Economic study of returnable refillable PET in the EU soft drinks industry

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FINAL
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Snapshot of findings

About this report

This report analyses a scenario in which the soft drinks industry across the EU27 group of countries begins to move away from production and sale of soft drinks in one-way (disposable/recyclable) PET bottles, to a business model that incorporates production and sale of a larger share of soft drinks in ‘returnable refillable’ PET (or Ref-PET) containers, that can be returned by consumers to retail outlets for bottling companies to refill. These bottles are therefore reused in a circular loop multiple times, rather than discarded or recycled after a single use. The objective of investigating the impact of moving to such a business model is that it is claimed it may improve environmental outcomes, but not enough is yet known about what the practical ‘real life’ impact on industry would be of such a business model change, particularly if the European Commission (EC) was to introduce specific targets around reuse for PET beverage containers, that the industry would need to comply with.

This study, undertaken by PricewaterhouseCoopers LLP (PwC) and commissioned by UNESDA Soft Drinks Europe in 2021, aims to demonstrate the type and scale of change that would likely be required along each stage of the soft drinks supply chain – and therefore cost estimates – for a particular scenario in which the EC establishes a target of 20% market penetration for reusable PET containers for soft drinks across the EU27. It is intended to provide an evidence-based view of potential industry impact that can inform government and industry dialogue on the direction of reusable plastic beverage packaging. It is not intended to reach a specific conclusion on what policy directions should be pursued, but to provide one important part of the evidence base on the considerations and costs of business model transformation from the soft drinks industry’s perspective – taking the whole supply chain into consideration. It should be considered alongside other evidence and analysis on Ref-PET, such as studies on the economic and environmental benefits, studies looking at other beverage market segments, and expected effects of consumer behavioural change.

Findings at a glance

The findings of our study show that to achieve a 20% market share of Ref-PET soft drink beverage packaging in the EU27, whole-scale business model change will be required across the entire supply chain: from manufacturing of production machinery and bottle inputs, through the bottling process and distribution logistics, to wholesale and retail outlet set up, and operation of reverse logistics for bottle return and refill.

Our analysis assesses costs across six unique segments of the soft drinks supply chain from the bottom up. We estimate that such a business model change would result in a net present value (NPV) cost to industry of €18.7bn. This is broken down into €12.5bn in estimated additional capital expenditure and €6.2bn in estimated additional operating expenditure. We assess this to be a conservative estimate of total cost to industry, as we were not able to aggregate all costs (particularly in retail activities) with available data. Table 1 shows how our cost estimate is broken down across each segment of the supply chain.

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2 NPV costs applies a discount to future potential benefits to allow for comparison of costs and benefits occurring at different points in time, taking into account society’s time preference for incurring costs and benefits.

3 For the costs we were able to calculate at the aggregate level in this study only. This NPV estimate is calculated based on incremental costs that would occur over a period between 2021 and 2040, and includes both capital and operating expenses of moving to a business model where the industry achieves 20% Ref-PET market penetration across the EU27 by 2030, maintaining this to 2040. These costs are estimated against a counterfactual scenario in which Ref-PET market penetration of soft drinks does not change from its current (2020) level across the EU27, (4% based on GlobalData Data Set (2021)).

4 Where data was unavailable to develop quantified total cost estimates in an identified cost category, we have provided qualitative discussion on expected additional costs, and any supporting quantitative input cost assumptions available throughout this report.

5 PwC’s work was completed between March and December 2021, for publication in 2022. All data were sourced at the time of the work.
Table 1: Summary of total incremental costs at each stage of the soft drinks industry supply chain (NPV)

<table>
<thead>
<tr>
<th>Supply chain stage</th>
<th>Manufacturing Capex*</th>
<th>Bottler activities Capex*</th>
<th>Distribution logistics Capex*</th>
<th>Wholesaler activities Capex*</th>
<th>Retailer activities Capex*</th>
<th>Reverse logistics Capex*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated Total Capex*</td>
<td>€1.9bn</td>
<td>€10.6bn</td>
<td>N/A – all incremental costs captured as opex</td>
<td>Not totalled</td>
<td>Not totalled</td>
<td>N/A – all incremental costs captured as opex</td>
</tr>
<tr>
<td>Estimated Total Opex*</td>
<td>€3.8bn</td>
<td>€0.2bn</td>
<td>€0.3bn</td>
<td>Not totalled</td>
<td>Not totalled</td>
<td>€1.8bn</td>
</tr>
</tbody>
</table>

*Note: all total amounts are NPV total of estimated cashflows in real Euro between 2021 and 2040, discounted to 2021 at 5% p.a.

Basis of our estimate

Our cost estimates are based on detailed consultations with industry participants about what they would need to change at an activity level in their business operations, in order to meet a target 20% market penetration of Ref-PET in the EU27. Table 2 outlines the key differences in activities required for one-way PET and Ref-PET across the six unique segments we have defined for the soft drinks supply chain, showing the key additional activities that will be required in upscaling the proportion of Ref-PET in the supply chain.

Table 2: The key differences in activity between one-way PET and Ref-PET supply chains

<table>
<thead>
<tr>
<th>Supply Chain Stages</th>
<th>Description</th>
<th>Activity</th>
<th>One-way supply chain</th>
<th>Ref-PET supply chain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturing</td>
<td>Manufacturing of bottles &amp; packaging to be supplied to bottlers</td>
<td>Production of preforms</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Blowing Ref-PET preforms</td>
<td>x</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Production of crates</td>
<td>x</td>
<td>✓</td>
</tr>
<tr>
<td>Bottler activities</td>
<td>Washing and filling of empty bottles</td>
<td>Store bottles</td>
<td>x</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wash and QC bottle</td>
<td>x</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Blow one-way preforms</td>
<td>✓</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fill and pack bottle</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Distribution logistics</td>
<td>Transporting bottles from manufacturers to bottlers and wholesalers/ retailers</td>
<td>Transport bottle to bottler</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Transport bottle to wholesaler</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Transport bottle to retailer</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Wholesaler activities</td>
<td>Storage, sale and return of bottles by wholesalers</td>
<td>Sell bottle</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Store Ref-PET bottle</td>
<td>x</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sort Ref-PET bottle</td>
<td>x</td>
<td>✓</td>
</tr>
<tr>
<td>Retailer activities</td>
<td>Storage, sale and return of bottles by wholesalers</td>
<td>Sell bottle</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Store Ref-PET bottle</td>
<td>x</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sort Ref-PET bottle</td>
<td>x</td>
<td>✓</td>
</tr>
<tr>
<td>Supply Chain Stages</td>
<td>Description</td>
<td>Activity</td>
<td>One-way supply chain</td>
<td>Ref-PET supply chain</td>
</tr>
<tr>
<td>---------------------</td>
<td>-------------</td>
<td>----------</td>
<td>----------------------</td>
<td>----------------------</td>
</tr>
<tr>
<td>Reverse logistics</td>
<td>The distribution of bottles back to bottlers after consumption</td>
<td>Return bottle to wholesaler</td>
<td>×</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Return bottle to retailer</td>
<td>×</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Return bottle to bottler</td>
<td>×</td>
<td>✓</td>
</tr>
</tbody>
</table>

While there may be multiple ways for the soft drinks industry to meet any target market penetration set by the EC, our cost estimate is based on definition of a specific scenario; defined through in-depth consultation with UNESDA Soft Drinks Europe and multiple industry representatives at each stage of the supply chain. Our cost modelling parameters aim to simplify the complexities of how bottling firms and their up and down stream supply chain partners would likely respond in practice if the EC was to introduce such a target. We set out the details of these parameters and other aspects and assumptions inherent in our scenario in the body of this report.

**Implications**

Beyond this specific scenario and the cost estimates presented in this report, in conducting this study we gained a richer understanding of the soft drinks industry in the EU27, and the implications of proposed business model change towards more refillable PET. From our consultations with industry participants, we identified multiple additional complexities in moving to a Ref-PET system that should be carefully considered in developing a successful transition plan for any new industry Ref-PET business model. Key implications include:

- **Real life complexities must be carefully and fully considered in advancing any new policy proposal for Ref-PET.** Overall, the purpose of moving to Ref-PET is to achieve net environmental and economic benefits by reducing packaging waste through lowering demand (use) for one-way (disposable/recyclable) PET. The complexities involved in the supply chain that are required to make this change, mean that the costs to industry in any case will be substantial. This needs to be appropriately and fairly accounted for in any broader cost-benefit analysis of proposed policies to increase Ref-PET. Scaling up Ref-PET should also be assessed against other possible options that could be used to meet the same policy goals – such as improving recycling methods for one-way PET and using higher shares of recycled content.

- **A Ref-PET supply chain system involves environmental trade-offs which must be accounted for in its design and operation.** These externalities (either positive or negative) are not included in the scope of our analysis. While the purpose of moving to Ref-PET is to achieve environmental benefits through reducing packaging waste and lowering demand for one-way PET, there will also be additional environmental costs. These come from increased utility consumption from additional washing and sorting processes, as well as increased fuel consumption arising from the increased logistical complexity of returning bottles to bottlers. Information provided by industry participants in this study indicated that in a Ref-PET supply chain, bottling lines must be located an estimated maximum distance of ~600km away from retailers to attain a net environmental benefit. To achieve this in most countries, a much more decentralised model of production would be required than is currently set up, including possible construction of new greenfield bottling plants. Effectively, more plants are required to serve the same geographical area compared to one-way bottles. This is accounted for in our estimate in our assumptions around the number of additional bottling lines required to achieve 20% Ref-PET market share. In practice, it may not be possible for all bottling companies to decentralise their supply chains, so there could be negative impacts to market competition and/or reduced environmental benefit. Any future policy proposal must take into account operational complexities such as these, that will drive both industry cost and environmental impacts.

- **The effects of consumer preferences and behaviour will be a huge determinant of consumer uptake of Ref-PET, and must be fully considered in designing a Ref-PET system.** Our modelling assumes a 95% return rate for Ref-PET bottles, but the consumer behaviour changes required to buy and return Ref-PET bottles are substantial and may deter users from returning bottles (especially when one-way PET still exists as a substitute product). The design of deposit return schemes, product pricing, and product characteristics will all be really important factors that influence consumer demand, and these will vary by market and customer demographics. We have not considered any wider economic impacts of a change in sales as a result of an increase in Ref-PET.

- **Not all countries are the same, and country specific differences will need to be accounted for in design of any new Ref-PET policy targets and supporting industry business models.** Countries across the EU27 are all at a very different baseline or starting point in terms of their use of DRS and refillable beverage containers. Any policy to increase Ref-PET at EU27 wide level must take these nuances into account – as
compliance costs will be far higher in some countries than others because of their starting point, and because of geographical differences. Countries with established DRS systems may achieve higher consumer return rates and those with some existing refillable markets (such as Germany and refillable glass) will face lower transition costs. Countries with certain geographies may face prohibitively high logistical costs, as bottles must travel further or more bottling lines must be set up to serve its population. These factors mean that consideration must be given to how the system is expected to be rolled out – in which countries and by when – and whether targets should be introduced at the EU-wide, national or company level.

The move to a returnable refillable system is complex and further research will be required to fully understand the key costs of transition and how policy can maximise environmental benefit whilst minimising cost.
Executive Summary

In this Executive Summary, we outline the high-level context, approach and findings of this study as follows:

E.1 The EU policy context and UNESDA’s strategy for transition to a circular economy
E.2 What we mean by ‘Returnable Refillable’ or ‘Ref-PET’ in this report
E.3 What scaling up Ref-PET would actually entail for the European soft drinks industry
E.4 Summary of our approach to cost analysis
E.5 Break down of our cost estimate to industry
E.6 Key parameters, boundaries, and assumptions of our cost estimate
E.7 Operational barriers to moving to a returnable refillable system

E.1 The EU policy context and UNESDA’s strategy for transition to a circular economy

The European Commission (EC) published its new Circular Economy Action Plan (CEAP) in March 2020.6 It is one component informing the broader European Green Deal (adopted by the EC in July 2021), which is Europe’s new agenda for sustainable growth incorporating a package of proposals to make the EU’s policies fit for reducing net greenhouse gas emissions by at least 55% by 2030 (compared to 1990 levels).7

The EU’s transition to a circular economy aims to reduce pressure on natural resources while creating sustainable growth and jobs.8 The CEAP outlines a future-oriented agenda for achieving a cleaner and more competitive Europe in co-creation with economic actors, consumers, citizens, and civil society organisations. It identifies both plastics and packaging as key product value chains where urgent, comprehensive and coordinated actions are needed to develop a sustainable policy framework for circularity.

Plastic waste is a growing concern in the European Union (EU) because of its significant negative environmental impacts, such as marine pollution, contribution to global warming, and threat to wildlife. 87% of Europeans are worried about the impact of plastic products on the environment.9 In an effort to address this issue, on the 22nd February 2021, UNESDA Soft Drinks Europe launched its 2030 Vision for Circular Packaging, which sets out the European Soft Drinks industry’s aim to achieve full circularity of beverage packaging (plastic, aluminium and glass) by 2030. UNESDA members aim to deliver this vision through three pillars:

1. Collect: Create closed-loop beverage packaging collection and recycling systems with an aim to achieve at least 90% collection of all packaging by 2030. This is to include wider introduction of well-designed Deposit Return Schemes (DRS)10 for PET and other materials, where needed to help meet this target.

1. Recycle: Use only packaging that is circular by design and boost the uptake of recycled PET to meet an ambition for PET bottles to be made from 100% recycled and/or renewable PET by 2030, where technically and economically feasible.

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8 A ‘circular economy’ is focused on products and materials being used over and over, in a continuous loop, rather than discarded.

9 https://ec.europa.eu/environment/topics/plastics/single-use-plastics_en

10 “A DRS is a collection scheme whereby consumers pay a small amount of money (deposit fee) for their packaging at the point of purchase and are reimbursed upon the return of the empty packaging to specific collection points” Zero Waste Europe (October 2021) It’s time to acknowledge the role of Deposit Refund Systems (DRS) in achieving a Circular Economy for beverage packaging in the EU. Available at: https://zerowasteeurope.eu/press-release/its-time-to-acknowledge-the-role-of-deposit-refund-systems-drs-in-achieving-a-circular-economy-for-beverage-packaging-in-the-eu/
2. **Reduce and reuse**: Increase the use of refillable packaging, with the aim to use more refillable packaging by 2030 compared to 2020. To support this goal, UNESDA members have committed to studying the best environmental and economic pathway to increase use of refillable models.

Full circularity for PET soft drink bottles can be achieved through both recycling and refill methods. Refill methods involve manufacturing sturdier, refillable PET (‘Ref-PET’) bottles, so that consumers can preserve the bottle whole after use and then either return it to the bottle to be washed, refilled and resold, or keep for continued home use, using technology such as home soda refill machines.

Across the EU there has recently been a shift in policy priorities away from recycling and towards reuse models of plastic packaging. In some EU Member States, policy has already been introduced in this area. For example, in France a cross-sector reusable plastic packaging target of 5% has been set for 2023, rising to 10% by 2027.\(^{11}\) Austria and Spain are also exploring and implementing options to increase the proportion of reusable plastic packaging across their economies,\(^ {12}\) and Germany has committed to a quota of 25% reusable plastic in PET beverage bottles by 2025.\(^ {13}\)

The EC is currently investigating options to increase reusable beverage packaging in Europe. One possible option may be the introduction of targets or quotas for refillable beverage containers, including soft drinks. While designed with positive policy intentions, if the impacts of a policy change like this are not adequately considered, this could cause significant challenges and costs for industry and supply chains involved, and may result in unintended consequences that negatively impact consumers.

### E.2 What we mean by ‘Returnable Refillable’ or ‘Ref-PET’ in this report

There are multiple possible models to meet an EC target for reuse of PET bottles. The Ellen MacArthur Foundation in partnership with New Plastics Economy identifies four different business-to-consumer reuse models of packaging, that differ in terms of packaging ‘ownership’ and the requirement for the user to leave home to refill / return the packaging.\(^ {14}\)

We have developed our own definitions for this report. We categorise below four different types of business models that could be employed to meet a reuse target in the figure below. They distinguish between:

- **Where the drink is consumed (y-axis)** [either on-trade premises such as a bar, or off-trade premises at home or ‘on the go’], and:
- **Where in the supply chain the container is ‘reused’ (x-axis)** [either ‘refilled’ by a consumer or retailer at the front end of the supply chain; or ‘returned’ to a bottler [back end of the supply chain] for processing, washing and refill].

**Figure 1: Business model categories for reuse**

The four different categories we have defined are:

1. **Refill on trade**: reusable container is refilled at ‘on trade’ premises - e.g. hotels, restaurants, cafes.
2. **Return on trade**: reusable container is picked up from on trade premises and returned to bottlers to be refilled.
3. **Refill off trade**: consumers purchase drinks from a retailer, consume off premises, and refill their reusable container (e.g. at an in-store dispensing system, or an in-home refill solution).
4. **Return off trade**: consumers purchase drinks from a retailer and return the packaging at a store or drop-off point

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\(^ {12}\) Recycling today, Austrian effort targets plastic packaging recycling, available at: https://www.recyclingtoday.com/article/austria-plastic-packaging-recycling-platform-erema-engel/


The scope of our study examines a version of category 4: Return off trade with a focus on PET only. We have selected this option based on consultation with UNESDA and its members. Our study examines an industry business model change that involves increasing the share of bottles purchased in off-trade channels (i.e. in retail) and returned to the production line to be refilled and reused. This means the consumers purchase the bottles at a retail outlet, consume the product away from the outlet (e.g. in their home or on-the-go), then return the bottles to a retail outlet and in exchange receive back the bottle deposit they paid on the initial purchase. Then, through a logistics process, the used bottle is returned to a bottling line to be washed and reused, starting the cycle again.

We in no way are suggesting this is the only method or way of meeting a reuse target for PET beverage containers, and the findings of this study set out in this report should be interpreted as such, keeping in mind there are multiple options for business model reform that could help the industry move towards more reuse. The report by the Ellen Macarthur Foundation and New Plastics Economy provides more detail on the typical benefits and potential challenges of the different business models for reuse.15

E.3 What scaling up Ref-PET would actually entail for the European soft drinks industry

Scaling up the production and sale of Ref-PET soft drinks is not a simple process that can be ‘integrated’ into current industry systems and processes used by the European soft drinks industry.

One reason for this is that Ref-PET bottles will have to be produced, filled, and sold in parallel to one-way PET bottles, as entire replacement of one system with the other would be prohibitively expensive and unlikely to be operationally possible. The supply chain systems, processes, and activities required differ greatly between one-way PET and Ref-PET, so this will require whole-scale change in the infrastructure, inputs, and processes required to manufacture, bottle, and sell soft drinks. It will also require a complete new set up of reverse logistics to enable PET containers to be returned and refilled, that do not currently exist in most of the EU27.

There are multiple factors driving the scale of industry change that will be required. Those we found to be particularly significant in conducting this study, and should be considered carefully in establishing any new targets, quotas or regulation to increase Ref-PET market share are:

- **Change in the manufacturing processes, inputs, and logistics required for PET containers:** The bottles for one-way PET and Ref-PET bottles are considerably different. Therefore, a move away from one-way PET bottles to Ref-PET will require an industry-wide change in the manufacturing of PET packaging. One-way bottles are blown and filled one time before being sold and recycled. However, in a Ref-PET system, the bottle needs to be filled and washed at high temperatures multiple times, in order to meet the hygiene requirements of the industry. Therefore, the materials used in producing Ref-PET bottles need to be twice as heavy as in one-way. In addition to this, Ref-PET bottles require crates to be transported and sold, as opposed to the less costly shrink or carton wrap used to package one-way bottles. Both these factors will add costs to the industry.

- **Changes required to the set up and operation of the bottling process:** The move from one-way PET to Ref-PET requires significant change to the bottling process. For example, existing one-way PET bottling lines are unable to handle Ref-PET bottles, due to the different product dimensions and additional machinery and space is required for sorting of return bottles, cleaning and filling required on Ref-PET lines. Therefore, a gradual move to Ref-PET will require one-way PET and Ref-PET bottling lines to run separately but concurrently. This will need to happen either in the same location or at completely separate sites, if existing sites do not have the space requirements for Ref-PET (which are a considerable barrier to set up). These additions will require both significant industry investment and increased operational costs.

- **Logistics / reverse logistics:** Ref-PET bottles need to be returned to the bottler (uncrushed), whereas one-way bottles are recycled or discarded after consumption. This means that there are significant additional logistical features of the Ref-PET system, which adds complexity and therefore cost for soft drinks companies and supporting businesses along the supply chain.

- **Additional lines / sites are required:** a significantly higher number of lines (and likely corresponding sites) are needed in a Ref-PET system, so that heavier ref-PET bottles that need to travel in two directions, do not travel a distance of which the logistics and reverse logistics costs offset the benefits of reuse (economic and environmental).

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Through our consultations, we identified the key activities that would be required at each stage to transition from a one-way system to a Ref-PET system, as shown in Table 3.

Table 3: Key activity changes required at each stage of the supply chain that will drive increased investment (Capex) and additional operating costs

<table>
<thead>
<tr>
<th>The supply chain</th>
<th>Key changes driving investment (capex) costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturing</td>
<td>• Investment in additional Ref-PET bottle and crate manufacturing machinery</td>
</tr>
<tr>
<td>Bottler activities</td>
<td>• Additional Ref-PET bottling machinery (Pre-wash sorting, washing) – a Ref-PET line costs ~€10m more than a one-way line</td>
</tr>
<tr>
<td>Distribution logistics</td>
<td>• More lines (and likely sites) to account for geographical and transport complexities</td>
</tr>
<tr>
<td>Wholesaler activities</td>
<td>• Additional space for machinery and sorting (2-3x a one-way line)</td>
</tr>
<tr>
<td>Retailer activities</td>
<td>• Bottle and crate ‘float’ (4x number of bottles needed in system to support 1 bottle on the shelf)</td>
</tr>
<tr>
<td>Reverse logistics</td>
<td>• Ref-PET bottles in a crate require around 35% more space than one-way bottles</td>
</tr>
<tr>
<td>Installation of Ref-PET compatible Reverse Vending Machines for collection, costing around €25,000 to install</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Key changes to operations that will affect ongoing operational costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Increase in complexity of manufacturing as thicker Ref-PET bottles will take longer to cool</td>
</tr>
<tr>
<td>• Additional raw materials required to produce bottles – although cost per use will fall as bottles are reused up to 10-20x</td>
</tr>
<tr>
<td>• Decrease in speed of lines for Ref-PET from more washing time, reduced line productivity</td>
</tr>
<tr>
<td>• Net increase in opex (higher labour and utility costs outweigh lower packaging costs) due to additional sorting and machinery</td>
</tr>
<tr>
<td>• To realize presumed environmental benefit requires a more decentralised model of production, due to the two-way bottle flows, this will reduce the average distance travelled and lower costs</td>
</tr>
<tr>
<td>• Increased ongoing cost of sorting (labour and utilities)</td>
</tr>
<tr>
<td>• Increased ongoing cost of sorting (labour and utilities)</td>
</tr>
<tr>
<td>• Increase in number and length of return trips as bottles now need to be returned to the specific bottler rather than sent to a recycling plant</td>
</tr>
</tbody>
</table>

E.4 Summary of our approach

Very little previous analysis has been undertaken to understand the relative costs of a refillable system compared to a one-way system for PET. Because of this, our approach to estimating the impact of scaling up Ref-PET in the EU27 soft-drinks industry involved conducting extensive consultations with industry representatives from across the soft drinks supply chain. This allowed us to understand the implications in terms of changes required in industry activity (and therefore investment and operational cost) of moving to a Ref-PET system for manufacturers, bottlers, wholesalers and retailers; and to collect unit cost data estimates where available to input into our cost model, which was built bottom-up.

Our approach to developing the cost estimates involved five main steps:
1. **Defining scenarios:** In consultation with UNESDA and industry members, we then defined our main scenario for market penetration of Ref-PET, and the counterfactual against which we estimated incremental costs to industry at each stage of the supply chain (see definitions in Section 1.6).

2. **Extensive industry consultation and data gathering to estimate unit costs:** As well as our initial consultation to understand activity changes required, we gathered cost data from multiple industry representatives in the supply chain (including large machinery manufacturers and bottling companies, SMEs, retailers, and other industry experts) to develop a range of unit cost and other assumptions. We supplemented this with use of secondary market data sources and available literature, and tested and retested our assumptions through ongoing industry consultation.

3. **Developing volume estimates:** We estimated future volumes of PET carbonate soft drink sales in the EU27 using historical sales reported by GlobalData, estimating year on year sales growth by applying a compound annual growth rate in sales volumes between 2015 and 2019.16 We combined these results with information from our consultations and research to develop assumptions for a wider set of key volume drivers to 2040 for both our Ref-PET and counterfactual scenarios, including the numbers of bottles that would be sold and manufactured, number of crates used and manufactured, and numbers of bottling lines in use and installed.

4. **Estimating total costs:** We developed aggregate cost estimates for each scenario by applying our unit cost assumptions to our volume drivers as appropriate. We then calculated the additional (or incremental) cost to industry by subtracting the main scenario gross costs from those of the counterfactual. A net present value was then calculated using a 5% discount rate, as recommended by the EC.17

5. **Undertaking sensitivity testing:** We performed two sensitivity tests on our results, testing higher and lower market penetration as defined in Section 3.3

Further detail on our modelling methodology is provided in Section 1.5.

E.5 **Break down of our cost estimate to industry**

Based on the expected changes required at each stage of the supply chain summarised above, we have (through extensive consultation, data provided by industry participants, establishing and testing assumptions, and developing a supporting cost model) estimated the costs to the soft drinks industry across each stage of our defined supply chain of moving from one-way PET packaging, to a business model that involves scaling up Ref-PET packaging to a 20% market share by 2030 for carbonated soft drinks sold off-trade (i.e. retail sales). Our cost estimate includes both one off and ongoing incremental costs over the period 2021 (now) to 2040, that apply to industry sales within the EU27. The analysis relies on the central assumptions that business model change would apply to off-trade soft-drink sales only,18 and Ref-PET containers would maintain a penetration rate of 20% throughout the EU27 markets from 2030-2040.

Our analysis found a total net present value (NPV)19 cost to the soft drinks industry of €18.7bn20 compared to a counterfactual scenario where Ref-PET market penetration remains at 4% across the EU27 from 2021 to 2040. This total NPV cost estimate is broken down into two parts:

1. Capital expenditure of €12.5bn for items including:
   - **Manufacturing of inputs:** Investment in reusable bottles and crates.
   - **Bottling:** Upfront investment in new bottling lines that can accommodate Ref-PET bottles (existing one-way lines are unable to bottle Ref-PET bottles). This new investment includes additional sorting, washing, and quality control machinery; and additional space to store and sort returned empty bottles. There is also not a direct one-for-one replacement of the number of one-way to Ref-PET bottling lines as the efficiency of Ref-PET

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18 Off-trade consumption refers to drinks that are consumed off-premises, either at home or on the go, therefore excluding ‘on-trade’ consumption at hotels, restaurants, and cafes (known as ‘HoReCa’).
19 NPV costs applies a discount to future potential benefits to allow for comparison of costs and benefits occurring at different points in time, taking into account society’s time preference for incurring costs and benefits.
20 All NPV figures use a discount rate of 5% as recommended by the European Commission and are presented in real terms, 2020 values. For discount rate see: European Commission, ‘Guide to Cost-Benefit Analysis of Investment Projects’ (2014)
2. Incremental operating expenditure of €6.2bn, which is comprised of:

- **Bottling**: Increased bottling costs from running additional machinery, typically at lower speeds (due to slower line speeds of Ref-PET lines compared to one-way lines), and a net increase in activities required on the line for Ref-PET (from additional sorting, to washing and Quality Control).
- **Bottling/Wholesale/logistics**: Additional labour sorting requirements and rental costs across the value chain.
- **Logistics / Reverse logistics**: Increased logistical costs required to transport returned bottles from the point of consumption back to bottlers, and additional logistical requirement and complexity due to heavier bottles and crates.

Our analysis showed that moving to a Ref-PET business model would be likely to provide some cost savings to the soft drinks industry, mainly from reduced packaging (around 2.4 cents per bottle depending on pack size and number of turns per bottle); these savings would be far outweighed by the additional costs incurred from increased complexity and loss of efficiency across the supply chain; as well as the substantial upfront investment requirement for additional bottle production sites.

The total NPV costs presented in this report are a conservative estimate of the cost to the soft drinks industry of moving to a Ref-PET business model (at 20% market penetration off-trade) for three main reasons:

1. We exclude the costs that would be required to set up a DRS, where one is not already functioning. This allows us to isolate costs of a move from one-way PET to Ref-PET on its own.

2. The aggregate cost estimate excludes additional costs that would be incurred by retailers from investing in manual sorting processes or Reverse Vending Machines (RVMs) that are compatible with and required for handling Ref-PET bottles and crates (these are estimated to cost around €25,000 each).

3. The estimate excludes costs that would arise from additional sorting space needed for retailers to deal with the increased complexity of Ref-PET bottle logistics (e.g. around 40-60m² of space per RVM).

Additionally, the environmental costs and/or benefits of a Ref-PET system are out of scope of this study and therefore have not been estimated.

### E.6 Key parameters, boundaries, and assumptions of our cost estimate

Our cost estimates and the findings presented in this report rely on a number of core parameters, boundaries, and assumptions, which we explicitly used to define the business model change scenario that we analysed, agreed with UNESDA, and used as a basis to estimate the costs presented in this report. Core assumptions underpinning our estimate include:

- **Our modelling only estimates the net costs incurred by the industry of moving to and operating a Ref-PET system, and does not capture or include analysis of any potential economic benefits or costs that may accrue to consumers, wider society, or any other parties.** The impact on consumers is out of scope of the study, as is analysis of consumer behaviour, and how this will affect demand for Ref-PET and therefore the success of any business model change. How consumers perceive Ref-PET soft-drinks as a product (either perceiving them as a premium product or the opposite) will affect demand, pricing, and ultimately the industry business model of any change to Ref-PET. See Section 4.2 for further discussion.

- **Our costs apply to the carbonated Soft Drinks market only**: This represents only 30% of the EU27 non-alcoholic beverage market (see Figure 2 in Section 1.4). We have not investigated synergies or differences in requirements if business model change was to be considered across a wider range of beverages such as bottled water and juices.

- **We only take into account PET (no other substrates)**: In this study, we examined costs for PET soft drink containers only, excluding any analysis of metal and glass beverage containers. PET makes up the bulk (51%) of

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21 Our modelling assumptions used to support this additional investment are detailed further into this report. Not all complexities in terms of geographical decentralisation were able to be incorporated in our cost model, so the total upfront additional capex cost for bottling does implicitly include assumptions for a larger number of bottling sites, but does not explicitly include costs of greenfield development. See Appendix A1.4 for further details

22 We have not considered the cost of end-of-life processing of packaging in any of our scenarios
one-way soft drink packaging in the EU27. Additionally, the activities and therefore the costs involved of producing and handling different packaging substrates vary along the supply chain, so exclusive focus on PET makes sense practically from a modelling perspective.

- **We examine the 'Off-trade' sales market only** – On trade consumption was excluded from our study as this uses higher proportions of glass packaging, which is not in scope, and involves substantial differences in the supply chain processes for return and refill of bottles. Including on-trade sales would involve a completely separate modelling exercise.

- **We assume 20% market penetration of Ref-PET in EU27 carbonated soft drinks retail trade by 2030** – In the main scenario we analysed, we assumed that Ref-PET reaches a market penetration in retail sales across the EU27 of 20% by 2030, and stays at this level as a constant for the next 10 years to 2040. We compared this to a counterfactual scenario in which current (2020) levels of Ref-PET market penetration in the EU27 (estimated at 4%) remain constant to 2040. Ref-PET market share is currently negligible in all EU markets other than Germany, and a limited number of country level targets for refillable plastic packaging exist for 2030 ranging from 10% - 80% (with varying channel definitions), but with an estimated median of approximately 20%.

We agreed with UNESDA and its members the central assumption of 20% market share based on information about the direction of government policy, and consultations with industry stakeholders on what would be feasible if they were required to make changes to their business operations. We assumed a nine year period to get to a 20% level of market penetration to account for the realities in what it takes to practically transform an industry business model that involves a high level of capital equipment. The depreciation rates of bottling machines and related equipment is in the realm of 15-20 years, so assuming replacement will happen more quickly than at the half way point to this could increase expected costs substantially, for no justifiable benefit that we know of. As we are not considering wider benefits as part of this study, we opted for this assumption to maximise efficiency and reduce overall transition cost to industry.

**We also performed sensitivity tests for higher (30%) and lower (10%) market share scenarios**, which show that:

1. Increasing market share from 20% to 30% (a 50% increase) results in an 13.7% increase in total cost
2. Decreasing market share from 20% to 10% (halving market share) results in a 12.5% decrease in total cost.

The change in cost in each case is lower in magnitude than the percentage change in market share from the central scenario. This is because only part of the overall cost of change and ongoing operation will vary based on market penetration. Fixed costs (which make up most of the capex estimate) remain the same under each sensitivity test. Importantly, these results may not hold true for larger changes in market share. E.g. examining a case in which we assumed an 80% market share for Ref-PET, would require revisiting assumptions entirely around industry response, and associated changes in activities and fixed and variable costs.

- **DRS** – For modelling purposes we assume that all of the EU27 countries have a DRS in place as part of our counterfactual scenario. This allows us to isolate the incremental effects and costs of moving from a one-way to a Ref-PET system across the EU27 without adding costs of adopting a DRS. In reality, only 10 countries currently have a DRS in place, and from our consultations with industry a well-functioning DRS would be required in all cases to make a Ref-PET business model work (to appropriately incentivise consumers and retailers to return Ref-PET bottles)

**E.7 Operational barriers to moving to a returnable refillable system**

Our approach estimates costs for a scenario that assumes a 20% market penetration target for off-trade Ref-PET is achieved by 2030. It also assumed there is an existing well-functioning DRS in place in all countries, with a consumer return rate of 95%. Beyond these parameters, there are many additional complexities that may prevent the successful transition of the industry to more Ref-PET, including:

- **Speed of transition:** The speed of transition will be a key determinant of the overall cost of transition. With more time to transition, actors along the supply chain will have more time to invest in order to meet the increased demand, helping to keep prices lower and reduce cost for bottlers. Along with this, the longer bottlers have to transition, the more they are able to take advantage of the natural depreciation cycle of existing one-way lines. This will prevent bottlers having to replace one-way lines that still have a considerable asset life remaining. Given that

\[23\] PwC analysis based on GlobalData Data Set (2021) Retrieved from: https://www.globaldata.com/

\[24\] Plastic Smart Cities, Deposit Refund Scheme, Available at: https://plasticsmartcities.org/products/deposit-return-program
bottling lines have an estimated useful life of around 15 to 20 years, a transition time of at least 10 years will help to avoid bringing forward machinery replacement costs before required. An accelerated transition, not aligned to business-as-usual capex replacement cycles, would likely incur balance sheet write offs, which would have a financial impact on businesses.

- **Heterogeneity between countries:** Countries across the EU27 will be impacted by the transition to Ref-PET differently, due to current systems and processes used within their supply chains, and different geographical needs for logistics and distribution (including reverse logistics). Countries with established DRS systems will be likely to transform their business models more easily, achieve higher consumer return rates, and face lower transition costs. Countries with certain topographies may require bottles to travel further, creating higher (possibly prohibitively high) distribution costs; that come with corresponding environmental impacts. These country differences have not been accounted for in our modelling, but must be considered in further development of any Ref-PET policy, for example in terms of how to introduce any targets for refill (e.g. EU-wide, national, or company level).

- **Environmental considerations:** A key objective of investigating a move to increased Ref-PET packaging is to improve environmental outcomes. The proposition for Ref-PET is that it could lower the carbon footprint of the soft drinks industry because of less PET disposal / better environmental outcomes than recycling can achieve. However, from the perspective of bottom-up supply chain analysis (which is what we have done in this study from an industry cost point of view), a Ref-PET system has a lot of additional complexity, with overall economic and societal cost/benefit results very uncertain. More work needs to be done. The change required in manufacturing and bottling processes that we analysed could potentially result in additional environmental costs rather than benefits overall (e.g. through increased utility consumption from operating additional machinery and washing bottles, and higher fuel consumption from increased logistical complexity). These issues need further exploration and analysis. One key sticking point is in logistics / distribution – according to our research and consultations – to gain an environmental benefit, the distance between manufacturers, bottlers, and retailers needs to be at maximum around 600km. If this is not the case, there will be significant impacts on productivity, as more lines (at dispersed locations) will be required to serve the same area compared to the current set up for one-way bottles. Otherwise the transportation costs outweigh other benefit in our business model change scenario. We have included the costs of assumed additional lines in our cost model (see Appendix A.3), but no additional costs for greenfield development of new sites.

- **Potential harm to competition:** Scaling up or moving to a Ref-PET business model as described in this report requires a lot of upfront investment from industry across the supply chain, in particular for bottlers. This means that Small to Medium Enterprises (SMEs) are likely to have much greater difficulty in scaling up / changing their business operations to meet and/or comply with any policy targets than large businesses, creating the risk that SMEs are no longer able to compete in the EU market for PET carbonated soft drinks. Analysis from a competition perspective should be investigated and understood before any new policy on Ref-PET targets is introduced. Consideration needs to be given to how and to who any targets would apply – for example at the business level, national level, or EU-wide level.

- **Potential need for greenfield development of new bottling sites:** Operationally, the bottling process for Ref-PET compared to one-way PET requires 2-3 times the amount of floor space – including for the machinery itself, and additional sorting. Additionally, as described above, according to our consultations with industry experts, to achieve efficient distribution logistics and reverse logistics in a Ref-PET model such as described in this report, more decentralised approach to bottling lines and plants is required – such that plants are located nearer to the retailers they serve (estimated within 600km). Otherwise distribution becomes cost prohibitive (both operationally and environmentally). This means that in many countries and regions (particularly outside of major cities and in very rural locations), scale up of Ref-PET will be much more costly and/or infeasible without development of new greenfield bottling sites. This could add a whole new level of cost and complexity in a transition to Ref-PET across the EU27 – and must be considered carefully and with detailed analysis in any further policy development. We have not explicitly included any costs in our modelling for development of new greenfield sites. Further detailed operational analysis should be undertaken on the logistical complexities of Ref-PET for individual geographies, to usefully inform future policy development.

- **Consumer uptake:** A prerequisite for any successful returnable packaging scheme, whether one-way PET or Ref-PET, is the existence of a well-functioning collection system and processes (such as a DRS) that results in high bottle/package return rates. In the EU27, this will require both set up of these systems in many countries, and also behavioural change and buy-in from consumers themselves. Consumers will need to choose to purchase Ref-PET bottles instead of one-way bottles; and choose to return these bottles back into the system once their soft drink is consumed. Without buy-in, consumers may either switch to other packaging options or choose to not return bottles, threatening the success and sustainability of the system. Consumer uptake will be influenced by many factors, including relative product prices; willingness to pay (WTP) to support better environmental outcomes; and views on
the relative convenience of purchasing, consuming, and returning Ref-PET products compared to purchasing, consuming, and recycling/disposing of one-way products. Beyond design and implementation of the DRS itself, the soft drinks industry can use relative product pricing and marketing to incentivise consumer uptake of Ref-PET. This will have further implications for industry costs. These costs are out of scope of this study and have not been considered in our modelling.

In general, consumer behavioural change is a slow process. We assume 95% uptake of Ref-PET in our modelling. In reality, this is not likely to happen overnight, and it will be slower paced in some markets. As our analysis is focused on supply side industry change only, we have not examined the effect of slower or different uptake rates in different markets, but have simply applied uptake assumptions from the German beverage market, which is the most developed in terms of refillable. Further analysis would be needed in considering implementation of any Ref-PET system.

As a further complication, consumer perceptions and therefore expected behavioural change is likely to be different across markets based on a number of factors including historical practices; socio-economic and demographic characteristics; and social and cultural norms. From our consultations with industry representatives, we heard that their research to date indicated that in some markets consumers are willing to pay a premium for returnable/refillable packaging; and in others it is perceived as an inferior product. These complexities should be assessed and considered further in development of any future policy on Ref-PET.

- **Supply side constraints (manufacturers):** The increased demand on manufacturers for new bottling equipment and machinery could put pressure on existing supply chains, as only a handful of companies currently supply the specific bottling machinery needed for returnable refillable lines. Based on our consultations with industry, evidence to support this being a constraining factor was mixed, particularly if there is a long enough lead time before any new regulations were to come into effect. Our modelling therefore assumes that most capital expenditure required for the change to Ref-PET occurs between 2023 and 2030, giving seven years for bottlers to undertake large-scale investment in new machinery and a stock of bottles and crates to flow through the system.
1. Introduction

1.1. Context

The European Commission (EC) published its new Circular Economy Action Plan (CEAP) in March 2020. It is one component informing the broader European Green Deal (adopted by the EC in July 2021), which is Europe’s new agenda for sustainable growth incorporating a package of proposals to make the EU’s policies fit for reducing net greenhouse gas emissions by at least 55% by 2030 (compared to 1990 levels).

The EU’s transition to a circular economy aims to reduce pressure on natural resources while creating sustainable growth and jobs. The CEAP outlines a future-oriented agenda for achieving a cleaner and more competitive Europe in co-creation with economic actors, consumers, citizens, and civil society organisations. It identifies both plastics and packaging as key product value chains where urgent, comprehensive and coordinated actions are needed to develop a sustainable policy framework for circularity.

Plastic waste is a growing concern in the European Union (EU) because of its significant negative environmental impacts, such as marine pollution, contribution to global warming, and threat to wildlife. 87% of Europeans are worried about the impact of plastic products on the environment. In an effort to address this issue, on the 22nd February 2021, UNESDA Soft Drinks Europe launched its 2030 Vision for Circular Packaging, which sets out the European Soft Drinks industry’s aim to achieve full circularity of beverage packaging (plastic, aluminium and glass) by 2030. UNESDA members aim to deliver this vision through three pillars:

1. Collect: Create closed-loop beverage packaging collection and recycling systems with an aim to achieve at least 90% collection of all packaging by 2030. This is to include wider introduction of well-designed Deposit Return Schemes (DRS) for PET and other materials, where needed to help meet this target.

2. Recycle: Use only packaging that is circular by design and boost the uptake of recycled PET to meet an ambition for PET bottles to be made from 100% recycled and/or renewable PET by 2030, where technically and economically feasible.

3. Reduce and reuse: Increase the use of refillable packaging, with the aim to use more refillable packaging by 2030 compared to 2020. To support this goal, UNESDA members have committed to studying the best environmental and economic pathway to increase use of refillable models.

UNESDA and its members want to demonstrate responsibility and commitment to accelerating the transition to a circular economy. Beverage packaging can be fully circular and has a central role to play in a circular economy: it has value, is recyclable, is collected and used as recycled content. UNESDA believes that packaging is a resource that should never be wasted and end up as litter.

Full circularity for PET (i.e. plastic) soft drink bottles can be achieved through both recycling and refill methods:

- For recycling this involves ‘closing the loop’ where recycled PET material generated from the recycling of bottles is used to manufacture fresh bottles, rather than downcycling the material into non-packaging uses such as textiles. The ultimate aim is to move towards manufacturing 100% recycled PET bottles, minimise material waste during the recycling process and maximise consumer recycling rates.

- Refill methods involve manufacturing sturdier, refillable PET (‘Ref-PET’) bottles, so that consumers can preserve the bottle whole after use and then either return it to the bottler to be washed, refilled and resold, or keep for continued home use, using technology such as home soda refill machines.

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27 A ‘circular economy’ is focused on products and materials being used over and over, in a continuous loop, rather than discarded.


29 A ‘circular economy’ is focused on products and materials being used over and over, in a continuous loop, rather than discarded.
Currently, 68% of all soft drink packaging across the EU is PET of which 94% is non-refillable PET (i.e. one-way) and only 4% is refillable. Eunomia’s study on the PET Market in Europe: State of Play estimates that in 2018 only 52% of PET bottles were sorted for recycling. There is considerable variation by country, and markets with a DRS have the highest recycling rates, with an average of 88% recycling rate compared to 50% for those without. In 2019 the EU set a collection target for beverage plastic bottles of 77% by 2025 and 90% by 2029. As a consequence, the industry has already begun investing in optimising processes to increase the amount of recycled PET and improve circularity of PET bottles through recycling.

Across the EU there has recently been a shift in policy priorities away from recycling and towards reuse models of plastic packaging. In some EU Member States, policy has already been introduced in this area. For example, in France a cross-sector reusable plastic packaging target of 5% has been set for 2023, rising to 10% by 2027. Austria and Spain are also exploring and implementing options to increase the proportion of reusable plastic packaging across their economies and Germany has committed to a quota of 25% reusable plastic in PET beverage bottles by 2025.

The EC is currently investigating options to increase refillable beverage packaging in Europe. One possible option may be the introduction of targets or quotas for refillable beverage containers, including soft drinks. While designed with positive policy intentions, if the impacts of a policy change like this are not adequately considered, this could cause significant challenges and costs for industry, and may result in unintended consequences that negatively impact consumers.

1.2. Purpose of this study

PricewaterhouseCoopers LLP (PwC) was independently commissioned by Union of European Beverages Associations (UNESDA) to undertake this study in 2021, examining the potential economic costs of policy change on refillable packaging models for plastic soft drink bottles. Whilst we recognise that there will be benefits of a refillable system, these are not examined in this study. The objective of the study was to gather evidence and undertake independent analysis to understand the likely cost implications falling on the stakeholders involved in pursuing various economic pathways to increase the use of Ref-PET. The findings of the study are intended to help support UNESDA’s policy discussions at an EU level through establishing an evidence base on the costs of moving to a returnable refillable system. This economic study should be complemented by an environmental study and other wider studies on benefits and the impacts of consumer behaviour to have a full picture of the consequences of moving to refillables.

1.3. Scope of work

This study estimates the economic costs between 2021 and 2040 to the European soft drink industry of meeting a 2030 EU wide 20% target for production and sale of Ref-PET carbonated soft drink bottles in EU27 retail markets. It is intended to provide an understanding of the level of change, and therefore associated costs, that would be incurred across the supply chain to meet such a target. It also identifies potential operational barriers to this change that could make such a target prohibitive for industry, and other possible unintended effects of implementing such a policy.

It is intended that the analysis presented in this report will help to inform the development of European policy in relation to refillable beverage containers. This report does not provide a comprehensive economic impact assessment of the soft drinks industry moving entirely to reusable refillable beverage packaging. It examines the estimated costs to industry only of meeting a Ref-PET target, compared to an assumed counterfactual situation in which industry continues to produce

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30 These figures are taken from the 2030 Vision for Circular Packaging and represent figures at EU level. Note that they include estimates for the EU as a whole. The figures used in our modelling are from Global Data and are based on EU27 group of countries only. Based on this source, Ref-PET represents 4% of the EU27 PET carbonates softdrink market (as of 2020).
35 In this document, ‘PwC’ refers to the UK member firm
36 PwC’s work was completed between March and December 2021, for publication in 2022. All data were sourced at the time of the work.
one-way or recyclable PET soft drink bottles for the EU27 retail market at current proportionate levels of production. It does not examine any environmental costs or benefits. An environmental study is one additional component that would contribute to a fuller picture of the consequences of moving to refillable packaging. A consumer behaviour study is another important consideration.

1.4. Scope of markets analysed

The scope of our study specifically focuses on the PET carbonates soft drink market, which is 16% of the overall EU27 non-alcoholic beverage market (see Error! Reference source not found.2).\textsuperscript{37} In considering any new policy direction for beverage packaging, the findings and costs presented in this report must be taken within this context of this market share. The scope of our modelling also represents what would happen in the case of a business model change for carbonated soft drinks sold off-trade only\textsuperscript{38} (in PET bottles) – and relies on a number of simplifying assumptions which are set out in Appendix 1.

Figure 2: Non-alcoholic drinks containers purchased in the EU27 – by drink type category and substrate of primary packaging

![Figure 2: Non-alcoholic drinks containers purchased in the EU27 – by drink type category and substrate of primary packaging](image)

The scope of our study focuses on PET carbonates, which make up 51% of the carbonates market and 16% of the EU27 non-alcoholic beverage market as a whole.

Note: Totals may not sum due to rounding

1.5. Methodology

Our approach to estimating the impact of scaling up Ref-PET in the EU27 soft-drinks industry involved conducting extensive consultations with industry representatives from across the soft drinks supply chain. This allowed us to understand the implications in terms of changes required in industry activity (and therefore corresponding investment and operational cost) of moving to a Ref-PET system for manufacturers, bottlers, wholesalers and retailers. Costs were classified into categories of capital and operational expenditure, and unit cost estimates in each category were multiplied by volume estimates (of bottles, of crates, machines etc) that were estimated to be required to meet the 20% market share target over the appraisal period.

Our methodology incorporated:

- **Data collection:** We used GlobalData for our volume unit sales up to 2020.\textsuperscript{39} We received cost information through a series of consultations with industry experts, supplemented by review of existing literature.

- **Defining cost categories and inputs for our cost model:** We categorised costs as either capex costs, which cover the upfront investment required to set up a Ref-PET bottling system, or opex costs, which cover the ongoing

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\textsuperscript{37} PwC analysis based on GlobalData Data Set (2021) Retrieved from: https://www.globaldata.com/

\textsuperscript{38} Off-trade consumption refers to drinks that are consumed off-premises, either at home or on the go, therefore excluding on-trade consumption at hotels, restaurants, and cafes (known as ‘HoReCa’).

\textsuperscript{39} PwC analysis based on GlobalData Data Set (2021) Retrieved from: https://www.globaldata.com/
costs of operating the system. A full list of the cost inputs used within our modelling, along with the source of information and key assumptions underpinning these estimates are provided in Appendix 2.

- **Volume estimations:** We estimated future volumes of PET carbonated soft drink sales based on Global Data’s volume unit sales from 2015-2019 for carbonated soft drinks across a range of pack sizes. We estimated future volumes of bottle sales up to 2040 using the compound average growth rate between 2015 and 2019 for specific pack sizes. See Appendix A2.1 for a full description of our volume modelling.

- **Net cost calculations:** To calculate overall gross costs for both scenarios, we applied our volume driver estimates to the relevant cost inputs for each cost category across the supply chain. These gross costs were netted off to calculate the net cost to industry of the main scenario across the supply chain, i.e. the total additional cost of moving towards a 20% Ref-PET target compared to a counterfactual scenario in which current market levels of penetration remain unchanged over the appraisal period.

**1.6. Modelling scenario definition**

Costs were calculated for what we defined as our ‘main scenario’, where the industry moves to achieving 20% market penetration of Ref-PET within the EU27 retail PET carbonated soft drinks market by 2030 and maintains this market share to 2040; against our assumed counterfactual scenario, where the industry maintains its current (2020) level of market penetration of 4% to 2040.

The key assumptions underpinning each scenario are provided in Table 4. These assumptions were developed and agreed with UNESDA and its members for modelling purposes – to simplify as usefully and as accurately as possible a complex real-world change into a representative and relevant cost model, that could be used to inform discussions about future policy direction. We agreed to separate specifically the effects of the industry impact (and therefore cost) of a move to refillable packaging for PET carbonated soft-drinks only (as this subset of the beverage market best represented industry interests and aligned with current policy priorities of reducing disposable plastics).

**Table 4: Key assumptions in our cost model**

<table>
<thead>
<tr>
<th>Scenario:</th>
<th>Counterfactual</th>
<th>Main scenario</th>
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</thead>
<tbody>
<tr>
<td>Geography</td>
<td>EU27</td>
<td></td>
</tr>
<tr>
<td>Appraisal period</td>
<td>2021 to 2040</td>
<td></td>
</tr>
<tr>
<td>Type of collection system</td>
<td>DRS in place in</td>
<td>DRS in place in all countries</td>
</tr>
<tr>
<td>in place for recycling</td>
<td>all countries</td>
<td>+ returnable refillable</td>
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<tr>
<td>and/or refill</td>
<td></td>
<td></td>
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<tr>
<td>Substrate</td>
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<td>Carbonated soft drinks</td>
</tr>
<tr>
<td>Product</td>
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<td></td>
</tr>
<tr>
<td>% Market penetration</td>
<td>Current [2020]</td>
<td>20% market penetration reached</td>
</tr>
<tr>
<td>Ref-PET</td>
<td>market penetration maintained to 2040</td>
<td>by 2030 and then maintained to 2040</td>
</tr>
<tr>
<td>Channel (where drinks</td>
<td>Off-trade</td>
<td></td>
</tr>
<tr>
<td>consumed)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pack sizes for reuse</td>
<td>All pack sizes based off costs for 0.5l, 0.75l, 1l, 1.5l</td>
<td></td>
</tr>
<tr>
<td>Standardisation of bottles</td>
<td>Manufacturers own and operate distinct (branded) bottle floats</td>
<td></td>
</tr>
</tbody>
</table>

Further information on the selection of the key parameters is given below (see Section 3.5 for a more detailed explanation of the limitations and scope of the model):

- **PET** – In this study, we examined costs for PET soft drink containers only, excluding any analysis of metal and glass beverage containers. PET makes up the bulk (51%) of carbonated soft drink packaging in the EU27.  

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40 Taken as an average estimation based on our consultations with industry experts

41 We collected cost information based on these pack sizes and then applied costs to the entire market, so we effectively capture all pack sizes in our cost estimates, rather than just the proportion of the market covered by these 4 pack sizes.

42 PwC Analysis based on GlobalData Data Set (2021) Retrieved from: https://www.globaldata.com/
Therefore, any substantial change within the industry towards an increase in reusable packaging, will require a move to Ref-PET. Additionally, the activities and therefore the costs involved in producing and handling different packaging substrates vary along the supply chain, so exclusive focus on PET makes sense practically from a modelling perspective.

- **Off trade** – On trade consumption was excluded from our study as this uses higher proportions of glass packaging, which is not in scope, and involves substantial differences in the supply chain processes for return and refill of bottles. Including on-trade sales would involve a completely separate modelling exercise.

- **20% market penetration by 2030** – Our sensitivity analysis also looks at costs in low (10%) and high (30%) market penetration scenarios. 20% was selected as our core scenario as this was determined to be a sensible average of likely scenarios for moving to Ref-PET, given current levels of returnable refillables across the EU and existing targets set by individual countries.

- **DRS** – For modelling purposes we assume that all of the EU27 countries have a DRS in place. This allows us to isolate the incremental effects and therefore costs of moving from a one-way to a Ref-PET system across the EU27 without adding costs of adopting a DRS. In reality, only 10 countries currently have a DRS in place, and from our consultations with industry a well-functioning DRS would be required in all cases to make a Ref-PET business model work (to appropriately incentivise consumers and retailers to return Ref-PET bottles).

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43 Plastic Smart Cities, *Deposit Refund Scheme*, Available at: https://plasticsmartcities.org/products/deposit-return-program
2. The move to Ref-PET

This Chapter outlines qualitatively the business model change required to move from a one-way PET system to a Ref-PET system across each stage of the soft drinks supply chain and the key operational barriers that may prevent a successful transition of the industry.

2.1. Overall scope of business model change required

Transitioning to more Ref-PET will involve whole scale industry change across the soft drinks supply chain: from manufacturing of inputs to retail and return of bottles.

Scaling up the production and sale of Ref-PET soft drinks is not a simple process that can be ‘integrated’ into current industry systems and processes used by the European soft drinks industry. One reason for this is that Ref-PET bottles will have to be produced, filled, and sold in parallel to one-way PET bottles, as entire replacement of one system with the other would be prohibitively expensive and unlikely to be operationally possible. The supply chain systems, processes, and activities required differ greatly between one-way PET and Ref-PET, so this will require whole-scale change in the infrastructure, inputs, and processes required to manufacture, bottle, and sell soft drinks. It will also require a complete new set up of reverse logistics to enable PET containers to be returned and refilled, that do not currently exist in most of the EU27.

Through our consultations with UNESDA industry members and other industry representatives, we mapped the processes from beginning to end across the supply chain, for Ref-PET, including processes that are needed for circularity of packaging. The process map of a Ref-PET supply chain is shown in Figure 3.
Figure 3: Ref-PET carbonated soft drink supply chain
There are multiple factors driving the scale of industry change that will be required. Those we found to be particularly significant in conducting this study, and should be considered carefully in establishing any new targets, quotas or regulation to increase Ref-PET market share are:

- **Change in the manufacturing processes, inputs, and logistics required for PET containers:** The bottles for one-way PET and Ref-PET bottles are considerably different. Therefore, a move away from one-way PET bottles to Ref-PET will require an industry-wide change in the manufacturing of PET packaging. One-way bottles are blown and filled one time before being sold and recycled. However, in a Ref-PET system, the bottle needs to be filled and washed at high temperatures multiple times, in order to meet the hygiene requirements of the industry. Therefore, the materials used in producing Ref-PET bottles need to be twice as heavy as in one-way. In addition to this, Ref-PET bottles require crates to be transported and sold, as opposed to the far less costly shrink or carton wrap used to package one-way bottles. Both these factors will add significant costs to the industry.

- **Changes required to the set up and operation of the bottling process:** The move from one-way PET to Ref-PET requires significant change to the bottling process. For example, existing one-way PET bottling lines are unable to handle Ref-PET bottles, due to the different product dimensions and additional machinery required for sorting of return bottles, cleaning and filling required on Ref-PET lines. Therefore, a gradual move to Ref-PET will require one-way PET and Ref-PET bottling lines to run separately but concurrently. This will need to happen either in the same location or at completely separate sites, if existing sites do not have the space requirements for Ref-PET (which are a considerable barrier to set up). These additions will require both significant industry investment and increased operational costs.

- **Logistics / reverse logistics:** Ref-PET bottles need to be returned to the bottler, whereas one-way bottles are recycled or discarded after consumption. This means that there are significant additional logistical features of the Ref-PET system, which adds exponential complexity and therefore cost for soft drinks companies and supporting businesses along the supply chain.

- **Additional lines / sites are required:** a significantly higher number of lines (and likely corresponding sites) are needed in a Ref-PET system, so that heavier ref-PET bottles that need to travel in two directions, do not travel a distance of which the logistics and reverse logistics costs offset the benefits of reuse (economic and environmental).

The next section outlines the key industry changes required for each stage of the supply chain in detail, split by upfront investment (requiring additional capex) and ongoing operational changes (requiring additional operating expenditure).

### 2.2. Key business model changes required at each stage of the supply chain

#### Upfront investment

Converting production from one-way PET, to integrate a greater proportion of Ref-PET requires significant upfront investment at each stage of the soft drinks industry supply chain. Key changes that will result in additional upfront investment are listed below as they relate to each stage of the supply chain. The assumptions presented here have been ascertained from our detailed consultations with industry and supporting data provided. Where enough data was available and tested for reliability with industry representatives, we have used the assumptions below as inputs to our cost model.

#### 1. Manufacturing of inputs (bottles and crates)

- In most cases Ref-PET bottles will need to be procured from suppliers rather than blown at the bottling line, which will increase logistical complexity (to transport the bottles) and therefore upfront investment cost in blown bottles, which is currently incorporated into bottling operational costs for one-way PET production.
- New investment in blowing machines will be required because bottles are thicker and **up to 2x heavier** than one-way bottles.
- There will be a new need for crate production lines (which are not required for one-way PET production).
2. Bottling

- Replacement of entire bottling lines is required for Ref-PET bottles, as it is not possible to simply optimise current one-way systems or repurpose one-way lines. One-way lines are unable to bottle Ref-PET bottles and therefore bottlers will have to run separate lines to accommodate both. Discussions to date suggest that a one-way bottling line costs ~€10m to purchase and set up, whereas a Ref-PET line costs ~€20m.
- **2-3x** the space is needed to accommodate a Ref-PET bottling process, including the bottling line itself, and space for packing and storage of crates and empty bottles. Most current production facilities cannot accommodate this, even if replacing a one-way PET line with a Ref-PET line. A further complication is the seasonality of storing bottles, as demand for soft drinks is considerably higher in the summer. Storage requirements are therefore even higher in the winter (when product moves more slowly) and this also increases the risk of damage to bottles.
- Upfront investment in ‘float’ required of bottles and crates. **Up to 4x** the amount of bottles and crates on the retail shelves are needed in float. Float size is a key cost driver for the industry due to the large upfront investment required.
- Additional lines/sites are required so that heavier ref-PET bottles that need to travel in two directions, do not travel a distance of which the logistics and reverse logistics costs offset the benefits of reuse (economic and environmental).

3. Distribution logistics

- Ref-PET bottles are transported in crates, which require ~35% more space than one-way bottles (which do not require crates for transportation). Ref-PET bottles are also heavier, meaning more vehicles are required for transportation per million bottles (all else equal).
- To make Ref-PET operationally efficient (and environmentally beneficial), a more decentralised model of production is required than for one-way PET. This is because of the two-way bottle flows, which means more km travelled overall. This translates in practice operationally, to a requirement for more bottling sites per million bottles consumed.

4. Wholesaler activities

- There is an additional requirement for space and operations to sort empty Ref-PET bottles before they are returned to the original bottler. This could lead to more upfront investment required in floor space.
- There is an additional storage requirement presale due to the larger size of Ref-PET crates. This could lead to more upfront investment required in floor space.

5. Retailer activities

- Installation of reverse vending machines (RVMs) that accommodate Ref-PET bottles and crates. Each Ref-PET RVM costs up to an estimated €25,000 to install\textsuperscript{44}. One RVM can process around **400,000 bottles** per year for **10-12 years**.\textsuperscript{45}
- Investment in back-end storage and sorting space required to deal with returned bottles (as they are not crushed so take up more space). This requires **40-60m\textsuperscript{2}** of additional space for sorting per RVM\textsuperscript{46}.

\textsuperscript{44} Taken as an average estimation based on our consultations with industry experts
\textsuperscript{45} Ibid.
\textsuperscript{46} Ibid.
Reverse logistics

- A complete new set up is required for returning empty bottles and crates from the retailer (possibly through the wholesaler) back to the original bottler, rather than collecting shredded plastic for recycling (the requirement for one-way PET).

Ongoing operational cost changes

Changes in ongoing operations and associated operating costs will also affect the industry across each stage of the soft drinks supply chain. Key changes are listed below as they relate to each stage of the supply chain.

1. Manufacturing of inputs (bottles and crates)

- Production of bottles is more complex as the material is thicker and takes longer to cool. Therefore, it will be difficult to achieve economies of scale for Ref-PET bottle blowing in small production quantities.
- Additional raw materials are required to produce Ref-PET bottles (that are up to 2x heavier than one-way bottles), and to produce the crates. However, cost per use will fall as bottles are reused up to 10-20x (compared to only once for one-way bottles) and crates up to ~50x.  
- There are new ongoing operational costs for production of crates, including machinery operation and additional labour.

Bottling

- Ref-PET bottling lines are estimated to run up to 50% slower than one-way bottling lines (depending on pack size) due to the added time to wash and do additional quality control checks on returned bottles. This means that Ref-PET bottling production has a lower production efficiency than a comparable one-way line.
- Overall increase in operating cost per bottle:
  - ↑ labour and other overheads, as the process is more complex
  - ↑ movement due to heavier bottles
  - ↑ rent and property taxes as a result of more space required
  - ↓ raw material cost, as the cost is spread over the lifecycle of the bottle
  - ? Net impact on utility costs (e.g. Ref-PET does not require a blower, but does need additional sniffing and inspection machines and a bottle washer)

Distribution logistics

- Ref-PET will require a large increase in distribution logistics operating complexities, especially with the current centralised production models in most countries within the EU27. Cost increases come from the additional space that Ref-PET bottles in crates take up compared to shrink wrapped one-way bottles, meaning more trips have to be made to transport the same number of goods.
- Fewer Ref-PET bottles can be packed per m³, and each weigh more due to a heavier bottle and the addition of a crate. Therefore, more trucks, more fuel and more labour are required.

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47 Ibid.
2.3. Operational considerations and barriers

During our research, we identified a number of key considerations, and possible barriers for implementation of an EU policy target for reusable refillable soft drink bottles, including Ref-PET; along with potential unintended consequences from such a policy move if not implemented carefully. These factors must be considered carefully by policymakers, to achieve success in implementation of any new policy designed to increase reusable packaging.

2.3.1. Speed of transition

The speed of transition will be a key determinant of the overall cost of transition and will impact the level of supply constraints the industry faces. With more time to transition, suppliers will have more time to convert their plant, equipment, and operational processes – and thus do so in a strategic rather than reactive manner. This will help to align new capital expenditure required with natural depreciation cycles, avoiding unnecessary early write-off of current one-way bottling machinery that is not yet obsolete (which affects financial balance sheets and efficient resource use). This will help to reduce the cost of transition for bottlers and avoid higher prices being passed on to consumers.

Bottling lines have an asset life of around 15 to 20 years, so on average, a cost-effective transition period will need to be approximately at least 10 years.

2.3.2. Heterogeneity between countries

Member States across the EU have varying reuse/recycling schemes in place already. As such, a blanket policy target that does not take these differences in starting positions into account would be a blunt policy tool. Our modelling assumes that a Deposit Return System (DRS) is already in place in each of the EU27 countries, in order to exclude the costs of setting up a DRS from our cost estimates. However, in reality only 10 of the EU27 countries currently have a DRS in place. This means for other countries there will be an additional layer of set up and associated cost to setting up the Ref-PET system. These countries are also likely to have lower consumer uptake initially, as larger changes in consumer behaviour are required as consumers will be not be used to paying deposits on bottles or returning them centrally at all (see Section 4.2 for more information on consumer uptake).

There is wide heterogeneity among Member States in a variety of factors that impact the ability to implement bottle reuse schemes, e.g. population density, topography, capacity to provide support services (e.g. bottle cleaning). As a result, an

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Ibid.
EU-wide policy target is not necessarily appropriate to apply uniformly to all countries to comply with at the same level and by the same date. Countries with a larger proportion of rural areas or that are very long would have higher logistical costs when running a Ref-PET scheme. These countries may also need smaller plants across the country to better serve its population, reducing potential economies of scale and therefore increasing unit costs for bottlers.

2.3.3. Environmental considerations

Our analysis focusses on the cost implications for the soft drinks industry of a move to a Ref-PET business model. However, it is important to contextualise our findings within wider economic and environmental considerations and impacts. We outline below the some key factors that need to be considered in assessing how environmentally beneficial a Ref-PET system may be:

- **Level of consumer uptake** (see Section 4.4 for more detail). Any environmental benefits that come from Ref-PET bottles compared to one-way, rely on consumers choosing to switch from one-way PET to Ref-PET. Similarly, the bottle return rate will impact the environmental benefits. If the return rate is low, then a higher number of new Ref-PET bottles will need to be manufactured as replacements, reducing any environmental benefits of a refillable system.

- **Bottle utilisation rates and overall system efficiency.** The number of Ref-PET bottles produced will be impacted by:
  - The number of turns a Ref-PET bottle makes. Our conversations with industry experts suggest that in order to have environmental benefits, a Ref-PET bottle needs to have 9-10 turns (i.e., be consumed and returned 9-10 times).
  - The length of a bottle turn (how long it takes for a Ref-PET bottle to travel through the system). As this turn length increases, a larger float is required, meaning more bottles need to be produced.

- **Distance travelled** – The distance that Ref-PET bottles need to be transported, and therefore the amount of fuel required, will be determined by:
  - Bottler to retailer radius. Our conversations with industry experts suggest that the maximum distance a Ref-PET bottle can travel from a bottler to a retailer and still have environmental benefits is 600km. Therefore, if the radius of bottler to retailer is more than 600km, then the environmental benefits of refillables are lost.
  - The efficiency achieved in utilising return trips for reverse logistics. For example, if the trucks that are already returning to bottlers, are also used to transport empty used bottles, then the additional distance travelled is reduced.

2.3.4. Potential harm to competition

Small and Medium Enterprises (SMEs) may be less able to comply with policy targets and potentially pushed out of Ref-PET soft drinks markets. The move to a Ref-PET system requires considerable upfront investment, both in new refillable bottling lines, and for crate and bottle floats to support the circular system. This presents a large barrier to entry, particularly for smaller bottlers that are less able to raise the capital required to undertake this investment.

Smaller bottlers are also disadvantaged due to a larger number of bottling sites likely needed to operate a Ref-PET system. To achieve a net environmental benefit within a returnable refillable system, bottling lines need to be located nearer to retailers than in a one-way system, therefore requiring a higher number of lines to serve the same geographical region. Smaller operators that are currently able to run a one-way system efficiently may be unable to set up operations at a higher number of sites, as they do not have sufficient demand to operate at the minimum efficient scale. This means that operating costs will increase per bottle and bottling line productivity will fall considerably compared to larger companies. Along with this, the environmental benefit may be eliminated below a certain level of operation, removing the case for moving to returnable refillable for smaller bottlers.

2.3.5. Potential harm to consumer choice

Consumers may face reduced choice within a Ref-PET soft drinks system compared to a one-way system. Certain products may not be suitable for a Ref-PET bottling system, for example those with a small overall demand, as the fixed costs of setting up the necessary Ref-PET lines may be prohibitively high to spread across the small quantity of product sold. This means that a move to a Ref-PET system may constrain the range of consumer choice for soft drinks as drink types below a certain level of demand become too costly to manufacture and supply within a Ref-PET system.

Consumers are also likely to face a reduced number of pack sizes as bottlers face a reduced capability to cater to different consumer consumption occasions and needs. In a one-way system, bottlers can innovate packaging to cater to
all tastes and preferences with a large range of pack sizes. However, given the complexity of sorting processes and high fixed costs for Ref-PET, bottlers are pushed to increase standardisation within a Ref-PET system and limit the number of pack sizes offered to consumers.

2.3.6. Possible supply side constraints

Our modelling considered a scenario where the industry moves to a 20% target by 2030, with significant investment beginning in 2023. This transition will require large-scale investment in Ref-PET bottling lines, bottles and crates in order to meet demand. It is possible that manufacturers of this machinery can not fully meet this shift in demand from bottlers. Currently there are a handful of companies that supply bottling machinery to the entire returnable refillable market and therefore demand could easily outstrip short-term supply, leading to potentially substantial increases in lead times and prices for machinery. There are similar concerns for the Ref-PET bottle and crate markets. However, this effect may be partly alleviated by the equivalent reduction in demand for one-way bottling machinery and bottles.

Retailers may also face supply constraints from bottlers, as bottlers will need to upgrade bottling lines to Ref-PET lines. Ref-PET lines take up around two to three times the floor space of a one-way line, including the additional sorting space required. This means that many existing facilities will not be large enough to accommodate Ref-PET lines, which could cause a delay in supply of product, as bottlers invest in new greenfield sites to accommodate, which can take multiple years to set up.

2.3.7. Getting buy-in from stakeholders

For reuse schemes to be effective, stakeholders across the value chain need to be engaged in the process, for example retailers need to be on-board with the schemes. Agreements also need to be formed as to who is responsible for costs at different stages. Compared to the status quo today, returnable refillables in off-trade sales would constitute a fundamentally different business model across all stages of the supply chain. This means that as well overcoming barriers to change, success will require over-coming barriers to a new status quo. For example, in retail, offering returnable refillable bottles with a deposit and crate would require changes to store layouts and operations, as well as changes to the price point and range of products structure offered to the consumer. Commercially this is neither inherently positive nor inherently negative – but it is inherently different and will need thorough consideration in any implementation plan.
3. Detailed cost estimates

This Chapter provides the results of our cost modelling our ‘main scenario’, where the industry moves to achieving 20% market penetration of Ref-PET within the EU27 retail PET carbonated soft drinks market by 2030 and maintains this market share to 2040; against our assumed counterfactual scenario, where the industry maintains its current (2020) level of market penetration of 4% to 2040. It also presents our sensitivity analysis.

3.1. Summary of total cost estimates

Total cost

Based on the assumptions defined for our central scenario (see Section 1.6), we estimate a total NPV cost to the soft drinks industry across our appraisal period (2021 to 2040) of €18.7bn. This includes capex of €12.5bn (Total, NPV) to the industry for the upfront change from one-way/recyclable PET to returnable refillable PET and incremental opex of €6.2bn (Total, NPV) that would not be incurred in the case of no scale up of Ref-PET.

The net capex and opex is calculated as the net change of capex and opex from the counterfactual to main scenario. Figure 4 shows how the annual net capex and net opex profile are estimated to change from 2021 to 2040, presented in constant 2021 prices.

Figure 4: Annual net capex and opex 2021 to 2040 (2021 constant prices)

Capex

We estimate that the first years (2023 to 2030) of the move from one-way PET to Ref-PET will require significant capex investment to meet an EU27 20% market penetration target. While there would likely be some costs prior to 2023 (depending on the timing of any target), we estimate a one to two year time period for strategic planning by industry, such that major expenditure begins in 2023. We then discount all costs back to 2021 to reflect them as real values in 2021 prices at NPV).

Between 2023 and 2030, we estimate that an additional annual capital investment of approximately €1.9bn will be needed across the EU27. (This is equivalent to €0.11 of capex per additional Ref-PET bottle sold). This is based on our
estimated increase in the overall number of bottling lines required to meet to a 20% market penetration target by 2030 and the cost of this investment; as well as estimated capex required for new bottles and crates (see Appendix A1.2). These investments will be made by industry over that period to 2030, and we have assumed that the capex profile is smoothed over the time period and therefore cash flows are the same each year. This is a simplistic assumption for modelling purposes. In reality, capex will likely not be the same year on year, and will be incurred more sporadically, with some years having greater investment than others (e.g. based on when it makes most sense for a bottler to replace existing machinery).

From 2030, when our assumed market penetration target is met, annual capex falls to €154m each year. (This is equivalent to €0.01 of capex per additional Ref-PET bottle sold). This represents the incremental capex that is required to maintain a float of bottles and crates (that would not be required if Ref-PET production was not scaled up – i.e. as in the counterfactual case). This annual figure also includes some costs for business as usual (BAU) replacement of bottling machinery that would also not be incurred in the counterfactual case.

**Opex**

Our modelling assumes that as new Ref-PET machinery comes on board from 2023, market penetration of Ref-PET increases linearly from 2023 to 2030. This is also a simplified assumption for modelling purposes, and in reality the increase will likely occur more irregularly. This linear increase in market penetration is the key driver of the linear increase in incremental operating expenses between 2023 and 2030 – as the number of Ref-PET bottles produced and sold increases each year – with annual opex reaching €800m a year by 2030 when 20% market penetration is reached.

From 2030, as we assume market penetration of Ref-PET remains constant, annual opex also remains reasonably constant at roughly €800m each year (This is equivalent to €0.05 opex per additional Ref-PET bottle sold). This represents the BAU incremental operating costs across the supply chain of a scaled up Ref-PET business model, compared to the counterfactual in which no scale up of Ref-PET occurs.

For further detail on volume and cost assumptions, please see Appendix A1.1 and A1.3.

### 3.2. Cost estimates for each stage of the supply chain

**Capex**

Our total NPV capex estimate of €12.5bn (NPV) includes estimated total incremental capex incurred at the first two stages of the soft drinks supply chain – manufacturing of inputs, and bottling. The split between these at the aggregate level is shown in Figure 5 and the annual capex profile for each in Figure 6. The most significant driver of capex from 2023-2030 is the number of new bottling lines we estimate will be needed across the EU27 to meet our assumed 20% market penetration for Ref-PET. A description of the methodology used to estimate the number of EU27 bottling lines can be found in Appendix A1.3.
Opex

Our total NPV opex estimate of €6.2bn (NPV) includes estimated total incremental opex incurred across the first four stages of our defined supply chain. The split between these at the aggregate level is shown in Figure 7.

Figure 8 shows the annual opex profile for each stage of the supply chain over our appraisal period, split between the bottling, distribution logistics, wholesaler costs and reverse logistics stages of the supply chain. In all areas of the supply chain, excluding distribution logistics, we estimate that opex increases linearly between 2023 and 2030, corresponding with our assumption of linear increase in Ref-PET market penetration.

By 2030, we estimate that bottling will reach an annual net opex of €491m, reverse logistics to reach €235m, wholesaler opex to reach €42m and distribution logistics to reach €25m. These annual incremental costs then remain constant to 2040. The one exception is in the case of distribution logistics. This falls from €25m in 2030 to €4m per annum going
forward from 2031, as the bottle ‘float’ requirement is reached,\textsuperscript{49} and fewer bottles are required to be transported each year in the BAU situation.

Figure 8: Annual net opex by supply chain stage (2021 constant prices)

3.3. Sensitivity analysis

We performed two sensitivity tests on our results to determine how the total cost estimate to industry changed for a higher (30%) and lower (10%) level of market penetration. For this, we adjusted our 2030 market penetration assumptions by 10 percentage points in each direction. We performed these tests to get an indication of how different levels of Ref-PET target might impact industry cost. Our sensitivity tests were defined as:

- **Lower: 10% market penetration target (halving market share compared to the central scenario):** EU27 Ref-PET market penetration reaches 10% by 2030 (straight line growth between 4% and 10% from 2023 to 2030) and stays constant until 2040

- **Higher: 30% market penetration target (a 50% increase in market share compared to the central scenario):** EU27 Ref-PET market penetration reaches 30% by 2030 (straight line growth between 4% and 30% from 2023 to 2030) and stays constant until 2040.

As market penetration of Ref-PET rises, we would expect bottlers to be able to ‘sweat’ their investment in new Ref-PET bottling lines more (i.e. increase efficiency by producing a higher output from the same number of assets). This is because in our cost model we do not account for any change in the geographical distribution of Ref-PET lines as market penetration increases (a simplifying assumption that has the likely impact of underestimating overall costs, as in reality a more decentralised model of production will be required).

The results of our higher and lower market penetration sensitivity tests on our estimates of total additional annual capex and opex are shown in Figure 9. The results show that the change in cost in each case is lower in magnitude than the percentage change in market share from the central scenario.

For the lower scenario (10% market share), we see a 12.5% decrease in total cost involving:

- Total capex decrease by 6.7% 

\textsuperscript{49} A bottle ‘float’ is the number of bottles needed at any one time across the whole supply chain to support a single bottle sold by a retailer/wholesaler. Given the timeframe needed to return, wash, and refill a bottle, more bottles are needed to flow through the system than just the number of bottles sold at any one time.
Total opex decrease by 24.2%

For the higher scenario (30% market share), we see a 13.7% increase in total cost involving:

- Total capex increase by 8.4%.
- Total opex increase by 24.2%.

Figure 9: Annual net capex estimates; including sensitivity test results (2021 constant prices)

![Capex Graph]

Figure 10: Annual net opex estimates; including sensitivity test results (2021 constant prices)

![Opex Graph]
3.4 Costs unable to be estimated in total cost estimate

There are certain costs that exist in the supply chain that we were unable to estimate due to data not available. Some of these will be significant, and should be considered in the case of more detailed policy development. The main costs we could not calculate total estimates for were:

- **Total costs (capex and opex) for retailers:** Due to data limitations, we were unable to estimate the number of bottle collection points that would likely be needed / set up over our appraisal period in the EU27, to meet the target market penetration defined. This is a key volume driver needed to estimate total costs to retailers. For our total retail cost calculations. From our consultations with industry, we established that the cost of purchasing one Reverse Vending Machine (RVM) for Ref-PET would be ~€25,000 per machine. Data received from industry participants showed that current levels of RVM penetration for glass, metal and PET containers is around 2000 RVMs per inhabitant across a subset of EU countries in which DRS operates for recycling. To reach a similar level of penetration for Ref-PET would require around 220,000 RVMs across the EU27. Based on a simple calculation, this could add up to about €5.5bn of additional upfront cost at the retail stage of the supply chain simply to purchase these machines, which is almost 30% of the total NPV €18.7bn cost estimated in this study across the rest of the supply chain. We have not estimated the total number of RVMs that would be required for the scenario specified in our cost model, due to limited data and assumptions available, but this simple calculation provides an idea of the potential order of magnitude of this cost.

- **Gross costs for one-way and Ref-Pet:** Due to data limitations, we were unable to estimate total costs at a gross level for one-way PET at every stage of the supply chain. Therefore, our estimate of additional Ref-PET costs is at times based on only a consideration of incremental changes to activities at each stage of the supply chain. For example, wholesaler operational cost estimate is based only on considering additional costs incurred by a Ref-PET system on top of a one-way system. Ideally, we would have a gross estimate of costs for both our counterfactual and selected scenario for analysis of business model change.

3.5 Limitations to the model

When performing our study, we designed our model in consultation with UNESDA and its members to best capture the cost impacts to industry of a move from one-way PET to Ref-PET, such that the model would accurately represent the level of change and level and types of cost involved in the case the industry was required to try and meet a 20% target for Ref-PET by 2030. We built our cost model based on bottom up analysis of how the industry told us they would be affected and be most likely to respond and adapt in such a situation. However, as in every modelling exercise, there were some really important real-world complexities that we were not able to fully account for, and are therefore either not captured, or are represented through simplified assumptions in our model. The main limitations of our analysis are listed below:

- **The model is not dynamic and captures supply side cost analysis only, from the point of view of the soft drinks industry:** No assessment of changes in price or consumer demand has been undertaken in our analysis. Our model represents an assessment of the cost to industry only on the supply side of the equation. In order to understand more fully the effects of any policy proposal around targets for Ref-PET carbonated soft drinks, a more in depth and dynamic assessment of the market on both sides should be considered, including how consumer demand would respond to different prices. Both economic benefits and economic costs should be considered from the point of view of society – including environmental assessment.

- **The model represents one simplified version of industry investment and operational change:** From our consultations, it was evident that the industry response required to meet any target for increase in Ref-PET market penetration is extremely complex. As a change like this has never been undertaken at this scale, across the board there were a range of responses at varying levels of detail that we received from industry participants in terms of the estimated impact such a change may have on their business activities and associated costs. For some participants, no prior cost analysis had been undertaken. Others provided calculations based on a range of different scenario parameters and benchmarking information from various geographies. We have pieced all of the information collected together, and added information from our own research to form the assumptions that are the basis of our cost model and our total cost estimates. We believe our total estimates are conservative based on the information we analysed, as described throughout this report. We were not able to capture all of the complexities of business model change in our cost model – particularly all of those relating to specific geographies or markets, and all of the costs that could be incurred if the current bottling process needed to shift to a more decentralised model. As an example, this could additional costs to account for new greenfield development required. This was beyond the scope of our analysis and as such the results of this study must be interpreted with these limitations.
front of mind. Further detailed work on operational modelling (both demand and supply side) should be undertaken of any proposed policy options for Ref-PET targets/quotas going forward.

Additionally, as described elsewhere in this report there are other possible ways to meet any refill PET target for carbonated soft drinks. For example, ‘Home refill’, i.e. having a machine that fills your bottle at home such as SodaStream, is a growing market. This is however, a fundamentally different market and business model change from the returnable refillable and DRS approach we have considered in this study. We have agreed that home refill is not in scope for cost modelling under this study. See Section 4.3 for our discussion on alternative refill methods.

- **Country specific differences were not able to be incorporated**: Our modelling is based on the assumption that all EU27 countries are the same in terms of geography, and level of maturity in terms of their DRS and ability to adapt their supply chains to new ways of operation for scaled up supply of Ref-PET. We have estimated cost results at the EU27 level and we have not accounted for country specific differences. We have not analysed for example, the different distribution requirements and associated costs for Ref-PET in countries based on where their bottling facilities are located in relation to retail outlets, average distances needed for transport, breakdown of the carbonated soft drink market in terms of market share for large companies versus SMEs, or the type and complexity of different retail markets. All of these things will have an impact on the specific costs incurred on a country by country basis if a ‘one-size-fits-all’ target for Ref-PET was to be introduced. These issues should be considered in more detail before the introduction of any new policy.

- **Market penetration target assumptions are rigid across geographies**: We are not able to vary market penetration target by country in our model. We assume the target is EU27 wide, and because we assume no cross-border trade, the costs assessed represent our estimate of what they would be if every country complied with this same target. However, this doesn’t take account of the fact that each country comes from a different starting point in terms of maturity of supply chain operations, so the cost results represent an average across the EU27 and do not account for country specific differences related to current market penetration, and what it would take to reach 20%.

- **Seasonality**: Demand for soft drinks is seasonal, with higher demand and higher sales in summer. This means that storage requirements for bottles are much higher in the winter (due to lower demand) and there is also greater risk of damage to bottles from being stored for long periods of time. Our modelling assumes an annual average cost of storage and so does not account for seasonality, making it a conservative estimate of costs. We could have instead assessed costs using the storage assumptions for winter months – so as not to underestimate industry impact. This may or may not be a binding constraint operationally depending on how business models adapt (further analysis would be needed in development of any future policy detail).

- **Standardisation**: Our analysis assumes that each soft drink brand is able to produce their own type of bottles under the returnable refillable scenarios, thus the model excludes standardisation of bottles. This was agreed with UNESDA and its members upfront, due to concerns that standardisation could have an effect on brand differentiation and therefore competition in the market. We have therefore not analysed whether there could be cost savings or economies of scale if bottling/reverse logistics or other supply chain activities could be combined. Costs not estimated.
4. Broader considerations

This chapter outlines other factors outside of our modelling that will impact the transition to Ref-PET for the soft drinks industry that should be considered from a policy perspective.

4.1. Trade-off between refill and recyclable PET

Full circularity for PET soft drink containers can be achieved through both: (1) increasing the use of Ref-PET; and (2) investing in improvements in recycled PET. While policy in certain countries is more recently moving towards returnable refillable PET, much of the industry has invested in ‘closing the loop’ through recycled PET as a way to improve environmental outcomes instead.

Our understanding through research and consultation undertaken for this study, is that significant environmental gains can be made in the one-way PET supply chain e.g. light weighting plastic bottle designs and optimising processes to recycle a higher proportion of plastic and reduce wastage. There are even cases (such as in Norway) where countries have switched ‘back’ – i.e. away from refillables back to single use systems, in order to invest in optimising recycling processes. Some consultees stated that their own analysis showed that much of the environmental gap between recycled PET and Ref-PET can be closed through investments in the one-way system.

Investigation and comparison of environmental benefits between one-way PET and Ref-PET systems is outside of the scope of this study. We did speak to some consultees who raised the concern that a switch towards investing heavily in Ref-PET may come at the expense of further investment in recyclable PET, and therefore the potential environmental benefits of optimising recycling may be lost. Policymakers should fully investigate this trade-off, both environmental and economic, and from an overall cost/benefit perspective to inform future policy development.

4.2. Consumer preferences and pricing

Our modelling assumes that there is already a DRS in place for PET bottles (whether recyclable or refillable) in each of the EU27 countries, in order to exclude the costs of setting up a DRS from the costs we have assessed of bringing in and operating a Ref-PET system. It also assumes a 95% bottle return rate for consumers (based on that achieved in Germany). Essentially, this means that our modelling excludes / does not account for the impact of consumer preferences and uptake rates on overall industry costs, and does not assess any demand or pricing impacts that could affect cost or benefit outcomes in a market equilibrium situation. In practice, high consumer uptake is needed for a DRS to function well, both in incentivising purchase of bottles and return. This is essential for both one-way PET (in terms of recycling outcomes) and Ref-PET bottles. However, achieving high consumer uptake may require significant behaviour change in some markets, and strong general buy-in from consumers in all markets. Otherwise, consumers might prefer to buy soft drinks in one-way PET bottles (or other non-refillable packaging like cans). They will choose this instead of returning bottles for refill. This is a very real issue that needs to be considered in any further policy development on reusable packaging.

There are several key factors that will influence uptake – based on consumer preferences and pricing, that all add up to determine an individual’s relative willingness to pay (WTP) for soft drinks in Ref-PET versus one-way PET. Consumer preferences are influenced by wider industry context and set up, in particular whether there is an existing DRS system in place. The level of consumer uptake for will also likely vary considerably by market and country – based on historical and sociological / socioeconomic factors. While this detail is excluded from our modelling in this study, it will be an important factor in how the soft drink industry chooses to change systems and processes to meet any refillable targets (e.g. in terms of pricing, marketing, and understanding of consumer preferences across different markets)/

In order to maximise consumer uptake (assuming a DRS is in place), the soft drinks industry should focus on these areas, each of which consumers will consider in their purchasing decisions and weigh up in total to determine which product they prefer:

- **Convenience** – to increase consumer uptake, DRS must be as convenient for the consumer as possible. To maximise convenience, return points must be accessible (e.g. in large supermarkets and quick/easy to use). Consumers who live in a rural area or don’t have access to a car are much less likely to use DRS as they have concerns about the difficulties of transporting many bottles from their home to a return point. Research in some markets, for example, shows that consumers with a lower socioeconomic status are likely to have a lower uptake than those with a higher socioeconomic status as they may face additional challenges storing their empty
companies have already invested bottles returned to bottlers. Our modelling has focussed on increasing the use of refill through refillable DRS scheme.

4.3. Alternate business models for refill

Our modelling has focussed on increasing the use of refill through refillable DRS schemes, in particular using Ref-PET bottles returned to bottlers – the specifics of which we describe throughout this report. However, there exist alternate business models for bottle refill that could be used to reach target market penetration. For example, several drinks companies have already invested in product that allows consumers to directly refill reusable drink containers using
machines that can provide water, flavours and/or carbonation as desired. These machines can be purchased by consumers for use in the home (e.g., SodaStream, owned by PepsiCo) or used in schools, universities, and offices (e.g., PepsiCo’s SodaStream professional; or Dasani PureFill owned by Coca-Cola). Both types of machine can reduce PET plastic usage and reduce the need for complex return logistics to return bottles back to bottlers. Cost analysis related to this type of business model is outside the scope of this study.
Appendix: Supporting Assumptions
### A.1 Volume inputs

<table>
<thead>
<tr>
<th>Assumption</th>
<th>Small bottles</th>
<th>Large bottles</th>
<th>Source</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proportion of market that is ‘Off-trade’</td>
<td>One way: 85%</td>
<td>One way: 85%</td>
<td>PwC expert input</td>
<td>Stakeholder information suggests that the level of the market that is off-trade varies across the EU. We assume that the EU27 average is 85%</td>
</tr>
<tr>
<td>Lifetime bottle turns&lt;sup&gt;50&lt;/sup&gt;</td>
<td>NA: 16</td>
<td>NA: 16</td>
<td>Discussion with industry experts</td>
<td>Stakeholder information suggests bottles can go through the refillable system between 9 and 25 times on average before they must be replaced. We used a weighted average of these responses for our assumption.</td>
</tr>
<tr>
<td>Length of turn bottles (years)</td>
<td>NA: 0.33</td>
<td>NA: 0.33</td>
<td>Discussion with industry experts</td>
<td>Stakeholder information suggests it takes a bottle 4 months to go through the refillable system once, i.e. 3 turns per year</td>
</tr>
<tr>
<td>Static bottle float requirement</td>
<td>NA: 400%</td>
<td>NA: 400%</td>
<td>Discussion with industry experts</td>
<td>Stakeholder information suggests that a float of 4x the bottles sold by retailers is required in a refillable system (i.e. 3 additional bottles in the system to support each bottle on the shelf).</td>
</tr>
<tr>
<td>Bottles per crate</td>
<td>NA: 12</td>
<td>NA: 8</td>
<td>Discussion with industry experts</td>
<td>As per the German refillable market, we assume 12 bottles per crate for 0.5L and 0.75L bottles and 8 bottles per crate for 1L and 1.5L bottles</td>
</tr>
<tr>
<td>Spare crate requirement</td>
<td>NA: 10%</td>
<td>NA: 10%</td>
<td>Discussion with industry experts</td>
<td>Stakeholder information provided indicates that the system requires an extra 10% of crates additional to the minimum required transport the bottles going through the system, in order to move around any leftover bottles.</td>
</tr>
<tr>
<td>Annual crate replacement rate</td>
<td>NA: 10%</td>
<td>NA: 10%</td>
<td>Discussion with industry experts</td>
<td>Stakeholder information provided indicates that crates for Ref-PET are replaced every 10 years. We have therefore calculated that the total capex of replacing a crate is evenly spread over 10 years, suggesting a 10% replacement rate every year.</td>
</tr>
<tr>
<td>Bottling line hourly line speed</td>
<td>60,000</td>
<td>40,000</td>
<td>Discussion with industry experts</td>
<td>Stakeholder information provided indicates that 1W bottling lines for 0.5L-0.75L have a line speed of 60,000 bottles per hour, and 40,000 for 1L-1.5L. For Ref-PET, bottling lines</td>
</tr>
</tbody>
</table>

<sup>50</sup> A bottle ‘turn’ refers to a single loop around the refillable bottle system, from being filled by the bottler to being distributed and sold by wholesalers or retailers and then returned back to the bottler.
### Economic Study of Returnable Refillable PET in the EU Soft Drinks Industry

<table>
<thead>
<tr>
<th>Assumption</th>
<th>Small bottles</th>
<th>Large bottles</th>
<th>Source</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bottling line productivity</td>
<td>100% 80%</td>
<td>100% 80%</td>
<td></td>
<td>Discussion with industry experts</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Stakeholder information suggests that Ref-PET bottling lines are run less efficiently than 1W lines. Some respondents suggested efficiency could be as low as 50% in some cases and so this estimate could be somewhat conservative.</td>
</tr>
<tr>
<td>Production line working hours per week</td>
<td>72</td>
<td></td>
<td></td>
<td>Discussion with industry experts</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Stakeholder information suggests that bottling lines run for an average of 72 hours per week.</td>
</tr>
<tr>
<td>Annual bottling line replacement rate</td>
<td>6%</td>
<td></td>
<td></td>
<td>Discussion with industry experts</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Stakeholder information provided indicates that bottling lines are replaced every 17.5 years. We have assumed annual 1W bottling line replacement capex of 1/17.5 per year x 1W investment.</td>
</tr>
<tr>
<td>Annual bottles processed per RVM</td>
<td>400,000</td>
<td></td>
<td></td>
<td>Discussion with industry experts</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Stakeholder information provided suggests that RVMs process 400,000 bottles on average every year. However, this information is not applied in the model as we have not been able to calculate a reliable estimate of the number of new RVMs that will be needed across the appraisal period for the EU27.</td>
</tr>
<tr>
<td>RVM coverage target (inhabitants/RVM)</td>
<td>2,000</td>
<td></td>
<td></td>
<td>Discussion with industry experts</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Stakeholder information provided suggests that approximately 1 RVM is required per 2,000 people. However, this information is not applied in the model as we have not been able to calculate a reliable estimate of the number of new RVMs that will be needed across the appraisal period for the EU27. This is due to country specific geographical and market differences.</td>
</tr>
<tr>
<td>Existing Ref-PET lines in EU27</td>
<td>28</td>
<td>PwC estimate</td>
<td></td>
<td>Calculated using the number of Ref-PET carbonates units sold in Germany divided by number of bottling lines in Germany and then scaled to each country using the number of units of</td>
</tr>
<tr>
<td>Assumption</td>
<td>Small bottles</td>
<td>Large bottles</td>
<td>Source</td>
<td>Notes</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>---------------</td>
<td>---------------</td>
<td>-------------------------</td>
<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td>One way</td>
<td>Ref-PET</td>
<td>One way</td>
<td>Ref-PET</td>
</tr>
<tr>
<td>Consumer bottle return rate</td>
<td>95%</td>
<td>Discussion</td>
<td>Consumer bottle return  rate</td>
<td>Ref-PET carbonates sold in each country.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>with industry experts</td>
<td>rate</td>
<td>We assume that the EU27 will reach the same consumer bottle return rate as Germany, which is 95%. For simplicity, we assume this happens as Ref-PET sales increase, as our modelling is not designed to examine the effects of consumer behavioural change.</td>
</tr>
<tr>
<td>Market penetration</td>
<td>4% 20%</td>
<td>4% 20%</td>
<td>Discussion</td>
<td>Market penetration in retail carbonated soft drinks markets reaches 20% by 2030 in our main scenario. This is based on the assumption that the EC will bring in a 20% Ref PET target by 2030. Based on stakeholder information and PwC calculations, we assume that the 2021-2023 level of refillable market penetration is 4%. We assume linear growth from 2023 to 2030 to reach the 20% target. In the counterfactual scenario, there is no growth in Ref-PET market penetration.</td>
</tr>
<tr>
<td>Ref-PET target</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proportion of market that is small bottles</td>
<td>53% 59%</td>
<td>53% 59%</td>
<td>GlobalData, PwC estimate</td>
<td>Estimated using GlobalData relative size of small bottles (50cl &amp; 75cl) vs large bottles (1L &amp; 1.5L) volume units.</td>
</tr>
<tr>
<td>Proportion of market that is large bottles</td>
<td>47% 41%</td>
<td></td>
<td>GlobalData, PwC estimate</td>
<td></td>
</tr>
</tbody>
</table>
## A.2 Cost inputs

<table>
<thead>
<tr>
<th>Cost Item</th>
<th>Measurement Parameter</th>
<th>Small Bottles</th>
<th>Large Bottles</th>
<th>Small Bottles</th>
<th>Large Bottles</th>
<th>Source</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Capex Assumptions</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>New machinery for bottling line</td>
<td>Cost (Euro) per bottling line</td>
<td>8,500,000</td>
<td>8,500,000</td>
<td>19,250,000</td>
<td>19,250,000</td>
<td>PwC estimate based on discussion with industry experts</td>
<td>Assumes asset life of 17.5 years.</td>
</tr>
<tr>
<td>Line installation costs</td>
<td>Cost (Euro) per bottling line</td>
<td>4,300,000</td>
<td>4,300,000</td>
<td>4,500,000</td>
<td>4,500,000</td>
<td>PwC estimate based on discussion with industry experts</td>
<td>Includes infrastructure fit out (€4m) and floor preparation costs (200 EUR/m²)</td>
</tr>
<tr>
<td>Retail investment</td>
<td>Cost (Euro) per RVM</td>
<td>28,000</td>
<td>28,000</td>
<td>28,000</td>
<td>28,000</td>
<td>Discussion with industry experts</td>
<td>Not directly included in our model as we are missing data to estimate accurately number of RVMs required across EU27.</td>
</tr>
<tr>
<td><strong>Opex Assumptions</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bottle - Cost of Goods Sold (COGS)</td>
<td>Cost (Euro) per bottle</td>
<td>0.04</td>
<td>0.06</td>
<td>0.14</td>
<td>0.18</td>
<td>PwC estimate based on discussion with industry experts</td>
<td>Assumes a manufacturers’ margin is subtracted from the bottle sale price.</td>
</tr>
<tr>
<td>Crate - COGS</td>
<td>Cost (Euro) per crate</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>4.40</td>
<td>4.40</td>
<td>PwC estimate based on discussion with industry experts</td>
<td>Assumes a manufacturers’ margin is subtracted from the crate sale price.</td>
</tr>
<tr>
<td>Additional warehouse space costs</td>
<td>Cost (Euro) per bottling line</td>
<td>465,600</td>
<td>465,600</td>
<td>832,500</td>
<td>832,500</td>
<td>PwC estimate based on discussion with industry experts</td>
<td>This is based on an assumption taken from internal PwC experts’ estimate of an average warehouse size of 50,000m².</td>
</tr>
<tr>
<td>Bottle filling cost</td>
<td>Cost (Euro) per bottle</td>
<td>0.07</td>
<td>0.10</td>
<td>0.06</td>
<td>0.11</td>
<td>PwC estimate based on discussion with industry experts</td>
<td>Includes secondary materials (cap and shrink wrap), secondary packaging (labelling) and maintenance, labour and utilities. Excludes ingredient cost. Ref-</td>
</tr>
<tr>
<td>Cost item</td>
<td>Measurement parameter</td>
<td>One Way</td>
<td>Ref-PET</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------------------------</td>
<td>------------------------</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Small</td>
<td>Large</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Small bottles</strong></td>
<td><strong>Large bottles</strong></td>
<td><strong>Small bottles</strong></td>
<td><strong>Large bottles</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Source</td>
<td>Notes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PET bottles do not use shrink wrap. As the price of large bottles has a smaller proportion of packaging costs, Ref-PET small bottles have a lower filling cost than 1W.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<p>| Transport costs (manufacturer to bottler) | Cost (Euro) per bottle sold | 0.003 | 0.005 | 0.03 | 0.06 | See next table for methodology |
| Transport costs (bottler to retailer)   | Cost (Euro) per bottle sold | 0.07  | 0.11  | 0.07 | 0.11 | See next table for methodology |
| Wholesaler costs                      | Cost (Euro) per bottle sold | Not applicable | Not applicable | 0.01 | 0.02 | PwC estimate based on discussion with industry experts and third party research | Assume no Wholesaler in 1W |
| Retail costs                         | Cost (Euro) per RVM      | 45,000 | 45,000 | 125,000 | 125,000 | PwC estimate based on discussion with industry experts | Not directly included in our model as we are missing data to estimate accurately number of RVMs required across EU27. |
| Reverse logistics costs              | Cost (Euro) per bottle sold | Not applicable | Not applicable | 0.06 | 0.11 | PwC estimate based on discussion with industry experts | Assumes that reverse logistics is 80% of distribution transport cost. Note that 1W is excluded, as we do not consider the cost of 1W bottles after they have been used by the customer. |
| Transport costs                      | Cost per truck per mile  | 1.9    |         | PwC industry expertise | 32 tonne tractor + tandem axle trailer |</p>
<table>
<thead>
<tr>
<th>Cost item</th>
<th>Measurement parameter</th>
<th>One Way</th>
<th>Ref-PET</th>
<th>Source</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>(manufacturer to bottler)</td>
<td></td>
<td></td>
<td></td>
<td>PwC industry expertise and stakeholder information</td>
<td>Based on 720 small bottles per pallet and 432 large bottles per pallet for 1W (~36% for Ref-PET) and 28 pallets per truck. Preform bottles for 1W are assumed to take up 10% of the space of a fully blown Ref-PET bottle.</td>
</tr>
<tr>
<td>Bottles per truck</td>
<td></td>
<td>202,000</td>
<td>121,000</td>
<td>20,000 12,000</td>
<td>PwC industry expertise and stakeholder information</td>
</tr>
<tr>
<td>Average miles travelled per bottle</td>
<td></td>
<td>126</td>
<td>126</td>
<td>126 126</td>
<td>PwC industry expertise and stakeholder information</td>
</tr>
<tr>
<td>Transport costs (bottler to retailer)</td>
<td>Cost per truck per mile</td>
<td>1.8</td>
<td></td>
<td>PwC industry expertise</td>
<td>26-tonne GVW 6x2 Charge per mile (Euros)</td>
</tr>
<tr>
<td>Bottles per truck</td>
<td></td>
<td>12,000</td>
<td>7,000</td>
<td>12,000 7,000</td>
<td>PwC industry expertise and stakeholder information</td>
</tr>
<tr>
<td>Average miles travelled per bottle</td>
<td></td>
<td>440</td>
<td>440</td>
<td>440 440</td>
<td>PwC industry expertise</td>
</tr>
</tbody>
</table>
A.3: Calculation of volume estimates

To forecast how sales in the PET carbonated soft drink market will change over the 2021 to 2040 appraisal period, we have estimated the market growth based on some assumptions. We have collected information on the number of PET carbonated soft drink bottles were sold in 2019 across the EU27 using GlobalData. To normalise the effect of the COVID-19 pandemic on bottle demand, we assume that the market grows annually at the average 2015-2019 compound annual growth rate (CAGR) from 2019 onwards. We found that between 2015 and 2019, demand for smaller PET carbonated soft drink bottle sizes was growing, and demand for larger bottle sizes was falling. To address the differences in demand across bottle sizes, we make a simplifying assumption for market growth and applied it as follows:

Small bottles (<1L): 2% growth in sales per annum
Large bottles (≥1L): -1% growth in sales per annum

Figure 11 shows our estimates for one-way and Ref-PET bottles sold from 2021 to 2040 in our 20% market penetration (main) scenario and counterfactual scenario. Overall, the total number of PET bottles are the same in each scenario, but the split between One-way PET and Ref-PET varies across each scenario.

In the main scenario, we estimate that the number of one-way bottles fall from 16.3 billion (in 2021) to 14.4 billion (in 2040). The fall in sales for one-way PET bottles is a result of the (assumed) rising demand for Ref-PET (based on our assumption of 20% Ref-PET market penetration). This corresponds to the number of Ref-PET bottles sold in the main scenario rising from 0.7 billion in 2021 to 3.6 billion in 2040. In the counterfactual scenario, we estimate that one-way PET bottles sold in the EU27 will increase from 16.3 billion in 2021 to 17.3 billion by 2040, with no growth in Ref-PET.

As the number of Ref-PET bottles sold increases over the period 2023 to 2040, so do the number of bottling lines. To estimate the increase in the number of bottling lines across the EU27, we made the following assumptions:

- Each major soft drink company in Germany has about 10 refillable PET carbonate bottling lines for sizes 50cl, 75cl, 100cl and 150cl (our in-scope pack sizes). We use Germany as a comparator country, as this is where the refillable system is most advanced across the EU27.
- Using this information, we calculated the number of bottling sites that would be needed across the EU27 for an equivalent scale of production, by scaling Germany’s number to each country’s demand for Ref-PET. Each number

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51 PwC analysis based on GlobalData Data Set (2021) Retrieved from: https://www.globaldata.com/
was then rounded up to a minimum of one bottling site per country, to incorporate the assumption that cross-border trade does not take place (because of complexities in the reverse logistics process this would entail).

- Given that each major soft drink company will need its own bottling line (as we assume that standardisation of bottles across brands is not a part of the industry business model), we have scaled this figure by a factor of 4, representing a 25% market share of the largest soft drink companies.

Employing these assumptions in our main scenario, the number of Ref-PET bottling lines in the EU27 increases from 28 in 2021 to 608 in 2030 to meet our 20% market share assumption, and then stays constant to 2040. It is worth noting that our model assumes no trade in Ref-PET bottles between countries in the EU27, and no standardisation of bottles across brands, so all countries and brands require bottling lines to meet demand for their products in each country (see Appendix A1.4 for our geographical assumptions). This large increase in bottling lines allows the model to implicitly account for some of the additional costs that will be incurred from set up of new bottling lines (and likely new bottling plants) that will be needed to run effectively a more decentralised model of production and distribution for Ref-PET.

The number of one-way bottling lines in our main scenario falls from 112 in 2021 to 92 in 2030, before rising slightly to 94 in 2040.

For the counterfactual scenario, the number of bottling lines overall stays consistent in the period of 2021 to 2040: 28 in Ref-PET and 112 in one-way. The one-way bottling line figures were derived from market demand and, whilst there is some market growth predicted, the model finds that this additional demand can be supported by the existing number of bottling lines.

Figure 12: Number of bottling lines in use EU27 2021 – 2040

A.4: Geographical considerations

As outlined in our modelling limitations (see Section 4.1), the costs presented in this report are all presented for the EU27. The value of our cost estimates are based on consultations with several industry experts across the EU, some of which are specific to a certain country (in particular Germany, as this is where the refillable system is most mature). In these cases, country specific numbers are aggregated up to EU27 level, and price adjusted to an EU27 average price in Euros using a PPP conversion.

Due to the country-by-country approach for some cost estimates, there are several geographical considerations to consider when interpreting our results:
• **Pricing:** our analysis does not consider that product and input prices vary by countries across the EU27. In practice, countries will set specific prices for deposits and Ref-PET bottles which will impact the demand. Our model focuses on supply side costs only, and does not take pricing or demand considerations into account.

• **Country specific factors:** our analysis does not consider that consumer uptake and return rates will vary by country. We assume that the EU27 bottle return rate will be the same as in Germany (see Appendix A1.1 for our assumptions). This is a simplistic assumption as no analysis has been undertaken on the demand side of the market.

• **Trade:** our analysis assumes that there is no inter-country trade of soft drinks in Ref-PET bottles, and local markets are served by bottling lines in each country. It is possible that EU27 counties will meet their refillable targets through trade, however this is excluded from our model due to operational challenges of implementing reverse logistics and DRS, which would need to be considered in any implementation planning.

**A.5: Assumptions related to DRS**

As outlined in our model limitations (see Section 3.5), our analysis assumes that all EU27 countries have an existing DRS in the counterfactual and main scenario. This is a simplified assumption to isolate the cost effects of moving from one-way PET to a business model with a scaled up proportion of Ref-PET. We chose this specifically so as to not overestimate the costs that could be attributed to implementing a Ref-PET system itself. As a result, our cost estimates do not include the set up and maintenance of introducing a DRS. For EU27 countries that do not currently have DRS in place, DRS costs will be in addition to our cost estimates. From our industry consultations, we heard that having a well-functioning DRS in place was a perquisite for any successful refillable system to be implemented – in order to incentivise consumers to return bottles. Without a high return rate, there will be little benefit of a returnable refillable system as described and analysed in this report.

**A.6: Digital DRS**

Through our consultations with industry experts, it was suggested that countries within the EU27 may consider introducing a digital DRS. Digital DRS is a technological advancement on a traditional DRS that does not require the use of RVMs. Instead, consumers can return used bottles at several locations, including at home, on-the-go, in ‘smart bins’ or at an RVM. The technology scans the barcode of the bottle and uses an app to provide deposits. Whilst we recognise the potential benefits of a digital DRS, it is still in early stages of adoption across the EU27. We have considered it out of scope for our analysis.

**A.7: Payment systems and processes**

Underpinning any Ref-PET supply chain are payment systems and processes, which incorporates transfer of any bottle deposit along the supply chain, to the segment of the supply chain that incurs the costs of dealing with refill logistics. This is the same strategy as in a one-way DRS system which accounts for recycling costs. We have not analysed any differences in payment systems and processes that would be required in scaling up Ref-PET, so costs for this have not been included in our modelling. Within existing DRSs, retailers and wholesalers are reimbursed for the additional cost of handling the goods (the space, cleaning and handling and RVM costs). These costs are expected to be higher for retailers in the case of Ref-PET than they are for one-way PET, therefore it is possible that these reimbursement costs will be higher in a Ref-PET system. Our modelling does not examine this potential financial transfer that would occur between different stages of the supply chain in a scaled up Ref-PET model. This would need to be examined closely in moving towards implementation of any scaled up Ref-PET business model and processes.

**A.8: Economic versus financial costs**

Our analysis assesses the economic costs of transitioning to Ref-PET. Economic costs are the opportunity costs of resources used for the industry to transition, compared to financial costs which are the price paid for a good. By focusing on the resources used, an economic assessment excludes transfers between actors within the value chain. Therefore our assessment has removed the estimated margin from any price inputs received to calculate the resource cost input and excluded any tax payments, e.g. environmental taxes.

**A.9: Inflation assumptions**

Our modelling is based on 2021 real prices, with no inflation adjustment added to future costs. We have discounted future values using a real discount rate of 5%.