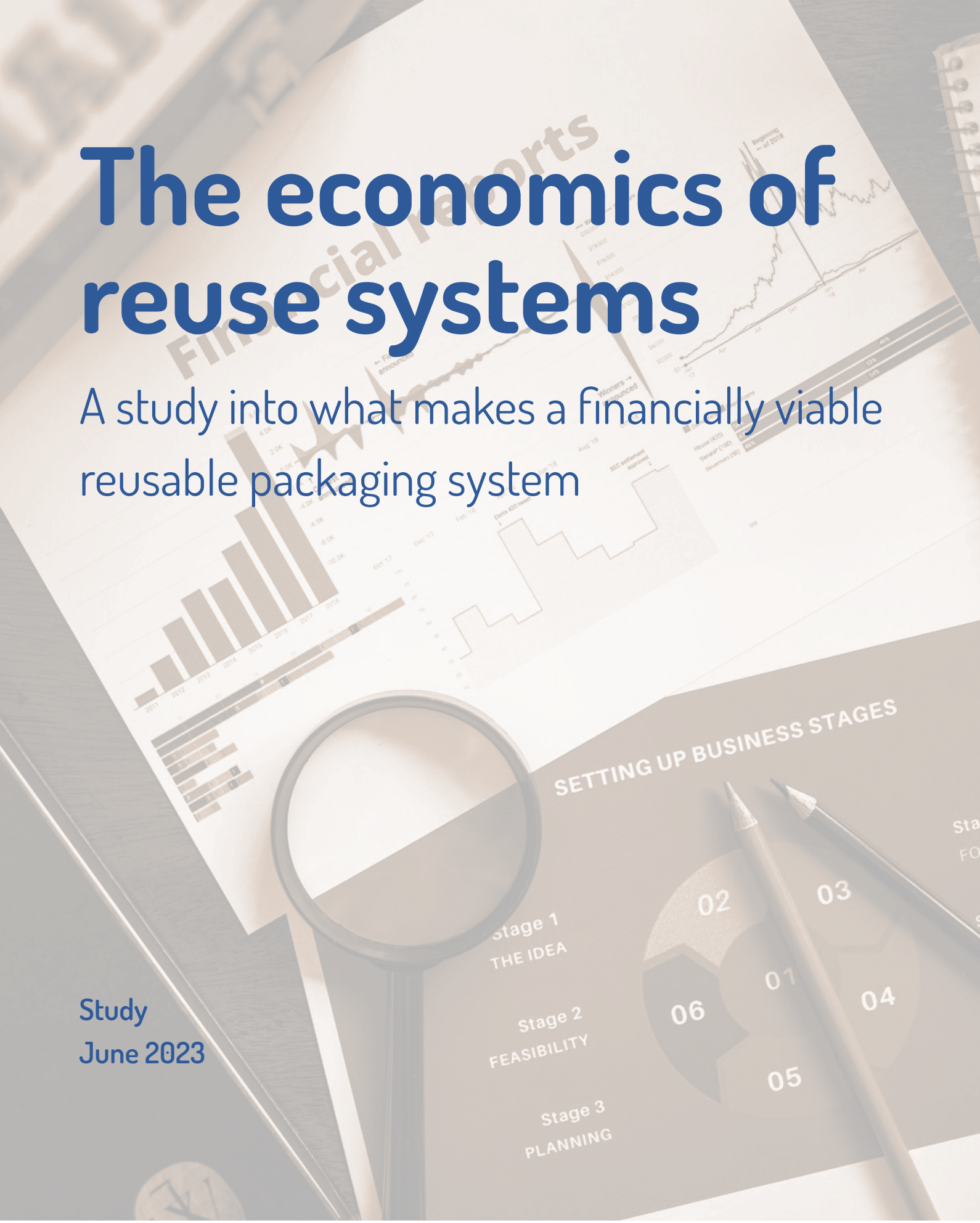
The economics of reuse systems

A study into what makes a financially viable reusable packaging system



Study
June 2023

Serious Business

#GetBack

RSVP
ReuSe Vanguard Project

Zero Waste Europe

Contents

Acknowledgements

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For the execution of this report, we have worked on providing a high-quality and independent outcome. We welcome constructive dialogue on our results, new insights or other relevant data.

Abbreviations

B2B	Business-to-Business
B2C	Business-to-Consumer
CAPEX	Capital Expenditures
CBA	Cost Benefit Analysis
EOL	End of Life
EPR	Extended Producer Responsibility
GDB	Genossenschaft Deutscher Brunnen (Association of German Wells)
IEO	Informal Eating Out
LCA	Life Cycle Assessment
OPEX	Operating Expenses
PET	Polyethylene terephthalate
PP	Polypropylene
PPWR	Packaging and Packaging Waste Regulation
ROI	Return on Investment
SME	Small and Medium-sized Enterprise

Examples of potential reusable packaging sectors

- Bottled beverages
- Hot beverage cups
- Events
- Informal eating out (fast food outlets)
- Take away (delivery or pick-up)
- On the go (snacks/confectionary)
- Restaurants
- Supermarkets
- Homecare (cleaning products)
- Personal care
- Transport packaging
- E-commerce

Executive Summary

The urgency to act on plastic pollution is now widely understood, as is the fact that we cannot continue along the linear path of resource exploitation.

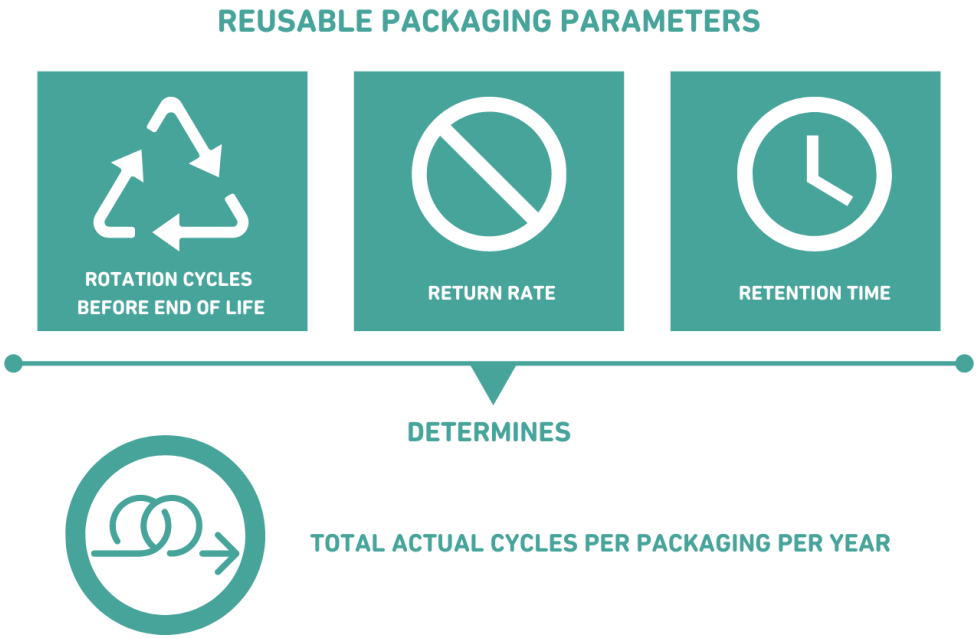
Adopting circular economy principles could not only benefit Europe environmentally and socially but could also generate a net economic benefit of €1.8 trillion by 2030.[1] Recycling alone will never be able to mitigate uncurbed plastic production, which is on track to triple by 2050. Solutions must be focused upstream to the source of the problem, production.

After elimination, the widespread uptake of reusable packaging has the highest potential to reduce plastic production. **This view is sustained by a recent shift in legislative focus in the European Union's Packaging and Packaging Waste Regulation (PPWR) and the United Nation's Global Plastic Treaty to end plastic pollution**. The popularity of reusable packaging is also growing within businesses under pressure both from upcoming regulations and a customer base increasingly concerned with the over-use of plastic.

However, several brands and industry associations have been hesitant to wholeheartedly embrace reusable packaging, citing doubts over environmental credibility, customer acceptance, needed behavioural change, and the fear of heavy investments and operational costs. While several independent LCAs prove the environmental benefits of multi-use over single-use plastic packaging, and as many surveys indicate customer readiness, there is a gap in analysing the costs vs benefits of a scaled and optimised reuse system.

[1] Source: www.mckinsey.com/~/media/McKinsey/Business%20Functions/Sustainability/Our%20Insights/Europes%20circular%20economy%20opportunity/Europes%20circulareconomy%20opportunity.ashx

This study identifies the following parameters to decide on the performance of a financially healthy reuse system:



Considering the relative infancy of reusable packaging, it would be hard to compare it with a fully optimised single-use system. For this reason, the profitability of a 100% reuse system has been compared against a 100% single-use system and determines what thresholds would need to be met to ensure the profitability for all stakeholders.

The study examines 3 packaging categories in an open loop system (so not within one location), in Spain as an archetype country: 1) food containers for takeaway food, 2) secondary transport packaging and 3) beverage bottles. The economic viability has been analysed based on return on investment for a reuse systems provider and the accumulated costs of single-use plastic packaging vs reusable plastic packaging for the system user.

1. For the first packaging category, takeaway food containers, the study finds that reusable containers are more profitable for users, and return on investment can be reached by system providers between years 3 and 4.

2. In secondary transport packaging, the study compares reusable and single-use plastic big bags. Based on our model, results show that the return on investment for a systems provider is achieved between years 2 and 3 and the costs for the user are similar.

3. Lastly, the third case, beverage containers, found that reusable beverage containers are economically advantageous for the users, compared to single-use beverage containers. The return on investment for system providers can be reached between years 5 and 6.

Based on current regulatory developments in Europe, reusable packaging will likely become even more economically viable, with faster return on investments, as single-use packaging will go up in price. In providing more clarity on costs and benefits, this study intends to inform both decision-makers in business and policymakers in future decision-making to confidently support reuse.

We conclude that, even in isolation, the break-even point for all three packaging formats is of only a few years. This represents both a sizable business and political opportunity to reconcile environmental concerns with economics in the foreseeable future, to the benefit of societies as a whole.

REUSE ADDS UP

Introduction

The environmental benefits of reuse are long established. By keeping products in use as long as possible, we reduce the use of raw materials, cut CO_2 and energy use in production, and ease the pressure on overburdened recycling and waste management systems.

Most importantly, reusable packaging changes the way consumers interact with their packaging, changing their view of the value of packaging and making them less likely to litter. This is especially relevant for plastic packaging due to its heavy usage across many industries. Many B2C and B2B brands recognise the potential reusable plastic packaging has towards meeting their plastic and CO_2 reduction targets while satisfying a consumer increasingly concerned over single-use plastic.

However, there remains concern in the industry over anticipated high investment and operational costs, particularly regarding the burden these would place on SMEs. In recent years, there have been several high-profile reusable packaging trials by major household supermarket chains, such as Tesco, Carrefour and Asda, and localised trials from informal eating-out (IEO) chains like McDonald's and Burger King, with mixed success. The relative failure of these trials is being assigned to a lack of customer willingness or financial sustainability. However, discounting reusable packaging as a failure based on isolated, small-scale pilots is a conclusion drawn too fast. Reuse is immature as a system, and its future success depends on sufficient scale, standardisation and supporting infrastructure. Heightened urgency of the climate crisis and the threat of plastic pollution has led to a rush of legislation proposals prioritising reuse, causing disorientation in an industry previously focused on linear material use and recycling. It is clear that there is a lack of (consolidated) data on reuse, particularly the economic factors involved. Building an optimised reuse system will require a concerted effort from governments and industry, and these uncertainties must be resolved to secure the necessary investment and commitment. Businesses need clarity over critical economic success indicators and return on investment, and policy-makers need confirmation that it will create economic growth.

This study will analyse the costs and benefits surrounding a high-performing reusable plastic system compared with an equally efficient single-use plastic scenario. By evaluating the return on investments for

system providers and accumulated costs for reuse system users over a time span of 10 years, the study will determine what factors make reusable packaging economically competitive with disposable plastic packaging. This will be done based on three use cases: food containers, transport packaging and beverage containers.

Can reuse be economically viable? Let's find out.

Aims of the Study:

- Provide objective, reliable data on potential costs & benefits of reusable packaging.
- Address financial uncertainties of reuse and single-use plastic packaging.
- Determine thresholds and critical success factors for economic viability.
- Give recommendations to policymakers and decision makers in business.

Disclaimer

What is reusable packaging? Within this study, we distinguish between the two different systems 'reuse' and 'refill'. 'Refill' means an operation by which an end-user fills its own container. In this sense, the container is not a delivery packaging but a consumer-owned product. 'Reuse' means an operation by which reusable packaging is used again for the same purpose for which it was conceived. In this case, reusable packaging is an asset owned by the system operator, which ensures it is collected, washed and refilled. In the following research we are focusing solely on 'reuse'.

Single-use Paper Packaging - Single-use paper or fibre-based packaging is the most commonly used alternative to single-use plastic packaging, particularly for takeaway food. It is important to note that all paper food packaging contains a percentage of plastic for its functional properties such as water-resistance. This study does not evaluate the environmental impact of one single-use material over another, but rather the economics of single-use over reuse. To allow a strarightforward comparison, the study compares packaging formats of the same material. However, as single-use paper packaging typically costs the same as, or more than, single-use plastic packaging, similar results are to be expected in further analyses. Further, although paper packaging typically will not be affected by plastic taxes as much in the future, the typical multimaterial build-up of paper-based packaging will adversely affect recyclability, which will be valued negatively in future packaging fees.

Methodology

The logic of an independent CBA

The principle of a Cost-Benefit Analysis (CBA) is simple – it compares all projected or estimated costs of an object or plan with the projected or estimated benefits it might unlock.

If the benefits that can be obtained are greater than the costs, one can argue that it is advantageous to invest in the given object or execute the plan. In this way, a CBA is a valuable decision-making tool.

A comparative CBA is contained in this document, wherein the costs and benefits of reusable plastic packaging are compared to those of single-use plastic packaging. This is achieved by examining three different use cases where typically, plastic packaging is prevalent. Models can never capture exact reality, but they strive to get as close as possible. Considering the scope of this study and the varied economic performance of different countries, an archetype of high relevance for most European countries has been created. The archetype country has the following characteristics:

- Industrialised country;
- Urban area, with access to reuse infrastructure within, i.e. 300 km radius;
- Medium-to-high legislative pressure, with packaging EPR in place.

A systems approach is applied in this comparative packaging CBA, looking at not only baring purchasing costs but considering the complete life cycle of both packaging types. The reasoning for this is based on the following logic:

1. The lifecycles of single-use plastic and reusable plastic packaging operate differently, resulting in varying capital and operational costs. For instance, electricity, water, and detergent costs are incurred due to the sanitation required for reusable food containers. However, using single-use plastic packaging entails payment of specific taxes or collection and recycling charges.
2. As the lifecycle varies significantly between the two packaging types, the indicators used to compare the performance of single-use plastic packaging versus reusable plastic packaging also differ. Typically,

the user rents reusable packaging (including the costs for transporting and logistics) and pays a pay-per-use fee, whereas the user purchases single-use plastic packaging and owns the packaging, paying a price at point of sale.

3. For a producer of single-use plastic packaging, the price is determined by the amount of material used. This points to single-use plastic packaging being as thin and lightweight as possible. Of course, this principle applies to reusable plastic packaging as well. However, since reusable packaging is utilised multiple times, the more cycles it can complete, the more cost-effective it becomes.

How to define a lifecycle for the purpose of a CBA

A life cycle includes the costs of raw materials, manufacturing, use, and end of life management. For the purpose of this CBA, the packaging purchasing costs of single-use plastic and reusable plastic packaging are compared. The raw material and manufacturing costs are assumed to be already included in the purchasing price of the respective packaging. Regarding the costs of the use phase, we factor all costs that need to be paid in order for the two systems to run smoothly. This means that for reusable packaging, which depends on reverse logistics, tracking and cleaning of containers, these costs need to be incorporated. On the other side, single-use plastic taxes, if any, need to be factored in for single-use plastics. Lastly, the costs of end-of-life, or disposal of the packaging, has been narrowed down to Extended Producer Responsibility fees and/or single-use plastic taxes, as these are the dominant End-of-Life policy tools in Europe.

These fundamental differences are important to understand as they determine how we look at and compare single-use plastic and reusable plastic packaging. It is believed that a fair comparison between these two packaging types can only be achieved through a systems perspective, taking into account these different aspects. Therefore, decision-makers in public and private entities should be informed about fair and independent tools to evaluate the performance and economics of single-use plastic and reusable plastic packaging systems and avoid economic losses.

Although the study calculates costs and benefits for the reuse system providers, the primary attention of this CBA is the comparison between single-use plastic packaging and reusable plastic packaging **from the point of view of the packaging user** (so e.g. a restaurant, brand owner or bottler). It is a straightforward calculation, as the packaging user has essentially one cost point per packaging type:

- **For single-use plastic packaging**: the purchasing costs of the single-use plastic packaging;
- **For reusable plastic packaging**: the pay-per-use fee paid to the systems provider;

However, as we are looking at both types of packaging from a systems perspective, it is important to consider the entire life cycle.

In our selected country archetype, packaging producers must pay EPR fees when placing products on the market. This is reflected in the purchasing price of the plastic packaging. EPR applies to reusable and single-use plastic packaging, as both types eventually reach their end of life. However, for single-use plastic packaging, the EPR fees have greater impact. As they are paid per kilogram of plastics put on the market, EPR fees tend to be higher compared to reusable plastic packaging as users can only use each single-use plastic packaging once – resulting in the need to buy more material over time. The uptake rate is the percentage of packaging used that is reusable, compared to single-use plastic packaging in a given use case. In our analysis, we have assumed 100% reusable packaging uptake, even though this is not yet the case for all use cases. However, to ensure a level playing field in the comparative analysis, both systems are compared at the same scale.

Description and relevance of the three investigated cases

This study compares single-use plastic and reusable plastic packaging in three representative use cases. All cases are in open loop systems, so in an open environment (not within one location). Besides, all cases currently use huge packaging volumes and show good potential for a scaled approach.

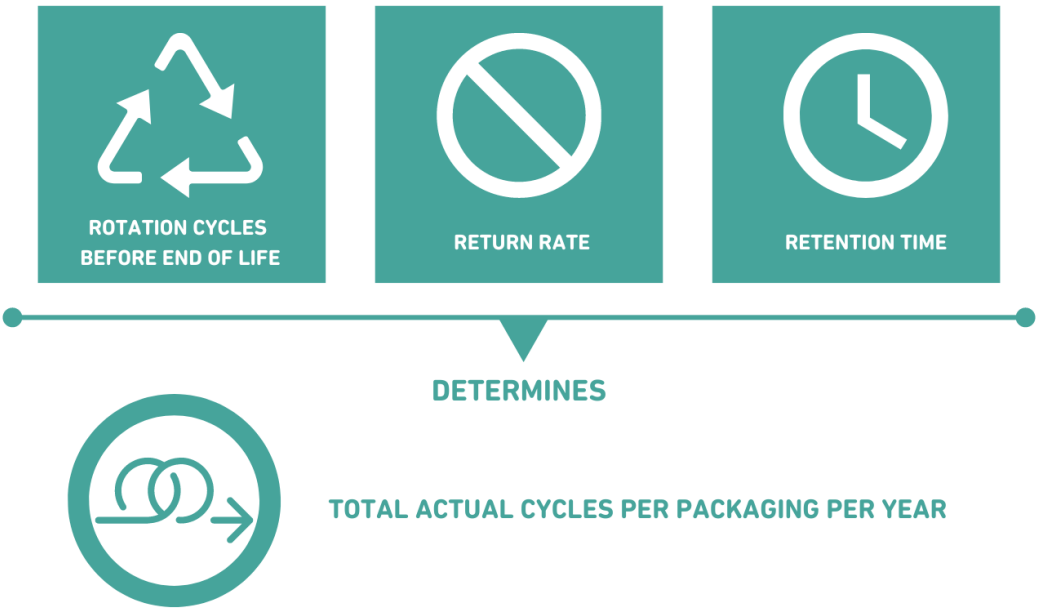
Case 1 – Food containers for takeaway food: Case 1 focuses on the food delivery sector, comparing single-use plastic food containers with reusable plastic food containers. This use case was chosen due to the sharp increase in food deliveries, resulting in increased volumes of packaging, and increasing need for legislation. Moreover, the food delivery market is mostly a local industry with short transport distances.

Case 2 – Secondary Transport Packaging: This case contrasts reusable and single-use big bags used as secondary transport packaging for B2B shipping of products and goods. It is of interest to this study as B2B secondary packaging has bigger distances to overcome than in case 1 and is highly relevant for the Intra-European trade routes.

Case 3 – Beverage bottles: The last case compares single-use PET beverage bottles with reusable PET beverage bottles. Bottled water is one of the most popularly consumed types of packaged goods. It is also the most easily recyclable plastic on the market and the only one that is being recycled in a closed loop at scale. Furthermore, both single-use plastic and reusable plastic packaging systems have already been developed at scale, for example, in Germany.

Description of parameters used

Reusable packaging parameters



- **Average rotation cycles before EoL**: The average number of use cycles before end of life indicates the number of times a reusable packaging can function before it becomes unusable. This often happens due to damage, such as scratches, bursting, or staining. The number of reuses before EoL varies greatly, depending on the packaging type.
- **Return rate**: The return rate is the percentage of packaging returned to the starting point at the end of a use cycle. It is an important indicator with major impact on the economics of reusable packaging, as it indicates the number of reusable containers that need to be re-purchased. The higher the return rate, the more economically viable the reuse system. A return rate higher than 95% should always be pursued, in order to make a system economically feasible for a system provider.
- **Retention time**: The retention time is the average time measured in days a packaging needs to complete one rotation, thus unavailable for reuse as it is currently at another point in the use cycle (e.g., with the consumer, being washed, or being transported). The retention time can vary greatly, depending on the industry and geography of the reuse system. Retention times should generally be reduced to a maximum of 30 days in order to use reusable packaging effectively.
- **Actual average use cycles**: Based on the average number of use cycles before EoL. The return rate and rotation speed indicate the actual number of use cycles that all the reusable packaging units in a

system undergo. This number is typically lower than the average use cycles before EoL due to packaging losses and unavailability. In general, systems with less than 4 use cycles should be avoided, as this low number jeopardises the environmental advantages of reusable packaging.

Single-Use Plastic Packaging Parameters

- **Recyclability**: In a best-case scenario, single-use plastic packaging should be easy to recycle. Even though this works quite well for some of the evaluated materials, e.g. PET, closed-loop recycling is not yet the reality for all types of plastic packaging today. Recyclability is typically highest if the single-use plastic packaging is made from mono-material, so from only one type of plastic.

- **Eco-modulated EPR fees**: The trend towards eco-modulation of producer responsibility fees based on bonuses for recyclability is increasing in Europe. This means that the higher the recyclability of packaging, the lower the EPR fees paid by the company placing the packaging on the market. Even though the direct impact on the purchase price of single-use plastic packaging for the user is small, it is important to note that, cumulatively, it can make a substantial difference for packaging producers.

- **Single-use plastic taxes**: A few European countries are implementing or preparing single-use plastic taxes, which is an environmental levy that needs to be paid by producers or importers of single-use plastic packaging. It is linked to the "plastics own resource tax" from the EU, which member states are obliged to pay. Levies are typically paid per tonne of single-use plastic material put on the market. This means the lighter a single-use plastic packaging, the less material is being used and the cheaper it is.

Case 1

Reusable food containers for takeaway food (return on-the-go)

Single-use plastic packaging is currently the dominant packaging type for this use case, although paper-based or fibre packaging is gaining popularity as a plastic alternative.

It should also be noted that paper food packaging nearly always contains some percentage of (bio)plastic for its functional properties, such as water resistance. For this use case, paper packaging was not compared. However, as the price of paper packaging is generally higher than single-use plastic packaging, the results are expected to be similar.

Several best-practice examples of reusable takeaway food container schemes are already on the market. These typically include a reuse systems provider. Established companies that operate at scale include Recup, Vytal, Bumerang, Pyxo, Sykell and Recircle. System users include, for example, individual restaurants, food outlets and delivery companies, such as Just Eat, Deliveroo or Uber Eats. In several markets, packaging for takeaway food delivery is a mix of single-use plastic and reusable plastic containers (at scale) – with single-use plastic containers still being the dominating packaging type. In Germany, for example, reusable plastic packaging is already available in multiple restaurants in multiple cities.[2]

Baseline assumptions

- **Reusable packaging**
    - **Costs**: The costs are derived from the average purchasing costs of different reusable food container providers.
    - **Average number of meals sold per day**: Derived from ongoing projects with food delivery companies.
    - **Average reusable packaging use cycles before EoL**: Based on data from reusable food container practices in the market, a theoretical lifetime of 200 – 1000 cycles before end of life was tested. Due to stress marks, discolouration and migration from food into the packaging, a much more conservative number of 50 reuses was chosen.
    - **Reusable packaging average retention time (at consumers)**: This number has been set to 4 days. This is based on a retention time model in the market, where the consumer is charged a

[2]Source: Lieferando (2023). Derived from www.lieferando.de/nachhaltigkeit/mehrwegverpackung

fee of 10 Euros if (s)he does not return it within 14 days. It is unrealistic to expect all consumers to return their packaging on day 14, as statistically, some will return it much earlier. Therefore, the estimated average retention time has been set at 4 days based on real-life data from system providers who use the penalty model.

- **Reusable packaging average retention time (full rotation)**: This number has been set to 12 days, which is the time a reusable food container stays at the consumer plus the time a container required to travel from the restaurant to a regional cleaning facility and back.
- **Reusable packaging return rate (per cycle)**: The return rate has been set to 98%, calculated from the average return rates seen by reuse system providers in Europe. Some system providers reach higher return rates, however, it was chosen to stick to the more conservative number.
- **Reusable packaging loss rate (per cycle)**: Based on the return rate, the loss rate is the remaining 2%.

- **Handling, Cleaning & Transport**
  - Decentralised cleaning: The reusable food containers are washed by the user (i.e. restaurant owner), who bears the costs. We consider costs of EUR 0.02 per container.
  - Centralised: Reusable food containers are washed in a washing facility organised by the system provider, who bears the costs. The combined cost of transport (including re-distribution) and cleaning is EUR 0.10. These are the approximate costs for reuse systems if economies of scale can be achieved. The data is an average of data from different network partners active in cleaning reusable packaging.

- **Geographic scope**: Spain was chosen as a focus country, as it is a representative archetype for a future model of an average European country. Furthermore, reusable food container pilots are still novel, and Spain is a relatively large economy.[3] The analysis aims to add value where the business model has not yet been tested at a large scale.
- **Legislation in target country**: Spain has an established EPR system and a novel plastic tax of EUR 0.45 per kg of single-use plastics.
- **Externalities**: Based on the latest reports on the management of plastic packaging from WWF.[4]

[3] Diario Sustentable, 2022. Derived from: www.diariosustentable.com/2022/04/uber-eats-triciclos-y-food-pack-lanzan-inedita-iniciativa-de-despacho-de-comida-con-envases-reutilizables

[4] WWF (2023). Derived from: wwfint.awsassets.panda.org/downloads/wwf_regulating_high_risk_plastic_products.pdf

- **The reward model, communication and marketing approaches** are based on behavioral change analysis, identification of buying personas, their trigger points & buying patterns to facilitate targeted behavioral change, building on both Searious Business' and Rare's behavioral change model.[5]

System boundaries

- Reusable packaging needs to be easy to use and convenient for the consumer, and profitable for both the system provider as well as the system user. Otherwise, it is unlikely that a reusable food container system will be established. We define profitability based on a positive return on investment.
- Uptake rate will be based on either 100% use of reusable packaging, or 100% use of single-use plastic packaging.
- Externalities are not incorporated in the direct results of the CBA, but are highlighted in the green-coloured parts of the column chart.
- Return of empty packaging follows the two following return options, developed by the Ellen MacArthur Foundation:[6] Return-from-home (packaging is picked up from home from delivery service using reverse logistics) or Return-on-the-go (consumer drops off packaging at a drop off station).
- Comparisons include costs for system maintenance for the systems provider.
- The CBA is not focusing on hygiene & safety, as these are only remotely and indirectly attached to the CBA (in terms of business risks).

Assumptions

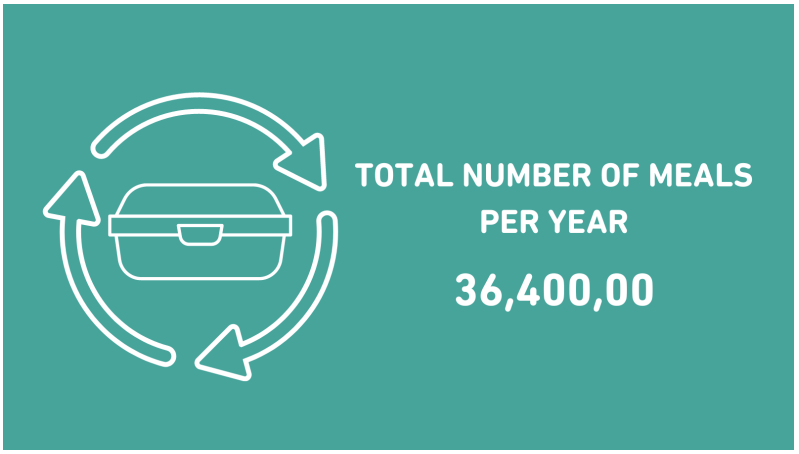
Costs in Euro	
Cost of Single-Use Plastic Packaging Unit:	0.20
Costs of Reusable Plastic Packaging Unit:	2.50
Cost of reusable packaging unit charged by system provider (pay-per-use fee):	0.18
Costs of cleaning & transport per reusable packaging unit:	0.10

[5] RARE (2023). Derived from: behavior.rare.org
[6] Ellen MacArthur Foundation (2023). Derived from: ellenmacarthurfoundation.org/upstream-innovation/reuse

Platform maintenance costs for system provider per unit:	0.02
Reusable Packaging Performance Indicators	
Number of meals sold per week	700,000
Reusable packaging use cycles before EoL	50
Reusable packaging avg. retention time (full rotation)	12
Reusable packaging return rate (per cycle)	98%
Fee upon non-return	10
Other	
Geographic focus	Spain
Packaging Tax [Euro/tonne]	450

Results

For this use case in a given region in Spain, a total of 36.4 million meals needs to be packed, either in single-use plastic or in reusable plastic packaging.



In order to determine whether a switch from single-use plastic packaging to reusable packaging makes economic sense, we first had a look at how much packaging can actually be reused multiple times, based on the loss rate. Single-use plastic packaging is "lost" after one initial cycle by default. However, as it is thinner, lighter and cheaper in purchasing costs compared to reusable packaging, reusable packaging needs to effectively go through many use cycles in order to break even with single-use plastic packaging. Figure 1 shows how many reusable containers are lost over 100 use cycles, if a 98% return rate per cycle applies.

It can be seen that at a 98% return rate per cycle, the number of containers in the system is shrinking steadily. At 20 cycles, 120,000 000 containers are left in the system. This means that statistically, much less containers can reach their full potential of use cycles before they reach the end of their life. If the return rate is reduced to 90%, as shown in Figure 2, the number of reusable containers in the system shrinks to 20,000 after 20 cycles and gets close to zero after only 40 use cycles.

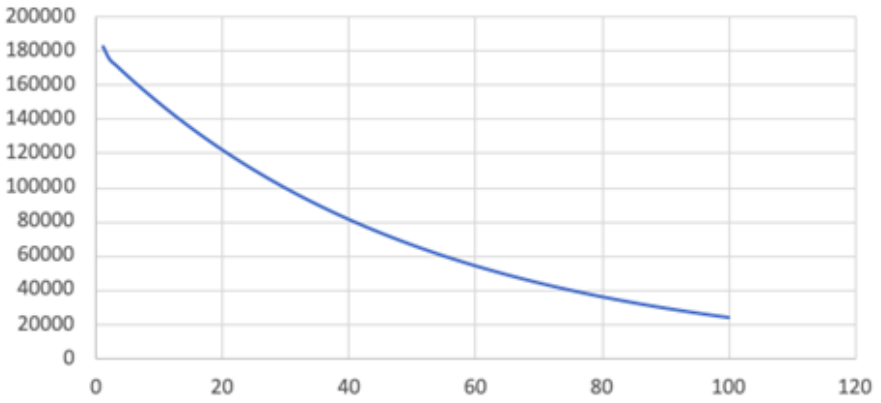


Figure 1: Loss of reusable food containers over 100 cycles at 98% return rate

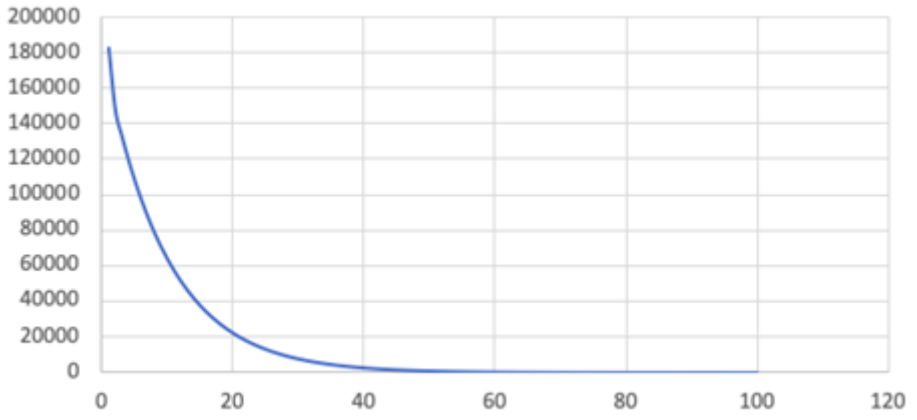
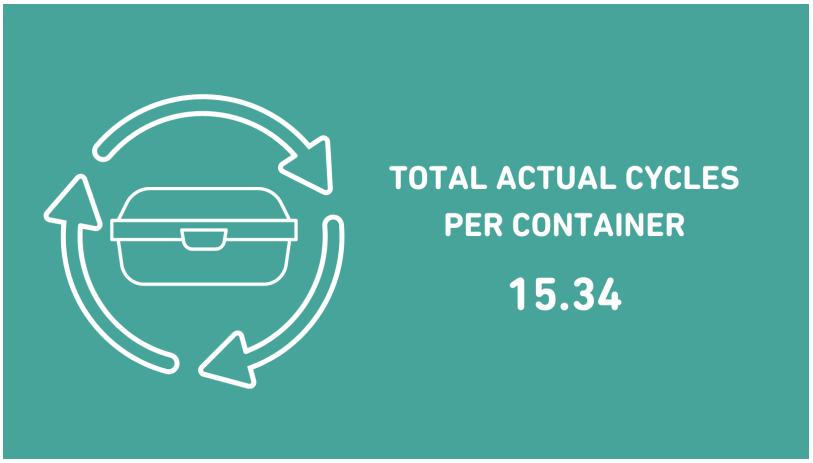


Figure 2: Loss of reusable food containers over 100 cycles at 90% return rate

This translates into substantial costs for the reuse systems provider, which in turn, implies a higher pay-per-use fee for the systems user. For an economic reuse model, it is therefore crucial to aim for a return rate as close to 100% as possible and to take measures to achieve this. In these dynamics, behavioral change aspects play a vital role. For example, by charging a fee upon non-return of the container after 14 days, and by making return points easily accessible, consumer behavior can be heavily influenced to return food containers in time.

In the best-case scenario, where a high return rate of 98% or more can be achieved, owning reusable food containers becomes cheaper and cheaper with each use cycle. In this model, based on a total of 50 cycles before the end of life, a 98% return rate per model, and an average retention time (full rotation) of 12 days, every container can be used roughly 15.34 times on average, in the first year of the system.



In this use case, a total of 36.4 million meals need to be packed, either in single-use plastic or in reusable plastic packaging.

This leads to an understanding about the total amount of packaging which is required for both packaging types. For single-use plastic packaging, the amount needed is quite straightforward. As there are 36.4 million meals delivered per year, the exact same amount of single-use plastic food containers is needed. For reusable food containers, the quantity required is based on the actual total number of cycles per container (as stated above) and is lower as they can be reused several times: 1,557,511 containers.

Based on the data above, the Return on Investments (ROI) for the systems provider was calculated. Based on a time horizon of 10 years, it can be seen that a significant amount of capital expenditure (CAPEX) is required, as shown in Figure 3 below. However, in this scenario, the break-even point can be reached between years 3 and

4, thanks to the revenue generated by, for example, the pay-per-use fee charged by the system provider to the system user, with a ROI of 17.9% over a 10-year period.

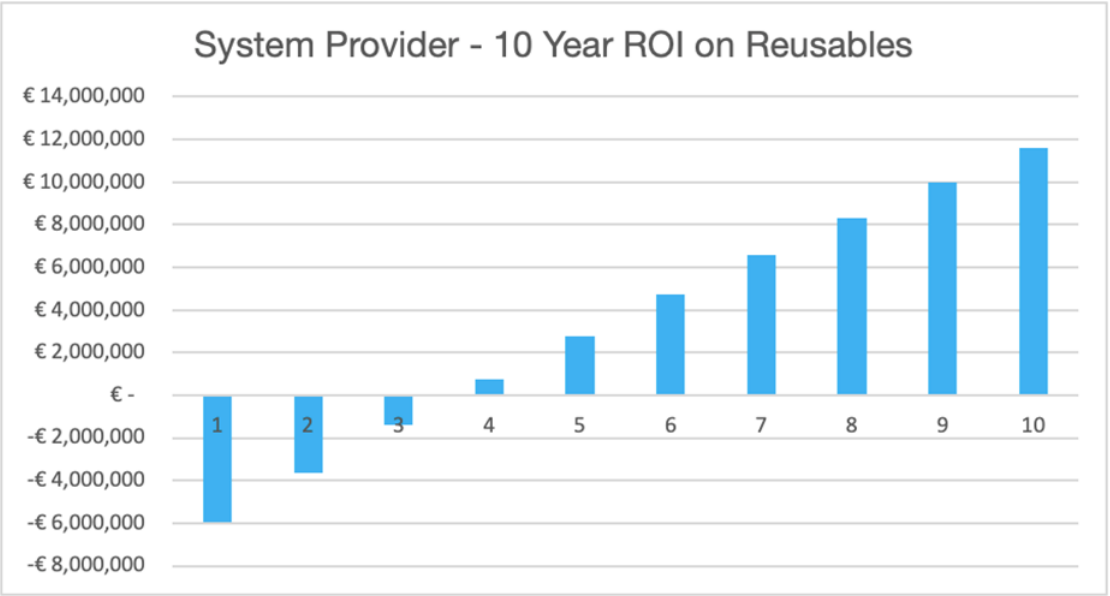


Figure 3: Return on investment for the system provider of reusable food containers

Therefore, the business case for reusable food containers for takeaway food with return at home is clear for the reusable system supplier.

But what about the system user?

The study investigated typical pay-per-use fees for reusable plastic containers for delivery and purchasing costs of single-use plastic containers. Based on our assumptions above, the pay-per-use fee can be as low as EUR 0.17 per unit, making it competitive with the purchase price of single-use plastic packaging. This takes into account the fact that EPR fees have a greater impact on the purchase price of single-use plastic food containers than on reusable plastic food containers, as reusable plastic food containers are used multiple times. Even though a reusable plastic container is much heavier than a single-use plastic one, in a reuse system, there is less material used in total as the container is being used an average of 15.34 times (which was calculated and explained above). Furthermore, there are single-use plastic taxes that need to be paid in Spain.

Figure 4 below show a comparison of the accumulated lifecycle costs of the two types of food container. Even though not factored in, we have shown the costs of externalities of single-use plastic containers in light green, to raise awareness of the fact that they are indirectly paid by taxpayers, public authorities, and waste management companies. It is likely that these costs will be incorporated in the real purchasing price, according to "true pricing" mechanisms, in the near future.

It can be seen that reusable plastic packaging is cheaper than single-use plastic packaging for the system user, even without factoring in externalities and plastic taxes.

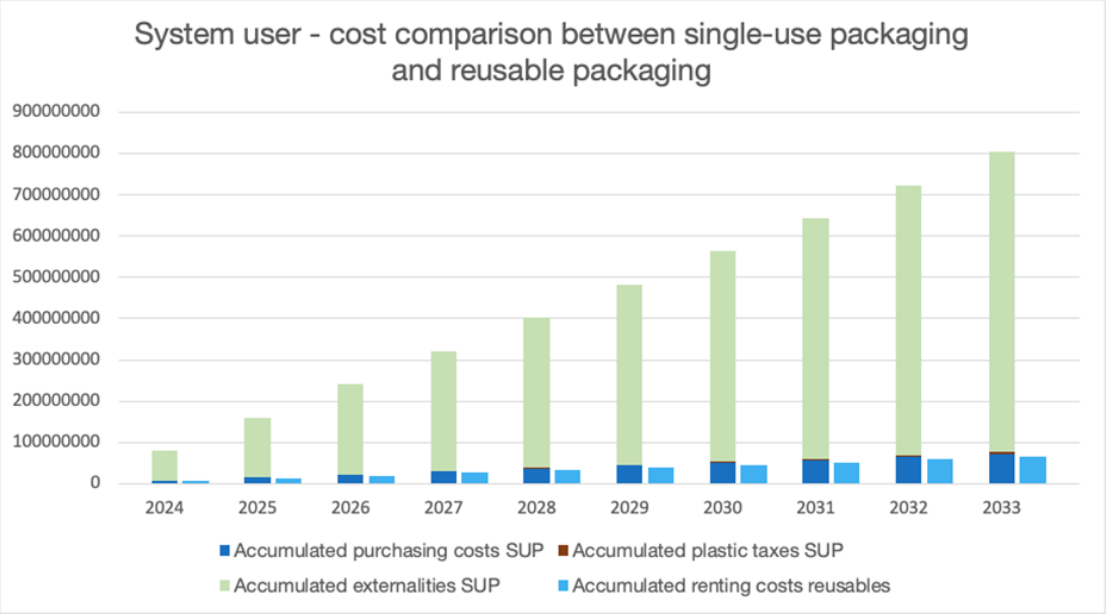


Figure 4: Accumulated costs comparison for the food container user

In conclusion, reusable plastic food containers can be more economically advantageous than single-use plastic food containers for system users. In the best-practice system investigated, users of the system pay a pay-per-use fee of EUR 0.17 per use, which is cheaper than purchasing a single-use plastic food container of EUR 0.20 per item. The more cycles completed, the more money can be saved using reusable plastic packaging. In addition, reusable plastic packaging appears to be more "hassle-free" as the user does not own the packaging. The user does not have to worry about taxes, collection and disposal regulations, or EPR fees that may affect them. No upfront investment is required, by i.e. restaurants, as a result of the pay-per-use model, nor does it need complicated logistics and additional washing services to clean the containers, as the containers are cleaned in-house. And lastly, it also simplifies bureaucracy for administrations and reduces the risk of fraud and/or free-riding.

Case 2

Transport packaging (B2B packaging)

This use case compared single-use plastic transport packaging, specifically 1 cubic metre big bags (FIBCs), with reusable plastic big bags of the same size.

A higher safety factor ratio (6:1 for reusable FIBCs, vs 5:1 for Single Use FIBCs) was applied. Made from woven polypropylene, big bags are an established form of secondary packaging for the transport of materials and goods. They are popular with users because of their low weight, ease of handling and low cost.

Baseline assumptions

- **Purchasing price of single-use plastics and reusable plastic big bags**: Assumed to be the same, as the properties of the two big bag types are similar. Big bags are quite sturdy, and are already now, at their current design feasible for reuse.
- **Costs of the pay-per-use fee**: Need to be competitive with the purchasing price of single-use plastic packaging units, while at the same time being profitable for the reuse system provider. It is thus set at the same amount as the purchasing price of the single-use plastic big bag.
- **Transport**: Based on a long-wheelbase (LWB) vehicle of 7.87 ft with maximum 500 km transport distance. For the given number of bags, 262.7 trips per year are needed. This includes the trips from the brand owner to the cleaning facility and from the cleaning facility to the brand owner. It is assumed that transport works at optimal efficiency because both cleaning and transport are managed by the reuse operator.
- **Platform maintenance costs for reuse provider**: This number is based on interviews with platform developers.
- **Total number of cycles per week**: Based on a scaled system.
- **Reusable plastic packaging use cycles before EoL**: This number is based on a conservative assumption for a sturdy reusable big bag.
- **Reusable plastic packaging average retention time**: Bulk packaging needs time to be emptied completely, and the steps of cleaning and transporting are also in between before the reusable big bag is ready to be used for another cycle.
- **Reusable plastic packaging return rate**: Based on interviews with reuse system providers from other industries. As big bags are B2B packaging and the number of different users will be more limited than for B2C packaging, it is assumed that this number is likely to be achieved.
- **Reusable plastic packaging deposit**: Based on purchasing costs of one reusable big bag.

- **Geographic focus**: Italy was chosen as an archetype country it has a big food industry, that requires bulk transport from the producer or brand owner to retailers.
- **Externalities**: Based on the latest reports on the management of plastic packaging from WWF.

System boundaries

- Both systems are compared at a scaled stage of at least 100,000 single-use big bags or uses per year.
- Transport reaches a maximum of 500 km for reverse logistics.
- Reuse operator manages both cleaning as well as transport of big bags, which is a common set-up.
- The system focuses on a reuse operator, e.g. a big bag manufacturer, and the users - brand owners and food producers.
- Brand owners must return the bags or face a deposit penalty, doubling the cost of the original charge (pay-per-use fee).
- Uptake rate will be based on either 100% use of reusable packaging, or 100% use of single-use packaging, as fully scaled systems are compared.

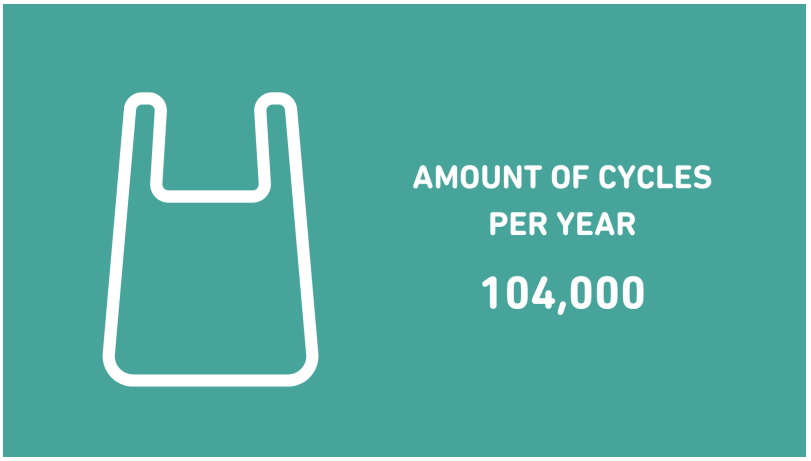
Assumptions

Costs in Euro	
Cost of Single-Use Packaging Unit:	6 Euros
Costs of Reusable Packaging Unit:	6 Euros
Cost of reusable packaging unit charged by system provider	6 Euros
Costs of cleaning & transport per reusable packaging unit:	0.5 Euros (cleaning) + 0.63 Euros (transport) / 0.31 Euros (20ft truck)
Platform maintenance costs for system provider per unit:	1,500 Euros / year

Platform development costs for system provider (capital expenditure)	100,000 Euros
Reusable Packaging Performance Indicators	
Total number of cycles per week	2000
Reusable packaging use cycles before EoL	10
Reusable packaging avg. retention time (at user)	30
Reusable packaging return rate (per cycle)	98%
Reusable Packaging Deposit (based on cost of new reusable big bag)	6 Euros
Other	
Geographic focus	Italy
Packaging Tax [Euro/tonne]	450

Results

A total of 2000 trips per week was defined as the system is assumed to be scaled. This equates to 104,000 cycles per year. These cycles are made using either disposable or reusable big bags.



For the single-use big bags, the amount of packaging required is identical, with each big bag being used exactly once. The number of reusable big bags required is based on lifetime, return rate and retention time, which determines the average number of use cycles per big bag.

Based on the capital expenditures for the system provider, the ROI is at 86% over a 10-year period, as shown in Figure 5 below.

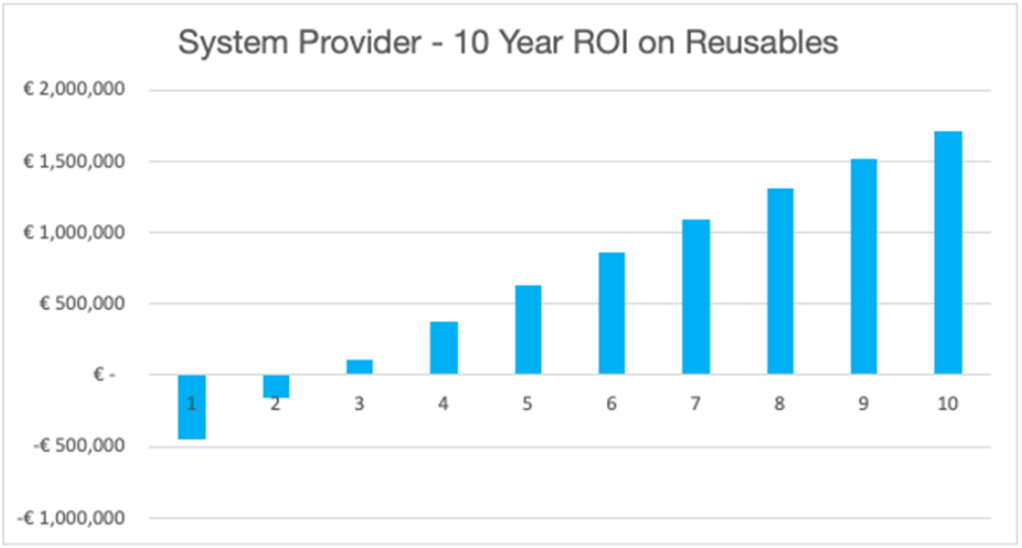


Figure 5: Return on investment for the system provider of reusable big bags

While this reuse case is even more advantageous for the system supplier, it is also important to look at profitability for the system user, which would be a brand owner or food producer who needs big bags to deliver their products to retailers.

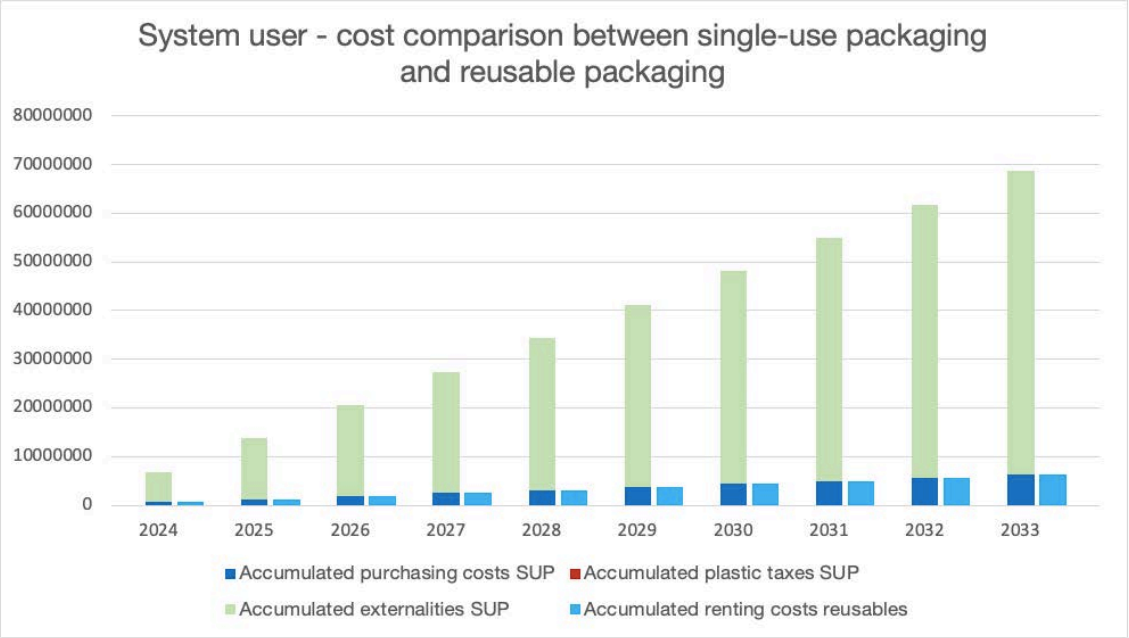


Figure 6: Accumulated costs comparison for the big bag user

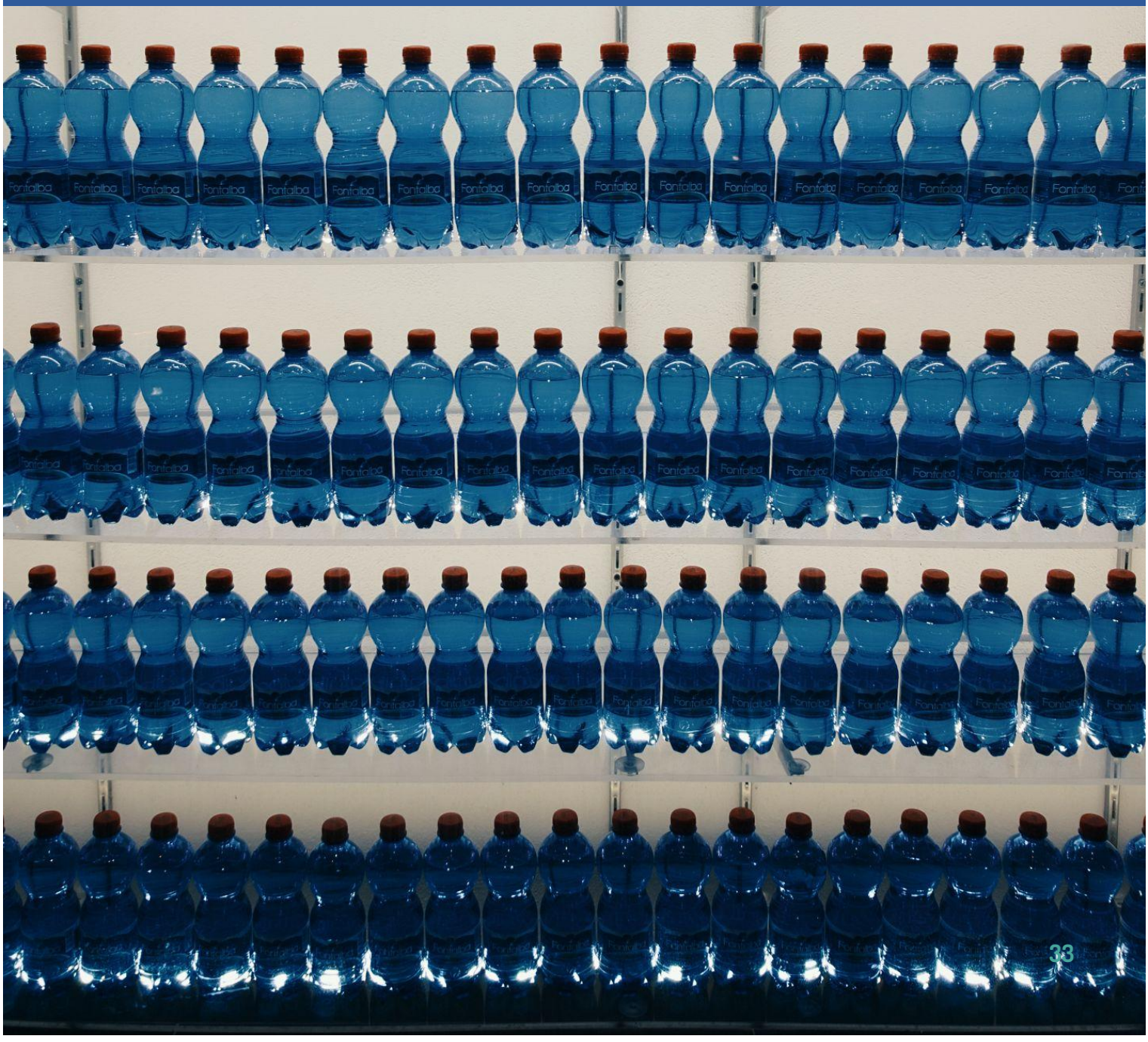
For the system user, the direct costs are the same if they return their packaging. However, the externalities are once again striking, and these will likely be incorporated through true cost accounting as single-use plastics legislation tightens around the globe. One benefit of reusable packaging is not having to take care of the disposal of big bags. Further research is needed to determine the cost savings from the waste levy, which was not included in this model due to a lack in available data. It is expected that this will enhance the economics of reusable big bags even more.

In conclusion, there is a vast potential for transforming transport packaging into reusable packaging at scale. Specifically due to the vastly implemented tracking and tracing of the products within, and the highly controlled environment, there is a high likelihood for reusable transport packaging to achieve a high return rate. As a result, the reuse system can reach high numbers of rotations which makes the case for an investment into the set-up of such a system. For the system users, there are little differences in costs, as reusable big bags and single-use big bags are expected to not vary greatly from another, regarding design and costs.

The model shows that the purchasing costs of single-use packaging and the pay-per-use fee of reusable packaging can be the same. The big advantage for users of reusable transport packaging is that they do not have to organise the disposal of their packaging and can run these operations without creating waste.

Case 3

Beverage containers (return on-the-go)



The third use case investigated in this report is plastic packaging for beverage containers. The dominating packaging type for PET beverage containers is single-use bottles.

However, reusable PET beverage container systems have existed alongside for a long time. One country where reusable PET beverage containers are widely established is Germany, where reusable and single-use beverage containers exist next to each other. The system provider for the pool system in Germany is the Association of German Wells (Genossenschaft Deutscher Brunnen, GDB), which currently supplies more than 1 billion bottles and 100 million crates to German bottlers. The bottlers are the users of the packaging. Being a cooperative, GDB is partially owned by bottlers, and thus has a fundamentally different business model than in the case presented below. This analysis shows an alternative case based on a pay-per-use fee paid by the system user to the system provider, so to give a more simplistic and more generic comparison.

Baseline assumptions

- **Cost of single-use plastic packaging unit**: Based on commercially-available single-use preform prices.
- **Cost of reusable plastic packaging unit**: Based on commercially available reusable preform prices, which need to be sturdier and thus use more material.
- **Pay-per-use-fee per packaging unit**: Based on exemplary data from pool system managers.
- **Costs of cleaning per reusable packaging unit (paid by bottlers)**: Extrapolated based on costs for cleaning of reusable food container washing hubs.
- **Platform development and platform maintenance costs** have been excluded from the model in this case, as the model has worked for 20 years, where a digital reuse platform has not yet been required.
- **Total number of litres per week**: Based on exemplary data from GDB.
- **Reusable bottle use cycles before EoL**: Based on exemplary data from GDB.
- **Reusable packaging average retention time**: Based on consumption behaviour of regional system set-up.

- **Reusable packaging return rate**: Based on actuals for the German system.
- **Reusable packaging deposit**: Based on actuals for the German system.
- **Geographic focus**: Germany was chosen as an archetype country, as it has been the location for a successfully running reusable PET bottle system in practice for many years already, and crucial elements will be exemplary for other countries following suit in the future.
- **Externalities**: Based on the latest reports on the management of plastic packaging from WWF, factoring in that PET is the most sustainable and well-managed plastic packaging type in Germany, with extremely low littering and a closed-loop recycling percentage of roughly 30%.

System Boundaries

- The comparison factors in pool system manager and bottlers.
- The CBA is based on a regional system, with a maximum of 300 km transport routes.
- Uptake rate is based on either 100% use of reusable packaging or 100% use of single-use packaging, as fully scaled systems are compared.
- The CBA is not accounting for technological advancements such as reuse platforms, as not required for first set-up of the system.
- The CBA is based on one-litre bottles for both reusable and single-use bottles.

Assumptions

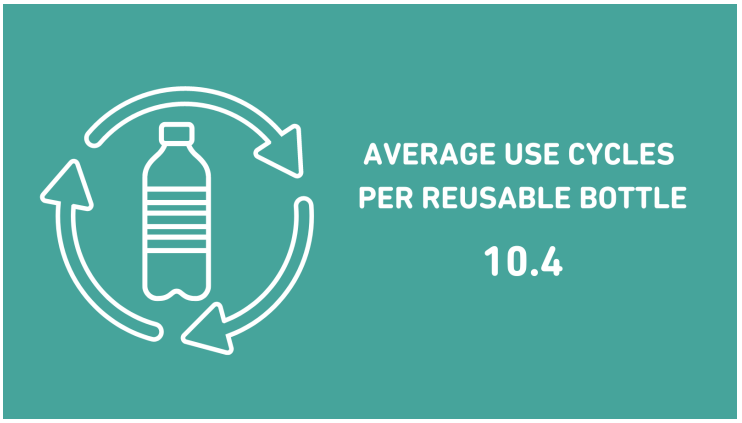
Costs in Euro	
Cost of Single-Use Packaging Unit:	0.05
Costs of Reusable Packaging Unit:	0.12
Pay-per-use-fee per Packaging Unit:	0.08

Costs of cleaning per reusable packaging unit (paid by bottlers)	0.05
Platform maintenance costs for system provider per unit:	n.a.
Platform development costs for system provider (capital expenditure)	n.a.
Reusable Packaging Performance Indicators	
Total number of litres per week	115,349
Reusable packaging use cycles before EoL	25
Reusable packaging avg. retention time (at consumer)	15
Reusable packaging return rate (per cycle)	98%
Reusable Packaging Deposit	EUR 0.15
Other	
Geographic focus	Germany
Packaging Tax [Euro/tonne]	n.a.

Results

Germany has a large population. The total amount of water that needs to be bottled is 115,349 litres per week. This equates to a total of 6 million litres of water per year that needs to be bottled, either in refillable or disposable containers.

For the reusable bottles, it has been calculated that each bottle has an average of 10.4 cycles per year based on the return rate, lifetime and retention time. This equates to 581,744 reusable bottles needed per year. The number of single-use bottles required in one year is equal to the number of litres to be packaged, adding up to 6,000,000 units.



Lastly, the ROI has been calculated for the reuse pool operator, shown in Figure 7. There are extensive investment costs again, as the reuse pool operator needs to invest in suitable stock levels of reusable PET bottles in order for the system to run the system as efficiently as possible. The recurring costs, such as transport costs and the re-stocking of PET bottles, are factored in. However, due to the pay-per-use fee, the pool manager can achieve a ROI of 16.4% in a period of 10 years.

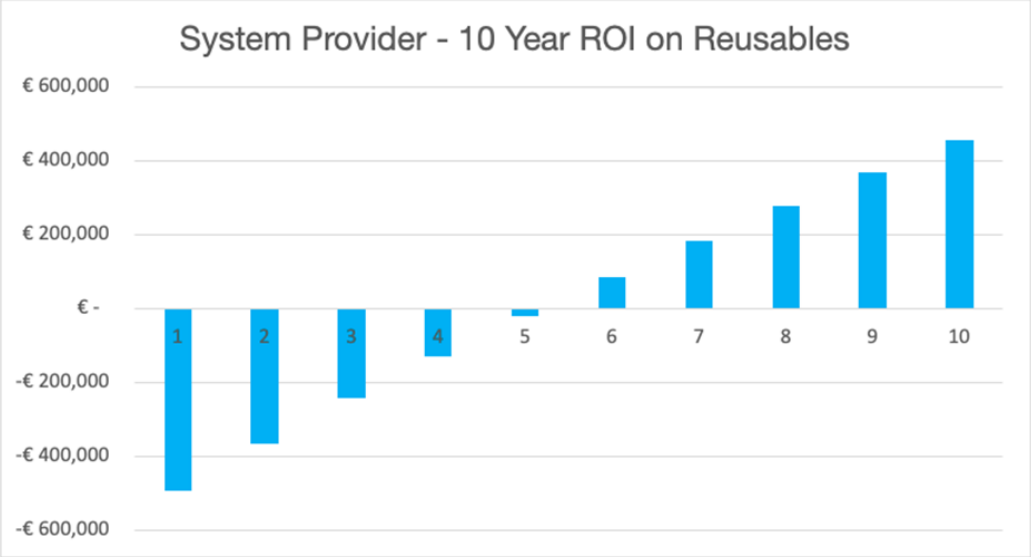


Figure 7: Return on investment for the reusable beverage bottle system provider

Looking at the user of the system, it is important to note that Germany has a deposit return scheme that impacts the profitability of the system. Figure 8 below shows that although the purchase cost of the single-use bottle is cheaper than the pay-per-use fee, the deposit on single-use bottles is more expensive than the deposit on reusable PET bottles. However, a bottler using reusable PET bottles also needs to pay for the cleaning costs of the reusable bottle, which typically happens at the bottling site right before the next refill. This makes the reusable system slightly less advantageous compared to single-use packaging. However, the reusable pool system is overall economically more advantageous than the single-use system for the user. This is due to the highly decentralised and scaled nature of the system.

The externalities have been shown in light green. Here it is important to note that the externalities for PET are much lower than for other types of plastic, due to the following reasons: in Germany specifically, the DRS system very successfully prevents litter and PET packaging from ending up in the general waste stream or in the mixed plastic waste stream. This reduces the costs of sorting and municipal cleaning. In addition, there is already a high level of recycling of PET bottles in Germany, which allows resources to be used efficiently and reduces externalities even further.

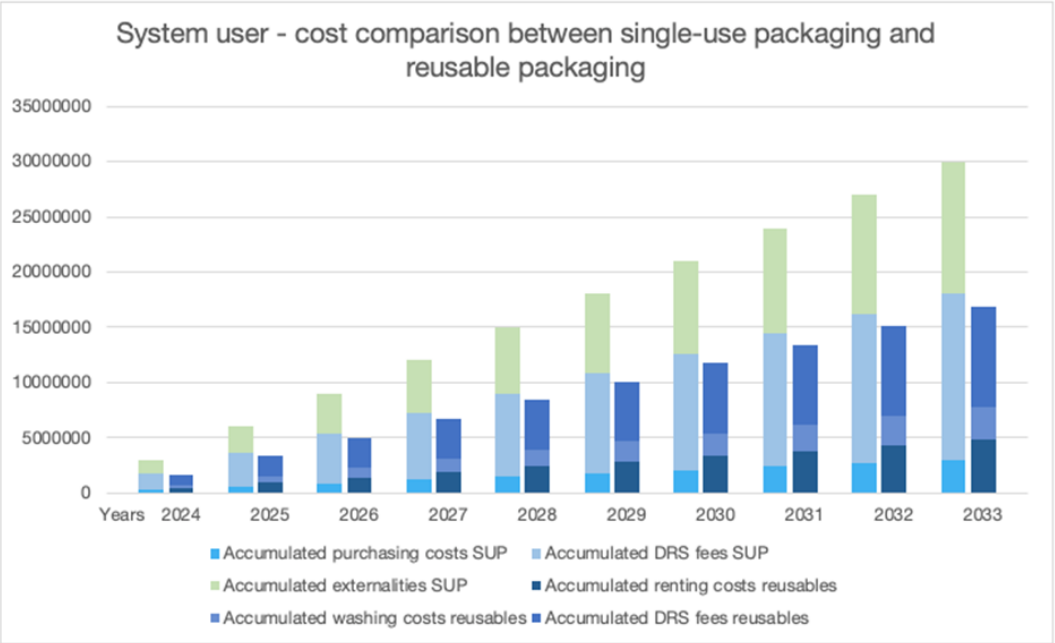
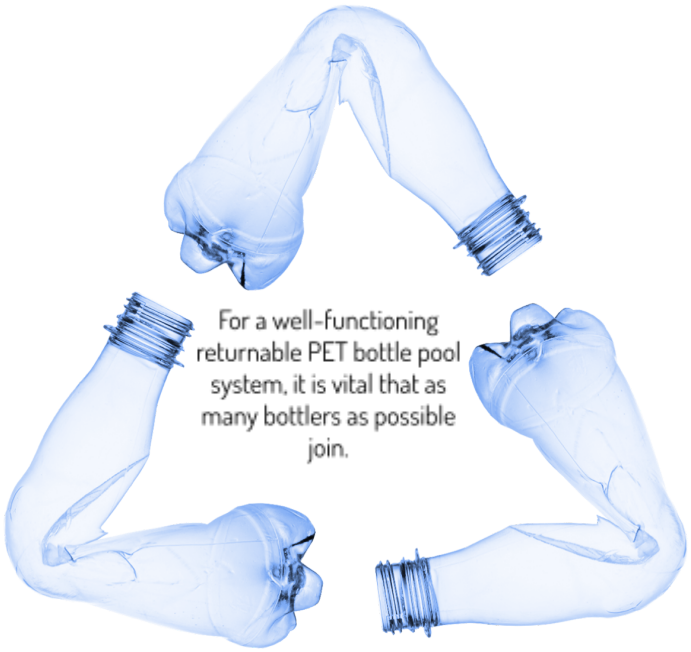


Figure 8: Accumulated cost comparison for the beverage bottle user

In summary, reusable PET bottles, as well as single-use PET bottles, are part of economically well-functioning systems in Germany. Reusable packaging has a slight advantage due to the lower deposit paid on the packaging. This also reflects in the prices for consumers, effectively helping bottlers to make their products more appealing on the shelf.



Discussion

The CBA for the three use cases has been calculated using real data where available. Any necessary assumptions used have been made as transparent as possible. Future uncertainty over material prices and legislative developments could affect the ongoing accuracy and results of the three models. However, there are strong signals indicating the economic advantage of reusable packaging will be affected positively:

- **Price fluctuations** - Movements in the raw material market landscape show that virgin plastic prices are increasingly volatile. This is particularly true for the European market, given political conflicts such as the war in Ukraine and supply chain disruptions caused by the covid pandemic.

- **Resource availability** - Population growth will affect the European market through increased pressure on material availability. The need to recycle and reuse materials will increase, especially plastics. Although well-established for PET, recycling is still lagging for other plastic packaging groups, making reusable packaging particularly appropriate for cases 1 and 2.

- **Governmental tariffs** - Recent developments in regulatory affairs also impact pricing. It is expected that additional single-use plastic taxes and eco-modulated EPR will be developed in the coming years, making the use of reusable packaging more favourable for packaging users.

- **Consumer behavior** - There is a growing demand for convenience putting pressure on packaging development and requiring innovative new solutions. At the same time, consumers are becoming more environmentally aware and educated about sustainability, especially in Europe. Reusable packaging is increasingly recognised by the general public as a strong, sustainable packaging solution.

Finally, it should be acknowledged that the authors of this paper hold an ideological belief in well-performing reuse systems. However, in developing this paper, the intention was to set this aside and focus purely on the basic economics of reusable packaging to direct policy decisions and assuage concerns over the impact on jobs and GDP. In reality, complementary environmental and health benefits should weigh heavily on policy-making. In the graphs depicted, the externalised costs of single-use plastics therefore have been indicated in a different colour, thus highlighting the hidden, but so-called true costs of materials.

Conclusions

This report has shown that reusable plastic packaging can be a viable alternative to single-use plastic packaging if the right conditions apply.

If we succeed in building and scaling reuse systems, they will outperform single-use systems. This not only benefits the environment but also business.

Market pressure from the supply chain, consumers and regulators is encouraging the adoption of more sustainable packaging choices, reuse increasingly being the focus. However, the decision to switch to a reusable packaging model can be a daunting one for businesses accustomed to relying on single use convenience. They fear that heavy start-up investment and ongoing operational costs will negatively impact overall economic growth, citing unsuccessful reusable packaging trails as evidence. There are numerous technological factors which will influence the success rate of any reuse system – packaging design, material choice, tracking technology and effective consumer engagement. Reusable packaging performance parameters of retention time, return rate and the average number of rotations before EoL need to be optimised to ensure sustainable economic advantage.

It is often assumed that reusable packaging needs the creation of a wide-scale supporting infrastructure for it to be financially viable, but the use case studies above have shown, even in isolation, there is a break-even point for all three packaging formats where investment is recovered and the system becomes profitable. The development of collaborative pooling systems for logistics and cleaning services would only share the burden of investment and shorten this profitability threshold.

This should reassure businesses that switching to reusable packaging could unlock huge economic benefits for their company at the same time as encouraging brand loyalty and satisfying sustainability targets.

The establishment of coordinated reusable packaging at a systems level would also open up whole new sectors for economic growth. New business opportunities in services such as transport, cleaning and repair would create a host of green job opportunities within the circular economy, relieving pressure on finite resources and ensuring a sustainable future for us all.

REUSE ADDS UP

Recommendations

To realise Europe's circularity and waste reduction ambitions a myriad of solutions need to be deployed.

From general packaging elimination, through material substitution to effective collection and recycling of eventual waste, reduction of virgin resource use must remain a priority.

The widespread adoption of reusable packaging within a circular economy will play a driving role in relieving pressure on virgin resources, extending the lifecycle of products and keeping materials in the loop. Policy-makers and business owners must not be influenced by misinformation and intense lobbying from those with a vested interest in continuing business as usual. We cannot continue down a linear track, the track will soon run short.

Policy-makers

- **Maintain the focus on the objectives of waste prevention** and improving environmental performance.
- **Avoid marginal improvements on waste management** when targets should be focused on long-term systems change preventing over-consumption, waste and pollution.
- **Examine all evidentiary studies** with a critical view of the interests of the authors.
- **Question methodology and assumptions** made by studies favouring single-use.
- **Accelerate radical systems change** through the regulatory incentivisation of reduced production and virgin material extraction.
- **Incorporate externalised costs** into true pricing of materials and products.
- **Provide a level playing field for a reuse system** still in its infancy but with a bright and profitable future.
- **Build a functional circular economy** which creates green job opportunities and sustains responsible economic growth.

Business Owners

- **Critically look at your own single-use plastic use** and be open to profound changes in your business model in order to unlock a sustainable and profitable future.
- **Analyse risk and benefit factors from an objective perspective** using the appropriate packaging performance parameters.
- **Make valuable connections with other stakeholders** to create a shared system where all parties will prosper.
- **Work proactively towards your commitments**, do not be distracted by nay-sayers and the risk-averse.
- **Get ahead of enforcing legislation** and your competitors and be the leaders of change.

"Reuse is now mathematically proven to be financially viable when operated at scale. This should support the transition towards a circular economy that prevents plastic pollution."

Willemijn Peeters, CEO of Searious Business

Searious Business is an impact-driven company based in the Netherlands, working towards the goal of zero plastics entering our ocean. They help businesses in the plastic value chain to keep plastics in the economy and out of the environment. Searious Business regularly performs in-depth Cost Benefit Analyses for individual companies or case-by-case examples. For this study, Searious Business has made a high-level overview of the costs and benefits of three plastic packaging cases, comparing reusable plastics with single-use plastics options. www.seariousbusiness.com

Zero Waste Europe is a European network of communities, local leaders, experts, and change agents working towards the elimination of waste in our society. Advocating for sustainable systems and the redesign of mankind's relationship with resources, they accelerate a just transition towards zero waste for the benefit of people and the planet. www.zerowasteeurope.eu

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