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Perspectives on Plastic—The Imperative for Better Management

Sustainability pressures set to reshape plastics industry.

June 2019

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EXECUTIVE SUMMARY

Sustainability pressures are expected to change the dynamics of plastic consumption with regulation, innovation, consumer preferences, and corporate responsibility all playing pivotal roles.

Certainly, the prolific use of plastics and the negative consequences of disposal is a major sustainability problem that the world must solve. However, we would caution that the media hype around plastic's imminent demise, and the subsequent impact to the industry, is grossly overstated. Our analysis of those industries/sectors most directly impacted support this view, and these insights, in turn, help guide our investment decisions.

Understanding the magnitude of the problem, both in terms of the environmental impact as well as concerns relating to human health, is central to defining plastic's role in a sustainable world. Given plastic's many positive attributes, we believe the sustainability debate should not ultimately be about "if" we use it, but "how" we use it and, crucially, how we dispose of it.

Ultimately, we believe the magnitude of plastic waste will drive change, and this will fundamentally reshape segments of the plastics industry. This paper analyzes the key areas where this reshaping is likely to play out. That said, the changing use of plastic will be gradual and punctuated by regulation and the emergence of technology solutions along the way.

The Positive and Negative Impact of Plastics

Since their introduction in the early 1900s, plastics and plastic packaging have become integral to modern life.

Global demand for plastics has increased twentyfold over the past 50 years, and the International Energy Agency predicts that demand will grow by an additional 45% by 2040, with nearly two-thirds of that growth coming from Asia.

The obsession with plastic is easy to understand—cheap, lightweight, and durable, the material is beneficial to society in a multitude of ways, including:

- **Reducing food waste**—by extending the freshness period
- **Lowering vehicle emissions**—by making cars lighter
- **Increasing energy efficiency**—through improved building insulation

Despite the many benefits, the vast consumption of plastic is a major sustainability problem that the world must solve. Meanwhile, most plastics have a very short life span (less than one year), yet they can take up to an estimated 450 years to break down, creating a major environmental impact if not disposed of properly.

Accordingly, we believe that the sustainability debate should center on how, not if, we use plastic and, most importantly, how we dispose of it.

Scoping the Problem

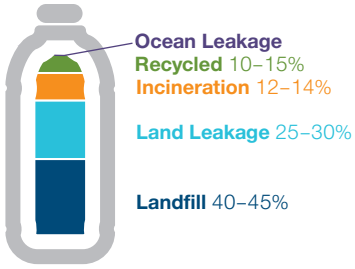
The environmental impacts of plastic are numerous, with implications for human and animal health.

- **Ocean leakage**—Estimates suggest that there are more than 150 million tons of plastic in the ocean, with a further 8–10 million tons leaking into oceans annually. It has been suggested that, by 2050, there could be more plastic in the oceans than fish. Plastic waste harms marine life in many ways:
  - Sea animals ingest plastic, leading to injury or death
  - Natural ecosystems vital to ocean health are polluted
  - Microplastics consumed by marine life make their way into human food chains
- **Land leakage**—An estimated 25%–30% of plastic waste is left on land as it escapes waste collection systems or is never collected. As this plastic waste breaks down, chemical byproducts seep into soil, groundwater, and waterways.
- **Landfill and incineration**—Landfills account for 40%–45% of plastic waste disposal. In many countries, poor disposal practices lead to chemical seepage into soil and waterways. With proper disposal, the environmental impact can be contained. Incineration has negative consequences as it releases carbon back into the atmosphere. However, better practices such as high-temperature incineration can greatly reduce the emissions impact, while the energy generated can be sold as a byproduct.
- **Bisphenol A (BPA)**—BPA is used in harder plastics for use in food containers and drink bottles. While the science is not conclusive, there are concerns about the potential health risk for humans and animals. As such, several countries have restricted BPA usage, and the U.S. has listed it as an endocrine disruptor.

(Fig. 1) Global Plastics—Where Does It All End Up?

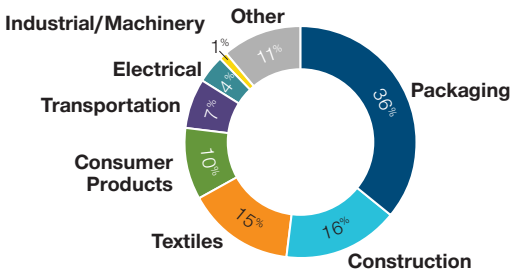
Global plastics end usage by industry, and how it is ultimately disposed of
As of January 2018

Global Plastics Disposal



Source: The New Plastics Economy, Ellen MacArthur Foundation (2018).

Global Plastics End Use



Source: IEA, The Future of Petrochemicals (2018) (adapted from "Production, use and fate of all plastics ever made", Geyer, R., J.R. Jambeck, and K.L. Law (2017).

(Fig. 2) Top 20 Country Contributors for Land-to-Ocean Plastic Waste Leakage

Plastic waste leakage into the world's oceans shows little sign of abating

As of February 28, 2015

		Coastal Population (mln)	Waste Gen. Rate (kg/ppd)	Plastic Waste (%)	Mismanaged Waste (%)	Mismanaged Plastic Waste (mmt/yr)	Mismanaged Waste That Is Plastic Waste (%)	Estimated Plastic Marine Debris (mmt/yr)
1	China	262.9	1.10	11	76	8.82	27.7	1.32–3.53
2	Indonesia	187.2	0.50	11	83	3.22	10.1	0.48–1.29
3	Philippines	83.4	0.50	15	83	1.88	5.9	0.28–0.75
4	Vietnam	55.9	0.80	13	83	1.83	5.8	0.28–0.73
5	Sri Lanka	14.6	5.10	7	84	1.59	5.0	0.24–0.64
6	Thailand	26.0	1.20	12	75	1.03	3.2	0.15–0.41
7	Egypt	21.8	1.40	13	69	0.97	3.0	0.15–0.39
8	Malaysia	22.9	1.50	13	57	0.94	2.9	0.14–0.37
9	Nigeria	27.5	0.80	13	83	0.85	2.7	0.13–0.34
10	Bangladesh	70.9	0.40	8	89	0.79	2.5	0.12–0.31
11	South Africa	12.9	2.00	12	56	0.63	2.0	0.09–0.25
12	India	187.5	0.30	3	87	0.60	1.9	0.09–0.24
13	Algeria	16.6	1.20	12	60	0.52	1.6	0.08–0.21
14	Turkey	34.0	1.80	12	18	0.49	1.5	0.07–0.19
15	Pakistan	14.6	0.80	13	88	0.48	1.5	0.07–0.19
16	Brazil	74.7	1.00	16	11	0.47	1.5	0.07–0.19
17	Myanmar	19.0	0.40	17	89	0.46	1.4	0.07–0.19
18	Morocco	17.3	1.50	5	68	0.31	1.0	0.05–0.12
19	North Korea	17.3	0.60	9	90	0.30	1.0	0.05–0.12
20	United States	112.9	2.60	13	2	0.28	0.9	0.04–0.11
	Worldwide					**31.88**		
	~of which the top 20 countries account for					**83%**		

Data are based on 2010 estimates. ppd = per person per day, mmt = million metric tons.
Source: *Science Magazine,* February 2015, "Plastic Waste Inputs From Land Into The Ocean," JR Jambeck, et al.

The Role of Plastic in a Sustainable World

Given the magnitude of the disposal problem, we believe the plastics industry will be fundamentally reshaped in four key areas: (1) reduced usage, (2) increased recycling, (3) increased incineration (waste to energy), and (4) replacement by plastic alternatives and/or new biodegradable plastics.

Today, the primary focus in terms of reducing plastic waste is on single-use plastics. This is a shift from past decades where the focus was on reducing material usage through making plastic packaging lighter weight. Consumer goods companies are now turning their focus to packaging alternatives and/or redesigning packaging to make it recyclable.

On a global basis, only 14% of plastic packaging is collected for recycling, and only 10% is ultimately recycled. Certain plastic packaging materials are recycled at higher rates—such as polyethylene terephthalate (PET) bottles, high-density polyethylene (HDPE) bottles, and post-commercial films. Some geographies achieve much higher recycling rates, with the difference usually being dependent on recycling economics for the format and region.

PET used in beverage bottles has a higher recycling rate than any other type of plastic, but recycling rates for PET vary by region. On a global basis, it is estimated that only half of PET bottles are even collected for recycling, and then only 7% is recycled, bottle-to-bottle.

In Focus—Plastic and the Packaging Sector

In 2015, plastics made up 25% of global packaging volumes (up from 17% in 2000). Demand for plastic packaging has been driven by increasing applications including food and beverages, personal and household care, consumer electronics, and construction. Most estimates for future growth sit around 4% compound annual growth rate, with food and beverage applications growing at a slightly faster rate than other categories.

While gross domestic product growth will be a key driver of growth in plastic packaging, it is also true that regulators, companies, and consumers are all showing interest in addressing the end-of-life problems that come with plastic packaging. This is especially the case for food and beverage applications, so we believe key drivers of success among packaging companies will be: (1) product innovation and (2) the ability to develop a circular business model.

Highlighted below (Appendix 1) are just some of the regulatory measures that have been introduced, or that are planned, specifically aimed at reducing plastic packaging. Similarly, Appendix 2 details the corporate commitments being undertaken by many of the industry's key customers. (Note: The lists are illustrative and not exhaustive.)

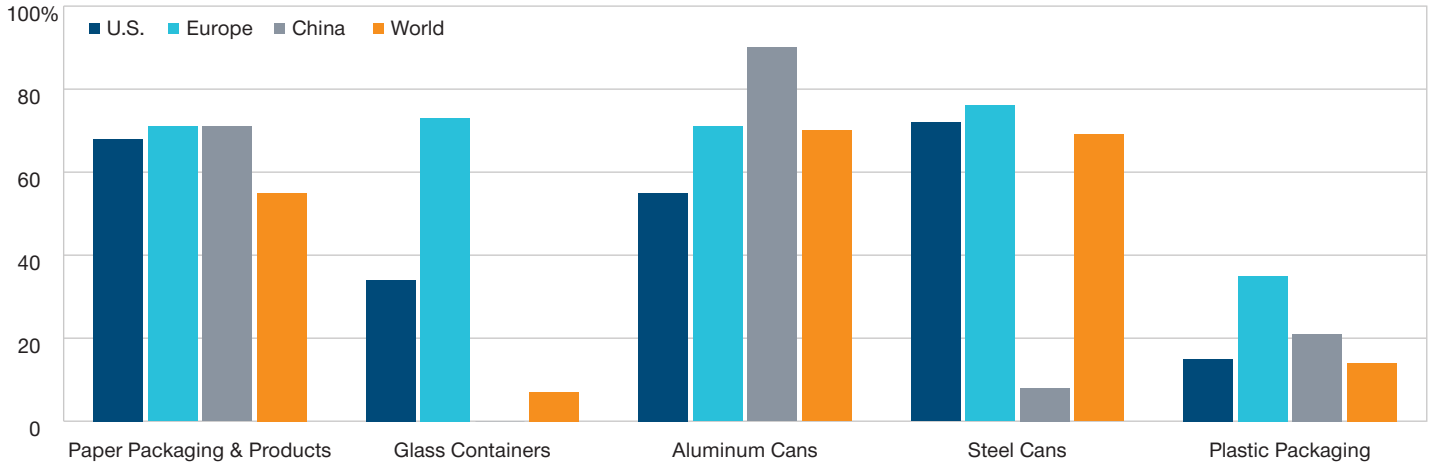
(Fig. 3) Industrial Impact of Reshaping Plastics Usage

Source: T. Rowe Price research.

(Fig. 4) Recycling Rates Vary Notably Between Regions and Materials

Plastic recycling lags other materials significantly

As of December 31, 2015



Sources: MSCI ESG Research, U.S. EPA, *Recycling Today*, Ball Corp., International Paper.

In Focus—Plastic and the Energy/Chemical Sectors:

Petrochemicals account for 14% of oil consumption (13m barrels per day) and 8% of natural gas consumption (300bn cubic meters). Petrochemicals play an important role in the broader chemicals sectors as they account for roughly 90% of chemicals feedstock (raw material that fuels an industrial process) today, but it is light olefins (ethylene and propylene) and aromatics (benzene, toluene, and BTX) that are the precursors to plastics, synthetic fibers, and rubber.

Light olefins and aromatics are collectively known as high-value chemicals or HVCs. These HVCs can technically be made from materials other than oil and gas, such as biomass, water, CO^2, and other carbon sources, but today oil and gas are the cheapest and most prevalent feedstocks. Coal-to-chemicals chains have proven economically competitive in Asia and will see some growth in the coming decade, but they remain small in a global context. (Coal has accounted for 1% of all plastics feedstocks since 1970, while oil has accounted for 74% and natural gas for 25%.)

The entire plastic packaging sector accounts for approximately 36% of petrochemical production.[1] While some companies will have material exposure to production of HVCs for the purpose of plastic packaging production, we don't think this exposure automatically correlates with an extreme sustainability risk. Many of the companies involved will likely end up as solutions providers as packaging products are adapted to solve for their end-of-life problem.

However, we caution that there will be winners and losers in this category, and with government regulation becoming more focused on this issue, demand patterns could change quickly (i.e., in the next five years versus the next 10–20 years). Another important point to note is that the most at-risk companies tend not to be that closely tied to their end market. They simply sell a commodity product into a global market. As such, it is possible that company managements may not be best positioned to see the change coming.

Figure 5 indicates that only 2% of global plastic packing demand is currently "displaced" through closed-loop recycled feedstock. If closed-loop recycling methods gain traction around the world, this would be a small, but persistent, drag on volumes for the petrochemicals sectors. Each ton of polyethylene recycled replaces 1.5 tons (or 11 barrels) of oil.

The petrochemicals chain also faces a sustainability issue in its synthetic fibers segment, which accounts for approximately 15% of petrochemicals production. Studies conducted by the Circular Fibers Initiative and Ellen MacArthur Foundation indicate that 63% of feedstocks into clothing is plastic (Figure 6). Furthermore, only 13% of the total material input in the apparel industry is recycled, with the majority going into lower-value products such as insulation and furniture filling.[2]

[1] The Future of Petrochemicals, OECD/IEA December 31, 2018.

[2] A New Textiles Economy: Redesigning Fashion's Future, Ellen MacArthur Foundation (January 31, 2017).

The CO^2 Impact of Plastic

A unique aspect of petrochemical production is that hydrocarbons are used as a feedstock, with about half of the sector's energy consumption used as a raw material and not combusted. Two of the main hydrocarbon feedstocks are naphtha and ethane. Naphtha is primarily derived from crude oil, while ethane is more prevalent in natural gas and natural gas liquids. The majority of ethylene is produced using a process called "steam cracking", a thermal process where hydrocarbons are broken down, or "cracked" into smaller molecules that are then used to manufacture more useful (and valuable) chemicals.

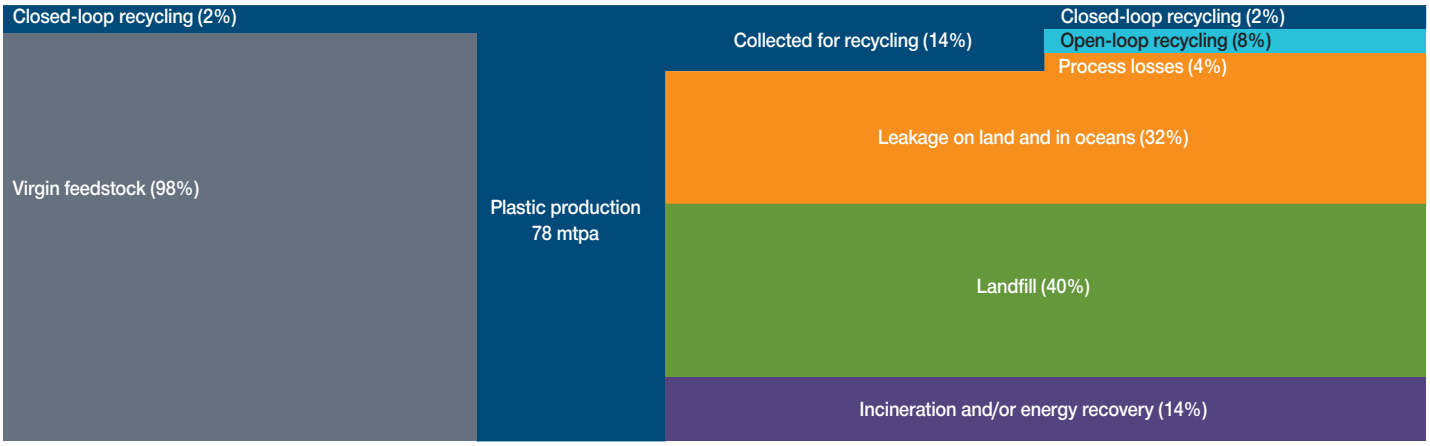
Looking more carefully at the emissions released in the manufacturing process, ethane crackers are far more efficient, releasing 1–1.2 tons of CO^2 per ton of ethylene produced, compared with naphtha crackers releasing 1.8–2.0 tons of CO^2 per ton of ethylene produced.

Bioplastics

While the economics for plant-based plastics remain challenging, we do see a lot of research and development and pilot projects going into bioplastics today. The benefits of bioplastics are that no fossil fuels are required to make the

(Fig. 5) Global Flows of Plastic Packaging Materials

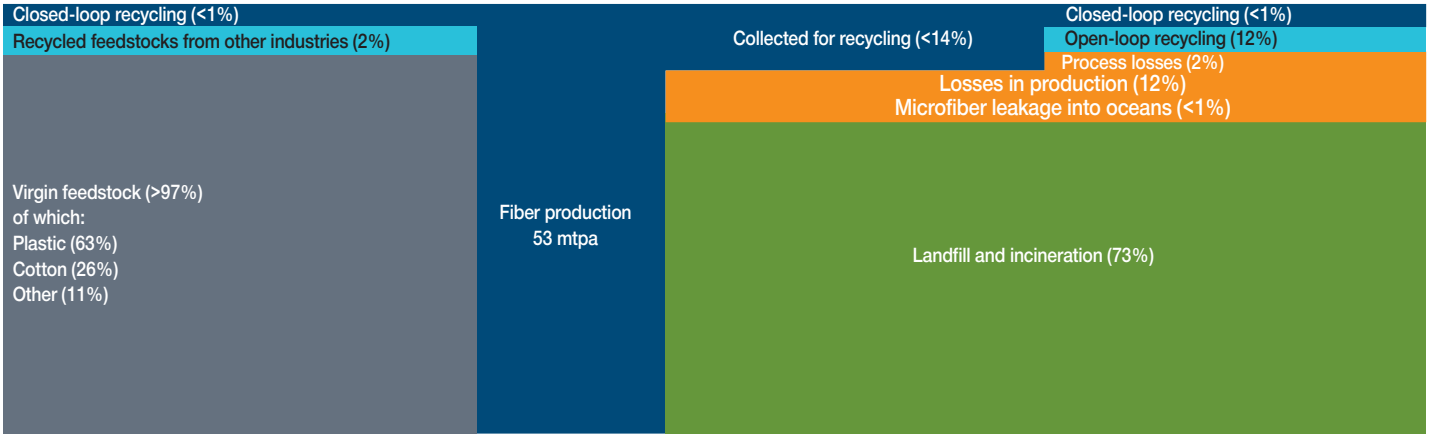
As of January 31, 2018



Source: The New Plastics Economy: Rethinking the Future of Plastics, Ellen MacArthur Foundation (2018). Analysis based on 2013 data.

(Fig. 6) Global Flows of Clothing Materials

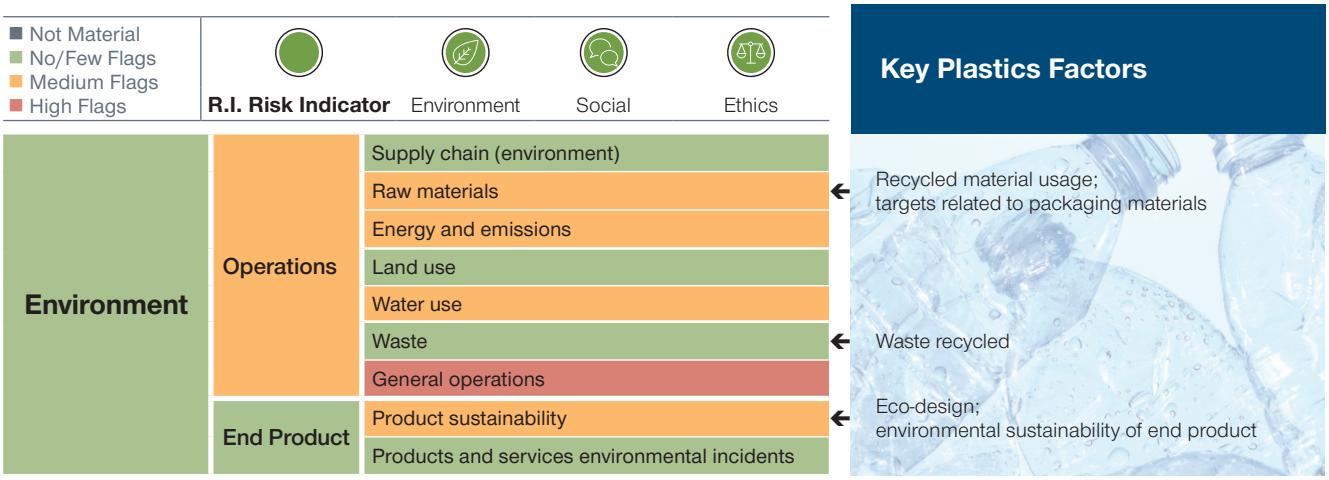
As of January 31, 2017



Source: A New Textiles Economy: Redesigning Fashion's Future, Ellen MacArthur Foundation (2017). Analysis based on 2013 data.

(Fig. 7) Plastics Factors Incorporated Into T. Rowe Price Research

Proprietary RIIM analysis rates companies on their plastics sustainability



product and they break down more quickly than traditional plastics. However, even if the economics were right, there are some notable drawbacks to the implementation of bioplastics. First, they must be separated from traditional plastics in the recycling process. Second, they are not as strong as fossil fuel-based plastics. And third, the amount of plant-based materials required is significant. To replace 3% of the global plastics market, 5% of global corn crops would be required.[3]

Factoring Plastics Sustainability Into T. Rowe Price's Responsible Investing Indicator Model (RIIM)

Our proprietary RIIM incorporates a broad range of plastics-related factors, varied across subindustries, against which we then measure and score companies on their plastics sustainability. An example model output is illustrated in (Figure 7, above). Note that this is not an exhaustive list of factors.

In Conclusion

The prolific use of plastic and negative consequences of its disposal are major sustainability problems that the world needs to solve. However, we would caution that the negative media hype around plastic and its imminent demise, and the subsequent impact to the industry, is grossly overstated.

Indeed, as we consider the various business impacts that could come from moving to a more sustainable world, plastic does not reside in the highest-risk category. This is because cost-effective substitutes are not readily available, and many of the companies targeted will likely be solutions providers as packaging products are adapted to solve their end-of-life problem.

[3] Plastic Pollution FAQs, HSBC Research (November 15, 2018).

(Appendix 1) Government Regulation Affecting Plastic Packaging

As of December 31, 2018

Country/Region	Regulation	Enacted/Targeted
Denmark	Plastic bag tax	1994
Italy	Ban on non-biodegradable plastic shopping bags	2011
California	Single-use plastic bag ban	2014
UK	5p charge for plastic bags Ban on microbeads in cosmetics Plastic bag tax	2015 2017 2017
China	Ban on import of plastic waste	2018
Malaysia	Revoked 114 licenses for factories processing plastic waste	2018
Vietnam	Announced no new waste import licenses would be issued in the country	2018
Thailand	Ban on import of plastic waste	2021
India	Pledge to ban single-use plastics	2022
UK	Tax on all packaging with <30% recycled content (still subject to consultation)	2022
Australia (target)	All packaging to be reusable or recyclable	2025
France (target)	Recycle 100% of plastics	2025
EU (target)	55% of all plastic waste to be recycled	2025
EU (target)	Reduce plastic bags usage from 90/person/year to 40/person/year	2026
UK (target)	Zero avoidable plastic waste	2042

Source: T. Rowe Price research.

(Appendix 2) Corporate Commitments Concerning Plastic Packaging

As of December 31, 2018

Company	Commitment	Enacted/Targeted
AB InBev	50%+ of packaging is reused (refilled 20x–30x)	Enacted
Adidas	Using ocean plastics in shoes (1m shoes using ocean plastic content were sold in 2017)	Enacted
Britvic	All plastic bottles are 100% recyclable	Enacted
Coca-Cola	All drink packaging is 100% recyclable All drink packaging has 25% recycled content	Enacted Enacted
Ecover (SC Johnson)	All packaging recyclable, reusable, or compostable	Enacted
Werner & Mertz	100% of packaging is recyclable 100% recycled content to be used in 70m bottles (estimated 65% of volumes)	Enacted Enacted
Ecover (SC Johnson)	Introduce recycled content into bottle caps	2018
Waitrose	Remove all black plastic in meat, fish, fruit, and vegetable products	2018
Marriott	Eliminate plastic straws	2019
Unilever	Publish full plastics palette	Before 2020
Ecover (SC Johnson)	100% recycled plastic in all bottles	2020
Ikea	Zero single-use plastics on products or in restaurants	2020
Pernod Ricard	Zero plastics at point of sale	2020
Procter & Gamble	90% recyclable packaging across divisions Reduce packaging per customer by 20%	2020 2020
Starbucks	Eliminate plastic straws globally	2020
Adidas	100% recycled bag usage	2024
Amcor	Pledge to develop all packaging to be recyclable	2025
Evian	Make 100% of bottles from plastic packaging	2025
L'Oreal	All plastic packaging to be rechargeable, refillable, recyclable, or compostable	2025
Marks & Spencer	100% of UK plastic packaging to be recyclable and widely recycled Exploring developing all plastic packaging from one polymer group	2022 (UK only) 2025
Coca-Cola	100% of packaging to be recyclable	2025
Mars	Work toward 100% recyclability of packaging	2025
PepsiCo	Make all packaging recyclable, compostable, or biodegradable Increase recycled material in plastic packaging Increase recycling rates Reduce its packaging's carbon footprint	2025 2025 2025 2025
Unilever	100% reusable, recyclable, or compostable plastic packaging Source 25% of its resin from post-consumer recycled content	2025 2025
Waitrose	All packaging to be widely recyclable, reusable, or home compostable	2025
Walmart	100% of private brand packaging to be recyclable	2025
Werner & Mertz	100% recycled content to be used in all bottles	2025
Coca-Cola	Help collect and recycle 100% of packaging it sells 50% of packaging to be from recycled content	2030 2030
Iceland	In-house brands to be plastic-free	2030
Lego	Plastic packaging to be sourced by sugar cane (unclear on % of total)	2030

Source: T. Rowe Price research.

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ID0002187 (06/2019)
201905-847091