and glass bottles. The RVM market is occupied by several key players, including Diebold Nixdorf, Envipco, Incom, Kansmacker, Siemens and TOMRA.

The global RVM market is expected to grow 8.4× by 2029, from 84,100 installed machines in 2019 to a potential of 705,257 installed machines in 2029. This growth shows the radical shift in the way communities will deal with their beverage packaging, and thereby the preliminary growth stage of this industry. Performance in the RVM market is typically linked with waste regulation, resulting in high exposure to short-term unpredictability, as well as a certain inevitability to strong growth in the long term. In Europe, taking into account legislative timelines, this growth is likely to emerge in 2022 and to fully develop in the following years (see Figure 3.3).

REVERSE VENDING MACHINE 10 YEAR MARKET POTENTIAL

	Conversion ratios				CDL likelihood	2029 expected install base (x1000)	10 year order potential (x1000)
	RVMs per Million capita	RVMs /billion container	Containers per caapita	RVMs per collection hub			
Europe	559	1:832	352	1,19	90%	240	191
US& CANADA	251	626	825	4	60%	55	43
LATAM	251	626	299	4	20%	47	47
Asia	350	1.000	409	-	50%	330	330
Rest of the world	251	626	200	-	50%	34	26
TOTAL						706	638

Figure 3.3: Reverse vending machine ten-year market potential

3.3. Case study: TOMRA



Analysis commissioned by Changing Markets models the key assumptions from our policy and market research through a discounted cash-flow model. We took a ten-year outlook and modelled five scenarios, with input data based on country-specific RVM studies, conducted by SPAAK Circular Solutions.

Norwegian company TOMRA has built a key position in the collection of post-consumer beverage containers market for the past 20 years. TOMRA's collection-division business is selling, servicing and leasing RVMs. With a revenue of 4,936 million Norwegian krone (NOK) (5.68 billion USD) in 2020, TOMRA Collection accounts for half of the total TOMRA Group and 70% of the global market share. Strong management, strategic acquisitions and an international strategy have helped the company grow far beyond industry average. Beyond generating revenue from RVM unit sales, the company has long-term viability through its leasing and servicing of these machines.

TOMRA has a second core activity: optical sorting. TOMRA Sorting accounts for half of the company, servicing markets in food (32%) and waste (16%). TOMRA's waste sorting sells solid waste-sorting lines to municipalities and bottle-flake purification machines to plastic recyclers for food-grade quality. The food-sorting business, built on the same optical-sorting platform, capitalises on the increasing focus on food safety and reduction of food waste. This second core activity positions the company well in light of waste trade restrictions, meaning countries must now invest in sorting waste domestically rather than exporting mixed waste. Growth is expected in this area as TOMRA builds its technology; for example, the company recently partnering with plastic producer Borealis on a state-of-the-art recycling plant, able to use sorting and mechanical recycling to produce high-quality recycled material.¹⁰⁸

TOMRA's global positioning is a rare and welcome find in today's need for scalable solutions to waste, and has attracted the attention of circular-economy investors, including being included in Blackrock's Circular Economy Fund in October 2019. On 19 August 2021, TOMRA Group represented a market cap of 75.31 billion NOK (8.44 billion USD). From 2015–2018, revenue growth was an average 16.3% – with share price more than doubling in the same period – and in the past ten years, gross margins have consistently been well above 40%. TOMRA's

Figure 3.4: TOMRA share price, in Norwegian krone
Source: Bloomberg (accessed 19 August 2021)

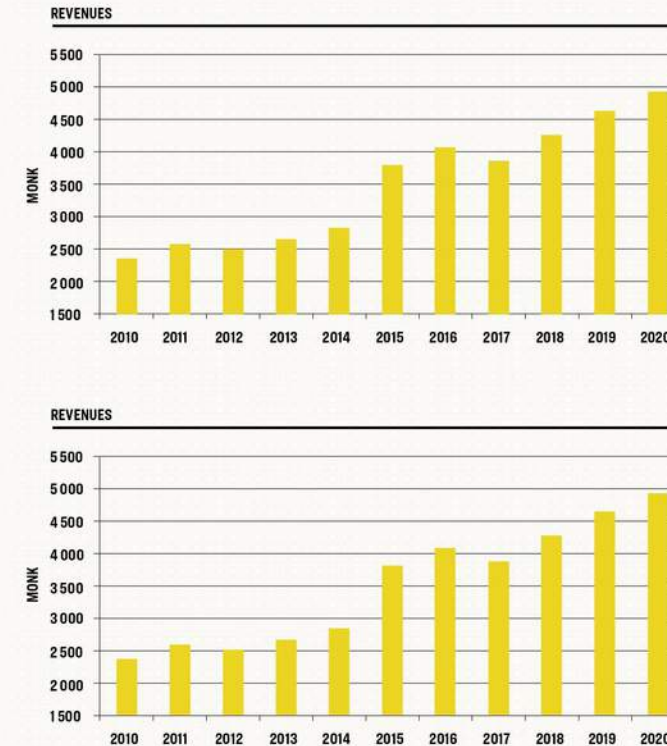


Figure 3.5: TOMRA Group and TOMRA Collection performance

collection division has also seen steady growth, mainly originating from Europe, with growth peaks originating from new legislation. Margins have been kept stable for the past ten years at around 40%.

TOMRA is uniquely positioned because of the increasing deployment of container-deposit legislation with DRS, which dovetails with RVM technology; increased recycling rates, which benefit sorting technology; growing pressure on domestic solutions to plastic waste, due to export bans; and the general gaining of momentum of circular-economy solutions to the waste crisis. Our modelling looked at expected TOMRA sales from RVM order potential out to 2029, in combination with revenue generated from leasing and services of RVMs over the same period. We expect revenue from sales to peak in 2023, and stable income derived from recurring leasing and servicing to become dominant from 2025. Our modelling projects revenue from the collection side of the business to reach 21.04 million NOK (2.4 million USD) by 2027. From 2021 onward, we expect a 4-year above-20% CAGR for the company, with our models discounting market share by 10% due to increased competition in a maturing market.

Figure 3.6: TOMRA order potential and revenues for reverse vending machines
Source: Changing Markets Modelling

(units: 000 NOKs)	10 year total	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Total Europe	190,138	5,897	16,079	18,071	27,677	27,225	19,490	19,122	24,185	16,338	16,052
Toatal Usa-Canada	43,343	626	626	1,257	4,290	3,933	3,933	5,804	10,208	7,985	4,683
Total LATAM	46,880	0	2,344	2,344	3,162	3,162	4,688	10,791	9,376	6,324	4,688
Total Asia	329,798	12,130	21,364	34,752	62,858	65,678	32,980	22,065	32,217	25,251	17,501
Total ROW	26,477	575	1,956	3,626	3,454	3,454	2,245	2,245	3,742	3,339	1,842
Total RVM machines	636,636	19,229	42,370	60,050	104,442	103,451	63,335	60,027	79,728	59,238	44,766

(units: 000 NOKs)	10 year total	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
RVM SALES REVENUE											
Europe	32,463,123.8	1,014,363	2,958,625	3,325,007	4,774,360	4,696,342	3,137,884	3,078,714	3,893,793	2,630,456	2,953,581
Usa-Canada	6,340,674.1	100,133	100,133	201,130	686,436	589,906	589,906	870,539	1,429,059	1,117,883	655,551
LATAM	4,210,691.2	-	281,279	253,151	303,571	303,571	450,046	906,453	787,581	531,249	393,790
Asia	12,841,863.6	424,565	940,029	1,390,091	2,634,339	2,627,100	1,319,191	882,617	1,127,588	883,792	612,551
ROW	3,990,003.3	68,998	312,962	580,118	552,605	552,605	359,153	314,259	523,947	467,523	257,835
Total RVM machines	59,846,356.0	1,608,058	4,593,027	5,749,496	8,951,311	8,769,524	5,856,179	6,052,583	7,761,967	5,630,903	4,873,308

Figure 3.6: TOMRA order potential and revenues for reverse vending machines - Source: Changing Markets Modelling

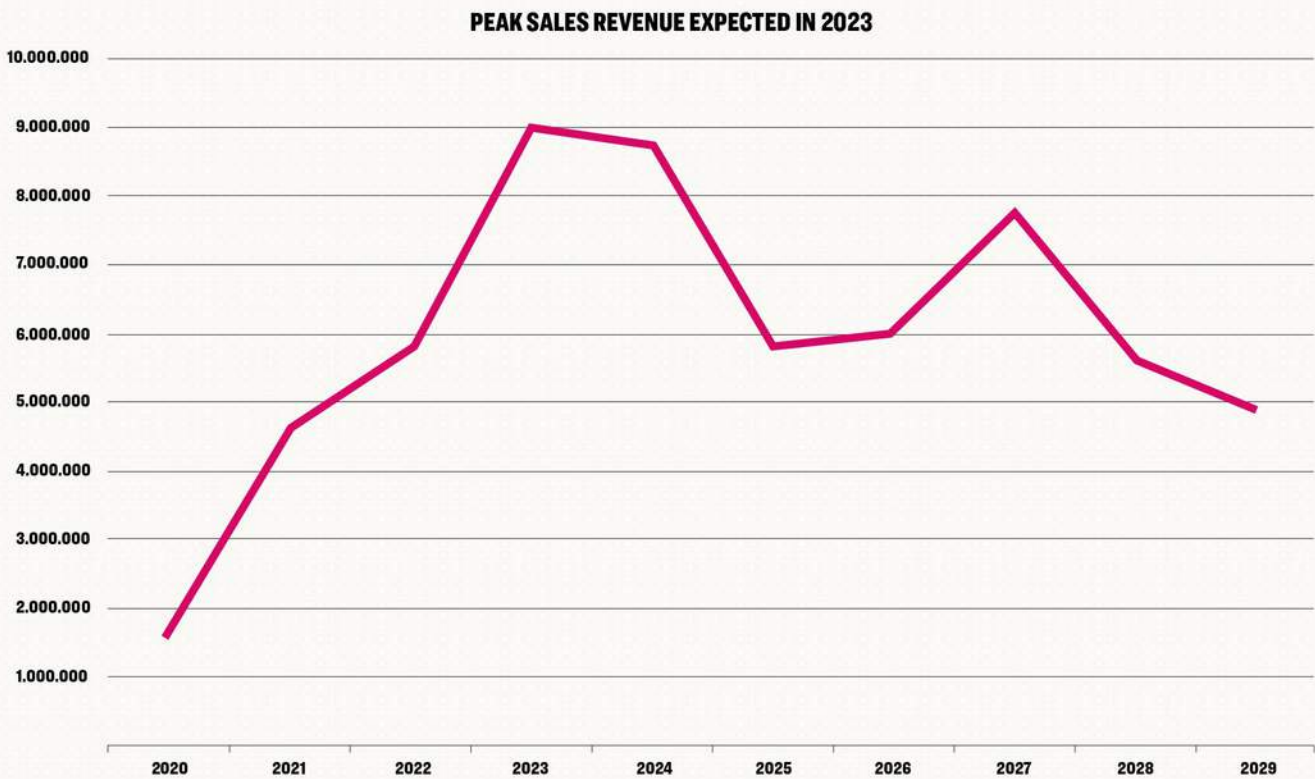


Figure 3.7: TOMRA sales revenue 2020-2029 - Source: Changing Markets Modelling

(units: 000 NOKs)	10 year total	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
RVM TO BE SERVICED		Pre - 2020 RVMs to be serviced										
Europe	59600	64,497	79,577	96,648	122,825	148,550	166,540	184,663	208,148	223,786	239,138	238,438
Usa-Canada	16900	17,026	17,152	17,909	21,699	25,132	28,564	33,868	43,376	50,660	54,643	53,943
LATAM	0	0	2,344	4,688	7,850	11,012	15,700	26,491	35,867	42,192	46,880	46,880
Asia	0	12,130	33,495	68,247	134,105	199,783	232,763	254,828	287,045	312,296	329,798	329,798
ROW	7600	8,175	10,131	13,757	17,211	20,664	22,909	25,154	28,869	32,236	34,077	34,077
Total RVM to be serviced		101,829	142,698	21,248	303,690	405,142	466,477	525,004	603,332	661,170	704,536	703,136

Figure 3.8: TOMRA servicing and leasing, 2020-2029 - Source: Changing Markets Modelling

(units: 000 NOKs)	10 year total	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
TOMRA servicing and leasing, 2020-2029											
Europe	48,686	1,179	3,216	3,614	6,919	6,806	5,847	5,737	7,256	4,901	3,201
Usa-Canada	11,640	125	125	251	858	983	983	1,451	3,062	2,395	1,405
LATAM	11,791	0	0	234	632	632	938	3,237	2,813	1,897	1,406
Asia	74,670	3,639	4,273	6,950	13,172	13,136	6,596	4,413	9,665	7,575	5,250
ROW	6,412	115	391	725	691	691	449	673	1,123	1,002	553
Total RVM to be serviced	153,198	5,059	8,005	11,776	22,272	22,248	14,813	15,511	23,918	17,771	11,824

Figure 3.8: TOMRA servicing and leasing, 2020-2029 - Source: Changing Markets Modelling

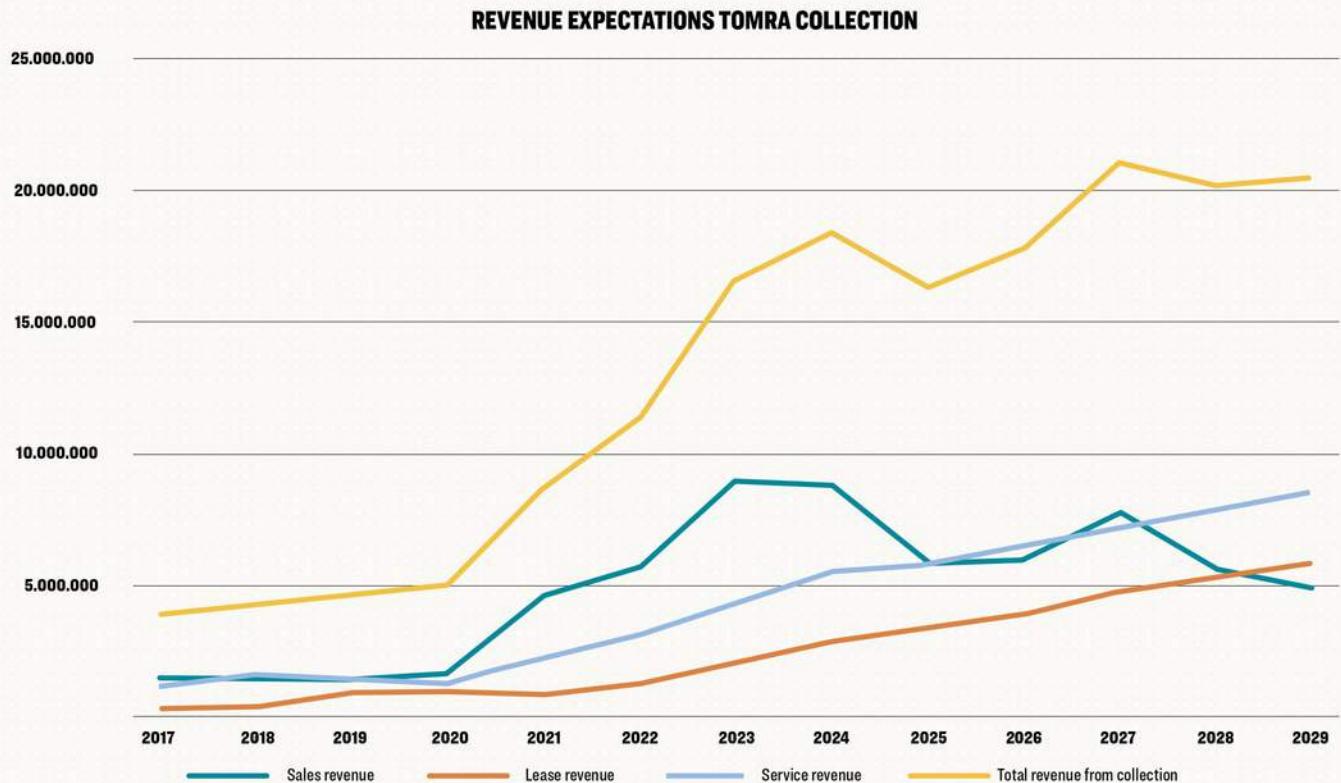


Figure 3.9: TOMRA revenue expectations - Source: Changing Markets Modelling

TOMRA is the only market player with an international distribution and service infrastructure. This gives the company risk-reducing proposition for main customers, like local governments and retail chains. It also enables TOMRA to invest in regions with potential sales peaks and take up capital expenditure for lease contracts. For example, a strategic joint venture with Incom in China gives TOMRA a competitive position in one of the main growth areas for recycling technology.

In a more maturing RVM market, new players will arrive. We estimate market share to reduce by around 10% depending on the region. TOMRA benefits from being a solid and professional company in a slowly maturing waste industry. TOMRA's prospects are illustrative of the opportunity presented by companies within the separate-collection system. The growth in number and scope of key enabling policies of DRS and recycled-content requirements, coupled with undiminished civil-society and consumer pressure, present a very positive outlook for this sector.

3.4. Innovation in DRS: Ball Corporation and Clynk

As DRS become more widespread, conventional deposit systems can be adapted to suit different contexts and circumstances, as illustrated by the innovations of companies such as Ball Corporation and Clynk.

Ball Corporation, a packaging and aerospace company headquartered in the US, has developed serialisation-enabled DRS for better tracking and deposit-return management. The system comprises assigning a unique code to each product so it can be tracked and traced, plus a variety of collection points in common spaces with technology to read the codes.¹⁰⁹ It is flexible enough to adapt to local needs, while at the same time allowing consumers across Europe to buy their beverage in one country and return the packaging with a deposit refund in another. The concept would help to overcome the potential pitfall of incompatible DRS in each country, while at the same time scaling and improving DRS cost structures by ensuring high efficiency and digitalisation of waste markets. Collection beyond the standard 'return to retail', and the potential for 'return to home' DRS, makes consumers' ease of use a key benefit of this system. Most importantly, since any fixed-form package can be serialised, the innovation could lead to DRS in other sectors, such as personal-care products and textiles.¹¹⁰

Clynk, on the other hand, has developed an adaptation of DRS that operates by consumers bagging and tagging bottles and cans for return at designated locations. The patented technology is currently operating in the US states of Maine, Iowa, New York and Oregon, and in New Brunswick, Canada. The technology sends reimbursed deposits into the customer's account after verification, making it easy and convenient for the user, and the system operates without the need for RVMs, showing the system's potential to be used in low-tech environments. Similar to Ball Corporation, Clynk aims for its innovation in DRS to eventually enable consumer recycling beyond containers and into other sectors.¹¹¹

Both of these companies illustrate that, as DRS for beverage containers becomes more widespread and embedded as the norm in more countries, more innovations are likely to occur that pave the way for deposits on other items, such as food containers, personal-care packaging and clothing.



4. The growth of refill and reuse

4.1. About refill-and-reuse models

Refill-and-reuse models are crucial to tackling plastic pollution and achieving a circular economy. Refillable plastic containers can be reused up to 25 times before they are recycled, keeping valuable resources in the production loop, eliminating the need to manufacture new containers and avoiding many of the environmental impacts associated with both production and waste management.¹¹² Although brands and retailers have adopted voluntary refill initiatives for some products, reuse is most effective when underpinned by mandatory DRS, because it establishes the incentives and infrastructure by which containers can be returned. There are four different formats of reusable consumer packaging: refill at home, return from home, refill on the go and return on the go. There is also secondary and tertiary packaging designed for reuse within a supply chain, constructed for multiple trips within a business-to-business (B2B) closed-loop system.¹¹³

4.2. Trends and trajectories

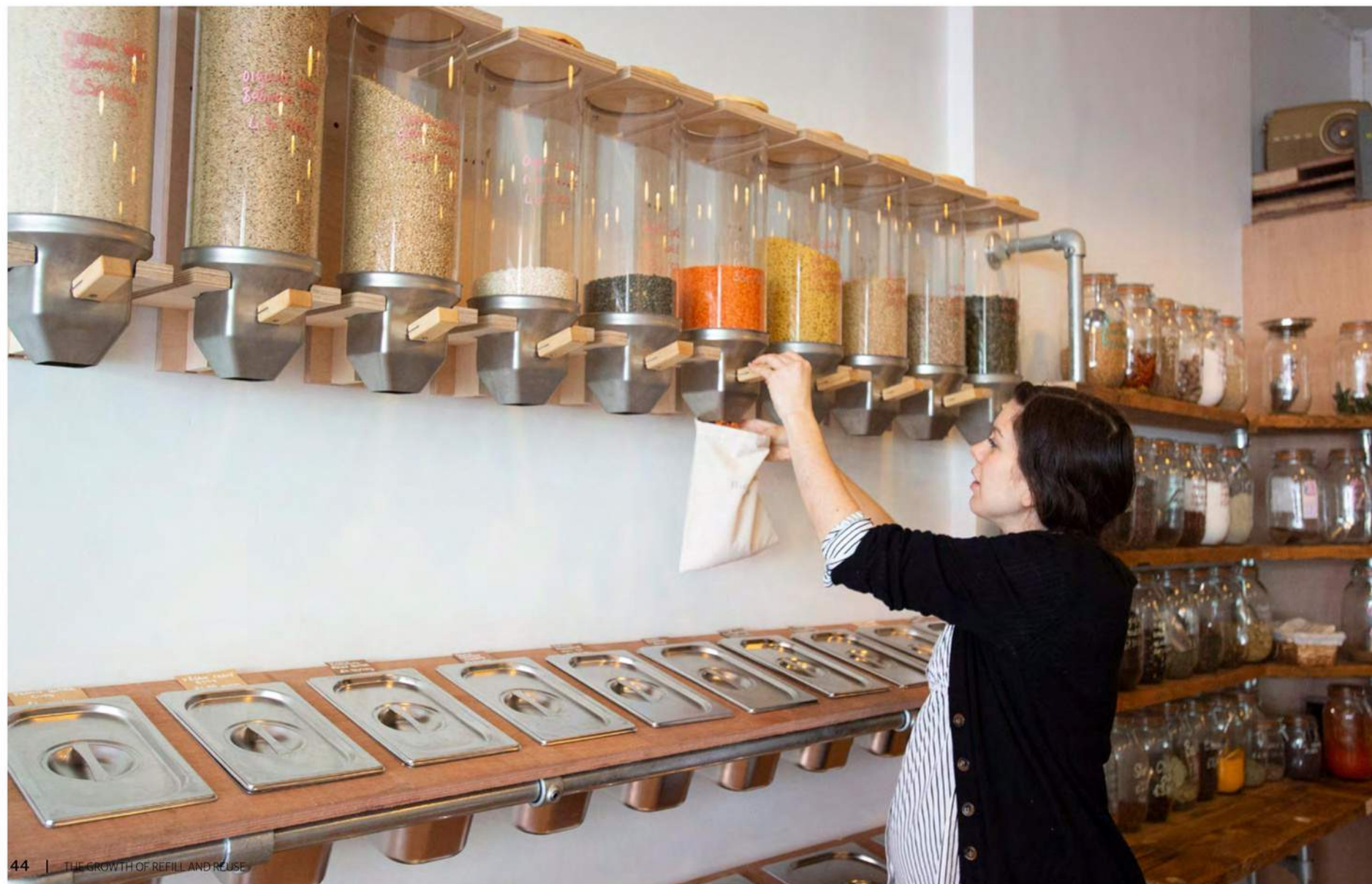
Although the past two decades have seen a decline in refillable containers across the world and the dominance of single-use packaging, a number of factors point towards a gradual reverse in this trend. According to data from GlobalData and Reloop, refillables have not declined in absolute terms – but neither have they grown along with the rest of the market in the past 20 years.¹¹⁴ However, the converging dynamics of consumer demand, legislation and business adaptation towards new delivery models all suggest that refill-and-reuse systems for consumer packaged goods are, once again, on the rise – and present a considerable opportunity for investment in the circular economy.

4.2.1. Projected market growth

The global returnable-packaging market size was valued at \$30.5 billion in 2019, and is expected to grow at a rate of 5.4% from 2020–2027.¹¹⁵ Although this market analysis is primarily focused on B2B provision of returnable transport packaging, it is noteworthy that, in 2019, the food and beverage end-use segment led the market

and accounted for more than 35% of the global revenue share.¹¹⁶ When it comes to refill-and-reuse systems for consumer packaged goods, the food and beverage sector is currently paving the way. According to data analysed by Oceana, in the global non-alcoholic beverage market, refillable systems have an overall market share of 23% by volume. Robust refillable systems currently operate in major markets; in Brazil, Germany, Indonesia, Mexico and the Philippines, refillable systems have well over 30% market share by volume. Most of the top-ten global non-alcoholic beverage markets – including Brazil, China, Germany, India, Indonesia, Mexico and Turkey – have refillable market shares of 26–61%.¹¹⁷ In 2018, the value of the global reusable-water-bottle market amounted to approximately \$8 billion; by 2025, it is projected to reach almost \$11 billion.¹¹⁸

Increasing the market share for refill-and-reuse systems in the beverage sector is more readily achievable in countries with DRS because the mechanism and incentives to return containers are already in place, meaning the consumer does not have to go the extra mile to specifically choose, and then return, refillable containers. DRS creates a level playing field between single-use and reusable, and can additionally be adapted through policy to favour reuse, such as through a differentiated deposit fee or mandatory reuse quotas. Establishing reuse systems for other products may be further down the line, but the Grantham Centre for Sustainable Futures has identified that people are most likely to reuse and refill soft drinks, milk and coffee product packaging, where a precedent is already set.¹¹⁹ DRS also creates business opportunities for intermediary companies that own and lease bottles to beverage producers, which then deliver their products to the consumer (see later examples from Oregon and Germany).



4.2.2. Public opinion and consumer demand

At the root of this projected market growth is pressure from society. Plastic is a growing concern for citizens worldwide. Consequently, there are strong signs of high consumer demand for reusable and refillable packaging and circular models of consumption. For example, in the EU, polls have shown 92% of citizens approve of action to reduce single-use plastic products.¹²⁰ The UK public is increasingly supportive of reuse; a 2020 YouGov poll found that around 60% of people surveyed said they'd be willing to buy dry goods using a reuse scheme, over half said they'd be happy to try reuse for household cleaning products, and two-thirds would prefer it if online shopping platforms made it easier to request less packaging.¹²¹ Furthermore, a recent report from GlobalData suggests this demand stretches beyond Europe, with 71% of Asia-Pacific consumers look for reusable and refillable product packaging.¹²²

4.2.3. Lockdowns shift consumer behaviour

Refill-and-reuse systems have become more popular during the Covid-19 pandemic, as shopping shifted online and brands experimented with direct-to-consumer models.¹²³ Stay-at-home orders and lockdowns have changed consumer behaviour and increased the appeal of doorstep refill services. For example, Chilean start-up Algramo reported a 356% increase in demand between April and June 2020, when Santiago residents were confined to their homes. The start-up Splosh, based in Wales, experienced similar trends. Splosh sell concentrates for a range of home essential items, from shower gels to toilet cleaners, and demand for its subscription-based service peaked in recent months.¹²⁴

4.2.4. Increased regulation

While the majority of legislation to curb the plastics crisis focuses on collecting, recycling and prohibiting certain items, policymakers are also responding to calls to shore up reuse with regulation.

The EU Single-Use Plastics Directive's targets for 90% separate collection of beverage bottles by 2029 – with DRS as the only practical way to achieve this rate – lays the foundation for effective refill and reuse in the European beverage sector. Binding reuse quotas can be used as policy instruments, in conjunction with mandatory DRS (to provide the return infrastructure) and green levies on single-use containers (to create a price advantage for refill).¹²⁵

Linked to this, the European Commission is now reviewing the Packaging and Packaging Waste Directive, with the goal of all packaging on the EU market being reusable or recyclable, in an economically viable way, by 2030.¹²⁶ Civil society will advocate for reuse targets of at least 50–60%, and potentially even higher for sectors where successful models are already in place – like beverages.¹²⁷ In addition to potential legislation at the EU level, there is an increased trajectory of national governments enacting regulation to boost reuse; for example, France's Anti Waste Law intends to increase reusable packaging to 5% of the market by 2023 and 10% by 2027 (although – critically – this does not include plans for a DRS).¹²⁸ Regional Spanish legislation in Navarra and the Balearic Islands requires hospitality businesses to serve 40% of bottled water (50% for the Balearics), 70% of soft drinks and 80% of beer in reusable packaging, and for shops to sell 15% of soft drinks in reusable packaging, by 2028;¹²⁹ and Romania's legislation stipulates that businesses must reach 5% annual average reusable packaging, increasing by 5% year on year to a minimum of 25% by 2025.¹³⁰

COUNTRY REGULATION EXAMPLES



4.2.5. Campaigning pressure

Additional pressure on businesses to switch to reuse systems comes from NGOs; for example, Greenpeace, Oceana and the Environmental Investigation Agency are calling for supermarkets to reduce their plastic footprint by ensuring 50% of their packaging is reusable by 2030.¹³¹ Under this type of pressure, retailers may decide to delist or place specific criteria within their sourcing policies as a key method to decrease their own plastic footprint and to influence the packaging of major brands. Given the enormous scale of the plastics crisis, and ongoing NGO and consumer pressure for change, it is highly likely that future regulation on this issue will become more – not less – ambitious.

4.2.6. Business opportunity

Increased pressure from the public and regulators has already pushed some FMCG companies and retailers to pilot refill-and-reuse systems and trial supply-chain innovations, with the aim of demonstrating they can transition to new models of delivery. There are six main benefits of reuse for businesses: to cut costs, adapt products to individual needs, optimise operations, build brand loyalty, improve user experience and gather intelligence on user preferences and system performance.¹³² The obvious economic benefit of reuse systems is the affordability for businesses – the low cost per trip in the longer term, and a reduction in cost associated with the purchase and disposal of expendable packaging.¹³³ According to HSBC global beverage analysts, beverage companies are beginning to grow their refillable businesses in important markets because of their appeal to more price-driven customers.¹³⁴ This trend can be seen particularly in Latin America; for example, in Brazil, market share has rebounded from the low single digits to over 20%.¹³⁵

The move towards refill and reuse opens up a huge business opportunity; the Ellen MacArthur Foundation shows that reuse provides an opportunity worth \$10 billion if 20% of single-use plastics are replaced by refillable

alternatives.¹³⁶ A number of brands are already capitalising on the opportunity, and early adopters could benefit by being ahead of the curve of this growing market. The consultancy Packhub, which tracks launches, shows that refill-and-reuse launches are up 68% year on year.¹³⁷ The Ellen MacArthur Foundation reports across their packaged-goods signatories – which include 6 of the top 10 FMCG companies globally (by revenue) – 42% are piloting reuse models, but by 2025 this will be 61%.¹³⁸ However, to prove commitment and truly grow reuse models, businesses need to demonstrate they can move beyond pilot projects.

4.2.7. Investor pressure

The adoption of sustainable packaging solutions by companies that wish to improve their brand reputation, coupled with rising regulatory pressure on single-use plastic packaging, is expected to fuel market growth for reusable and returnable packaging.¹³⁹ At the launch of the Oceana report *Just one word: Refillables*, Carlos Laboy – the Global Beverage Head and Latin American Food Analyst at HSBC – noted that “*the global beverage industry is grappling with the risk of brand damage and higher regulatory costs from its outsized reliance on disposable plastic bottles*”.¹⁴⁰ Pressure on the beverage industry for refillable systems is coming from institutional investors, such as HSBC, who have reported that “*the plastic pollution problem could become economically troubling for companies that are not investing in alternate packaging solutions*”.¹⁴¹ HSBC has also been urging companies like Coca-Cola and PepsiCo towards refillables, stating that the companies have focused on actions like increased recycling but could be doing more to reduce plastic through widespread use of refillable bottles, which would also help to differentiate the companies in the minds of consumers.¹⁴² HSBC is not alone in its concern; banks such as Credit Suisse, J.P. Morgan and Morgan Stanley are closely tracking developments in the plastic space, and watching for opportunities to steward the transition to a circular economy.

4.3. Infrastructure opportunities

As with ‘recyclability’, it is important that packaging is not only reusable by design but also part of a system through which it is able to be collected and reused in practice. A priority for investment should therefore be systems and infrastructure that allow reusability to occur, rather than investments in a product that is designed to be reused. Otherwise, given the durability of single-use plastic, there is a risk of greenwashing – where companies label the same single-use plastic products as ‘reusable’, as retailer Mercadona has done in Spain.¹⁴³ However, to date, investment has perpetuated linear models; for example, Green Alliance notes that, in the UK, the highest proportion of public and private infrastructure investment has been in waste-to-energy facilities – or incinerators – rather than targeting infrastructure that would help to grow a circular economy.¹⁴⁴ Shifting investment to essential infrastructure to support effective reuse systems is where the policy landscape is heading, and where the opportunity for growth lies.

A well-designed, mandatory DRS must be the foundation of any successful reuse system. Although mandatory DRS in itself may not be enough for companies to make the switch to refill and reuse, it establishes an infrastructure for return logistics, and is one of the most evidenced and effective ways to support high collection rates of containers (90%+) and ensure good material quality.¹⁴⁵

While the market share of refillables like beer, soda and water bottles has plummeted in Europe – from 47% to 21% in just 20 years – with single-use containers rising by over 200%, countries with DRS in place and a 25%+ refillable market share performed best of all, wasting 7 times fewer bottles and cans than those without either attribute. Of these countries, Germany stands out as best in class; its refillable share is 55%, and it wastes just ten containers per person per year.¹⁴⁶

Figure 4.1: Country regulation examples

Source: Reloop



The expansion of reuse systems will create further opportunity for investment in refill machinery, as well as in localised third-party business and industrial machinery, which provide high-quality washing services at scale to meet necessary hygiene requirements. Dishcraft is one example of such a business; operating in the San Francisco area, it offers a third-party dishwashing service using innovative robotics and AI.¹⁴⁷ Hassia Group, a family company and one of the largest German-brand providers of non-alcoholic beverages, has recently optimised its refill system for glass bottles to increase output by 40% while maintaining environmentally friendly credentials.¹⁴⁸ Investment that supports the incorporation of digital platforms into refill-and-reuse systems can allow businesses to gather valuable information on user preferences, and system performance can be tracked via digital technologies such as RFID tags, QR codes, sensors and GPS tracking.¹⁴⁹

Returnable or reusable packaging products need to be made of durable materials, designed to withstand rough handling through the supply chain and intended for multiple cycles. The average number of cycles can be increased by universal designs that allow containers to be shared across brands, sectors or wider networks.¹⁵⁰ While the initial investment for such containers is high compared to single-use packaging, lower cost per trip can be achieved with increasing trips, which ensures a rapid return on investment.¹⁵¹ Standardised sizes and shapes of reusable containers help to make logistics more efficient by maximising storage and distribution space. The efficiency of logistics can be further improved using a shared pool system, whereby a third-party operator owns the packaging and is responsible for storage, repair and redistribution, thus ensuring barriers in logistics do not interfere with supply-chain operations. This is already happening at scale with refillable beer bottles across the US state of Oregon. The Oregon Beverage Recycling Cooperative, which collects the bottle deposits for the state,

Plastic cava glasses are sold as a greener reusable alternative but are still made of single-use plastic.

also manages the refillable beer bottles and redistributes them to beer manufacturers.¹⁵² The state's DRS is credited as establishing the system conditions to allow a viable refillable option for brewers to thrive.

4.4. Examples of innovative reuse systems

In terms of what a refill-and-reuse system for both glass and PET looks like on a national scale, Germany is a good example. The country has a mandatory DRS, in addition to voluntary reuse quotas, which helps ensure refillable bottles can maintain significant market share. The bottles are standardised, which means multiple participants can use them. Glass bottles are reused up to 50 times and PET up to 20 times.¹⁵³ In Germany, reusable systems exist for beer, water and fizzy drinks, and – to a much lesser extent – juice, milk and wine.¹⁵⁴ The country has also recently approved the extension of DRS to all single-use plastic beverage bottles and cans, regardless of their contents, which is likely to pave the way for increased reuse and refill. Croatia provides another scalable example of reuse: Mandatory national DRS also exists, and the majority of beverages in the beer, water and carbonated drinks categories are sold in refillable glass or PET packaging.¹⁵⁵

Outside the beverage sector, there is more complexity; nevertheless, a raft of forward-thinking businesses are developing innovative reusable and refillable solutions. While the majority of refill-and-reuse systems currently operate on a small scale, there are already good examples of scalable technologies that, with the proper investments and consistent standards, could become the new norm for product delivery.¹⁵⁶

4.5. Case study: Best-in-class reuse systems

4.5.1. Beverage bottles



Oregon provides an example of a successful beverage-bottle reuse system currently operating at scale. The Oregon Beverage Recycling Cooperative runs the state-wide system for reusable glass beer bottles, underpinned by a state-wide DRS.¹⁵⁷



Genossenschaft
Deutscher Brunnen eG

German Wells Cooperative is a cooperative of around 180 mineral-water companies pioneering a successful pool reuse system, whereby crates and standardised refillable glass and PET bottles are shared across the system, to be returned and reused by any participating member, representing 70% of the mineral-water market share.¹⁵⁸ The system refills 1 billion bottles each year, and prevents the use of 5 billion single-use bottles. It has proven to be economically effective, with the same cost structure as single-use.¹⁵⁹



Hassia Group, one of the largest providers of non-alcoholic beverages in Germany, has recently optimised its refill system for glass bottles to increase output by 40% while maintaining environmentally friendly credentials.¹⁶⁰

4.5.2. Coffee cups



RECUP is a reusable coffee-cup sharing system operating across 3,000 vendors in 450 German cities. The system operates with a privately run deposit system, where the customer pays a refundable deposit for the cup.¹⁶¹ Each RECUP can be used 500 times before being recycled.¹⁶²



Muuse is a reusable coffee-cup service, primarily operating in Singapore but also starting up in Hong Kong, Jakarta and Toronto. The system operates on a subscription service for customers.¹⁶³ Likewise, **Usefull** in Boston operates a coffee-cup service on a similar subscription basis.¹⁶⁴

4.5.3. Food containers



Recircle operates in several cities in Switzerland and Germany, offering reusable food containers at 800 partner restaurants in Switzerland and providing reusable cutlery options in Germany. It has over 70,000 containers in circulation. This operates on a privately run deposit system, where the customer pays a refundable deposit for the container.¹⁶⁵

A number of food-delivery services have taken to providing meals in tiffin tins – reusable steel boxes. Examples include **Dabbawala** in Mumbai, **Dabbadrop** in London, **Tiffin** in Brussels and **Dispatch Goods**, **Green Tiffin** and **Planted Table** in San Francisco.¹⁶⁶

4.5.4. Reusable packaging



Repack, based in Finland, provides a solution to the huge amount of disposable e-commerce packaging.¹⁶⁷ The reusable packages are made of durable and recycled polypropylene, made to last at least 20 cycles and come in three adjustable sizes. The packages are designed to fold to letter size when empty, and can be returned via a mailbox anywhere in the world. The customer pays a small deposit for the delivery and its return, which is reimbursed in the form of a discount voucher for the next purchase upon the return of the packaging. Repack works with around 50 webstores in over 10 European countries, and the packaging has an 80% return rate.¹⁶⁸



Koinpack is an Indonesian start-up that provides a reusable alternative to plastic sachets, which are very difficult to recycle. Koinpack buys detergents and shampoos in bulk from FMCG manufacturers and packages them into refillable bottles, which it sells through small neighbourhood stores and at waste banks. Customers get a discount for the product when they return the bottles, and Koinpack washes and refills the bottles to ensure they stay in circulation. The start-up has already partnered with Procter & Gamble and Nestlé to test its business model, and has sold 1,500 bottles to about 200 customers. Koinpack is now seeking early-stage funding, with the aim of expanding within the Greater Jakarta region with 1,000 points of sale by the end of 2021, which is projected to reduce sachet waste by 4 million pieces.¹⁶⁹

LimeLoop

LimeLoop, based in the US, is another pioneer of durable shipping packaging.¹⁷⁰ Its packaging is made from upcycled billboard vinyl and lined with cotton, meaning it is durable, lightweight and can be used around 200 times.¹⁷¹

RETURNITY

Returnity, also based in the US, is another reusable packaging e-commerce solution. The company has developed packaging that they guarantee for 40 shipments, which is simple to use and clean. This means business partners – primarily online shops – can either redeploy the packaging independently or Returnity can manage the return and cleaning of the packs prior to redeployment.^{172,173}

This is not an exhaustive list, by any means; there are numerous examples around the world, evidencing that refill-and-reuse systems are not a flash in the pan – they represent a solid upward trend, which investors should watch closely for future investment opportunities. Smaller start-up businesses also provide an opportunity for venture-capital and angel investors currently looking for a stake in this growing market.



5. Conclusions and recommendations

5.1. The financial sector is primed to respond

The investment community has a vital role to play in the plastic-pollution crisis by responding to legislation and societal pressure, and by employing financial mechanisms to guide the market towards solutions that are on the right path - from financial, environmental and circular-economy perspectives.

From major philanthropy bridging market failures to a proliferation of plastic-related ESG policies and venture capital scanning for the next hot-ticket solution, in the space of a few short years the financial sector has recognised the economic opportunities in scaling up the circular economy. In this regard, we can also look to the trends: In 2018, just one public-equity fund focused (either fully or partially) on the circular economy, compared to ten in H1 2020; in 2016, just three private-market funds focused on the circular economy (including venture-capital, private-equity and private-debt funds), compared to 30 by H1 2020 - a tenfold increase.¹⁷⁴ These funds not only perform better, on average, than their non-circular-economy-related alternatives,¹⁷⁵ they also help to meet demands from financial regulators, which are increasingly realising the financial sector's potential to tackle key challenges like climate change.¹⁷⁶

This proliferation of market responses to the plastics crisis itself creates new difficulties: Difficulties in accessing rigorous, impartial research; difficulties in recognising overvaluation, resulting from ESG hype over silver-bullet solutions; and difficulties in navigating the complex policy landscape around plastic and waste to determine which companies will be the winners of the inevitable transition to zero-waste economies. In this briefing, we have used our analysis of plastics policy, our expertise in the circular economy and our understanding of campaigning and societal pressures to indicate how the next decade will unfold for key technologies in the plastics space.

Our research found a concerning number of banks and financial analysts unknowingly promoting false solutions (such as pyrolysis or ocean clean-ups) and highlighting ineffectual industry alliances (such as the Alliance to End Plastic Waste) that are actually greenwashing distraction tactics, and go against the grain of emerging policy, exposing them to risk. Wishful thinking and media hype around certain chemical-recycling companies and technologies make them seem much more viable and mature than they really are. While there may be a niche

role for some chemical recycling - like depolymerisation - in the future, our analysis shows it is not the panacea to the plastics crisis, and could lead to financial losses for investors.

In contrast, given the surge in policies towards separate collection and DRS, companies providing these services offer an investment opportunity that should be part of any circular-economy portfolio. Our analysis highlights TOMRA in particular, as a publicly traded company with a strong historical performance and 70% market share; but this is an area that should be watched closely for new entrants taking advantage of the regulatory trajectory. Furthermore, the pressure to increase countries' domestic capacity for mechanical recycling - created as a result of bans on exporting waste and new recycling targets and obligations, such as mandatory recycled-content targets - presents opportunities for investors in the separate collection and sorting space.

Meanwhile, the slow but certain shift towards greater reuse and refill is a longer-term, but promising, area of growth. Here, we see more investment opportunities for private equity, such as venture capital, to make a mark and help shepherd promising start-ups into commercial-scale enterprises.

5.2. Recommendations for investors

Institutional investors

- Recognise the environmental and financial risks involved in environmentally unproven chemical-recycling technologies.
- Produce a timebound plan to phase out investment from fast-moving consumer-goods companies that are highly dependent on chemical-recycling technologies to meet recycling targets.
- Restrict financial services, including advisory and asset management, to chemical-recycling companies.
- Include companies that provide services in support of deposit-return systems - including reverse vending machine technology, optical sorting and washing facilities, and mechanical-recycling plants - in circular-economy portfolios.
- Restrict financial service to companies growing their use of single-use plastic packaging.

Private-equity investors

- Provide capital investment into small- and medium-cap private companies operating or providing services in support of refill-and-reuse systems.
- Venture capital is best suited for emerging companies operating refill-and-reuse in the beverage sector, especially in countries where deposit-return systems are already in place.
- Venture capital can also provide investment in emerging companies that operate services in support of beverage refill-and-reuse systems; for example, industrial washing facilities for beverage-bottle refill.
- Angel investment is best suited for small refill-and-reuse start-ups in the non-beverage sectors, particularly business that are developing innovative reuse solutions for coffee, food containers, beauty and personal care.

Impact investors

- Those with an eye to impact investing can make a significant contribution to a future circular economy by investing in refill-and-reuse first movers.
- Impact investors in particular can play a role in investing in infrastructure for separate collection, mechanical recycling, and reuse and refill in economies where circular-economy policy is lacking.

Retail investors

- Publicly traded companies that are set to benefit from the uptake of mandatory separate collection look likely to be stable investments for retail investors.
- Engage with pension providers over the circular economy to ensure pension funds are not shoring up questionable technology, such as chemical recycling.

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