Plastic Pollution Prevention Final Report

The Impact of Beverage Brand Commitments for Recycled Content on the Flow of Plastic Bottles into Aquatic Environments

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Report for Oceana

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Executive summary

Marine debris is a high-profile environmental issue owing to its widespread and long-term impacts. A very high proportion of debris entering oceans is comprised of plastic (~ 75%).[1] Large-scale production and use of plastics only began in the 1950s, however as of 2015 approximately 6,300 million tonnes (Mt) of plastic waste had been generated. Only 9% of this plastic has been recycled, leading to a significant accumulation of plastic pollution in both terrestrial and aquatic environments (freshwater and marine). A recent estimate is that 19-23Mt of plastic waste generated in 2016 will enter the aquatic environment (11% of total plastic waste generated in 2016).[2]

The objective of this study is to assess the impact of the plastic pledges of five major beverage brands, to understand what they would mean in terms of reducing emissions of plastic bottles to the aquatic environment[3]. These pledges include increasing post-consumer recycled (PCR) content in their polyethylene terephthalate plastic (PET) bottles. To fulfil these pledges, more used plastic bottles – which if not collected could be mismanaged or littered and make their way into aquatic environments – will need to be recycled back into new bottles. This work was also carried out to create insights to inform the case for refillables, building on Oceana's previous work that estimated the potential that increasing the use of refillable bottles has for reducing this type of pollution.[4]

The work demonstrates that if the five brands meet their recycled content targets, there will be a 7% reduction in the contribution of used non-alcoholic ready to drink (NARTD) PET bottles to aquatic pollution. This relatively limited effect is because bottles used for recycling are expected to predominantly be derived from already collected and managed waste streams and not from mis-managed waste or littering. If the recycled content targets are not met – and in many regions there is not yet a coherent strategy in place to meet these targets - the reduction in ocean pollution will likewise be smaller.

To achieve a more significant reduction in PET bottles entering aquatic systems, a strategy to increase the use of refillable PET bottles could be considered. In 2020, Oceana published a

[1] Hardesty, B.D., and Wilcox, C. (2017) A risk framework for tackling marine debris, *Analytical Methods*, Vol.9, No.9, pp.1429–1436

[2] Borrelle, S.B., Ringma, J., Law, K.L., et al. (2020) Predicted growth in plastic waste exceeds efforts to mitigate plastic pollution, *Science*, Vol.369, No.6510, pp.1515–1518

[3] This study examines the emissions of non-alcoholic ready-to-drink (NARTD) PET bottles to the **aquatic ecosystem**, which includes major rivers, lakes, and oceans. Other studies, namely Jambeck *et al.* (2015) and Oceana (2020), focus explicitly on emissions to marine ecosystems. As such, there are references to both aquatic and marine ecosystems throughout the report, however, they have been applied appropriately to the study in question.

[4] Oceana (2020) Just one word: refillable. Available from: https://oceana.org/sites/default/files/3.2.2020_just_one_word-refillables.pdf

report which found that increasing the market share of refillable bottles by only 10% in all coastal countries in place of single-use PET bottles could reduce PET bottle marine plastic pollution by 22%, or by as much as 7.6 billion bottles. [5] A strategy based on refillables is not inimical to recycled content objectives – indeed refillable bottles can themselves contain high levels of recycled content.

E.1.0 Approach

This report:

- provides estimates of current emissions of beverage bottles to the aquatic environment;
- examines how the five brands' recycled content commitments would influence the bottle collection requirements;
- explores what effect this might have on aquatic litter; and
- discusses alternative scenarios for bottle management.

To support this a model was produced to estimate mass flow for SUP and refillable PET bottles and end destinations in terms of waste management and emissions. This was based on many sources of information. The base dataset is sales data for beverages sold in refillable and single-use PET bottles for 93 coastal countries, where commercial data on use of PET and beverage sales was available.[6] The emissions model is principally based on methods published by Lebreton and Andrady (2019)[7] and Borelle *et al.* (2020)[8]. Collection for recycling, deposit system return rates, recycling losses and the relationship between the type and coverage of waste collection and littering were based on desktop research, previous Eunomia reports and research, as well as ad hoc consultation with stakeholders.

E.2.0 Results

E.2.1 Current consumption of PET bottles and quantification of aquatic litter

The non-alcoholic ready-to-drink (NARTD) sector in the 93 countries currently places around 511 billion PET bottles on the market per year, weighing around 14.3Mt.

[5] Ibid
[6] Source: HSBC analysis of Global Data
[7] Lebreton, L., and Andrady, A. (2019) Future scenarios of global plastic waste generation and disposal, Palgrave Communications, Vol.5, No.1, pp.1–11
[8] Borrelle, S.B., Ringma, J., Law, K.L., et al. (2020) Predicted growth in plastic waste exceeds efforts to mitigate plastic pollution, Science, Vol.369, No.6510, pp.1515–1518

Table E1: Summary of PET beverage bottle consumption in 93 countries (2018)

	SU PET PoM	Refillable PET used	Total PET bottles used
Billion units	487.66	23.18	**510.84**
Weight (Mt)	13.63	0.64	**14.27**

It has been estimated that 29.1 to 51.8 bn PET bottles entered the aquatic environment in 2018, representing 5.7% to 10.2% of all PET bottles placed on the market (PoM), i.e. used by consumers. This equates to between 0.8 and 1.4 Mt.

Table E2: Estimates of PET bottle emissions to the aquatic environment by 93 countries (2018)

	Tonnes	Bottles (million units)	% PoM/used
Low emission scenario	**812,424**	**29,110**	5.7%
Mid emission scenario	**1,001,764**	**35,849**	7.0%
High emission scenario	**1,449,333**	**51,772**	10.2%

E.2.2 Brand commitments on recycled content and increase in bottle collection required to meet them

Most brands provide little detail on bottle-specific targets and rather define their targets across their total plastic packaging portfolio. Most brands are aligned with the targets set out in the Ellen-MacArthur Foundation (EMF)'s Global Commitment of the New Plastics Economy (25% PCR by 2025) with Danone and Nestlé aiming to go further with commitments for 50% and 30%, respectively.

In order to assess the implication of brand commitments on recycled content, these targets were translated into commitments for bottles (Table E3).

Table E3: PET demand in the NARTD sector (in Mt)

Brand	Market Share	PET bottles PoM	Total rPET available (derived from bottles)	Total rPET available (for bottle production)	PCR content target (by 2025)	Demand by brand
Coca-Cola	21.3%	2.90		-	25.0%	0.73
PepsiCo	8.2%	1.12		-	25.0%	0.28
Dr Pepper Snapple	1.2%	0.16		-	25.0%	0.04
Danone	3.2%	0.44		-	50.0%	0.22
Nestlé	5.1%	0.70		-	30.0%	0.21
Others	61.0%	8.31		-	13.9%	1.15
Total	100.0%	13.63	4.46	1.07	-	2.63

The five brands assessed in this study have a combined market share of approximately 39%. Taking into account the market share, individual commitments and adding the expected additional rPET demand of other brands expected to be maintained fairly close to current levels at 13.9%, the total rPET demand for the NARTD sector was estimated to be approximately 2.63 Mt by 2025 (Table E3). Of the total rPET produced from NARTD bottles placed on the market annually (4.46 Mt), only an average of 24.0% (1.07 Mt) is expected to be used in the same sector, with the remainder cascading into other PET products such as non-food contact bottles, other PET packaging and fibres. This results in a shortfall against demand of approximately 1.56 Mt (59.2% of total demand).

To meet this demand, an increase in the collected tonnage of PET bottles of 2.57 Mt is required. This collected tonnage needs to exceed the 1.56 Mt shortfall, as the sorting and processing of those bottles collected for recycling results in losses and not all recycled PET returns to bottles. The overall collection for recycling rate modelled to meet this was 62.4%, an increase of 18.8 percentage points on the baseline rate of 43.6% for PET bottles.

E.2.3 Aquatic litter impacts of collection scenarios

Collection rates and aquatic litter impacts of two scenarios were compared and considered:

- **Current scenario**: under existing levels of waste collection and mismanagement.
- **Five brand commitment scenario**: assumes that that the brand commitments are met successfully by the collection of the modelled tonnage requirement (this is a best case scenario for this approach as there is no guarantee these commitments can be met).

Although it is commonly held that the more bottles are collected for recycling, the fewer bottles that end up in aquatic ecosystems, the relationship is a complex one. The extent to

which this influences aquatic litter depends on whether the extra material collected for recycling come from residual waste or from mismanaged waste.

For the five brand recycled content scenario, the following considerations were made:

- In general, diverting material from streams that are already collected and managed, like residual waste, is easier and most cost effective.
- For countries with very low total waste collection, recycling collection is more likely to impact mismanaged waste and hence impact aquatic litter.
- However, the modest scale of the increases in collection for recycling mean the likelihood that recycling supply will be met by already collected material is higher.
- The influence on litter prevention is likely to be minimal, as the waste management scenario does not target the litter waste stream directly through improved behaviour or recovery.

In consequence, a conservative assumption was made that 10% of the increase in material collected for recycling is derived from mismanaged plastic waste, while 90% is derived from residual waste. Although there are uncertainties as to where the true effect on aquatic litter lies it seems more likely to be at the lower end of the range. In the absence of evidence to suggest that increased demand for recycled content will, of itself, stimulate additional collection of used bottles that would otherwise be mismanaged, it is appropriate to err on the side of caution and apply a conservative assumption.

The destinations of PET bottles in waste management and the environment and the resulting aquatic litter impacts of the collection scenarios assessed are shown in Table E4: Under the recycled content commitments scenario, it can be seen that a 7% reduction in NARTD PET bottles entering the aquatic environment is attained.

Table E4: Estimated material flow under two scenarios (Mt)

Scenario:	Baseline	Brand commitments on recycled content met
Litter emitted to aquatic environment (Mt)	1.00	0.93
Mismanaged remaining on land (Mt)	2.68	2.49
Other waste treatments (residual waste) (Mt)	3.02	1.04
Collected for recycling (Mt)	5.94	8.51
Managed by the informal sector (Mt)	1.00	0.67
Refillable returned (Mt)	0.63	0.63
Total PET bottles PoM/used (Mt)	**14.26**	**14.26**

E.2.4 Prospects for refill

To achieve a more significant reduction in PET bottles entering aquatic systems, an alternative strategy to increase the use of refillable PET bottles could be considered. In 2020, Oceana published a report[9] which found that increasing the market share of refillable bottles by only 10% in all coastal countries in place of single-use PET bottles could reduce PET bottle marine plastic pollution by 22%, or by as much as 7.6 billion bottles.

Currently, refill stands at 23% of beverage literage sold in the NARTD sector (for all types of containers) and 4.5% for PET containers only. The current trend is for this to be slowly decreasing, mainly as a result of the rapid expansion in the market of single use beverage containers. The market for refill in absolute terms is more stable, but still gradually eroding over time.

However, Coca-Cola, accounting for more than 21% of single-use PET bottles for NARTD, is bullish about the prospects for refillables across its multiple brands. In February 2022, the company announced a new industry-leading goal to significantly boost its use of reusable packaging:[10]

> *By 2030, [The Coca-Cola Company] aims to have at least 25% of all beverages globally across its portfolio of brands sold in refillable/returnable glass or plastic bottles, or in refillable containers through traditional fountain or Coca-Cola Freestyle dispensers.*

Alongside this announcement, the company reported that:

> *Returnable glass bottles and refillable PET currently represent more than 50% of The Coca-Cola Company's product sales in more than 20 markets, and more than 25% of sales in another 20 markets. Traditional refillable/returnable packaging accounted for approximately 16% of the company's total volume in 2020. Use of refillables is growing in several markets, outperforming non-refillables in Germany and parts of Latin America, where reusable bottles represented 27% of transactions in 2020.*

The Coca-Cola Company's 2020 World Without Waste Report[11] notes that in 2020, Colombia and regions of Brazil adopted the "universal bottle" first introduced in 2018 by Coca-Cola Brazil and in use in Argentina, Brazil, Chile, Colombia, Mexico, Guatemala and Panama. This is reported to drive efficiency of collection, cleaning and filling as it the same reusable bottle with a single colour, shape and size can be used by multiple brands.

Although Coca-Cola has been the first leading brand to announce a significant, quantifiable target on refillable bottles, it seems Pepsi may soon follow. Responding to a shareholder

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[9] Oceana (2020) Just one word: refillable. Available from: https://oceana.org/sites/default/files/3.2.2020_just_one_word-refillables.pdf

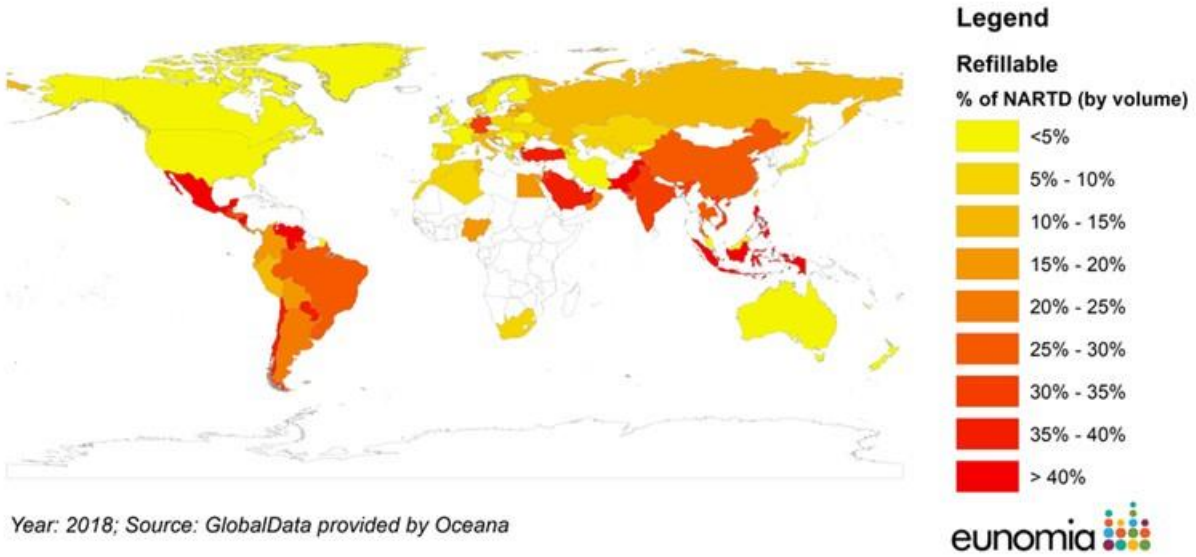
[10] https://www.coca-colacompany.com/news/coca-cola-announces-industry-leading-target-for-reusable-packaging

[11] The Coca-Cola Company (2021) 2020 World Without Waste Report, 6/07/2021, available at https://www.coca-colacompany.com/content/dam/journey/us/en/reports/coca-cola-world-without-waste-report-2020.pdf

proposal filed by As You Sow, in March 2022 PepsiCo agreed to set a time-bound goal by the end of 2022 for a percentage volume of its beverages to be delivered via strategies such as reusable and refillable bottles, in a bid to reduce dependency on single-use plastics.[12]

The market for refill is very different depending on the country and region, some having lower or greater barriers to entry. Countries with a particularly high % of refill in the sector include many in Latin America such as Mexico, Nicaragua, El Salvador, Venezuela, Chile, Columbia, Guatemala, Paraguay, Honduras, Uruguay and Argentina (all in the top tens for different container types). Asia-Pacific countries featuring in the top tens include Indonesia, the Philippines, Taiwan and Thailand (Figure E-1).

Figure E-1: Market share of refillable NARTD in 93 countries of the world (% of literage sales NARTD beverages, all container types) in 2018



Legal instruments to increase the refillable market shares for refillable bottles include refillable quotas (e.g. Germany), mandatory sales of refillable bottles in shops (e.g. Chile), or legal provisions to use universal bottles for different brands, which can facilitate efficient pooling systems. Brands may also take action to increase the market share of refill where demand and acceptance is high or where infrastructure exists or can be adapted incrementally.

While brands are clearly able to take the initiative and switch to a refillable system, further reductions in the number of PET bottles entering the aquatic environment can be achieved through the introduction of 'one-way' deposit return systems for the remaining single-use PET bottles. Such systems, however, typically require Government intervention to either mandate or incentivise their establishment.

[12] As You Sow (2022) PepsiCo Pledges to Reduce Single-Use Packaging as Requested by As You Sow Proposal, available at https://www.asyousow.org/press-releases/2022/3/16/pepsi-reduce-single-use-packaging

E.3.0 Conclusion

It's estimated that between 5.6% and 10.2% of the 511bn or 14.3Mt PET bottles from the NARTD industry entered the aquatic environment in 2018.

Increasing recycling or recycled content in bottles is likely to have only a small effect on ocean pollution as bottles used for recycling will mostly be derived from already collected and managed waste streams and not from mis-managed waste or littering.

Our projections show that, if the five top brands met their recycled content commitments, ocean pollution from NARTD PET bottles would only be reduced by 7%.

However, it is not clear that these commitments will necessarily be met. There is no coherent strategy, in any global region (save for Europe), to reliably increase rPET supply for the production of bottles in the NARTD segment. And it is precisely these regions that have the biggest gap between current supply and future demand for rPET. In addition, the market for NARTD, and hence the number of PET bottles, is predicted to grow in general. The aquatic litter reduction associated with these types of efforts to increase recycled content could well be significantly less than 7%.

To achieve a more significant reduction in PET bottles entering aquatic systems, a strategy to increase the use of refillable PET bottles could be considered. In 2020, Oceana published a report[13] which found that increasing the market share of refillable bottles by only 10% in all coastal countries in place of single-use PET bottles could reduce PET bottle marine plastic pollution by 22%, or by as much as 7.6 billion bottles. Future prospects for an expansion in the adoption of this strategy by beverage companies is promising. In February 2022, Coca-Cola announced a major commitment to increase its use of refillable bottles,[14] leading the way for other companies to follow suit.

Further reductions in the number of PET bottles entering the aquatic environment can be achieved through the introduction of 'one-way' deposit return systems for the remaining single-use PET bottles. Such systems, however, typically require Government intervention to either mandate or incentivise their establishment.

[13] Oceana (2020) Just one word: refillable. Available from: https://oceana.org/sites/default/files/3.2.2020_just_one_word-refillables.pdf

[14] https://www.coca-colacompany.com/news/coca-cola-announces-industry-leading-target-for-reusable-packaging

Contents

List of abbreviations

DRS	Deposit return scheme
EAS	East Asian & Pacific
ECS	Europe & Central Asia
EMF	The Ellen-MacArthur Foundation
HDPE	High-density polyethylene
LCN	Latin America & Caribbean
LIC	Low-income country
LMC	Lower-middle income country
MENA	Middle East & North Africa
Mt	Million tonnes
NAC	North America & Canada
NAPCOR	National Association for PET Container Resources
NARTD	Non-alcoholic ready to drink
PCR	Post-consumer recycled
PET	Polyethylene terephthalate
PoM	Placed on the market
rPET	Recycled PET
SAS	Sub-continental Asia
SSF	Sub-Saharan Africa
SUP	Single-use plastic
UMC	Upper-middle income country

1.0 Introduction

Large-scale production and use of plastics only began in the 1950s, however as of 2015 approximately 6,300 million tonnes (Mt) of plastic waste had been generated. Only 9% of this plastic has been recycled, leading to a significant accumulation of plastic pollution in terrestrial and aquatic environments.[15,16] Hardesty & Wilcox highlight that around 75% of debris entering oceans is comprised of plastic.[17]

The objective of this study is to assess the impact of the plastic pledges of five major beverage brands, to understand what they would mean in terms of reducing plastic pollution of aquatic ecosystems. These pledges include increasing post-consumer recycled (PCR) content in their polyethylene terephthalate plastic (PET) bottles. To fulfil this pledge, more used plastic bottles – which if not collected could be mismanaged or littered and make their way into aquatic ecosystems – will need to be recycled to make new bottles. This work will be situated in a broader strategy that creates insights to inform the case for refillables, building on Oceana's previous work that estimated the potential that increasing refillable bottles has for reducing this type of pollution.[18]

This report provides information on current emission of beverage bottles to the aquatic environment; examines how the five brands' recycled content commitments would influence the bottle collection requirements; explores what effect this might have on aquatic ecosystem litter; and discusses an alternative strategy for reducing aquatic ecosystem litter – increasing the use of refillable bottles.

This report covers:

- Quantifying the current level of consumption and emission of single-use (SU) PET beverage bottles to aquatic ecosystems.
    - Current consumption of bottles.
    - Current quantity mismanaged.
    - Current quantity flowing into aquatic environments.
- Quantifying the rPET demand from five brands' commitments on recycled content.
    - Identification of the major brands' commitments (and extent of their coverage in the brand product range).

[15] Geyer, R., Jambeck, J.R., and Law, K.L. (2017) Production, use, and fate of all plastics ever made, *Science Advances*, Vol.3, No.7, p.e1700782

[16] Lebreton, L., Egger, M., and Slat, B. (2019) A global mass budget for positively buoyant macroplastic debris in the ocean, *Scientific Reports*, Vol.9, No.1, p.12922

[17] Hardesty, B.D., and Wilcox, C. (2017) A risk framework for tackling marine debris, *Analytical Methods*, Vol.9, No.9, pp.1429–1436

[18] Oceana (2020) Just one word: refillable. Available from: https://oceana.org/sites/default/files/3.2.2020_just_one_word-refillables.pdf

    - Market shares of brands.
    - Recycled PET (rPET) demand under major brands' commitments versus current supply.
- Implications of rPET demand associated with five brands' commitments
    - Increase in supply of bottles required to meet rPET demand of major brands' commitments
    - Likely impact on aquatic ecosystem litter
    - Likelihood of rPET requirement from five brand commitments being met
- Consideration of alternative strategies (to recycled content commitments) to increase collection of bottles
    - Refill and return systems
    - Future prospects for refill and return systems
- Conclusions

To produce this report a model was produced to estimate mass flow for SUP and refillable PET bottles and end destinations in terms of waste management and emissions. This was based on many sources of information. The base data set is sales data for beverages sold in refillable and single-use PET bottles for 93 coastal countries, where commercial data on use of PET and beverage sales was available.[19] The emissions model is principally based on methods published by Lebreton and Andrady (2019)[20] and Borrelle *et al.* (2020).[21] Collection for recycling, deposit system return rates, recycling losses and the relationship between the level and mode of waste collection and littering were based on desktop research, previous Eunomia reports and research, as well as ad hoc consultation with stakeholders.

[19] Source: HSBC analysis of Global Data

[20] Lebreton, L., and Andrady, A. (2019) Future scenarios of global plastic waste generation and disposal, *Palgrave Communications*, Vol.5, No.1, pp.1–11

[21] Borrelle, S.B., Ringma, J., Law, K.L., et al. (2020) Predicted growth in plastic waste exceeds efforts to mitigate plastic pollution, *Science*, Vol.369, No.6510, pp.1515–1518

2.0 Quantifying current consumption and emission of SU PET beverage bottles to aquatic ecosystems

In this section, in order to provide a baseline for comparing the impact of different future scenarios for PET bottle management, the quantity of PET bottles used and the proportion entering aquatic environments is estimated.

2.1 Current consumption of bottles

Sales volume data from 2018 of the non-alcoholic ready to drink (NARTD) sector in 93 coastal countries was used to calculate number of SU bottles placed on the market (PoM), uses of refillable bottles, and the equivalent weights (for details, see Appendix 1 – Model assumptions).[22] Table 2-1 shows the key information used in this report.

Table 2-1: Summary of PET beverage bottle data in 93 countries (2018)

	SU PET PoM	Refillable PET used	Total PET bottles used
Billion units	487.66	23.18	**511.84**
Weight (Mt)	13.63	0.64	**14.27**

In total, 898 billion bottles were used by the NARTD sector. This included a range of packaging types, including PET, high-density polyethylene (HDPE) and glass. 511.84 billion (56.9%) of these bottles were PET, with an approximate weight of 14.27 Mt. Approximately 23.18 billion (4.5%) of these PET bottles, ~ 0.64 Mt, were refillables and thus the remaining 487.66 billion, 13.63 Mt, were single-use.

2.2 Current quantity mismanaged

At present, waste management systems do not have sufficient capacity at the global level to safely dispose of or recycle plastic waste, resulting in a significant portion of waste being mismanaged and thus polluting the environment.[23] The World Bank, a source of global waste management data, defines mismanaged waste as any municipal solid waste that is classified as 'open dumping', 'disposed of in waterways or the marine

[22] Source: HSBC analysis of Global Data

[23] Lau, W.W.Y., Shiran, Y., Bailey, R.M., et al. (2020) Evaluating scenarios toward zero plastic pollution, *Science*, Vol.369, No.6510, pp.1455–1461

environment', 'other' or 'unaccounted for'.[24] More recent and detailed data on waste management and mismanaged waste is provided by the Waste Atlas, a resource compiled using country-level data submitted by individual experts from each country.[25] Using the Waste Atlas, researchers Lebreton & Andrady (2019) produced low, mid, and high projections of mismanaged waste for each country, which have been used in the present report.[26]

In addition to mismanaged waste, accidental and/or deliberate littering also needs to be accounted for. The waste management datasets typically do not account for littering so that countries with good waste management systems can be assessed as having zero mismanaged waste, which does not reflect reality. In a previous study (Jambeck *et al.*, 2015), a littering rate of 2% was applied to all countries thereby resulting in the assumption that the minimum amount of mismanaged waste in any country was 2%.[27] This estimate was revised by Lebreton & Andrady where modelled littering rates were varied according to the country's waste management scenario. Accordingly, the minimum amount of mismanaged waste, to take into account littering, was set at 0.1%, 1% and 10% in the low, mid, and high projections of mismanaged waste, respectively.

In addition to the flow of SU PET bottles to the aquatic environment, there will also be some, much smaller leakage of refillable bottles into the aquatic environment. In Western Europe, the average refillable bottle completes four complete cycles in a year. A 2.5% loss rate per year is applied at each iteration to account for these refillable PET bottles being littered, reaching their end of life and breakages (a 97.5% return rate as a proportion of uses per year).[28] It is estimated that these inefficiencies cause approximately 575 million refillable PET bottles to be lost and therefore could enter the aquatic environment. The same emissions ratios are applied to these bottles to calculate the emissions to the aquatic environment

2.2.1 Recovery of bottles from mismanaged waste by informal sector

For some countries, such as Nigeria and Tunisia, it is reported that 100% of their municipal solid waste was mismanaged. However, to account for informal sector 'waste pickers', Lebreton & Andrady reduced the upper threshold of mismanaged waste to 90%, 99% and 99.9% in the low, mid, and high projections of mismanaged waste, respectively, suggesting that collection by the informal sector was estimated to reduce the proportion

[24] Kaza, S., Yao, L., Bhada-Tata, P., and Van Woerden, F. (2018) *What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050*, The World Bank

[25] University of Leeds, ISWA, Sweepnet, WIERT, and SWAPI *Waste Atlas - Interactive map with visualized waste management data*, accessed 8 January 2021, http://www.atlas.d-waste.com/

[26] Lebreton, L., and Andrady, A. (2019) Future scenarios of global plastic waste generation and disposal, *Palgrave Communications*, Vol.5, No.1, pp.1–11

[27] Jambeck, J.R., Geyer, R., Wilcox, C., et al. (2015) Plastic waste inputs from land into the ocean, *Science*, Vol.347, No.6223, pp.768–771

[28] Personal communication, Industry Expert (September 2020).

of mismanaged waste by 10%, 1% and 0.1%, respectively.[29] The term 'waste pickers' is used to describe those involved in the extraction of recyclable and reusable materials from mixed waste.[30] Although some informal sector waste collection activity is accounted for within the proportion of mismanaged waste data, informal sector 'waste pickers' provide a significant waste collection service around the world.[31] Using India as an example, Nandy et al. suggest that up to 80% of plastic waste generated is recovered by the informal sector and is thus kept out of the environment.[32] This is a more extreme example of the ability of the informal sector, however other studies do suggest that the informal sector plays a significant role; e.g. Lau et al. suggest the sector was responsible for 58% of post-consumer plastic waste collected for recycling on a global scale in 2016[33] and Ramusch states that the informal sector should achieve recycling rates as high as 30%.[34]

A report commissioned by Coca- Cola aims to provide a systematic and comparative baseline of the flow of plastics packaging in Indonesia, the Philippines, Vietnam, Thailand, Myanmar, and Malaysia. They find that the average collection rate is 26% in those countries, with Malaysia 16%, the Philippines 21%, Indonesia 22%, Vietnam 27%, Thailand 32% and Myanmar 64%, with collection by the informal sector responsible for 97% of these amounts.[35]

However, continued reliance on only the informal sector is problematic. As cities and countries develop and standards of living are rising, smaller parts of the population will rely on waste picking, while the amount of PET bottles is forecast to grow significantly.

Waste pickers come often from vulnerable communities, such as those in poverty, with addiction, mental illness, or children often used as labour. Slavery has also been identified as a problem in the PET recycling sector.

In this report, a methodology suggested by Lau et al. has been adapted to estimate the quantity of PET bottles (rather than all plastic or all waste – as per existing estimates) collected by the informal sector. This is based on estimating the number of urban waste

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[29] Lebreton, L., and Andrady, A. (2019) Future scenarios of global plastic waste generation and disposal, *Palgrave Communications*, Vol.5, No.1, pp.1–11

[30] Wilson, D.C., Velis, C., and Cheeseman, C. (2006) Role of informal sector recycling in waste management in developing countries, *Habitat International*, Vol.30, No.4, pp.797–808

[31] Ramusch, R. (2017) Measuring informality? Challenges in quantifying informal recycling sector activities, paper given at Sixteenth International Waste Management and Landfill Symposium, Sardinia, 2017

[32] Nandy, B., Sharma, G., Garg, S., Kumari, S., George, T., Sunanda, Y., and Sinha, B. (2015) Recovery of consumer waste in India – A mass flow analysis for paper, plastic and glass and the contribution of households and the informal sector, *Resources, Conservation & Recycling*, Vol.101, pp.167–181

[33] Lau, W.W.Y., Shiran, Y., Bailey, R.M., et al. (2020) Evaluating scenarios toward zero plastic pollution, *Science*, Vol.369, No.6510, pp.1455–1461

[34] Ramusch, R. (2017) Measuring informality? Challenges in quantifying informal recycling sector activities, paper given at Sixteenth International Waste Management and Landfill Symposium, Sardinia, 2017

[35] GA Circular (2019) *Full Circle: Accelerating the Circular Economy for Post-Consumer PET Bottles in Southeast Asia*, 2019, http://www.gacircular.com/full-circle/

pickers in each country and their collection capacity per capita. All assumptions used in this study are shown in Appendix 1 – Model assumptions (A.1.2).

For the 93 countries in this study, the resulting estimate is that 35.8 billion PET bottles (7.74% of PoM) are collected by the informal sector in the baseline scenario. This is a low-end estimate compared to the above studies but is considered appropriate given that the higher estimates have been heavily contested, and the informal sector should not be relied on over time to provide collection capacity, but should be formalised in the future, so this adjustment should not be counted on to be maintained at a high level or to increase when making future projections. This estimate is subtracted from the mismanaged waste tonnage estimates. In this way the quantity of bottles making their way to aquatic ecosystems, which is calculated as a proportion of mismanaged waste, is not overestimated. It is also assumed that PET bottles collected by the informal sector are downcycled into other PET applications, such as trays and fibres, and do not enter the PET bottle circularity loop. This is due to reported concerns among producers of PET bottles regarding the perceived quality of the recyclate collected in this way by consumers.[36]

2.3 Current quantity flowing into aquatic environments

Due to their durability, low recycling rates, and poor waste management, a significant proportion of PET bottles produced worldwide enter and persist in aquatic environments.[37] Aquatic environments are defined as both freshwater and marine environments, encompassing major rivers, lakes, and oceans.[38]

Jambeck et al. produced the first estimate of plastic debris entering the marine environment, predicting that between 4.8 and 12.7 Mt entered the ocean in 2010. However, this study only accounted for the population that lived within 50km of the coast, believing this population to be the most likely to contribute to marine litter. The study also assumed the conversion of mismanaged plastic waste to marine litter to be constant, with a 15%, 25% and 40% emissions ratio in their low, mid, and high projections, respectively.[39]

However, a substantial fraction of marine plastics originates from land-based sources distant from coastal areas, with rivers acting as a major transport pathway. Both buoyant and non-buoyant plastics can be suspended in the water column and transported to the

[36] Personal communication with confidential industry stakeholder

[37] Lebreton, L.C.M., Zwet, J. van der, Damsteeg, J.-W., Slat, B., Andrady, A., and Reisser, J. (2017) River plastic emissions to the world's oceans, *Nature Communications*, Vol.8, p.15611

[38] Borrelle, S.B., Ringma, J., Law, K.L., et al. (2020) Predicted growth in plastic waste exceeds efforts to mitigate plastic pollution, *Science*, Vol.369, No.6510, pp.1515–1518

[39] Jambeck, J.R., Geyer, R., Wilcox, C., et al. (2015) Plastic waste inputs from land into the ocean, *Science*, Vol.347, No.6223, pp.768–771

ocean, as has been shown for other terrestrial sediments and solutes.[40] Rivers are not the only transport pathway for PET bottles to enter the ocean; direct littering, tidal and wind transport also contribute to the presence of PET bottles in the ocean.

A new approach has been developed that accounts for the entire area, and thus population, of each country, and adapts the conversion rate for mismanaged plastic waste to marine litter according to geographic and hydrological factors. Borrelle et al. (2020) developed a distance-based probability function, which estimates the proportion of inadequately managed waste that enters the nearest aquatic environment based on spatially explicit waste generation and downhill flow accumulation. This means that the closer to an aquatic environment that waste is generated and mismanaged, the greater the probability that it will enter the aquatic environment.[41] To account for uncertainty, Borrelle et al. produced low-, mid- and high-range projections for 173 countries. These projections were adopted for the 93 countries considered in this report, amongst which there is wide variation in emissions ratios. For example, in the low-range projections the lowest emission ratio was 2% for Jordan, a country located in the Middle East with a short coastline. On the other hand, the highest emission ratio in the low-range projections was 64% for Hong Kong, a country with an extensive coastline relative to its land area. In the high-range projections, the emission ratios varied between 10% and 67%, again for Jordan and Hong Kong, respectively. The emission ratios for all countries can be found in Appendix 1 – Model assumptions. To quantify the number of bottles flowing into the aquatic environment for country *c* in scenario *s* the following equation was used:

Equation 1

$$PET\ emissions_{c,s} = \left(\left(SU\ PET_c \times \%MMPW_{c,s}\right) + \left(R \times \%L\right) - IS_c\right) \times E_{c,s}$$

where *SU PET* is the number of single-use PET bottles, *MMPW* is the mismanaged plastic waste, *R* is the number of refillable bottles used, and *L* is the loss of refillable bottles from waste management, *IS* is number of bottles recovered through informal sector collections, and *E* is the emissions ratio.

Based on the above equation, for the 93 coastal countries, the model's mid-range estimate (Table 2-2) predicts that just over 1 million tonnes (35.8 bn) PET bottles entered the aquatic environment in 2018, which is 7.0% of bottles PoM/used (511bn or 14.3Mt). The low- and high-range estimates provide a wider range, indicating that emissions were between 0.8 Mt (29.1 billion) and 1.4 Mt (51.7 billion) PET bottles, representing between 5.7% and 10.2% of all PET bottles PoM/used, respectively (see Table 2-2). These estimates are greater than those originally suggested by Oceana, who estimated between 21 billion and 34 billion PET bottles entered the marine environment each

[40] Schmidt, C., Krauth, T., and Wagner, S. (2017) Export of Plastic Debris by Rivers into the Sea, *Environmental Science & Technology*, Vol.51, No.21, pp.12246–12253

[41] Borrelle, S.B., Ringma, J., Law, K.L., et al. (2020) Predicted growth in plastic waste exceeds efforts to mitigate plastic pollution, *Science*, Vol.369, No.6510, pp.1515–1518

year.[42] However, it's important to note that the figures are not directly comparable as the model estimates emissions to all aquatic systems, not just to the marine environment as calculated in the Oceana study.

Table 2-2 Estimates of PET bottle emissions to the aquatic environment (2018)

	Tonnes	Bottles (million units)	% PoM/used
Low emission scenario	**812,424**	**29,110**	5.7%
Mid emission scenario	**1,001,764**	**35,849**	7.0%
High emission scenario	**1,449,333**	**51,772**	10.2%

Due to the different scope of studies, it is difficult to draw direct comparisons. There are various estimates of total plastic litter inflow to aquatic systems; for example, Jambeck et al. and Lebreton and Andrady estimate that 4.8 - 12.7 Mt and 3.1 - 8.2 Mt of plastic is emitted to the marine environment, respectively. Likewise, Borrelle et al. estimate that 19 - 23 Mt of plastic is emitted to all aquatic systems (all previously cited above). In this study, to reiterate, we focus only on NARTD PET bottles. It's important to note, however, that this weight of PET is only calculated for the 93 countries for which data was available, and as such is likely to underestimate the total flow of PET bottles into aquatic environments.

This baseline range estimated for the number and weight of PET bottles entering aquatic environments is used in the following sections to estimate the impact that brands' recycled content commitments could have on this form of plastic waste pollution.

[42] Oceana (2020) Just one word: refillable. Available from: https://oceana.org/sites/default/files/3.2.2020_just_one_word-refillables.pdf

3.0 Quantifying the rPET demand associated with the five brands' commitments

In this section, the five brands' commitments are explored to understand how much rPET would be required if they are to meet their commitments to increase PCR content in their plastic packaging and PET bottles specifically.

This involved the following steps:

- Review of publicly available brand statements and information on PCR content commitments
- Translation of this into a likely objective for PCR content for five brand PET bottles
- Determination of five brand NARTD beverage market share
- Estimation of baseline rPET requirement in the rest of the market based on current PET bottle PCR content
- Development of a whole market scenario for rPET requirement for bottles (taking into account upcoming legislative drivers)
- Determination of rPET supply for bottle manufacture by estimating collection for recycling, loss rates and requirements for rPET for items other than bottles.
- Determination of deficit in supply.

3.1 Identification of the five brands' commitments

The five brands' websites, sustainability reports, and media sources were analysed to determine their commitments to PCR plastic in their packaging. This presented some challenges, because some brands stated these commitments in terms of PET bottles, and others for all packaging. Likewise, some commitments cover the brands' entire global reach, and others focusing on specific markets. The outcome of this analysis is provided in Table 3-1, which shows the percentage PCR content that each individual brand has committed to by 2025 and 2030. This data supports modelling of the resulting rPET demands from the five brands, in relation to rPET supply, (Section 3.3). A more detailed breakdown of these commitments is provided in Appendix A.1.4.

Table 3-1: Summary of brands' commitments to increase PCR content in their plastic packaging

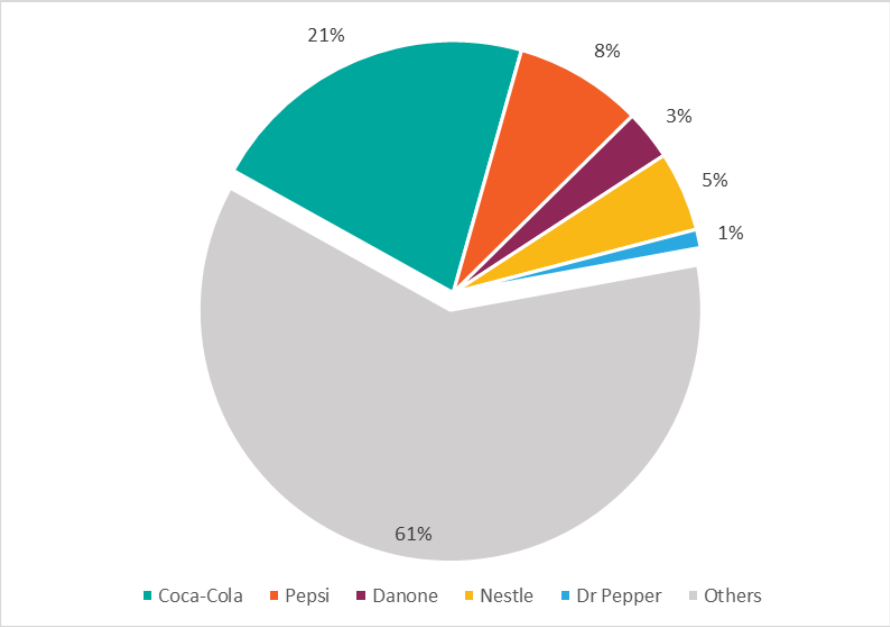
Brand		2025	2030
The Coca-Cola Company	Coca-Cola	25% PCR content – global plastic packaging	50% PCR content – global plastic packaging
	FEMSA	25% PCR content – total plastic packaging	50% rPET content – PET bottles
	Swire	5% PCR content – total plastic packaging	50% PCR content – total packaging
PepsiCo		25% PCR content – global plastic packaging	50% rPET – PET bottles in the EU
Dr Pepper Snapple		25% PCR content – global plastic packaging	None
Danone		50% rPET content – global PET bottles 100% rPET content – PET water bottles in Europe	None
Nestlé		30% PCR content – global plastic packaging 50% rPET content – global PET water bottles	None

3.2 Market share of brands

In order to understand how brand commitments influence future demand for beverage bottles for recycling we estimated the market share of 5 brands within the geographical regions. Data for brand market shares, specific to countries and volume shares in the NARTD sector specifically, is not readily available for the desired geographical and

product scope and Eunomia has used best available data to estimate this. Figure 3-1 shows literage volume shares of the five brands assessed in this study in the NARTD sector for PET bottles across the 93 countries.[43] The five brands are estimated to have a 39% market share; with other brands making up the remaining 61%. Coca-Cola leads, owning just over a fifth of the market (21%) based on volume in the specified sector. PepsiCo owns a far lower proportion of the market (8%), followed closely by Nestlé (5%) and then Danone and Dr Pepper Snapple. Though this shows the overall picture within the 93 coastal countries, the distribution is very different from region to region and even country to country (See Appendix A.1.5 for details). The rPET requirement for the "other brands'" bottles is estimated in the next section based on current PCR content in bottles, and is combined with rPET requirements quantified for the five brands' bottles. The influence of upcoming legislation on PCR content is also taken into account to estimate total market demand for rPET for bottles.

Figure 3-1: Volume share, NARTD sector, PET bottles (2018)



3.3 Demand under brand commitments versus current supply of rPET

Here, the current supply of rPET is estimated, as well as the requirement for rPET that is a consequence of the five brand commitments. To do this, process losses between collection for recycling and use of rPET, as well as market requirement for manufacture of PET items other than bottles, also need to be taken into account. Supply and five brand future requirements are then compared to determine if supply is sufficient or if

[43] Calculations based on data provided to Oceana by GlobalData (2020)

there is a deficit, and what is the magnitude of the deficit. This, and all the supporting assumptions on losses and non-bottle rPET requirements subsequently allows us to estimate the increased collection of PET bottles these commitments could, in theory, drive (Section 4.1).

In the 93 countries investigated, just over 13.6 Mt of single-use NARTD PET bottles are placed on the market each year. Only PET bottles are able to provide a high enough quality of rPET at acceptable cost for manufacture of PET bottles. Other sources of rPET are small (there is little collection in practice as it is not economically favourable) and the quality is not high enough for bottle making at acceptable cost, so they are not included in the analysis. Therefore, as a first step to estimate supply of rPET for bottles, country specific collection rates for PET bottles have been determined (see Appendix A.1.3). Where this data is unavailable, a collection rate was estimated based on the level of socio-economic development and region for that country. An average collection rate of 43.6%, results in an estimate of material collected for recycling of 5.94 Mt.

For process losses, European rates have been applied [44] as this is the most complete data available to us at time of writing and it is assumed that similar loss rates apply globally. The model underestimates losses owing to lack of information on the proportion of the material stream that is coloured or opaque (which in practice is diverted away from bottle manufacture),[45] but this is an unavoidable limitation at present. Loss rates for sorting and washing clear/blue food contact PET of 24.9% are therefore applied to the tonnage as a whole. When applied to the estimate of material collected for recycling this results in a total of 4.46 Mt rPET flakes suitable for making bottles available. This is an effective recycling rate of 32.8%.

Most brands have committed to a minimum 25% recycled content target by 2025 (Table 3-1). For the purpose of modelling in this report, it is assumed that the same amount of PCR content is used in all bottles of a brand's portfolio across the 93 countries. In the case of Danone and Nestlé, which have specified higher targets for some water bottles, Eunomia has assumed that their lower targets (for plastic bottles more generally) of 50% and 30%, respectively, are the average across all their beverage bottles. As the higher, product-specific targets are not included in the modelling, the estimated demand for rPET should be regarded as a minimum requirement, and an underestimate. The rPET demand for other beverage brands has not been individually assessed in this study. As a minimum, it is assumed that these brands would continue to use the average 11% PCR content currently found in PET bottles (based on European data, see Appendix A.1.4).[46]

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[44] Various sources (confidential)

[45] Coloured and opaque bottles (which are used in the NARTD sector) from mixed collection are generally diverted into PET tray or strapping applications rather than bottles; they could only be channelled into bottle production if bottles are segregated by colour during collection, to provide the right colour grade of feedstock - this is not widespread practice.

[46] EFBW, Petcore Europe and Plastics Recyclers Europe (2020) *PET Market in Europe - State of Play: Production, Collection and Recycling Data*, 2020

For EU member states we have applied an increase of the expected PCR content to 25% based on the EU Single Use Plastics Directive, which sets a minimum recycled content of 25% for PET beverage bottles by 2025, rising to 30% for all plastic beverage bottles by 2030. This gives a projected global average PCR content of 13.9%. This is potentially still an underestimate as the recycled PET in bottles is likely to grow as pressure on brands from consumers to act on reducing plastic waste mounts.

The demand for rPET in beverage bottles in the NARTD sector across the 93 countries investigated in this report and based on PCR targets for 2025, is presented in Table 3-2.

Table 3-2: PET demand in the NARTD sector (in Mt)

Brand	Market Share	PET bottles PoM	Total rPET available (derived from bottles)	Total rPET available (for bottle production)	PCR content target (by 2025)	Demand by brand
Coca-Cola	21.3%	2.90		-	25.0%	0.73
PepsiCo	8.2%	1.12		-	25.0%	0.28
Dr Pepper Snapple	1.2%	0.16		-	25.0%	0.04
Danone	3.2%	0.44		-	50.0%	0.22
Nestlé	5.1%	0.70		-	30.0%	0.21
Others	61.0%	8.31		-	13.9%	1.15
Total	**100.0%**	**13.63**	**4.46**	**1.07**	**-**	**2.63**

These individual commitments result in a total rPET demand of minimum 1.47 Mt for NARTD bottles for the five brands in the 93 countries (33.0% of the market). When you include the current ongoing demand of other brands, the total demand for rPET to produce beverage bottles in the 93 countries is 2.63 Mt.

Simply comparing rPET available to rPET demand is not sufficient though as there are many limitations that surround the recycling of PET and the subsequent use of rPET. As mentioned above, one major factor influencing the availability of rPET for the bottle manufacturers are cascades of materials that flow into different PET packaging applications, such as non-food contact bottles, trays, film or strapping, or even other PET applications altogether, such as fibres. Currently in Europe it is estimated that approximately 76% of rPET derived from clear food-contact bottles is used in other PET applications. This is predominantly driven by commodity prices. More recently, rPET has become more expensive than virgin PET because of increased demand from manufacturers (e.g., due to environmental policy or public pressures increasing use of recycled content). In addition, rPET used for trays or other packaging applications can be rPET flakes, the first output of the mechanical recycling process; this is lower grade PET (i.e., with shorter polymer chains which result from the recycling process). To prepare

rPET flakes into pellets which are suitable for use in beverage bottles, an additional extrusion process to strengthen the polymer chains needs to be applied as well as, potentially, additional filtration to reduce contaminants that might affect the production of bottles (blow moulding). Both of these processes increase the overall cost of the rPET pellets in comparison to flakes used in trays or other non-bottle PET applications. This is why most rPET is diverted away from being recycled into bottles. Of course, one may consider that brands like Coca-Cola, PepsiCo, Danone, Nestlé, or Dr Pepper Snapple may be willing to pay a premium for rPET over other PET applications (such as trays, fibres or strapping). Whilst this is a possibility, it means that less rPET would be available for use in these other applications, which in turn would need to rely on a higher virgin PET supply. There are currently no known commercially viable, large-scale methods to fill this shortfall for recycling for non-bottle PET products, and so such a scenario has not been modelled.

As a result of the above considerations, the available rPET needs to be split into two pathways: 24% for food contact bottles (NARTD), and 76% for other PET applications. With 4.46 Mt of rPET available to the entire PET market, the share available for NARTD bottles is circa 1.07 Mt, posing a **deficit of approximately 1.56 Mt** to meet the commitments (59.3% of the total 2.63 Mt NARTD sector demand projected).

In the next section, the deficit in supply is combined with assumptions developed on loss rates and other 'non-bottle' rPET needs, to understand the increase in supply of bottles required to meet rPET demand driven by five brand commitments, what this means for increased collection rates, and how this might influence volumes of litter in aquatic ecosystems.

4.0 Implications of rPET demand associated with the five brands' commitments

4.1 Increase in supply of bottles required to meet rPET demand associated with five brand commitments

For the five brands to meet their PCR content related brand commitments for bottles, while holding other demand equal, the total weight of rPET required in the 93 countries investigated is estimated to be 1.47 Mt. For other NARTD brands to be able to meet their own rPET demand, another 1.16 Mt is needed. In addition to this, the increased requirement for PET should not impact on other sectors, such as tray and film manufacturers, requiring rPET. At present, it is estimated that other sectors require 3.39 Mt, and therefore the total weight of rPET required to satisfy demand is around 6.02 Mt.

To achieve this, collection rates across the 93 countries need to increase. The next stage of the study was, therefore, to estimate the gap between each region's current supply of rPET and what is required, as a minimum, to meet the implicit demand from the five brands' commitments.

This involved constraining the model in order to provide an approximation of future improvements in recycling across the globe. In theory, increasing the collection rate in a large country like China could, alone, provide the global rPET deficit to meet the brand commitments by this nation alone. In practice, however, this is highly unlikely. The study, so as to be more realistic, considered the *minimum* change needed to meet requirements – and not what could be achieved in time with appropriate reforms. It was assumed that a realistic target collection rate must be greater than the existing collection rate but could not exceed the best practice in the country's geographic region by more than 10% (with an exception in one region – Sub-continental Asia - with very low collection rates where it was necessary to allow increases of up to 25% in order to meet demand). Also, cross border commodity trade is likely to happen to a large degree and this will satisfy demand, rather than large shifts in supply in single nations. The model assumes instead that demand must be met within geographical regions – i.e. that regional markets must be able to collect enough post-consumer PET bottles to meet the regional demand for rPET. It has not been possible to model actual global material flows within the scope of this project – and it is acknowledged that the approximation made is likely to 'overcompensate' to some extent, setting the boundary for material flows too stringently compared to the real-world situation, and perhaps overestimating the overall global collection for recycling rate increase that would be associated with meeting the five brand commitments.

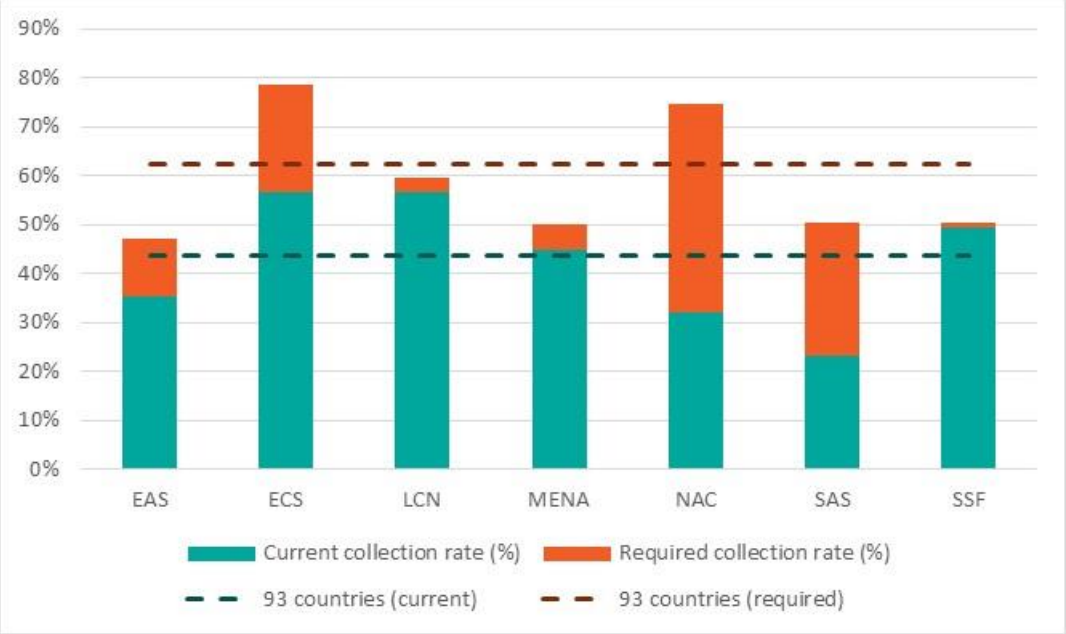
Based on these assumptions, we estimate that the current collection rate for all 93 countries investigated in this report needs to increase from 43.6% to 62.4% for the five

brands to be able to meet their recycled content targets. This equates to an increase of 43.1% or ~18.8 percentage points on average.

Figure 4-1 (data table in Appendix A.1.7) presents increases in collection rates, modelled for each geographical region, that can satisfy brand commitments. The graph shows that some regions must increase their current collection rates more significantly than others. This is a function of the whole market rPET requirement (e.g. in Europe this is higher, relatively, because of the SUP Directive recycled content requirements for bottles), existing recycling rates, and realistic constraints assumed regarding increases, as discussed above. The regions that require the highest increase to meet rPET demand from brand commitments are North America & Canada (42.8 percentage points to reach ~75%) and the lowest is Sub-Saharan Africa (1.0 percentage points to reach ~50%).

We note that the National Association for PET Container Resources (NAPCOR) reports a recycling rate of 35% across the USA, Canada, and Mexico in 2019.[47] However, NAPCOR also highlights that the U.S. PET recycling rate must double so that brand owners can meet their commitment to incorporate 25% recycled content in their bottles by 2025.

Figure 4-1: Current and required PET bottle collection rates, by geographic region



Note: EAS: East Asia & Pacific; ECS: Europe & Central Asia, LCN: Latin America & Caribbean, MENA: Middle East & North Africa, NAC: North America & Canada: SAS: Sub-continental Asia, SSF: Sub-Saharan Africa

The impact on collection for recycling tonnage is that compared to the current baseline scenario of 43.6% of bottles collected for recycling at 5.94 Mt, a collection for recycling

[47] NAPCOR (2020) *2019 PET Recycling Report*.

rate of 62.4% corresponds to an increase of 2.57 Mt. In the next section, we consider how this might influence plastic bottle litter in aquatic ecosystems.

4.2 Potential impact on plastic litter in aquatic ecosystems

It is clear that if brands are to meet their recycled content targets, they will need to increase the proportion of bottles that are collected for recycling. This section considers the potential impact of increasing collection to meet brands' recycled content requirements on plastic bottle littering of aquatic ecosystems.

Although it is commonly held that the more bottles are collected for recycling, the fewer bottles that end up in aquatic ecosystems, the relationship is a complex one.

The extent to which this influences aquatic ecosystem litter depends on the extent to which this influences the amount of total collection of material, including residual waste which is landfilled or incinerated. To recap – the estimate of aquatic ecosystem litter relies on quantifying mismanaged waste (emissions to water are calculated as a proportion of this). The remainder is 'total collected', or 'managed' materials. I.e.:

Total = mismanaged + managed

Managed = refill returned, waste collected for recycling + residual waste

It is the extent to which collection for recycling can reduce mismanaged waste that determines its influence on litter in the aquatic ecosystem. However, collection for recycling might equally reduce residual waste instead.

These different outcomes can be envisaged as diversion of waste from different streams. Does the extra material collected for recycling come from residual waste or from mismanaged waste? If all the extra material is derived from residual waste, there is no impact on litter in aquatic environments. If the extra material is derived from mismanaged waste, it will impact aquatic ecosystem litter proportionately to the reduction in mismanaged waste.

But in reality, the scenario is likely to be a blend of the two. Some material will come from residual waste and some from mismanaged waste. The proportions have never been determined empirically, but we can inform assumptions on this by considering:

- the waste management scenario (different collection approaches are likely to influence the balance of switches from the two key streams in different ways),
- the scale of the increase in recycling relative to residual and mismanaged waste (where the increase is more than or approaching the scale of one stream, diversion must or is more likely to also be happening from the other) – for example in countries with very low coverage of waste collection – increasing collection for recycling is more likely to influence total collection.

For the five brand recycled content scenario, the following considerations were made

- In general, diverting material from streams that are already collected and managed, like residual waste, is easier and most cost effective.
- For countries with very low total collection, recycling collection is more likely to impact mismanaged waste and hence impact aquatic litter.
- However the modest scale of the increases in collection for recycling mean the likelihood that recycling supply will be met by already collected material is higher.
- The influence on litter prevention is likely to be minimal, as the waste management scenario does not target this waste stream directly through improved behaviour or recovery.

In consequence, a conservative assumption was made that 10% of the increase in material collected for recycling is derived from mismanaged plastic waste, while 90% is derived from residual waste. Although highly uncertain as to where the true effect on aquatic ecosystem litter lies (but it is more likely to be at the lower end of the range), this still produces a useful comparison for the alternative scenarios for increasing bottle collection and reducing litter entering aquatic ecosystems. It is important to emphasise that because of the uncertainties around the switches, this is an illustrative approach that makes the best of the information available, but there is a high level of uncertainty around the outcome.

4.2.1 Impact of increased collection rate needed to meet five brands' recycled content commitments on litter in aquatic ecosystems

The impact of increased collection for recycling as a consequence of meeting the five brand's recycled content commitments on litter entering the aquatic ecosystem, was quantified by the same formula as the baseline (Equation 1), with an adjusted MMPW calculated to account for improved collection rates.

For the estimate of maximum reduction of litter entering aquatic ecosystems, MMPW proportions were decreased by 10% of the absolute percentage increase in collection rates required to meet the recycled content commitments, in each of the 93 countries. Due to the increase in global collection rates, from 43.6% to 62.4%, the number of PET bottles managed by the informal sector has also been reduced in proportion with the reduced residual waste expected – taking into consideration that the informal sector, with its poor labour conditions, should not be relied on over time to deliver the increased recycling rates required, but this should be delivered by the formal sector. Table 4-1 shows the impact of increased collection rates on the number, and weight, of PET bottles emitted to the aquatic environment.

The model's mid-range estimates suggest that the improved collection rates result in 33.4 billion (0.93 Mt) PET bottles entering the aquatic environment each year, 2.47 billion fewer (70 kt) than the baseline scenario shown in Table 2-2. This reduction represents a 7.0% fall in the tonnage of PET NARTD bottles entering the aquatic environment. The improvement in global collection rates, from 43.6% to 62.4%, means

that 6.5% of PET bottles PoM, enter the aquatic environment in comparison to 7.0% seen in the baseline scenario (Table 4-1).

Table 4-1: Weight and number of PET bottles emitted to the aquatic environment with improved collection rates, compared to the baseline

	Mid emission scenario		
	Tonnes	Bottles (million units)	% PoM/ used
Baseline	1,001,764	35,849	7.0%
Scenario 2 – Brands meeting recycled content commitments	931,660	33,380	6.5%
Change from baseline	7.0%	6.9%	0.5%

Baseline results shown in Table 2-2.

This however is a best-case scenario. In reality, there is no guarantee these commitments can be met. Firstly, the gap in supply and demand is large: projections based on business as usual estimate that the shortfall in rPET supply needed to meet the commitments by 2025 will be 59.2% of total demand.

Secondly, an analysis was undertaken of the prospects of the five brand commitments being met – and consequently the likelihood of realising the potential benefits modelled. To do this, the positive and negative drivers of bottle collection and recycling were assessed to determine the likely future trends of these activities. This covered legislation, collection, quality requirements and processing infrastructure capacity. The full analysis can be found in the Appendix (A.2.0).

The conclusion was that there is no coherent strategy, in any global region (save for Europe), to reliably increase rPET supply for the production of bottles in the NARTD segment. And it is precisely these regions that have the biggest gap between current supply and future demand for rPET.

In addition, the market for NARTD, and hence the number of PET bottles, is predicted to grow in general. The reduction in litter entering the aquatic ecosystem associated with these types of efforts to increase recycled content is therefore likely to be significantly less than 7%.

This next section discusses an alternative scenario to reduce litter entering aquatic ecosystems, rather than a strategy focused on recycled content of single-use packaging.

5.0 The role of refillables

This report has so far focused on brands' recycled content commitments and the impact on litter entering aquatic ecosystems if there is an increase in beverage container collections to improve the supply of rPET. As explained in Section A.2.5, there does not seem to be a coherent strategy to provide the necessary quantity and quality of rPET across all regions – bringing into doubt the ability of the brands to meet their commitments at the global level, and the likelihood of realising the potential benefits in terms of reduced litter entering the aquatic environment, which are already modest at 7%.

This chapter discusses an alternative strategy to reduce litter, one whereby the major brands switch to a refillable system, replacing single-use bottles with reusable PET bottles. In 2020, Oceana published a report[48] which found that increasing the market share of refillable bottles by only 10% in all coastal countries in place of single-use PET bottles could reduce PET bottle marine plastic pollution by 22%, or by as much as 7.6 billion bottles.

In the past, refillable systems for glass bottles have been relatively common in many countries, but their use has declined (albeit they still have a strong presence in some sectors, notably hospitality) – firstly with the increasing use of thinner one-way glass bottles, and then with the expansion of single-use PET bottles and metal cans.

It is assumed that refillable systems use a refundable deposit to incentivise high levels of return. Such a deposit return system (DRS)requires the consumer to pay a deposit at the point of purchase, which they then redeem when they return their used bottle to a retailer. The bottles are returned to beverage fillers/ distributors to be cleaned and re-filled or recycled. The consumer is incentivised to return their container by the refund value.

Based on the evidence of DRS return rates (Appendix A.3.0), as well as communication with a refill industry stakeholder, it is assumed that 97.5% of refillable bottles are returned for a deposit refund, annually. Refill systems necessitate a very high collection rate in order to function, and this is achieved by means of a DRS; for refill there is extra incentive to operate the highest efficiency scheme to avoid reduction in the stock of bottle; scheme operators bear the direct cost of these losses.

The research available suggests that a modern, well-designed DRS, whether implemented for refill or recycling, could reduce the littering of beverage containers by 95%, meaning that, on the basis that roughly 40% by volume of litter is comprised of

[48] Oceana (2020) Just one word: refillable. Available from: https://oceana.org/sites/default/files/3.2.2020_just_one_word-refillables.pdf

beverage containers, the volume of all litter could reduce by approximately a third.[49] Full background research on the impact of return systems on littering is available in Appendix A.4.0.

5.1 Prospects for refill

The prospects for future refill systems were assessed in terms of drivers and barriers to adoption. The summary and conclusions are presented here, while the full analysis supporting this is available in Appendix A.5.0 (research and discussion on all drivers and barriers) and Appendix A.5.1 (assessment of current brand refill and DRS activities).[50]

Currently, refill stands at 23% of beverage literage sold in the NARTD sector (for all types of containers) and 4.5% for PET containers only. The current trend is for this to be slowly decreasing, mainly as a result of the rapid expansion in the market for single use beverage containers.

The market for refill is very different depending on the country and region, some having lower or greater barriers to entry. Countries with a particularly high % of refill in the sector include many in Latin America such as Mexico, Nicaragua, El Salvador, Venezuela, Chile, Columbia, Guatemala, Paraguay, Honduras, Uruguay and Argentina (all in the top tens for different container types). Asia-Pacific countries featuring in the top tens include Indonesia, the Philippines, Taiwan and Thailand (Figure 5-1).

While NARTD companies don't regularly report on refillable shares, recent industry analyst reports have indicated strong recent and rapid growth in share in Latin American countries, including Brazil and Mexico. Where refillables systems are in place (and well managed) there is the potential for a fast increase in market share.

Coca-Cola, accounting for more than 21% of single-use PET bottles for NARTD, is bullish about the prospects for refillables across its multiple brands. In February 2022, the company announced a new industry-leading goal to significantly boost its use of reusable packaging:[51]

> *By 2030, [The Coca-Cola Company] aims to have at least 25% of all beverages globally across its portfolio of brands sold in refillable/returnable glass or plastic bottles, or in refillable containers through traditional fountain or Coca-Cola Freestyle dispensers.*

[49] Eunomia (2017) Impacts of a Deposit Refund System for One-way Beverage Packaging on Local Authority Waste Services. 11th October 2017

[50] The appendices also consider prospects for wider implementation of one-way DRS to better manage those NARTD PET bottles that remain non-refillable.

[51] https://www.coca-colacompany.com/news/coca-cola-announces-industry-leading-target-for-reusable-packaging

Alongside this announcement, the company reported that:

> *Returnable glass bottles and refillable PET currently represent more than 50% of The Coca-Cola Company's product sales in more than 20 markets, and more than 25% of sales in another 20 markets. Traditional refillable/returnable packaging accounted for approximately 16% of the company's total volume in 2020. Use of refillables is growing in several markets, outperforming non-refillables in Germany and parts of Latin America, where reusable bottles represented 27% of transactions in 2020.*

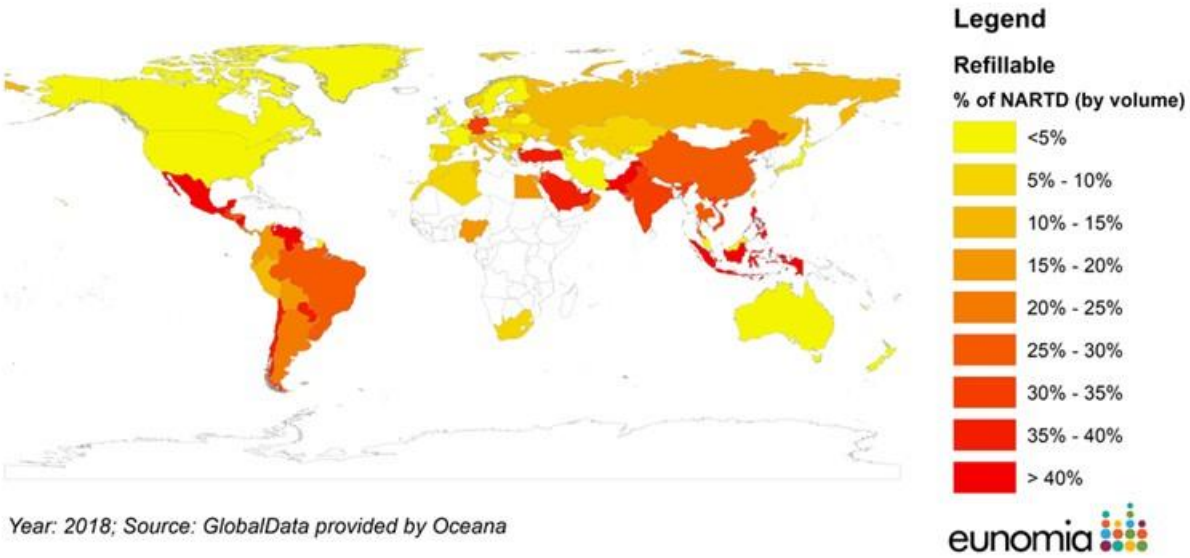
The Coca-Cola Company's 2020 World Without Waste Report[52] notes that in 2020, Colombia and regions of Brazil adopted the "universal bottle" first introduced in 2018 by Coca-Cola Brazil and in use in Argentina, Brazil, Chile, Colombia, Mexico, Guatemala and Panama. This is reported to drive efficiency of collection, cleaning and filling as it the same reusable bottle with a single colour, shape and size can be used by multiple brands.

Although Coca-Cola has been the first leading brand to announce a significant, quantifiable target on refillable bottles, it seems Pepsi may soon follow. Responding to a shareholder proposal filed by As You Sow, in March 2022 PepsiCo agreed to set a time-bound goal by the end of 2022 for a percentage volume of its beverages to be delivered via strategies such as reusable and refillable bottles, in a bid to reduce dependency on single-use plastics.[53]

[52] The Coca-Cola Company (2021) 2020 World Without Waste Report, 6/07/2021, available at https://www.coca-colacompany.com/content/dam/journey/us/en/reports/coca-cola-world-without-waste-report-2020.pdf

[53] As You Sow (2022) PepsiCo Pledges to Reduce Single-Use Packaging as Requested by As You Sow Proposal, available at https://www.asyousow.org/press-releases/2022/3/16/pepsi-reduce-single-use-packaging

Figure 5-1: Market share of refillable NARTD in 93 countries of the world (% of literage sales NARTD beverages, all container types) in 2018



Year: 2018; Source: GlobalData provided by Oceana

6.0 Conclusions

The impacts of the collection scenarios assessed on material flow and the tonnage of litter entering the aquatic ecosystems are shown in Table 6-1.

Table 6-1: Estimated material flow under the four modelled scenarios (Mt)

Scenario:	Baseline	Brand commitments on recycled content met
Litter emitted to aquatic environment (Mt)	1.00	0.93
Mismanaged remaining on land (Mt)	2.68	2.49
Other waste treatments (residual waste) (Mt)	3.02	1.04
Collected for recycling (Mt)	5.94	8.51
Managed by the informal sector (Mt)	1.00	0.67
Refillable returned (Mt)	0.63	0.63
Total PET bottles PoM/used (Mt)	**14.26**	**14.26**

The results presented in Table 6-1 indicate that increasing recycling or recycled content in bottles is likely to have only a very small effect on aquatic pollution. This is due to the assumption that bottles used for recycling will mostly be derived from already collected and managed waste streams and not from mis-managed waste or littering. Furthermore, existing commitments for increasing recycled content are unlikely to be met, as projections based on business-as-usual practices predict that the future supply of recycled PET will not meet demand.

To achieve a more significant reduction in PET bottles entering aquatic systems, a strategy to increase the use of refillable PET bottles could be considered. In 2020, Oceana published a report[54] which found that increasing the market share of refillable bottles by only 10% in all coastal countries in place of single-use PET bottles could reduce PET bottle marine plastic pollution by 22%, or by as much as 7.6 billion bottles.

[54] Oceana (2020) Just one word: refillable. Available from: https://oceana.org/sites/default/files/3.2.2020_just_one_word-refillables.pdf

There is potential for a large increase in refillable share, given Coca-Cola's announcement in February 2022 of a global goal to increase its use of refillable bottles, PepsiCo's plans for a similar announcement, and recent positive developments in the Latin American market. However, refill DRS is not yet available for other container types such as cans, pouches and cartons, and is not currently available in several large NARTD markets.

In addition to the refillables strategy, if 'one-way' deposit return systems were to be set up for the remaining single-use PET bottles (these typically require government intervention in the form of a requirement (or incentive, such as a graduated tax) to achieve a certain return rate (usually 90%) and/or to establish a DRS) there would be a further reduction in PET bottles entering the aquatic environment. Importantly, a one-way DRS can be used to increase the capture rate of packaging types beyond PET bottles, such as aluminium cans, glass bottles and cartons.

A refillable-led strategy - which could be undertaken by brands either individually, or through a collaborative approach involving 'universal' bottles – shows promise in bringing about a significant reduction in the proportion of NARTD PET beverage bottles entering the aquatic environment. While litter reduction is clearly a key benefit, it is important when designing and setting up refillable systems that full consideration is given to the optimisation of the system as a whole, to ensure very high return rates, efficient approaches to transportation and washing, with a view to minimising all associated carbon emissions.

It's important also to recognise that while certain actions can be brand-led, there will always be a part of the market, typically comprised of smaller producers, that does not have the ability or resources to set up their own system. Accordingly, in the absence of a collaborative producer-led approach involving all producers, there will be a need for Government intervention to require take-back schemes of the nature that will achieve significant reductions in littering.

Finally, while this report has demonstrated that focusing on recycled content is not an effective way to reduce the number of PET bottles entering the aquatic environment, it is important to emphasise that increasing recycled content, both for refillable and 'one-way' PET beverage bottles, *is* highly desirable from the perspective of reducing the demand for virgin PET, and keeping PET in a 'closed-loop' for as long as possible.

APPENDICES

A.1.0 Appendix 1 – Model assumptions

Selected specific assumptions discussed in more detail below.

A.1.1 Literage to units and weight conversion

Literage is converted to number of bottles and weight using the size breakdown provided by Oceana/GlobalData and the weight associated with each bottle size. This data was only available for Western and Eastern Europe, and therefore the average values have been applied where data is not available.

A.1.2 Informal sector collection rate

Due to the inherent value of PET bottles, collection rates by the informal sector are likely to be of significance.[55] A methodology suggested by Lau et al. has been adapted to estimate the quantity of PET bottles (rather than all plastic or all waste – as per existing estimates) collected by the informal sector. First, the number of 'waste pickers' in each country was calculated based on the proportion of the urban population that worked in that sector reported by Linzner & Lange.[56] The urban population data was provided by the World Bank.[57] Two important assumptions must be highlighted here. First, only the urban population of each country was considered due to the considerably lower number of 'waste pickers' operating in rural areas. Second, due to Lebreton & Andrady partially adjusting for informal sector waste picking activity, these assumptions were only applied to upper-middle (UMCs), lower-middle (LMCs) and low income countries (LICs). In these areas the informal sector has a significant additional impact. Using this methodology, Eunomia's model suggests that approximately 11.8 million people are working in the informal sector globally, slightly below Borrelle et al.'s estimation of 15 million.[58] For the 93 countries in this study, the informal sector consists of approximately 9.8 million people.

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[55] Lau, W.W.Y., Shiran, Y., Bailey, R.M., et al. (2020) Evaluating scenarios toward zero plastic pollution, *Science*, Vol.369, No.6510, pp.1455–1461

[56] Linzner, R., and Lange, U. (2013) Role and size of informal sector in waste management – a review, *Proceedings of the Institution of Civil Engineers - Waste and Resource Management*, Vol.166, No.2, pp.69–83

[57] World Bank Data (2021) *Urban population*, accessed 18 January 2021, https://data.worldbank.org/indicator/SP.URB.TOTL

[58] Borrelle, S.B., Ringma, J., Law, K.L., et al. (2020) Predicted growth in plastic waste exceeds efforts to mitigate plastic pollution, *Science*, Vol.369, No.6510, pp.1515–1518

Finally, the number of PET bottles collected by each 'waste picker' annually must be estimated. This is set depending on the level of economic development for each country, with waste pickers in countries of lower economic development picking more PET bottles per day, on the basis that more bottles are available and the economic advantages of waste picking are greater. For the 93 countries in this study, it is estimated that 35.8 billion PET bottles (7.74% of PoM) are collected by the informal sector in the baseline scenario.

A.1.3 Collection for recycling rates; sorting and processing loss rates; rPET available for bottle manufacture

A.1.3.1 Europe

Collection schemes in Europe are varied with high recycling rates from some of the countries with beverage deposit return schemes (DRS) and lower rates from countries and regions with separate collection schemes. An accurate estimate of current recycling is difficult as there are several reporting issues, but with minor amendments to work conducted by Plastic Recyclers Europe[59], Eunomia estimated that the collection rate of PET bottles in Europe is 63.2%. This figure accounts for bottles collected through a beverage DRS and separate collections. Following collection there are further losses associated with sorting and processing.

rPET used in beverage bottle manufacturing needs to be derived from beverage bottles because it has probably the highest overall quality criteria of all applications, and bottles are the best feedstock for satisfying these. Although an estimated 49% of PET bottles PoM are returned to rPET (i.e., 77% of the bottles collected for recycling, owing to the sorting and processing losses), the rPET content of PET bottles is only 11% (which accounts for 24% of rPET produced, equivalent to 12.25% of single use PET bottles PoM).[60] The remaining 76% of rPET produced is used in the manufacture of other applications such as trays and fibres. This is further explained in Section 3.3.

[59] EFBW, Petcore Europe and Plastics Recyclers Europe (2020) *PET Market in Europe - State of Play: Production, Collection and Recycling Data*, 2020

[60] EFBW, Petcore Europe and Plastics Recyclers Europe (2020) *PET Market in Europe - State of Play: Production, Collection and Recycling Data*, 2020

A.1.3.2 North America

The National Association for PET Container Resources (NAPCOR) reports a recycling rate of 35% across the USA, Canada, and Mexico in 2019.[61] However, NAPCOR also highlights that the U.S. PET recycling rate must double so that brand owners can meet their commitment to incorporate 25% recycled content in their bottles by 2025. Although significant growth has been seen in the food/beverage and non-food/beverage bottle categories in terms of rPET markets, with total bottle end markets up by 41% between 2017 and 2019, fibres remains the dominant end market category.

A.1.4 Brand recycled content commitments and current progress

A.1.4.1 The Ellen-MacArthur Foundation (EMF) Goals

The five brands presented in this study are all signatories to the EMF Global Commitments, which is a collaboration between the EMF and the United Nations Environment Programme (UNEP). One such commitment is to:

> *Set an ambitious 2025 recycled content target across all plastic packaging used*[62]

Therefore, the brands have a qualitative direction to increase the recycled content in their global plastic packaging design, but it is up to them what level they consider "ambitious" and ultimately, set this at.

A.1.4.2 The Coca-Cola Company

The Coca-Cola Company launched their World Without Waste initiative in 2018, which lays out their plans to 'design, collect, and partner' to increase sustainability.[63] The company reached a global average of around 10% (9.7%[64]) rPET in their bottles in 2020.[65] As of 2019, 18 of their markets sold beverages in 100% rPET bottles.[63,66] The Coca-Cola Company aims to incorporate 25% PCR content into their global plastic packaging by

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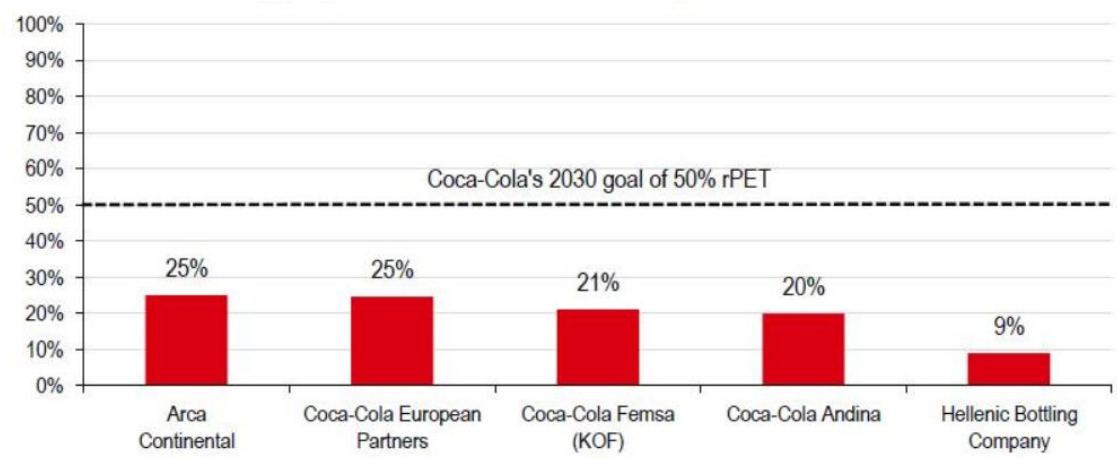
[61] NAPCOR (2020) *2019 PET Recycling Report*.
[62] https://www.ellenmacarthurfoundation.org/assets/downloads/13319-Global-Commitment-Definitions.pdf - page 2
[63] The Coca-Cola Company website: https://www.coca-colacompany.com/sustainable-business/packaging-sustainability
[64] The Coca-Cola Company EMF: https://www.ellenmacarthurfoundation.org/resources/apply/global-commitment-progress-report/organisation-reports/report/ppu/rec9MNy2Ttzw0iKe8
[65] https://www.foodnavigator.com/Article/2020/09/24/Biggest-plastic-polluters-accused-of-hypocrisy-Unilever-Danone-and-Coca-Cola-respond
[66] This includes brands across Australia, Austria, Belgium, Colombia, France, Germany, Hong Kong, Japan, Mexico, Netherlands, Norway, Peru, Philippines, Romania, South Africa, Sweden, Switzerland, and the UK.

2025 and reach 50% rPET content in their global plastic packaging by 2030.[67] Figure A1-1 shows progress on the global goal as of 2017: Europe was at 25% rPET content in their plastic packaging, and Coca-Cola FEMSA, which covers Latin America (see Section A.1.4.3), was at 21% rPET content in their plastic packaging. Some areas have higher or earlier targets than this: Coca-Cola in the UK aimed by 2020 to increase the recycled content of plastic bottles to 50%[63]; Coca-Cola in Western Europe is aiming for 50% recycled content in their plastic bottles by 2025[63]; and Coca-Cola aims for the whole of Europe to reach 100% rPET content in their plastic bottles by 2030.[68]

Figure A1-1: Coca-Cola bottlers' progress towards The Coca-Cola Company's global rPET goal.

KOF: Coca-Cola FEMSA. CCEP: Coca-Cola European Partners. HBC: Hellenic Bottling Company. Source: Company data, 2017 sustainability reports



A.1.4.3 Coca-Cola FEMSA

Coca-Cola FEMSA is the largest franchise bottler of Coca-Cola trademark beverages in the world by sales volume.[69] They cover 10 countries in Latin America: Argentina, Brazil, Colombia, Guatemala, and Mexico (territories only); and Costa Rica, Nicaragua, Panama, Uruguay, and Venezuela (nationwide).[70] 60% of their total packaging by weight is PET bottles. In 2019, they used 23.7% PCR content in their PET bottles.[71] Their goal by 2020 was to incorporate 25% recycled material into their PET bottles[71], and they aim by 2025 to reach 25% PCR content in their total plastic packaging across the 10 countries.[69] They

[67] The Coca-Cola Company EMF: https://www.ellenmacarthurfoundation.org/resources/apply/global-commitment-progress-report/organisation-reports/report/ppu/rec9MNy2Ttzw0iKe8

[68] https://www.businessgreen.com/feature/4025628/real-coca-cola-european-partners-joe-franses-unpacks-drinks-giant-net-zero-agenda

[69] Coca-Cola FEMSA EMF: https://www.ellenmacarthurfoundation.org/resources/apply/global-commitment-progress-report/organisation-reports/report/ppu/recAe8b8ckmbuUYK3

[70] https://www.femsa.com/en/business-units/coca-cola-femsa/

[71] Coca-Cola FEMSA website: https://coca-colafemsa.com/wp-content/uploads/2020/04/Coca-Cola-FEMSA-Integrated-Report-2019.pdf

have a further target of reaching 50% PCR content in their PET bottles specifically by 2030.[69]

A.1.4.4 Swire Coca-Cola

Swire Coca-Cola is the fifth largest bottling partner of The Coca-Cola Company by global volume, covering the Chinese Mainland, Hong Kong, Taiwan, and the Western USA.[72] They have their own sustainability strategy: the *2030 Sustainable Development Strategy.*[73] PET bottles comprise 82% of their product portfolio, and in 2019 their total materials comprised 1% PCR content.[72] Their goal is to reach 5% PCR content in their plastic packaging by 2025.[72] Although it is not clear whether this applies to all plastics or just PET bottles, it is worth noting that the actions they intend to take to achieve this goal include increasing the rPET content for specific products in the USA and Hong Kong.[73] By 2030, Swire wants to use 50% recycled material in their primary packaging, a target which ostensibly applies to all packaging including PET bottles, aluminium cans, and other types of plastics.[72]

A.1.4.5 PepsiCo

PepsiCo sells a wide range of products in 200 countries and territories.[74] They are a member of the UK Plastic Pact and they report that their approach to sustainable packaging is to reduce, recycle, and reinvent.[74] Their sustainability champion, which they reference repeatedly, is their brand 'SodaStream', an at-home carbonated drinks refillable product. Across all their packaging, they used 4% PCR content as of 2019.[74] Here are some examples of their reported progress on increasing rPET:

- **LifeWTR** – USA: transitioned to 100% rPET at the end of 2020;[74]
- **Lipton** – Belgium and the Netherlands: transitioned to 100% rPET in March 2020;[74]
- **Tropicana** – Western Europe: 50% rPET as of June 2019; [74]
- **Naked Juice** – USA, UK, and Canada: 100% rPET since 2009.[75]

PepsiCo's recycled content goals are largely brand- and country-specific. They aim to move to 100% rPET in plastic bottles for their brand Pepsi in 9 European countries: Germany, Greece, Poland, Romania, and Spain in 2021; and Belgium, France,

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[72] Swire Coca-Cola EMF: https://www.ellenmacarthurfoundation.org/resources/apply/global-commitment-progress-report/organisation-reports/report/ppu/recxk5VE55Rz2hABw
[73] Swire Coca-Cola website: https://www.swirecocacola.com/sbcorpweb/uploads/docs/SCC_SR_EN_Final.pdf
[74] PepsiCo EMF: https://www.ellenmacarthurfoundation.org/resources/apply/global-commitment-progress-report/organisation-reports/report/ppu/recTG1dd7ywLrssKA
[75] PepsiCo website: https://www.pepsico.com/docs/album/sustainability-report/2019-csr/2019-sustainability-performance-metrics-sheet.pdf

Luxembourg, and the UK in 2022.[76] In France, the UK, Belgium, and Luxembourg, PepsiCo is aiming to use 100% rPET in plastic bottles for a wider range of brands, including 7Up, Mountain Dew, and Lipton.[77] In Western Europe, Tropicana aims to transition to 100% rPET in their plastic bottles by 2025.[74] They aim to use 25% PCR content in their total plastic packaging by 2025, and although this target does not state whether this relates to PET bottles specifically, their planned actions include the aforementioned brand-specific rPET goals.[74] They aim to use 50% rPET in bottles across the EU by 2030.[77]

A.1.4.6 Dr Pepper Snapple

Dr Pepper Snapple released their second *Drink Well. Do Good.* report in 2020, which covers their environmental commitments, corporate responsibility information, and supply chain targets.[78] PET bottles make up 69% of their product portfolio[79] (26% of their packaging mix by weight[78]). In 2019, their material was sourced from 0.3% PCR content, and 2% pre-consumer recycled content[79] – the only brand to display a pre-consumer recycled content figure. They plan to start transitioning water products and Snapple beverage bottles to 100% rPET by June 2021.[79] They aim to increase their PCR content use across their total plastic packaging to 25% by 2025.[79]

A.1.4.7 Danone

Danone is a member of the UK, France, and South Africa Plastic Pacts.[80] Danone has three businesses: Essential Dairy & Plant-Based Products; Waters; and Specialised Nutrition.[80] Danone Waters UK and Ireland is a certified B-Corp, gaining their accreditation through switching Evian's 750ml bottle to 100% recycled plastic, among other measures.[81] PET bottles comprise 49% of their product portfolio.[80] Their total plastic packaging on average contains 10.6% PCR content.[80] Their Waters division uses 16% rPET in their plastic bottles – this value increases to 20% when looking only at countries that allow the use of rPET.[80] By 2021, they will launch 100% rPET in all major water markets – but the implication from their website is that this will not affect all products.[82] By 2025, they aim to reach 50% rPET content in their total global water and

[76] https://www.packaging-gateway.com/news/pepsico-eu-rpet-2022/
[77] https://www.politico.eu/sponsored-content/no-time-to-waste-time-to-collaborate-on-waste/
[78] Dr Pepper website: https://www.keurigdrpepper.com/en/our-company/corporate-responsibility
[79] Dr Pepper EMF: https://www.ellenmacarthurfoundation.org/resources/apply/global-commitment-progress-report/organisation-reports/report/ppu/recLXc9Kx9RIHS0dq
[80] Danone EMF: https://www.ellenmacarthurfoundation.org/resources/apply/global-commitment-progress-report/organisation-reports/report/ppu/rec22hjdEhlnfbT8k
[81] https://www.packagingnews.co.uk/news/environment/refillable-packaging/danone-secures-b-corp-accreditation-packaging-commitments-02-12-2020
[82] Danone website: https://www.danone.com/impact/planet/packaging-positive-circular-economy.html

beverage bottles.[82] This includes a target for Danone Waters specifically to reach 100% rPET in their plastic bottles across Europe in 2025.[80]

A.1.4.8 Nestlé

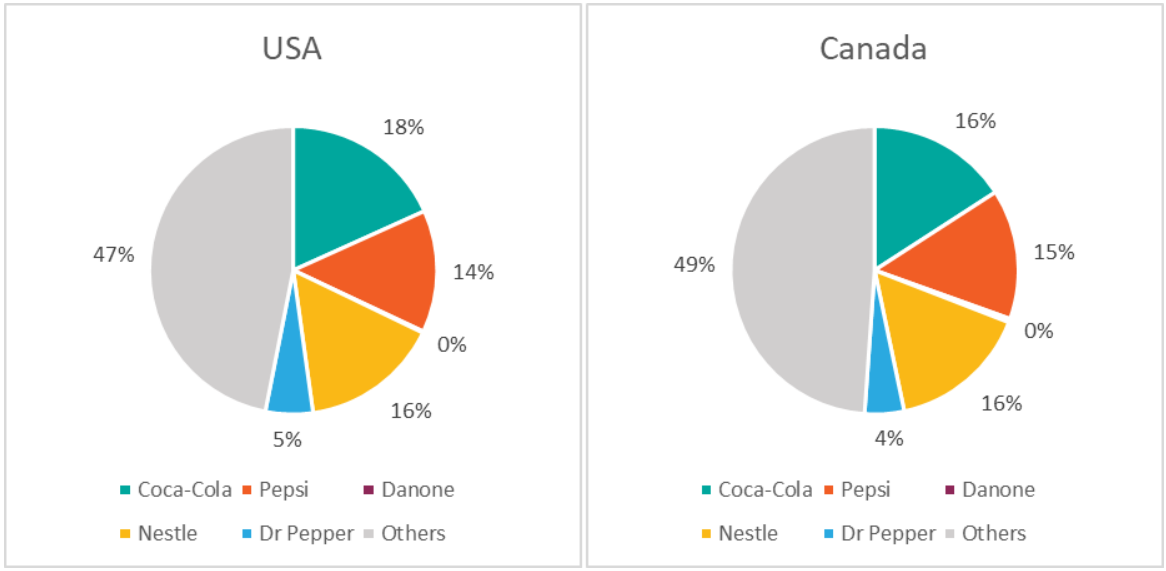
Nestlé is the world's largest food and beverage company, and they are a member of the Chile, France, European Economic Area (EEA), Netherlands, Portugal, and UK Plastic Pacts.[83] Their materials are currently 2% PCR content.[83] By the end of 2019, Nestlé used 5% rPET globally in their water bottles; they publicly publish their breakdown of rPET content by brand and by location.[83] In 2019, 40% of their global plastic use was PET.[84] By the end of 2020, they aimed to have 13% rPET as a global average in their water bottles.[83] Their goal is to have 30% PCR content in their global plastic packaging by 2025, and 50% rPET content in their PET water bottles.[83] In some markets they have short-term goals, such as reaching 100% rPET by 2022 for Poland Spring bottles in America and by 2021 for Buxton bottles in the UK.[84] Nestlé Waters North America, which covers USA and Canada, have a target of 25% rPET in their water bottles by 2021.[85]

A.1.5 Brand market share – regional differences

North America and Canada (Figure A1-2) both show a very similar profile, with Coca-Cola in the lead, but followed closely by Nestlé and Pepsi.[86] Danone shows a very small share of <1%, which Eunomia believes is due to errors in data as the USA was the highest selling market according to Danone's 2019 annual report.[87]

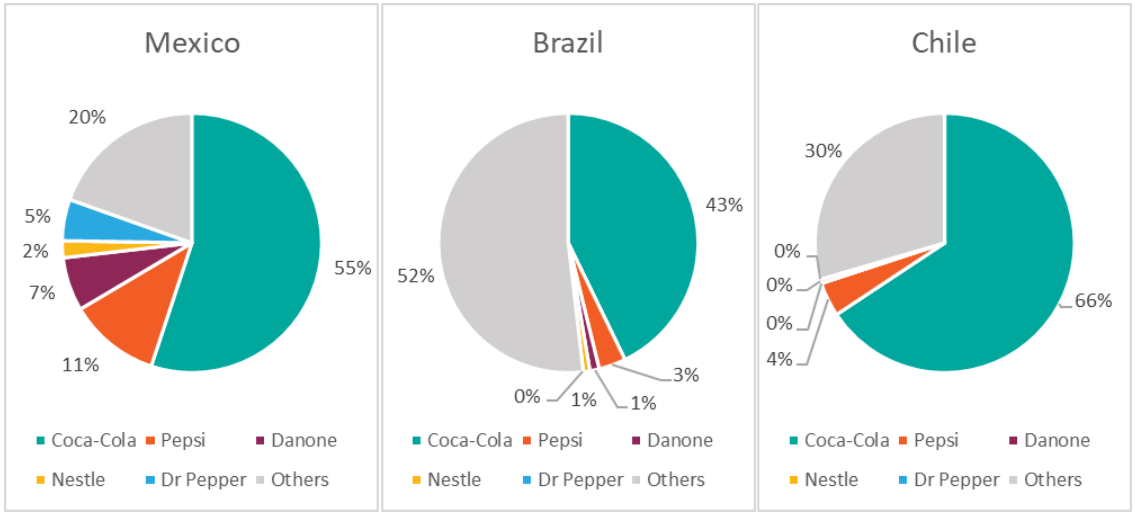
[83] Nestlé EMF: https://www.ellenmacarthurfoundation.org/resources/apply/global-commitment-progress-report/organisation-reports/report/ppu/rec1jcYlr68Ds0uw9
[84] Nestlé website: https://www.Nestlé.com/csv/global-initiatives/zero-environmental-impact/packaging-plastic-pollution
[85] https://www.bevnet.com/news/2020/Nestlé-waters-north-america-invests-in-startup-timeplast-to-explore-alternative-packaging-technologies
[86] Calculations based on data provided to Oceana by GlobalData (2020)
[87] https://www.danone.com/content/dam/danone-corp/danone-com/rai/2019/annual-report-danone-2019.pdf

Figure A1-2: North America and Canada volume share, NARTD sector, PET bottles



Latin America (Figure A1-3) shows a very different market share distribution.[88] Coca-Cola holds the vast majority, in some countries over half of the total NARTD sector. In Mexico, there are still some larger market shares for the other brands, but these are almost non-existent in Chile and Brazil. The difference in distribution in Mexico might be explained by its geographic proximity to North America.

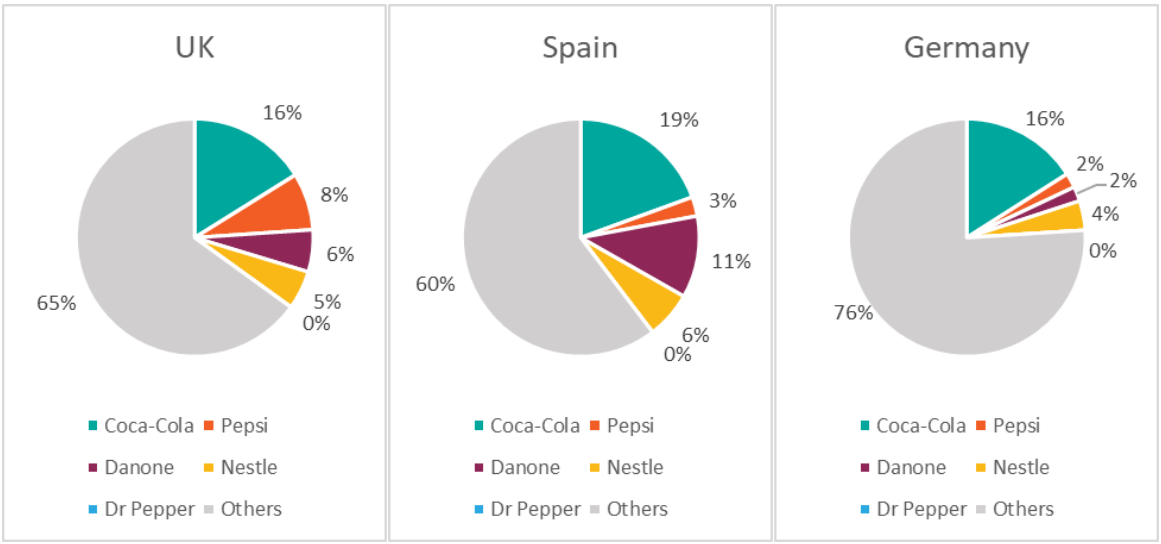
Figure A1-3: Latin America volume share, NARTD sector, PET bottles



[88] Calculations based on data provided to Oceana by GlobalData (2020)

European market share distributions (Figure A1-4) also see a variance between countries.[89,90] The five assessed brands have the lowest overall market share in Germany, which might be due to the large local mineral water market. In all cases, however, Coca-Cola has the largest volume share with differences seen predominantly in PepsiCo's and Danone's sectors. Dr Pepper Snapple is only minimally represented in Europe.

Figure A1-4: Europe volume share, NARTD sector, PET bottles



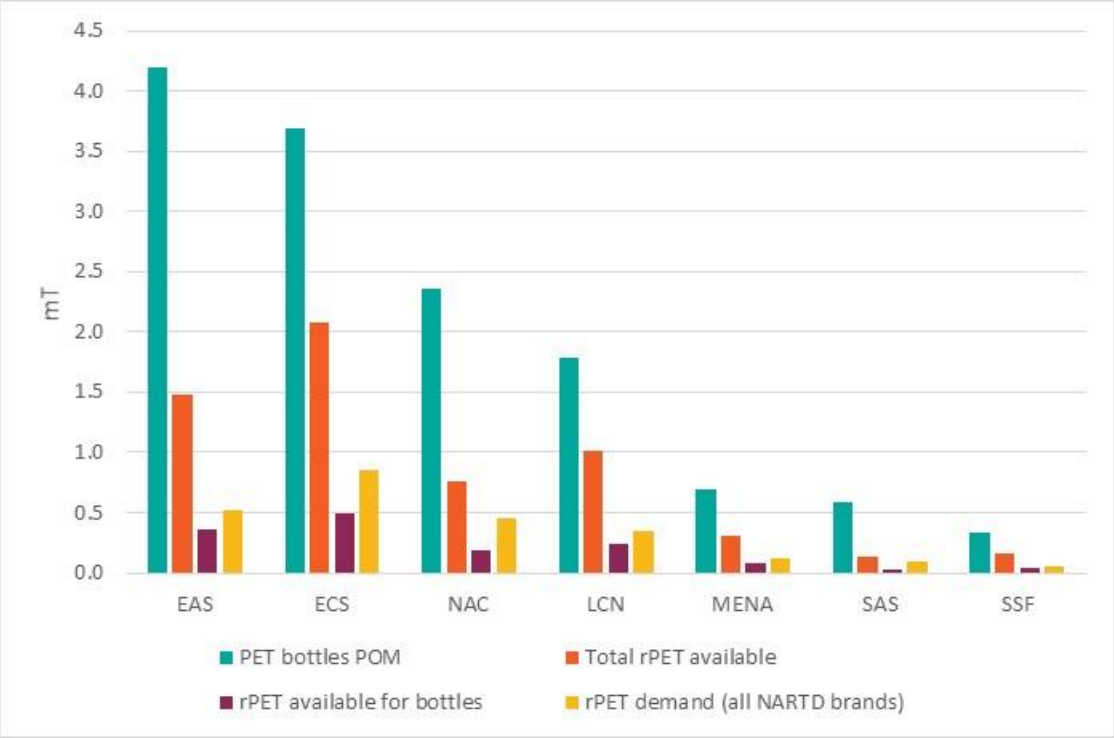
Data availability for other geographical regions was at best limited and no overriding conclusions could be drawn.

A.1.6 Geographic distribution of deficit in rPET supply

For the purposes of the model, it is assumed that PET is supplied and used in the same geographic regions, but in practice, this may be far removed from actual flows of material, which could not be accounted for in the model within the scope of this project. However, the working assumption allows some useful reflections to be made on how individual regions or nations contribute to future collection for recycling scenarios and hence litter entering the aquatic environment. Deficits by geographic region are shown in (see Figure A1-5).

[89] Calculations based on data provided to Oceana by GlobalData (2020)
[90] German data is based on reference year 2003 and taken from http://media.corporate-ir.net/media_files/irol/94/94566/presentations/EEME_05.pdf

Figure A1-5: rPET for bottles - demand vs supply by geographic region



Note: EAS: East Asia & Pacific; ECS: Europe & Central Asia, LCN: Latin America & Caribbean, MENA: Middle East & North Africa, NAC: North America & Canada: SAS: Sub-continental Asia, SSF: Sub-Saharan Africa

A.1.7 Geographic distribution of required increases in collection for recycling

The geographic variation modelled as to the increase in collection for recycling rates required as a consequence of the deficits is presented in Table A1-1). This is a function of the size of the deficit as well as existing regional collection for recycling rates.

Table A1-1: Data table for current and required collection rates, by geographic region

	East Asia & Pacific (EAS)	Europe & Central Asia (ECS)	Latin America & Caribbean (LCN)	Middle East & North Africa (MENA)	North America & Canada (NAC)	Sub-continental Asia (SAS)	Sub-Saharan Africa (SSF)	Total 93 Countries
Current collection rate	35.3%	56.5%	56.5%	44.9%	32.0%	23.3%	49.4%	**43.6%**

Required collection rate	47.1%	78.7%	59.6%	50.1%	74.8%	50.4%	50.4%	**62.4%**
Absolute increase	11.9%	22.1%	3.1%	5.2%	42.8%	27.0%	1.0%	**18.9%**
Relative increase	**33.7%**	**39.1%**	**5.4%**	**11.5%**	**133.4%**	**115.8%**	**2.0%**	**43.4%**

A.2.0 Likelihood of rPET requirement from five brand commitments being met - positive and negative drivers of bottle collection and recycling rates

This section explores in detail the prospects of the five brand commitments actually being met – and consequently the likelihood of realising the potential benefits modelled in Section 4.2.1. The positive and negative drivers of bottle collection and recycling are assessed to determine the likely future trends of these activities. This covers legislation, collection, quality requirements and processing infrastructure capacity.

A.2.1 Legislation and targets

There is the potential for existing legislation to act as a positive driver for bottle collection and recycling. Many countries have legislated mandatory targets for plastic packaging and/or bottle collection and recycling rates, which can act as a driver to increase recycling rates, depending on the strength of governance and whether the necessary investment in infrastructure is made. The imposition of taxes on packaging that does perform well in terms of collection for recycling is another mechanism for which there are examples. These are discussed below for Europe and the rest of the world.

The EU's Single-Use Plastics Directive (SUPD) sets a collection target of 77% for beverage bottles by 2025, rising to 90% by 2029.[91] More generally, EU plastic packaging recycling targets are 50% in 2025, and 55% in 2030 and 2035.[92] This is somewhat lower than the

[91] https://ec.europa.eu/commission/presscorner/detail/en/IP_18_6867

[92] Eunomia, COWI (2019) Study on investment needs in the waste sector and on the financing of municipal waste management in member states, *report produced for the European Commission*.

targets on municipal waste recycling (55% for 2025, 60% for 2030, 65% for 2035) and overall packaging waste recycling (65% for 2025 and 70% for 2030). These targets have encouraged both national governments and brands to investigate new collection methods, with many opting for a DRS (which is specifically referenced in the SUPD as a means of achieving the 90% target).

As an alternative, or addition, to targets, governments may introduce supporting economic instruments that can incentivise higher collection rates. The Norwegian beverage container tax, for example, is an excise duty per unit beverage packaging placed on the market. There are two elements to the tax: a base tax on single-use packaging specifically and an environmental tax. For containers with a collection rate less than 25%, producers pay the full amount of both taxes. Above 25%, the environmental tax falls as the collection rate increases and containers with a return rate of at least 95% are exempt. In response, the majority of beverage producers have chosen to join a one-way DRS as a cost-effective way to increase their collection rate and reduce their tax liability (balanced against the costs of the DRS).

In the East Asia & Pacific region, South Korea has set an objective to halve plastic waste and to increase its recycling rates to 70% by 2030.[93] Outside of Europe, however, many countries lack tangible recycling targets, but there are some positive examples. International initiatives, such as the UN Sustainable Development Goals – which requires countries to "substantially reduce" waste generation – do not lead countries to set specific, achievable targets.[94] In addition, the international shifts of recyclate from country of collection to country of recycling make accounting for recycling difficult, and this is compounded by heavy reliance on the informal sector and a lack of funding for recycling in receiving countries. On a global scale the shifts of material and the lack of unified targets make net increases in collection and recycling difficult to achieve.

Currently, the brands are struggling to meet their own targets for recycling because of the lack of national support in many markets.[95] Going forwards, the brands can use their leverage and investment potential to financially drive collection and recycling where targets are absent or insufficiently comprehensive. For example, PepsiCo, Danone, Coca-Cola, and others have invested in Circulate Capital for recycling in Southeast Asia[96] This collaborative effort could be replicated in other regions to contribute to the meeting of the brands' recycling targets.

[93] Ministry of Environment *Land & Waste*, accessed 4 May 2021, http://eng.me.go.kr/eng/web/index.do?menuId=466

[94] https://sdgs.un.org/goals/goal12

[95] https://www.reuters.com/investigates/special-report/health-coronavirus-plastic-recycling/

[96] https://www.danone.com/content/dam/danone-corp/medias/media-othernews-fr/2018/corporatepressreleases/Circulate_Capital_Announces_US$90_Million_in_Expected_Funding_To_Combat_Ocean_Plastic.pdf

A.2.2 Collection and sorting systems

The most significant driver affecting the ability to produce high quantities of rPET is the effectiveness of the collection and sorting systems. Options to increase collection include expanding a network of bring sites; introducing door-to-door recycling collections; and encouraging the use of door-to-door recycling where such collection systems are already in place (for instance by reducing the frequency of residual waste collections and using smaller residual waste bins). Introducing Pay as You Throw charges also encourage consumers to consider what more of their waste they can recycle. In countries where there is an active informal sector, engaging with waste collectors to support their work could also prove beneficial.

Depending on the existing collection rates, these changes could all help to increase collection rates. However, it is not clear that they can increase collections sufficiently to provide the necessary recycled content. These conventional collection methods are also susceptible to contamination, meaning loss rates can be high and they may not provide the food-grade rPET needed for beverage bottles. Door-to-door collections can additionally entail significant costs in areas with a high density of flats and apartments. Relying on door-to-door collections and bring sites, therefore, does not necessarily represent a cost-effective solution.

Deposit return schemes (DRSs), however, are proven to be a cost-effective way of increasing the collection rate of beverage containers specifically. The evidence from a number of countries in Europe, Australia, Canada and states in the USA is that using a deposit to incentivise consumers to return their used beverage containers will significantly increase collection rates; jurisdictions with a DRS generally have markedly higher collection rates than comparable countries and states without one. Importantly, the segregation such an approach offers means the material is of the required quality to enable bottle-to-bottle recycling. A DRS uses the financial incentive of a deposit to encourage consumers to return their containers to a dedicated return point. This is discussed in more detail in Section 5.1, but the salient point here is that the extent to which the brands can meet their recycled content commitments under the current outlook, is in great part dependent on the existing drivers/momentum for DRS.

A.2.2.1 Ease of use for consumers and communications

The potential changes discussed above are primarily focused on helping consumers to engage with bottle collections – whether that is by increasing the density of bring banks so consumers do not have to travel as far, enabling consumers to recycle at home, or providing a financial incentive to recycle.

Simplicity can also make a positive difference, so that consumers know exactly how they can recycle their bottles. While having multiple different collection systems that could cause confusion could potentially be a negative driver, this can be mitigated with effective communication and awareness-raising campaigns, for which there is much scope for improvement globally. Where new EPR includes obligations and funding

provision for engagement, these can positively drive such efforts, however where EPR already exists, historically this stipulation has been in place for decades and so gains may already have been realised.

A.2.3 Quality

The collection system will affect the collection rate and consequently the amount of material available for recycling, but quality also affects the quantity of material that can ultimately be used to manufacture new bottles. For instance, non-intentionally added substances and contaminants which migrate into the PET material during its use, collection, or sorting phases will reduce the amount of material collected that can be provide high quality recyclate. The introduction of higher quality collections, such as through DRS, reduces occurrence of these contaminants and supports bottle to bottle recycling; it is much harder to achieve quality improvements (and quality-driven quantity improvement) without it.

The design of bottles also directly influences the recyclability and subsequently quality of the recyclate. Certain materials and/or components might interfere with the recyclability of PET. In the production of PET, additives such as colourants and oxygen barriers are intentionally incorporated within, or bonded to, the PET resin. The addition of associated packaging such as caps and labels might also impede recycling. Interventions such as design guides or processes, however, can be put in place to mitigate negative impacts.

Notably, South Korea's Ministry of Environment has taken clear action to address difficult to recycle plastics, such as coloured PET and PVC, under the Act on the Promotion of Saving and Recycling of Resources.[97] In Europe, revisions to the Packaging and Packaging Waste Directive in progress have the potential to lead to the introduction of design for recycling requirements and drive implementation of related process.[98]

A.2.3.1 Food grade rPET quality requirements

In Europe, standards to produce rPET for use in food contact applications such as beverage bottles are set by the European Food Safety Authority (EFSA). Currently, EFSA limits the proportion of PET from non-food consumer applications to a maximum of 5%.

rPET derived from beverage bottles collected through a DRS can easily meet this standard as by definition beverage bottle DRS only collect food contact packaging. Separate collection schemes, however, will typically collect food contact PET packaging

[97] Neo, P. (2020) *No colour, no PVC: South Korea bans hard-to-recycle plastic materials for F&B packaging*, accessed 4 May 2021, https://www.foodnavigator-asia.com/Article/2020/01/31/No-colour-no-PVC-South-Korea-bans-hard-to-recycle-plastic-materials-for-F-B-packaging

[98] https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12263-Reducing-packaging-waste-review-of-rules_en

along with PET packaging used for non-food contact uses such as cosmetics. It may therefore be more challenging (but not impossible) to meet this standard in non-DRS collection systems.

Furthermore, regulations in some markets prevent the use of rPET in water bottles.[99] This underlines the issue that the quantity of PET collected must be considered in line with the quality of rPET produced.

A.2.4 How PET recycling capacity might develop over time and influence or limit recycling rates

Eunomia's model estimates that rPET demand for the five brands to meet their commitments, and other NARTD brands ongoing requirements, and other sectors that require rPET is 6.02 Mt. With an estimated current supply of rPET of 4.46 Mt, there is a deficit of approximately 1.56 Mt. Other research has indicated that expansions in mechanical PET recycling will be insufficient to meet the brands' commitments. A report by Lux finds that the brands consume approximately 300,000 tonnes of rPET annually, and under projections for their commitments, this will more than quadruple to 1.4 Mt by 2025 - an estimate similar in magnitude to Eunomia's projection of 1.47 Mt (see Section 3.3). Lux projects that mechanical recycling capacity would reach only 1.1Mt by 2025, falling short of demand.[100]

In 2019, ICIS published a report forecasting that the European recycling industry would miss its 2025 PET bottle recycling target.[101] The PET bottle collection rate in western Europe rose from 58% in 2016 to 63% in 2018 and was projected to reach 65% by 2019. However, under the SUPD, which requires a collection rate of 77% by 2025 and 90% by 2029, the industry will need to increase its collections by 7% year on year. The current rate of increase (2019-2020) is only 4%. Furthermore, following the SUPD, food-grade rPET rose in price by 13%, meaning it is typically 7% more expensive than virgin PET.[102] The slow pace of increase and the premium price mean that future brand-specific and national recycling targets are likely to be missed.

[99] Danone EMF: https://www.ellenmacarthurfoundation.org/resources/apply/global-commitment-progress-report/organisation-reports/report/ppu/rec22hjdEhlnfbT8k
[100] Lux (2020) The Sustainable Plastics Roadmap: Recycling, Bioplastics, and Alternatives. https://members.luxresearchinc.com/research/report/35965
[101] https://www.icis.com/explore/press-releases/europe-faces-challenges-in-meeting-plastic-bottle-recovery-target/
[102] https://www.icis.com/explore/press-releases/europe-faces-challenges-in-meeting-plastic-bottle-recovery-target/

A.2.5 Conclusion regarding likelihood of rPET requirement from 5 brand commitments being met

PET recycling is structured in a complex way with many leverage points on which the output of the high quality rPET necessary for inclusion in bottle manufacture is dependent.

Improving drivers such as the design of the bottle can minimize contamination and increase yield. One of the most important drivers, and one of the highest impacts, however, is the collection system. Looking at the evidence, it becomes clear that the five brands will not be able to meet their brand commitments unless the collection systems in each region are improved. While there is a clear target set out in policy in the EU to improve collections over the next decade, Europe is not the market that presents the largest deficit between current supply and future demand (based on brand commitments).

A different picture presents itself in other regions, where we see an absence of a coherent strategy to reliably increase rPET supply for the production of bottles in the NARTD segment.

In North America and Canada, for example, the current collection rate would need to be increased by 42.8 percentage points to 74.8% (Section 4.1 and Table A1-1) in order to meet the modelled demand. While legislation is being reviewed in the United States, there is no unified approach across the region, and it is unclear if the state specific bottle bills will be successful. Without a clear increase in PET bottle collections and recycling, the demand in this region will likely not be met. Similarly, in other regions such as East Asia & Pacific, estimated to need an increase in collection rate of 11.9 percentage points (33.7% relative increase), it is clear that some countries are actively pursuing higher recycling rates or even implementing a one-way DRS for PET bottles, but unless the entire region takes measures to increase collection rates, it is unlikely that the demand will be met.

Whilst policy is one way of increasing collection rates, some cross-organisational initiatives have already been initiated, such as a 'voluntary EPR' scheme in Indonesia "Packaging and Recycling Association for Indonesia Sustainable Environment" (PRAISE).[103] Amongst its members are Coca-Cola and Danone. Other collaborative project funding via the Alliance to End Plastic Waste included a $5 million investment in Renew Oceans over a 2-year period to improve amongst others the collection of end-of-life plastics and facilitate the sale of all plastic bottles for conventional recycling.[104] Such

[103] National Plastic Action Partnership (2020) Radically Reducing Plastic Pollution in Indonesia: A Multistakeholder Action Plan

[104] DeAnne Toto *Project funded by the Alliance to End Plastic Waste runs aground - Recycling Today*, accessed 4 May 2021, https://www.recyclingtoday.com/article/renew-oceans-shutters-indian-operations/

initiatives need to have wide coverage and significant impact in each country if they are to contribute successfully to increased collection rates globally.

A.3.0 DRS design principles and performance

The effectiveness of a DRS – and ultimately its impact on litter entering the aquatic environment – depends on the chosen design. Around the world, DRSs achieve return rates ranging from 50% (in Connecticut and in Massachusetts, USA) to 98% in Germany.[105] The success of a DRS (measured by the return rate) depends on its design and, while DRSs with low return rates are often cited as evidence against a DRS, they actually only provide evidence against a particular DRS design. A combination of factors will ultimately affect the return rate and these are discussed briefly below.

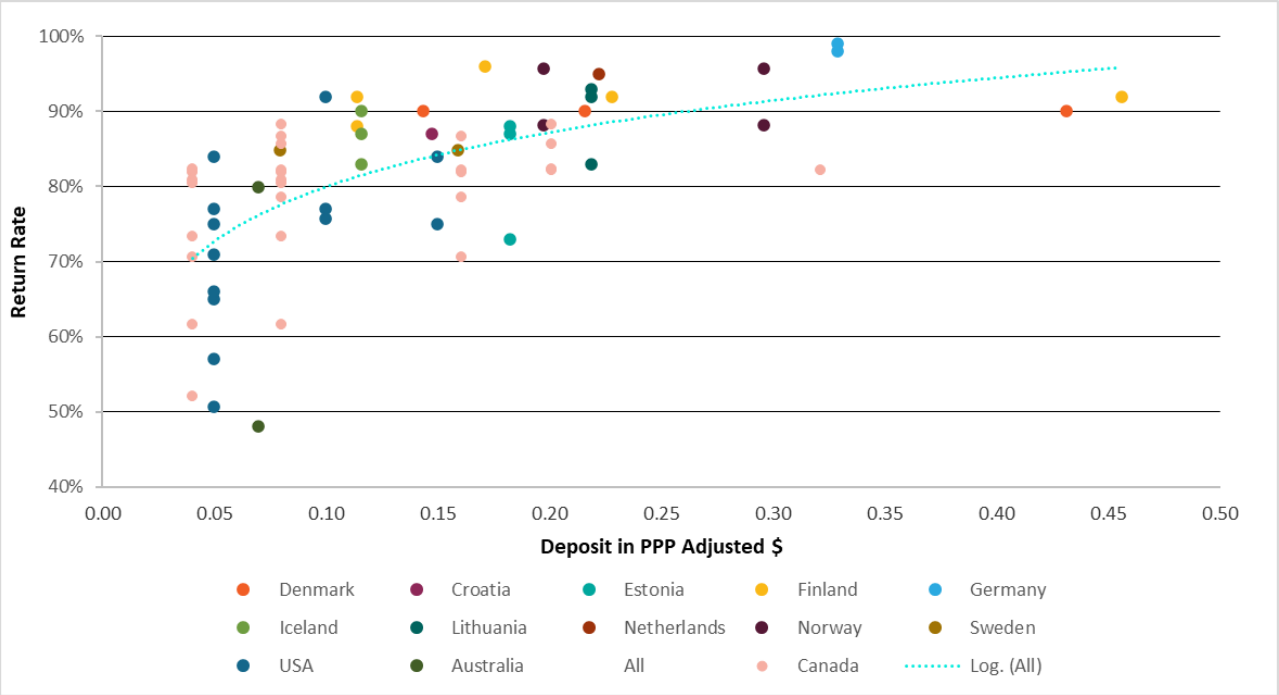
A.3.1 Deposit value

The deposit is the mechanism for incentivising consumers to return their used container. Applying a deposit to beverage containers signifies that the container has a financial value and requires the consumer to make an investment, which they will lose if they choose not to return their container.

Figure A1-6 illustrates how return rates increase with higher deposit values. The deposits have been adjusted for purchasing power parity to account for the relative strengths of the different economies; it is important to set the deposit at an appropriate value for the specific country – high enough to provide an incentive but not so high as to detrimentally affect cash-flow/ add prohibitively to the purchase price. Accordingly, the optimal deposit in lower and middle-income countries would be lower than the optimal deposit in Europe, North America or Australia (but would have an equivalent value to the consumer).

[105] https://www.reloopplatform.org/wp-content/uploads/2020/12/2020-Global-Deposit-Book-WEB-version-1DEC2020.pdf

Figure A1-6: DRS return rates & PPP-adjusted deposit values



Source: Eunomia 2019

In the USA, there are 10 "Bottle Bill" States with a DRS, which – generally speaking – have lower return rates than DRSs elsewhere. Many of the Bottle Bills (the State legislation mandating a DRS) were introduced in the 1970s and 1980s and have been updated very little in the intervening decades. Most of the Bottle Bills specified a $0.05 deposit when the legislation was first passed; this fixed deposit has not increased with inflation and has consequently lost value in real terms, while return rates have declined. It is notable that Michigan has a $0.10 deposit and has the highest return rate in the USA, at 88.7%.[106] It should be noted that Michigan is also unusual amongst the Bottle Bill states because it uses the return to retail approach, which is discussed below. Oregon increased its deposit from $0.05 to $0.10 in March 2017; the return rate increased from 59% in January – March 2017 to 82% between April and December 2017 and 85% in 2018.[107],[108] While this indicates that the higher deposit boosted return rates, it should also be noted that the system operator expanded the return opportunities, with the added convenience for consumers also likely to have had an impact.[109] Nevertheless,

[106] https://www.reloopplatform.org/wp-content/uploads/2020/12/2020-Global-Deposit-Book-WEB-version-1DEC2020.pdf
[107] OBRC (2017) *Oregon Beverage Recycling Cooperative 2017 Annual Report*, accessed 21 August 2019, https://www.obrc.com/Content/Reports/OBRC%20Annual%20Report%202017.PDF
[108] ORBC (2018) *Oregon Beverage Recycling Cooperative 2018 Annual Report*, accessed 21 August 2019, https://www.obrc.com/Content/Reports/OBRC%20Annual%20Report%202018.PDF
[109] https://www.recyclingtoday.com/article/oregon-bottle-bill-increased-redemption-2018/

there is clear evidence that, if the deposit is set at an appropriate level, it can form part of a system that reliably achieves return rates well above 80%.

A.3.2 Redemption system

While the deposit provides an incentive to return used bottles, it is also important that consumers have the appropriate opportunities to redeem their deposits. Most DRSs in the USA and Australia rely on the "return to redemption centre" approach, whereby consumers return their used containers to dedicated depots that exist for the purpose of taking back used containers. By contrast, European systems with higher return rates, and Michigan in the USA, use the "return to retail" model, which allows consumers to return their used container to beverage retailers. This greatly expands the return network and means consumers can simply return their used containers when they do their shopping.

The accessibility and convenience of the return locations can be a key determinant of the return rate. In California, USA, for example, thousands of redemption centres were forced to close because they were no longer financially viable and return rates have dwindled (from 85% in 2013 to 66% in 2017) as the convenience of the system has declined.[110] By contrast, the Oregon Beverage Recycling Cooperative has made positive efforts to expand their return network (in addition to increasing the deposit value), and return rates have been increasing.

California's experience highlights another advantage of the return to retail approach; this model tends to be more cost-effective because retailers do not need to be able to make a profit from the system and the overhead costs are shared. In lower income countries with less-developed waste management infrastructure, it could be particularly beneficial to use retailers because they provide an established distribution network that can be used to take back the used containers.

A.3.3 Governance and targets

In refill DRSs, brands have an inherent motivation to maximise the return rate in order to minimise the costs of replacement bottles and the brands themselves are often (not always) directly responsible for the operation of the system – reimbursing retailers, collecting containers etc. Successful one-way DRSs generally rely on targets (and potentially accompanying financial incentives) to support high return rates.

Statutory targets, with penalties if these are missed, are key to supporting high return rates. For example, Lithuania, Sweden and Finland have 90% targets, while Denmark's is

[110] Eunomia (2019) Reform for a Sustainable Future - The Time is Now. California's Beverage Container Program. September 2019.

set at 95% target.[111] Oregon's legislation required the deposit to increase if the return rate fell below 80% for two consecutive years. Supporting economic instruments can be used as an alternative or addition to targets. For instance, Norway's beverage container tax (see Section A.2.1) – provides an incentive to exceed the targets (at least up to 95%). Similarly, Estonia offers an Excise Duty exemption if collection rates surpass 85%.

If brands are responsible for meeting targets, they also need the flexibility to design and adapt the system to achieve high return rates. Making brands responsible for the DRS performance allows them to use their expertise to develop the most effective (and cost-effective) system for their customers.

One-way DRSs with low return rates – including many US Bottle Bills – do not have statutory targets, which could be used to hold the brands to account and indicate when remedial action is needed. In many Bottle Bill States, beverage brands are responsible for collecting their own containers, which creates inefficiencies and means their costs are based on the return rate for their own containers (rather than the volume of containers they place on the market) – disincentivising a high return rate. Some Bottle Bills are also be undermined by a lack of transparency, particularly relating to the unredeemed deposits (in a number of US Bottle Bill States, these are absorbed into government funds).

By contrast, centralised systems in Europe and Oregon, USA, tend to have higher return rates and benefit from having a central system administrator that is responsible for meeting targets set by the Government (whose role should be limited to the system regulator). This administrator organisation is responsible for managing all the data, finances and returned containers on the brands' behalf.

While it should be recognised that the governance challenges in some countries, especially those in a state of lower economic development, may mean monitoring and enforcing a target or tax is more difficult, there can still be reputational pressure on brands to act and a financial motive to collect containers because of the value of the recycled material. Indeed, some of the major brands are increasingly advocating a DRS after seeing the benefits of well-designed systems in Europe. Governments looking to improve their waste management systems may also be motivated to act after seeing the effectiveness of a DRS elsewhere. While it is arguably easier if government action requires the whole industry to coalesce around a single strategy, there is ultimately no reason why a deposit system in some form should not operate in countries around the world through more diverse pathways to action.

[111] Eunomia (2019) *A DRS for Turkey*. Final Report for Reloop & ISBAK. October 2019. http://tucem.org/wp-content/uploads/2019/10/iade-sistemi-arastirma-raporu.pdf

A.4.0 DRS and emissions to the aquatic environment

In addition to a DRS being introduced to increase collection and recycling of beverage containers, they have in some instances been introduced specifically to reduce beverage container litter.

Applying a deposit to beverage containers gives them a financial value, which means consumers are less likely to litter them and that other citizens have a financial incentive to pick-up any containers that are littered. Few studies examining the impact of DRS on littering have been carried out, but for example, there has been research comparing 'before and after' situations in the USA. A study conducted by Syrek in the 1970s-80s found that following the introduction of a DRS in several states, beverage container litter reduced by 85-97.2%.[112] This has led to the inference that a *modern, well-designed* DRS could reduce the littering of beverage containers by 95%, meaning that, on the basis that roughly 40% by volume of litter is comprised of beverage containers, the volume of all litter could reduce by approximately a third.[113]

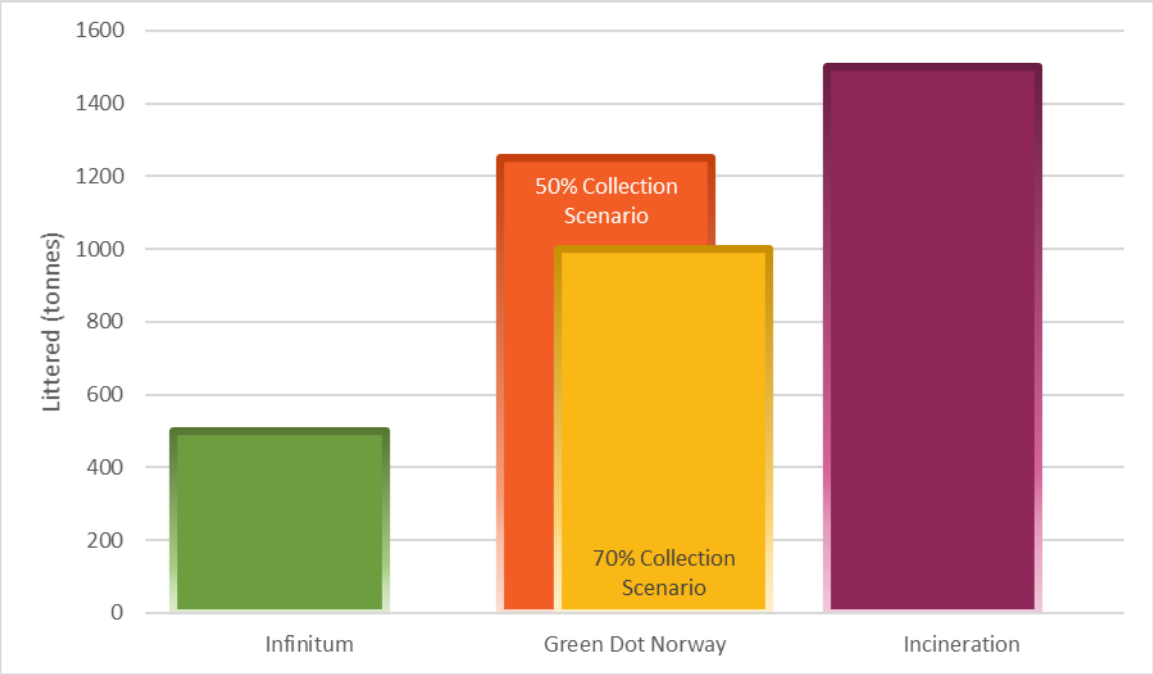
The impact of deposits on littering is supported by a study by Raadal *et al.*. The research was commissioned by Infinitum (which runs the Norwegian one-way DRS) to compare the DRS with the Green Dot kerbside recycling collection (modelled with 70% and 50% collection rates), and residual waste incineration (a hypothetical, not currently in practice).[114] The study found that on balance, *Infinitum* performs best on a number of measures, including littering. Figure A1-7 illustrates how, under the DRS, the weight of littered beverage containers is less than half the weight of containers littered under an alternative door-to-door collection system.

[112] Quoted in: Perchards (2005) *Deposit Return Systems for Packaging Applying International Experience to the UK*, Peer Review of a Study by Oakdene Hollins Ltd., Report to Defra 14 March 2005, available at http://www.oakdenehollins.com/pdf/Deposit_Returns_2005_Peer_Review.pdf

[113] Eunomia (2017) Impacts of a Deposit Refund System for One-way Beverage Packaging on Local Authority Waste Services. 11th October 2017

[114] Raadal, H. L., Iversen, O. M. K. and Modahl, I. S. (2016) 'LCA of beverage container production, collection and treatment systems', *Commissioned by Infinitum*, project number 1780, ISBN: 978-82-7520-746-1, Report number: OR.14.16, Ver. 1.0

Figure A1-7: Potential annual littered PET (by weight) from the Infinitum, Green Dot Norway, and residual waste incineration scenarios, based on 2015 data.



Source: Raadal et al.

An example of where DRS was introduced explicitly to reduce litter is New South Wales, Australia, where the Government cites it as "the largest litter reduction scheme introduced in [New South Wales]", which is intended to support their goal of reducing the volume of all litter by 40%.[115] The programme collected 5.4 billion bottles between 2017 and 2020.[116] Similarly, a number of DRSs in Canada and the USA were explicitly introduced as litter reduction initiatives, and these have all led to an increase in the proportion of containers collected for recycling. In California, the Bottle Bill is titled the "Beverage Container Recycling and Litter Reduction Act".[117] That said, a lack of appropriately quantitative data over time means impact is difficult to measure.

[115] https://www.epa.nsw.gov.au/your-environment/recycling-and-reuse/return-and-earn
[116] Return and Earn: Annual Statutory Report 2019–20. https://www.exchangeforchange.com.au/who-we-are/publications-and-reports.html
[117] Reloop (2021) *Fact Sheet: Deposit Return Systems Reduce Litter*. https://www.reloopplatform.org/wp-content/uploads/2021/01/DRS-Factsheet-Litter-long-29Jan2021.pdf

A.5.0 Drivers and barriers for refill and return systems

A.5.1 Prospects for Refill DRS

A.5.1.1 Positive drivers

Brands are currently involved in refill systems all over the world - as current performance testifies (their 2018 share of total refillable PET literage in the NARTD sector was 13%).[118] Refillable systems are reporting high levels of growth in Latin American countries. National legislation was just passed in Chile that requires supermarkets to have over 30% of the products displayed be refillables. Germany continues to have a 70% refillable quota in place, and Austria has recently established one.[119] In February 2022, Coca-Cola announced a new global goal to reach 25% reusable packaging by 2030, which includes its use of refillable glass and PET bottles.[120]

Some of the largest bottlers in the world are now marketing refillables aggressively. It is important to note that the main appeal of refillable products has primarily been price – refillables appeal to cost conscious consumers (happy to only pay for the bottle once). However, large bottlers are also now advertising refillables as environmentally friendly product. They are also currently involved in a wide variety of smaller pilot projects. Refillables also continue to be sold at a high level in other soft drink markets, such as the Philippines.

Aside from the five brand's current efforts, there are other examples of refill or dispensing currently in operation. Four examples in the USA, the locations of which are shown in Figure A6-8, include Oregon Beverage Recycling Cooperative (OBRC, which also operates a DRS for single-use containers), the Conscious Container in California, Thorsten Geier – Bayern Brewing in Montana, and Loel – LJ Crafted Wines in San Diego.[121] The Conscious Container offers a collection service to craft brewers, while Loel offers refillable wine bottles.

[118] Source: HSBC analysis of Global Data
[119] See https://www.bottlebill.org/index.php/current-and-proposed-laws/worldwide/austria
[120] https://www.coca-colacompany.com/news/coca-cola-announces-industry-leading-target-for-reusable-packaging
[121] Talk – the return of refillables

Figure A6-8: Locations of four refillable projects currently underway in the USA

The Conscious Consumer is shown on the map as one of its operating locations, Great Basin Brewing Company

The successful operation of these (albeit small) refill-based brands demonstrate that company-led refill can be implemented and is desirable to consumers even if limited to specific brands within a particular product category. Reflecting the successes of other individual brands operating a refill model, there is realistic potential for the brands to act on refillables individually. The brands' individual involvement in existing refillable schemes through third-party vendors demonstrates their ability to utilise refillable packaging. The brands can leverage their market share sizes to scale these much more effectively than smaller companies.

A.5.1.2 Negative drivers

Outside of Brazil, the five brands do not have targets relating to refillables. Soft drink companies do not consistently report on refillable share where it is available. And, most importantly, refillables are not available at scale in important commercial markets including the United States and most European Union countries. Furthermore, the cost and expertise for implementing refillable systems is substantial and requires capital investment by the brands. Refillables containers are not available for several popular product categories (such as cans and some smaller sized bottles).

A.6.0 Current brand refill and DRS activities

A.6.1.1 The Coca-Cola Company

Coca-Cola, accounting for more than 21% of single-use PET bottles for NARTD, is bullish about the prospects for refillables across its multiple brands. In February 2022, the company announced a new industry-leading goal to significantly boost its use of reusable packaging:[122]

> *By 2030, [The Coca-Cola Company] aims to have at least 25% of all beverages globally across its portfolio of brands sold in refillable/returnable glass or plastic bottles, or in refillable containers through traditional fountain or Coca-Cola Freestyle dispensers.*

Alongside this announcement, the company reported that:

> *Returnable glass bottles and refillable PET currently represent more than 50% of The Coca-Cola Company's product sales in more than 20 markets, and more than 25% of sales in another 20 markets. Traditional refillable/returnable packaging accounted for approximately 16% of the company's total volume in 2020. Use of refillables is growing in several markets, outperforming non-refillables in Germany and parts of Latin America, where reusable bottles represented 27% of transactions in 2020.*

The Coca-Cola Company's 2020 World Without Waste Report[123] notes that in 2020, Colombia and regions of Brazil adopted the "universal bottle" first introduced in 2018 by Coca-Cola Brazil and in use in Argentina, Brazil, Chile, Colombia, Mexico, Guatemala and Panama. This is reported to drive efficiency of collection, cleaning and filling as it the same reusable bottle with a single colour, shape and size can be used by multiple brands.

Coca-Cola operated a local-scale, short-term DRS in collaboration with several theme parks in the UK in 2019-2020[124] and in Disney Springs in 2018.[125] These schemes used so-called "universal bottles", which could initially be purchased with a Coca-Cola beverage but then refilled with any beverage brand. This indicates that multiple brands could collaborate on a universal bottle design, but this has only been done on a small scale

[122] https://www.coca-colacompany.com/news/coca-cola-announces-industry-leading-target-for-reusable-packaging

[123] The Coca-Cola Company (2021) 2020 World Without Waste Report, 6/07/2021, available at https://www.coca-colacompany.com/content/dam/journey/us/en/reports/coca-cola-world-without-waste-report-2020.pdf

[124] https://www.coca-cola.co.uk/sustainability/packaging-and-recycling/how-you-can-recycle-your-coca-cola-bottles

[125] https://www.delish.com/food-news/a24685458/disney-reusable-bottles-dollar-refills/

thus far, in Germany. The example above in Latin America of the universal bottle is only for beverages with Coca Cola's portfolio.

On a national scale, Coca-Cola successfully introduced refillable bottles in the Netherlands, Germany, and Switzerland prior to 2013.[126] These countries already had DRS and refillables in place, and Germany has mandated a specific market share for refillable bottles. This means that Coca-Cola's introduction of refillable bottles in these countries may be due to necessity to maintain its market share. Coca-Cola also has a refillable scheme in South Africa. However, only 2-litre bottles included. The return rate is 62%. This is not as high as it could be, suggesting the system could be optimised, and also, the large on-the-go market (in smaller bottles) is not captured.

Dispensing systems are used by Coca-Cola in professional and university environments to complement their refillable packaging and to promote brand loyalty. The brand operates both DASANI PureFill and Coca-Cola Freestyle drinks dispensers in North America and Reading, UK.[127] While these systems reduce the required number of plastic bottles, therefore reducing the number of items available to be littered, the exclusivity of the environments in which these machines currently operate is a limiting factor for a wider-scale refillable system.

Coca-Cola FEMSA

Coca-Cola FEMSA shows no quantifiable target on refill in their EMF submission.[128] They state that they expect to see an increase in the share volume of refillable bottles through universal bottles, such as those used for the DRS for refill in Brazil. The Brazilian DRS has a return rate of 90%, replacing 200m bottles per year in the country, but nonetheless accounts for only 7% of sales by volume in Latin America.[129] This is despite claims on their brand website that refillable PET and glass constitute more than half of their sales in some Latin American markets without any indication of which countries or what proportion is PET.[130]

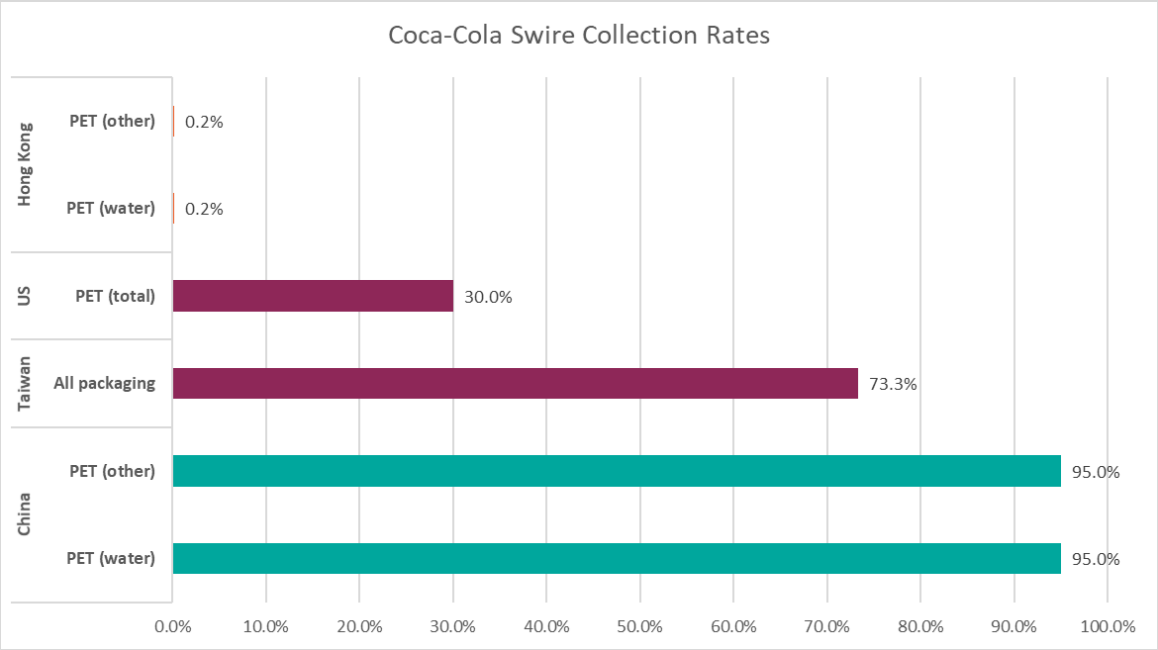
Coca-Cola Swire

Coca-Cola Swire has no quantifiable targets on refill and reuse.[131] They offer dispensing systems to enable customers to purchase items in bulk, but information on the nature

[126] Bø, E., Hammervoll, T. and Tvedt, K. (2013) 'Environmental impact of refillable vs. non-refillable plastic beverage bottles in Norway', *Int. J. Environment and Sustainable Development*, Vol. 12, No. 4, pp.379–395.
[127] https://www.coca-colacompany.com/news/coca-cola-delivers-drinks-without-packaging
[128] Coca-Cola FEMSA EMF: https://www.ellenmacarthurfoundation.org/resources/apply/global-commitment-progress-report/organisation-reports/report/ppu/recAe8b8ckmbuUYK3
[129] https://www.ellenmacarthurfoundation.org/assets/downloads/Reuse.pdf
[130] Coca-Cola FEMSA website: https://coca-colafemsa.com/wp-content/uploads/2020/04/Coca-Cola-FEMSA-Integrated-Report-2019.pdf
[131] Swire Coca-Cola EMF: https://www.ellenmacarthurfoundation.org/resources/apply/global-commitment-progress-report/organisation-reports/report/ppu/recxk5VE55Rz2hABw

and scale of these is not forthcoming.[132] The brand recently committed to installing 200 water refill stations in Hong Kong. They also publish their PET packaging collection by market and by material on their website. Figure A1-9 lays out these data, showing exceptionally low collection in Hong Kong with considerable potential to increase collection and consequently reduced litter entering the aquatic environment. As stated in Section 4.1, an increase in collection in that market alone could satisfy demand for rPET, but that is realistically unlikely to occur.

Figure A1-9: Coca-Cola Swire's PET packaging collection rates by country
Source: Coca-Cola Swire website[133]



Note: Taiwan's data are from their national EPA so are for all packaging combined, not just PET. Coca-Cola Swire also expresses doubt about the values presented for China.

[132] Swire Coca-Cola EMF: https://www.ellenmacarthurfoundation.org/resources/apply/global-commitment-progress-report/organisation-reports/report/ppu/recxk5VE55Rz2hABw
[133] Swire Coca-Cola website: https://www.swirecocacola.com/sbcorpweb/uploads/docs/SCC_SR_EN_Final.pdf

A.6.1.2 Nestlé

In its data submission to the EMF, Nestlé stated that it is too early in their investigations to define targets for refill. They currently have 20 pilots in operation, with the aim to achieve six product lines with a reuse model.[134]

Nestlé already operates refill, albeit on a small product line in just one of its markets. Nestlé Waters North America offers an exchange programme on its large bottles (13.6l and 22.7l).[135] This indicates a starting point from which to scale these activities. Nestlé has also invested in Loop, which is a packaging reuse model that currently exists in the UK, France, Canada, Japan, and Australia.[136] Loop is an online supermarket where consumers buy household essentials in refillable packaging for which they pay a deposit.[137] Customers can arrange pick-up of their empty containers; however, this may not be scalable (or make environmental sense) for all the five brands to roll-out in all their markets. Nonetheless, Loop's refillable products demonstrate that there is market interest for refillable packaging.

As a signatory to the UK Plastic Pact, Nestlé and PepsiCo have jointly produced 40% fewer items (30% by weight) of packaging that are unrecyclable in 2019 than 2018.[138] However, the Pact and the EMF both highlight a trend towards lightweight and alternative materials, rather than increasing the use of refillable containers. For example, recyclable bottles in Germany are now more than 20% lighter now than they were in the mid-2000s.[139] Furthermore, Nestlé Malta is currently operating a collection scheme for wrappers, tubs, and non-plastic packaging.[140] This scheme does not apply to PET bottles, because its purpose is to collect hard-to-recycle items. These trends do not contribute to waste prevention through refill and suggests companies' efforts have historically been elsewhere, and will have some momentum for continuing in the same vein.

[134] Nestlé EMF: https://www.ellenmacarthurfoundation.org/resources/apply/global-commitment-progress-report/organisation-reports/report/ppu/rec1jcYlr68Ds0uw9
[135] https://www.Nestlé-watersna.com/Nestlé-water-news/statements/our-5-gallon-bottle-exchange-program-how-it-works
[136] https://resource-recycling.com/recycling/2020/12/15/reusable-packaging-platform-draws-millions/
[137] https://loopstore.co.uk/how-it-works
[138] https://www.edie.net/news/5/WRAP--UK-s-biggest-businesses-have-cut-unnecessary-plastic-packaging-by-40-/
[139] https://einweg-mit-pfand.de/einweg-mit-pfand.html
[140] https://www.Nestlé-collect.com

A.6.1.3 PepsiCo

PepsiCo did not submit any quantifiable targets on refillables to the EMF.[141] However, responding to a shareholder proposal filed by As You Sow, in March 2022 PepsiCo agreed to set a time-bound goal by the end of 2022 for a percentage volume of its beverages to be delivered via strategies such as reusable and refillable bottles, in a bid to reduce dependency on single-use plastics. [142] Currently, the brand's leading approach for reducing packaging is SodaStream which allows consumers to carbonate their own drinks at home in refillable bottles. SodaStream is now in 1 in 4 homes in Sweden and is being rolled out into workplaces, campuses, and airports.

PepsiCo is making moves towards 'consumer convenience' rather than towards environmental benefit in New Delhi, where it introduced non-returnable glass bottles for the first time in 2017.[143] Pepsi Black is now sold in non-returnable glass bottles that cost the same as an aluminium can to the consumer, despite costing more to produce. PepsiCo has demonstrated a willingness to pay a premium on packaging where the benefits in market share can be shown. The case for refillables for PepsiCo, as for Nestlé, needs to highlight the energy savings, water savings, and litter reduction possibilities with a more complete and circular collection system.

A.6.1.4 Danone

Similarly, Danone has no quantifiable targets on refillables, despite aiming to expand its current collaboration with Loop.[144] Danone also aims to test dispensing for Danone Waters and Danone Dairy, but the nature of these pilots is not apparent. According to data Danone submitted to the EMF, their reusable water jugs for home and office comprise 50% of Danone's water sales by volume, predominantly in Latin America and Asia.[145]

Danone's website states that it aims to "go beyond" the EU's 2025 target of 90% collection for beverage bottles by investing in EPR and DRS.[146] While this was commended by Changing Markets, there has also been disappointment that Danone is

[141] PepsiCo EMF: https://www.ellenmacarthurfoundation.org/resources/apply/global-commitment-progress-report/organisation-reports/report/ppu/recTG1dd7ywLrssKA
[142] As You Sow (2022) PepsiCo Pledges to Reduce Single-Use Packaging as Requested by As You Sow Proposal, available at https://www.asyousow.org/press-releases/2022/3/16/pepsi-reduce-single-use-packaging
[143] https://www.livemint.com/Industry/qK1pxSz2JF3LkOEYmp4cFM/Pepsi-to-introduce-cola-in-glass-bottles-that-dont-need-to.html
[144] Danone EMF: https://www.ellenmacarthurfoundation.org/resources/apply/global-commitment-progress-report/organisation-reports/report/ppu/rec22hjdEhlnfbT8k
[145] https://www.ellenmacarthurfoundation.org/assets/downloads/Reuse.pdf
[146] Danone website: https://www.danone.com/impact/planet/packaging-positive-circular-economy.html

not calling for mandatory collection targets over 90%.[147] Danone expresses a willingness to participate and invest in DRS, and moreover a willingness to collaborate on such ventures. This may be an avenue between the five brands on a refillable DRS.

A.6.1.5 Dr Pepper Snapple

Dr Pepper Snapple's commitment to refill is poor. Their submission to the EMF states that they will "continue to innovate" in this area[148], but follow-up on their actions, existing or planned, is not reflected in the EMF, on their website, or even through other sources including the media. That is not to say that they have expressed negative attitudes toward refill, so there is the potential that the brand is open to discussions about a DRS for refill.

[147] https://www.foodnavigator.com/Article/2020/09/24/Biggest-plastic-polluters-accused-of-hypocrisy-Unilever-Danone-and-Coca-Cola-respond

[148] Dr Pepper EMF: https://www.ellenmacarthurfoundation.org/resources/apply/global-commitment-progress-report/organisation-reports/report/ppu/recLXc9Kx9RIHS0dq