Circular Economy Portugal

Por uma sociedade sem desperdício

Making the business case for packaging reuse systems

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Glossary

B2B
Business-to-Business

B2C
Business-to-Consumer

Deposit return system (DRS)
A DRS is a system whereby consumers buying a product pay an additional amount of money (a deposit) that will be reimbursed upon the return of the packaging or product to a collection point.

Extended Producer Responsibility (EPR)
EPR schemes are "a set of measures taken by Member States to ensure that producers of products bear financial responsibility or financial and organizational responsibility for the management of the waste stage of a product's life cycle".

HACCP
HACCP stands for 'hazard analysis and critical control points'. It is a certified process to ensure food safety and hygiene.

Life cycle assessment (LCA)
LCA is a methodology that analyses and assesses the environmental impacts of a product, process or activity over its whole life cycle.

Plastic
A material consisting of a polymer as defined in point 5 of Article 3 of Regulation (EC) No 1907/2006, to which additives or other substances may have been added, and which can function as a main structural component of final products, with the exception of natural polymers that have not been chemically modified.

Primary packaging
Packaging which is in direct contact with the product. Its main function is to protect the product, but it also has marketing and communication functions.

Reusable packaging
Packaging which has been conceived, designed and placed on the market to accomplish within its life cycle multiple trips or rotations by being refilled or reused for the same purpose for which it was conceived.

Return on the go
An Ellen MacArthur Foundation reuse model. Users return the packaging at a store or at a drop-off point (e.g. in a deposit machine), which means this model can be implemented across sectors with a wide use of disposable packaging such as traditional retail outlets for beverages and in the HoReCa and events sector (for on-the-go products).

Return from home
An Ellen MacArthur Foundation reuse model. The packaging is collected at home by a pick-up service (e.g. a logistics company). This model is particularly suitable for e-commerce, since the collection of the used packaging

can be combined with the delivery of new products. In addition, this model is especially appropriate for urban areas where travel distances between deliveries are shorter.

Reuse
Any operation by which packaging, which has been conceived and designed to accomplish within its life cycle a minimum number of trips or rotations, is refilled or used for the same purpose for which it was conceived, with or without the support of auxiliary products present on the market enabling the packaging to be refilled. Such reused packaging will become packaging waste when no longer subject to reuse.

Single-use product (SUP)
Single-use products are used once, or for a short period of time, before being thrown away.

Secondary packaging
Packaging that is not in direct contact with the product, but with a protective function towards the primary packaging.

Standard
A document, established by consensus and approved by a recognized body, that provides, for common and repeated use, rules, guidelines or characteristics for activities or their results, aimed at the achievement of the optimum degree of order in a given context.
There are several different types of standards. In simple terms, standards include requirements and/or recommendations in relation to products, systems, processes or services. Standards can also be a way to describe a measurement or test method, or to establish a common terminology within a specific sector.

3PL
Third-party logistics providers are companies that supply a wide range of services such as material/product management, transportation/distribution and warehouse space, in exchange for a fee.

User
In a circular economy, the term ‘user’ is used to define a person that uses or has access to a technical material (e.g. a washing machine).

Executive summary

Packaging is ubiquitous and has driven many of the modern distribution models that thrive today. B2C reusable packaging systems, though, have been in decline in Europe in recent decades, at the same time as B2B transport packaging has been showing that businesses can reap environmental and economic benefits from reuse.

To be effective and realize its potential, packaging reuse systems require a systemic change, in which all players of the value chain are involved, and all elements of the system are rethought. Straightforward processes, clear communication and reward for all actors are key to get successful systems delivering their potential benefits.

Reuse systems present opportunities for the environment, for people and for the economy. These benefits support the transition to a circular economy, are aligned with municipalities' waste policies, and decrease the costs of waste management. But reusable packaging can also have a positive effect on brands, driving loyalty, offering a better user experience and driving consumer engagement, besides the economic savings it offers.

There is clearly a lot of potential for reusable packaging, but reuse systems also face many practical challenges as a result of the linear economy in which they have to operate. Reuse businesses have high upfront investment (e.g. to purchase reusable packaging, set up washing facilities etc.) and operational costs (reverse logistics, collection, inspection activities etc.), and a clear need for scale.

There are some promising examples of reusable packaging operations, with a range of business models, tackling different product groups across Europe. Records of businesses funding their own growth or receiving investment from private investors are positive signs that it is possible to break down the barriers and succeed. There are also many examples of collaborative pilots and tests being carried out by manufacturers and retailers.

Food and beverage containers in HoReCa, e-commerce, fashion, and household care in retail are among the most promising product groups when it comes to packaging reuse. Reuse systems for these four product groups show much less environmental impact than single-use alternatives: they have between 3 and 13 times less impact, depending on the product category. Scaling up reuse systems across Europe for these product groups alone would bring significant environmental benefits. A target to replace 20% of single-use packaging with reusable systems in Europe by 2027 and 50% by 2030 across all four product groups would drive the following environmental savings: 938 and 2,660 truck loads saved from landfill in 2027 and 2030 respectively; the equivalent annual energy consumed by 898,705 and 1,650,585 households; enough water to fill 1,383,472 and 4,014,054 Olympic swimming pools; 1,265,707 and 3,485,529 truckloads of materials; and the carbon dioxide sequestered by 58,836,378 and 170,073,184 mature trees. Driven by viable business cases, economic incentives for users (retailers/manufacturers) would be significant too: savings could amount to more than €5.868 billion by 2027, rising to €16.261 billion by 2030.

As has been proved by DRS systems, standardization offers opportunities to reduce operational costs, create necessary economies of scale, and maximize the environmental benefits of reusable packaging systems. A clear definition of 'reusable' is needed, and a label could be developed to distinguish reusable from single-use packaging, following a set of systemic requirements. National guidelines could be developed by public institutions for aspects that are more difficult to standardize at international level and require some adaptation to local/regional contexts.

There is a clear need for policy support to maximize the business case and scale up aspirations in Europe. Public support (EU, national and local) to help reuse initiatives overcome challenges could be provided in the form of policies and regulations as well as through other instruments.

At EU level, the revision of the Packaging and Packaging Waste Directive (PPWD) should integrate concrete reduction and reuse targets. At national level, new legislation should be enacted to formalize these targets, and update existing EPR agreements and Plastic Pacts. Most importantly, government monitoring is needed to keep track of the level of reuse and the effectiveness of measures implemented by the industry, while non-compliance should lead to effective sanctions.

In principle, unnecessary and unsustainable single-use packaging (not only plastics, but all materials) should not be allowed on the market. It should be made mandatory to offer an option of a reusable alternative for all out-of-home consumption (take-away and delivery), e-commerce and household care.

To steer the circular economy in the right direction it is essential that the EU and national governments adopt ambitious and legally binding reduction and reuse targets for the packaging industry. To be in line with the ambitions for a circular economy, the total amount of virgin plastic packaging placed on the market should decrease by 25% by 2025 and 50% by 2030. Another option to force companies to avoid single-use packaging could be a quantitative limit, or cap, on the amount of single-use packaging material put on the market.

In addition, binding reuse targets create a safe environment for investments in reuse systems and infrastructure by SMEs and larger corporations alike. Different targets should be adopted for different product groups, since each has its own potential, market dynamics and challenges. The following targets (percentages for the share of the market covered) for reusable packaging are proposed:

- Drinking cups: at least 75% by 2030
- Take-away and delivery meal containers: at least 50% by 2030
- Household care products (laundry care etc.) distributed by large retailers: at least 20% by 2030.

To address the investment obstacle, government agencies could provide soft loans or create innovative funding schemes such as convertible loans or grants for reuse businesses. At the local level, municipalities could provide local businesses with financial support to develop and implement reuse pilots. Measures are needed to improve the business case for reusables (such as more economic disincentives for SUPs), as well as fiscal measures to make capital investments in reuse systems eligible for tax rebates.

In addition, government support for R&D programmes is needed to develop and improve reuse systems. At least 10% of EPR budget should be earmarked to be invested in the development and scaling-up of reuse systems. Furthermore, EPR mechanisms should be improved to promote design for reuse. This could be achieved through ecomodulation (differentiation) of fees, so that producers of reusable packaging would pay less. DRS for beverage containers – increasingly being adopted in EU countries, mostly for recycling – could be deployed for reuse as well.

Government agencies should provide information services to support stakeholders with the practical implementation of reuse systems, for instance through creating guidelines, and support the set-up of Communities of Practice (CoP). CoPs would allow different actors (e.g. supermarkets, brand owners, service providers, start-ups, research institutes and NGOs) to collaborate and exchange information on the challenges and opportunities for reusable packaging, and could be funded by packaging waste management contributions.

It’s time to embrace packaging reuse and its potential across Europe!

1. The reusable packaging opportunity

Over the last few decades, we have become dependent on single-use packaging as an accessory for the linear economy – it is, in fact, a symbol of it. Primary and secondary packaging are used in HoReCa (Hotels, Restaurants and Cafés), e-commerce and large retail to market products, protect goods in transit, extend product life, ensure health and safety, and facilitate logistics.

In Europe, and in the rest of the world, most packaging produced is designed as single-use – in other words, to be disposable. This has resulted in rapid and continued growth of the amount of materials used for the purpose: in 2018 40% of all plastics [1] [2] and 50% of all paper were used for packaging [3]. In addition, in 2017 packaging waste in Europe reached a record total of 173 kg per inhabitant [4]; and in 2019 it made up 36% of all municipal solid waste [5]. To a great extent, the externalization of the costs of single-use packaging has been the primary enabler of retail models based on one-way packaging [6].

To date, European policies addressing single-use packaging have been focused on recycling or on small changes in the packaging, such as a reduction in the amount or volume of material used, or the replacement of conventional materials with biobased ones. These changes are part of a trend observed in recent decades in which countries have been moving away from reusable solutions and replacing them with single-use ones. Meanwhile, the EU has prepared several directives and set targets specifically for recycling, but not for reuse. Only recently has the EU started (again) to pay attention to reuse, as recycling rates are low and recycling is proving to be a limited option to tackle this massive problem [7] [8].

As we set out to explore the business case and enabling conditions for packaging reuse systems and their potential in this report, it is important to note that although packaging has a generally negative environmental impact, in all product categories covered (HoReCa – food and beverage containers, e-commerce – fashion, shoes and accessories, and large retail – household care) it only represents a small portion of their full environmental impact, as typically the production phase is responsible for most of it. Nevertheless, the great majority of studies point to reusable packaging as the most environmentally friendly option [9], even though the business models still need to be created and tested to overcome various challenges mostly related with logistics and scaling up.

Many start-ups and small businesses have, in recent decades, attempted to develop reusable packaging systems across all three channels, but none has yet achieved this at scale. Meanwhile, in the B2B sphere there are many examples of reusable packaging in operation, especially in transit packaging. While there is room for scaling up here too, the main difference is that there aren't any consumers involved in such systems.

Packaging sustainability has also been an important topic on the public agenda in recent years, with internationally renowned bodies such as the Ellen McArthur Foundation and Reloop, and initiatives like the Plastics Pact, addressing some of the environmental challenges it poses.

Given the environmental issues involved and the urgent need for action, the European Union has made it a priority to promote and facilitate the implementation of reusable packaging and reuse systems across Europe. The New Circular Economy Action Plan [4] is part of a wider European strategy – the New Green Deal – which aims to create a climate-neutral, resource-efficient and competitive economy by 2050. With regards to packaging – one of the key product value chains identified – the document sets the target of "all packaging on the EU market being reusable or recyclable in an economically viable way by 2030". More specifically, the main actions on packaging are to reduce (over)packaging and packaging waste, to promote design for reuse and recyclability of packaging, and to reduce the complexity of packaging materials used.

In 2018, the new Waste Framework Directive (2018/851) was adopted, amending the Directive 2008/98/EC. In this directive, the waste hierarchy was reinforced as a principle to be applied as a priority order in waste prevention and management legislation, and Member States should prioritize the options with the most environmental impact: prevention and preparation for reuse and recycling. Member States should act to promote reuse activities through, for example, "encouraging the establishment of and support for preparing for re-use and repair networks (...) and by promoting the use of economic instruments, procurement criteria, quantitative objectives or other measures". Additionally, targets for preparing for reuse and recycling of waste were increased: by 2025, the amount of municipal waste prepared for reuse and recycling should be a minimum of 55% by weight, by 2030 this will increase to 60%, and by 2035 the target is to reach 65%.

In addition, the Directive 2018/852 of 30 May 2018 amending Directive 94/62/EC on Packaging and Packaging Waste (PPWD) sets out Article 5 specifically for 'Reuse'. The goal is to increase the share of reusable packaging available in the market, and to implement reuse systems that produce positive environmental impacts and that don't compromise food hygiene and safety for users. To achieve this goal, Member States are recommended to use measures such as deposit-return systems, economic incentives, or targeting a minimum percentage of reusable packaging to be placed on the market. The Directive is currently being revised, and a proposal for a revision is expected to be presented by the end of this year.

The EU also adopted the Plastics Strategy in 2018, building on existing measures to reduce plastic waste: it "aims to transform the way plastic products are designed, produced, used and recycled in the EU." One of the most relevant actions in this strategy is the establishment of mandatory requirements for the implementation of waste reduction measures for a set of products such as packaging.

Following this Strategy, the European Parliament and the European Council adopted the Directive 2019/904 on the reduction of the impact of certain plastic products on the environment, usually known as the Directive on Single-Use Plastics. The document sets out a number of measures which Member States should follow:

- Article 4, on "Consumption reduction": Member States should take measures to reduce the consumption of single-use plastic beverage cups (covers and lids included) and food containers by 2026, compared to 2022 levels.
- Article 5, on "Restrictions on placing on the market", bans among several items: cutlery (forks, knives, spoons, chopsticks), plates, straws (except for medical use), beverage stirrers and food containers made of expanded polystyrene used typically in take-away and delivery services; beverage containers made of expanded polystyrene, including their caps and lids; and cups for beverages made of expanded polystyrene, including their covers and lids, from 3 July 2021.

Primary reusable packaging systems in Europe have been in decline for the last few decades, and now mostly appear in the bottled beverages category [6], to varying degrees in different Member States. These systems exist in both HoReCa (with centralized refill by manufacturers) and retail in the form of deposit return schemes (compulsory or voluntary). At the same time, the adoption of reusable transport packaging has increased on the back of the economic savings and logistics efficiencies it offers.

2. Research methodology

This research aims to assess the business case for reusable packaging. The focus of the study is on B2C models, as the main source of packaging waste is driven by primary packaging, and there is a wider gap in reusable packaging systems in this sector in contrast with the B2B sector's broad use of reuse pallets and crates. Targeting the product groups that have the greatest potential for reusable packaging systems, this study explores the best strategies for putting them in place.

The focus of this study is on models in which the packaging is owned by the brands/retailers, and the user has to use it to participate in the system. It is important to note that the term 'user' is more appropriate than 'consumer' in these systems, since the individuals only use or have temporary access to the packaging during the usage phase, and therefore don't consume or own it.

There are already a number of examples of 'bring your own container' or refill models. However, although these models require less investment, they are mostly niche and they don't require the focus and scale necessary for the channels and product groups chosen in this study. In addition, channel replacement alternatives – such as online subscription models for large retail – were not considered to be the best options to drive user adoption and achieve scale. Nonetheless, grocery shopping (large retail) and HoReCa delivery services can be integrated in these systems in the future.

The four reuse models from the Ellen MacArthur Foundation [11] were chosen as references: 'Refill at home', 'Refill on the go', 'Return from home' and 'Return on the go'. These models are differentiated through two main aspects: packaging 'ownership', and where users refill and/or return the packaging. For the scope of this study, only the Return from home and Return on the go models were effectively covered.

The main research steps were the following:

1. Review of available studies, industry reports and scientific papers on reusable and sustainable packaging
2. Selection of the product groups with the biggest impact to be studied in depth by applying a multicriteria decision analysis method
3. Interviews with experts and players along the value chain regarding packaging, logistics, business models and ecodesign
4. In-depth analysis of the four selected product groups and identification of effective strategies for systems with potential to scale up
5. Identification of successful case studies of reuse systems in Europe for each of the product groups
6. Estimation of the potential environmental, economic and social impact of reuse systems for scaling up at European level.

A literature review focused on existing reports and scientific papers on the definition, characteristics and implementation of reuse business models (mostly in Europe) was carried out. Research was also performed on existing life cycle assessment (LCA) studies comparing traditional vs reusable packaging/business models, focusing – among other subjects – on the environmental impacts or operational costs of these systems. This was complemented with the consultants' own experience, work and knowledge of various packaging reuse systems, deepening the theoretical information mostly found online.

To select the product groups with the biggest potential for implementing reusable packaging systems, the research focused on three main distribution channels:

1. HoReCa: covering restaurants, hotels and cafés. In this case, the consumer goes to an outlet to purchase food/beverages to take away.

2. E-commerce: covering all products that are shipped from warehouses/retailers directly to users' homes. Secondary packaging is used to protect the goods being delivered.
3. Retail: covering large and small supermarkets and chains. This channel considers all the goods that are commercialized in a physical space, where the user goes to buy. Most goods are pre-packed and displayed on shelves, often in several layers of multi-material packaging.

A multicriteria analysis was applied to the main product groups to determine those with the greatest potential.

HoReCa	**E-commerce**	**Retail**
Take-away food	Fashion, shoes and accessories	Fruit and vegetables
Hot beverages	Cosmetics	Dry food
Cold beverages	Books	Refrigerated and frozen food
Fresh food (sandwiches, pastries, etc)	Electronic and electric equipment	Household care products
Beer	Food	Cosmetics
Wine	Toys and games	Beverages

Table 1: Main product groups sold through the three distribution channels considered

The goal was to identify product groups that generate high volumes of difficult-to-recycle packaging waste, for which reusable packaging solutions could have the biggest impact. Criteria related to potential barriers to such systems were considered, such as fewer health and safety restrictions, higher acceptance from users, and local and vertically integrated supply chains[1] (which increase control and capacity to implement a reuse system). Consideration was also given to criteria that could increase reuse opportunities, i.e. products with higher profit margins which could more easily accommodate more expensive packaging, and/or where a deposit for the packaging could be more acceptable to users; as well as the availability of data and case studies that show evidence of the feasibility of reuse models.

The four product groups deemed to have the greatest potential to implement reusable packaging systems were:

- Food and beverage containers and cups sold in the HoReCa sector
- Fashion, shoes and accessories that are distributed through e-commerce
- Household care products (e.g. laundry care, surface care, dishwashing etc.) that are distributed through large retailers.

Around 20 interviews and personal contacts were also conducted in order to assess and confirm information and data found in the literature review and to gather updated and in-depth information from relevant stakeholders in the field: these included businesses already implementing reuse systems in different European countries for all three product groups, manufacturers and retailers testing various reuse models and systems, logistics and packaging experts, and manufacturers' associations.

An in-depth analysis of the four selected product groups was carried out, studying current value chains and logistics in order to identify effective strategies for systems with the potential to scale up.

Case studies for existing reuse systems were prepared, to inspire and inform readers about how specific barriers have been overcome, to show the environmental and socio-economic impacts of these models (especially compared to single-use ones), and to identify the potential opportunities these cases reveal. The following case studies were selected: for the HoReca channel, Uzaje (France) for food containers and CupClub (United Kingdom) for beverage containers; for e-commerce for fashion RePack (Finland); for large retail, a combination of different pilot projects and initiatives from different companies.

[1] Vertically integrated supply chains involve the same actor controlling one or more stages in the production or distribution of a product.

The estimation of the potential environmental, economic and social impacts of reuse systems for each product group at a European level was calculated using an LCA methodology, based on a set of 16 impact categories from land use to human toxicity, climate change and water use. For each of the product groups, a comparative analysis between a reusable system and a single-use alternative was carried out.

An economic analysis of each of the systems was also conducted, taking into consideration the following cost categories: collection costs, inspection costs, washing costs, environmental protection costs, new packaging acquisition costs, and holding costs. The potential economic savings/additional costs of the system to the users (retailers/manufacturers) was then calculated compared to the most prevalent single-use alternative.

The scale-up potential was assessed by applying three different scenarios to a proportion of the packaging currently used by each of the product groups, to determine the potential number of packaging uses to replace: the food and beverage containers used by populations in urban areas; the packaging used in intra-European e-commerce orders of fashion items; and the liquid laundry detergents and fabric conditioners bought in retail stores.

3. General barriers and opportunities for packaging reuse systems

To realize their full potential, packaging reuse systems require a systemic change involving all players in the value chain. Straightforward processes, clear communication and incentives for all actors are key to getting systems to deliver their potential benefits.

Reusable packaging systems face many barriers during their implementation and scale-up, but there are also many opportunities.

The main barriers to reuse systems are those which make linear systems easy and convenient for everyone. The first issue is that single-use packaging is, in general, cheap due to the low prices of raw (virgin) materials, and the fact that the externalities of these types of packaging are not internalized in their prices. This makes it more difficult for reuse systems to compete since they have higher up-front investment and operational costs (e.g. to purchase reusable packaging, set up washing facilities etc.). Even though there is an increasing demand for (or at least interest in) 'eco-friendly' products, some users are not willing to pay an additional cost for reusable packaging [7]. Refuse systems also face the challenge of changing users' habits and behaviours since they must perform an additional step and return the package after being used – high levels of communication and education are needed. This can be a significant barrier if many non-standardized systems are implemented, because users may not find it easy to deal with multiple systems. In addition, if systems cannot achieve economies of scale they may not become profitable.

Despite these barriers, reuse systems present positive opportunities for the environment, for people and for the economy. One of the main benefits of reuse systems is their long-term environmental effects. Most LCA studies [8] [11] [12] report that they produce less waste and emit less CO2 than traditional systems. These benefits support the transition to a circular economy, are aligned with municipalities' waste policies, and decrease the costs of waste management. This can increase municipalities' interest in waste reduction initiatives and their willingness to support local businesses in adopting such systems (e.g. through paid trials).

For companies, the use of reusable packaging also offers several opportunities. For manufacturers it lowers their extended producer responsibility (EPR) since it reduces the amount of disposable packaging placed on the market (for which they are held accountable) and, consequently, lowers their financial costs. For businesses using reusable packaging this can not only promote cost savings but can also even be a source of profitability if the packaging goes through a high number of use cycles. In addition, companies using this type of packaging are perceived by users as being more sustainable, which improves their image and may attract more users [7]. Reusable packaging also offers a better user experience than single-use, as it is of better quality and eliminates the need to dispose of the packaging. Also, businesses using harmonized packaging and sharing centralized washing and logistics can benefit from streamlined operations and cost savings. These centralized and shared operations are already being tested in collaborations between players in the value chain, such as beer manufacturers creating DRS for reusable bottles in the Netherlands; brand owners and retailers testing and developing solutions, such as Loop with Tesco UK and Carrefour in France, Unilever and ASDA, Algramo and Unilever; and pilots such as Tchibo and Zalando's with Repack for e-commerce. Finally, registered venture capital investment levels in packaging reuse start-ups such as Algramo (€6.4 million), Loop (€22 million), The Modern Milkman (€4.4 million) and Good Club (€1.6 million) among others show that private investors are seeing the business case for these systems.

The main elements of reuse systems are packaging design and materials, ownership, logistics, incentives to return, and the role of users. Each of these aspects poses specific challenges for implementing and running these systems, and it is essential that practical solutions are found. These basic elements are described in more detail below, as they apply to all reuse systems for all product groups. However, at the same time, different product

groups in different distribution channels (HoReCa, e-commerce and retail) require different adaptations in order to function. These differences will be explained in the subsequent sections.

The organization of these basic elements will influence investment and operational costs, which will ultimately determine the business model of a reuse system and the extent of its success.

Reusable packaging design and material main characteristics – durability to maximize the number of cycles, take as little space as possible in storage and transport, being stackable and lightweight, designed to be repairable, made of recycled materials and recyclable.

Ownership – following a circular economy framework, packaging-as-a-service models mean that manufacturers or retailers would lease the packaging for temporary use (selling its 'function' and not transferring the ownership).

Logistics – reusable packaging logistics involve a number of new reverse logistics processes, from package recovery after use, to cleaning and washing, as well as redistribution for reuse.

Incentives for return – high return rates of reusable packaging can be obtained through a deposit or reward and by means of tracking technology.

User's role – identifies the role a user has to play in the system, such as refilling the packaging or returning it to drop-off points.

4. Priority product groups

4.1 HoReCa – Food and beverage containers

Product categories

In the current traditional system, food and beverage containers in HoReCa are used in take-away and delivery services. Even though take-away and delivery deal with different types of food (soup, salads, pizza, hamburgers, etc.) and beverages (hot and cold), they both present similar characteristics (materials used, legal requirements, opportunities). Therefore, for the scope of this report they have been analysed together, while specific aspects of each have been taken into consideration where needed.

Sector trends

Worldwide, the take-away and delivery of food and beverages is increasing rapidly. In the European Union alone, there are more than 2.556 billion take-away containers being used per year [13], and both food containers and beverage cups are among the top 10 single-use plastic items most commonly found on Europe's beaches [14]. The COVID-19 pandemic drove a surge in demand for single-use plastic, especially packaging, a category that saw a 40% increase[2] [15]. One of the sectors affected was food take-away and delivery services. As many businesses had to close because of the lockdowns in many European countries, food delivery services saw a surge in online orders as well as users, many of whom are expected to continue using these services after the pandemic is over. According to recent data, European online food delivery sector revenue is expected to grow at 7.06% CAGR[3] between 2021 and 2024.

Single-use packaging and materials

This sector uses a variety of single-use containers (mainly cups, trays and bowls) to package different food and beverage types. The environmental impacts of these items are most significant during the initial phase of (resource) extraction and production and at the end stage (disposal), since this packaging is used for a short period of time and then generally sent to landfill, incinerated, or dropped as litter.

Different materials can be used for single-use packaging for food and beverages, but the polymers that are used the most are polyethylene terephthalate (PET), polypropylene (PP), high (HDPE) and low (LDPE) density polyethylene, polystyrene (PS), or multilayers (combinations of different types of materials), along with bio-based plastics [16]. Aluminium, combined with a paper lid, is also often used for meal containers. Coated or waxed paper is starting to be used more as a substitute for plastics. However, single-use products made of other materials besides plastics still do not present a sustainable solution: they are still disposable and require materials and energy for production, and often the mix of materials hinders the recycling process [17].

Hidden chemicals in so-called 'green alternatives'

Moulded fibre products (often advertised as compostable or biodegradable) pose a danger to human health, since a study found the presence of PFAS (Per- and polyfluorinated alkyl substances, also known as 'Forever Chemicals'). PFAS are a group of more than 4,500 compounds that are used for their ability to repel grease and water, but they also can persist in the environment for a long period of time and don't degrade easily, thus creating harmful impacts in the environment. Another recent study conducted in four countries by BEUC (Bureau Européen des Unions de Consommateurs) and other consumer organizations found dangerous chemicals in single-use tableware such as plant fibre bowls, paper straws and palm leaf plates. Half (53%) of the sampled products contained one or more unwanted chemicals above recommended levels. The study also warns about green claims and marketing messages found in this type of packaging that

[2] This figure was also due to the increase of plastic use in the medical sector
[3] CAGR – Compound Annual Growth Rate

can mislead consumers into thinking these options are perfectly safe and 'environmentally friendly'. BEUC and its member organizations urge the EU to ensure these alternatives are safe since there are no specific rules for such materials (unlike plastics).

Reuse system alternatives

Different packaging reuse **implementation strategies** are presented below.

Packaging design and material

The main criteria for the functional performance of reusable packaging to be used in HoRecA are: leak-proof for transportability (better than single-use packaging if possible); a small number (not many) of formats and sizes should be standardized for specific types of food (e.g. soup, pizza, hamburgers); and easily washable, stackable and with enough airflow between packaging to prevent mould from forming. Packaging should also be heat-resistant to allow for warming up and washing at high temperatures, have a separate universal lid, and be firm [18]. Packaging should be adapted for marketing purposes and differentiation, especially in the case of large chains and well-known brands. Standardized in format, branded packaging can be sorted during washing, regrouped and distributed according to brand.

Reusable containers must also comply with national food safety legislation and/or international regulations such as HACCP regarding food contact materials, and also the handling and storage of dirty containers, in order to be safe for food and drink consumption. They should be made of materials that are proven not to leach chemicals into food, even with very hot drinks. Where possible, the use of recycled materials should be included, although material safety should be considered as the use of these materials may increase possible sources of contamination, as well as increase the levels of chemicals that can migrate from packaging into food.

Ownership

Each region or locality can have a different set-up for the structure and operation of the model, adapted to local circumstances.

However, the most effective model is the one where Reuse businesses are responsible for both the packaging and managing and operating services such as washing and transportation/distribution logistics. Reusable packaging (e.g. cups and food containers) is owned by an external third party (reuse-as-a-service provider) who leases the packaging to a network of HoReCa businesses. Due to the proximity element of this sector, this system offers an opportunity to small businesses to thrive in a new economy focused on local solutions for local actors and local users.

There is also another model in which the reusable packaging is owned by the HoReCa businesses, making them responsible for managing the system. However, due to limitations of space and washing capacity (reusable packaging usually takes up more space than single-use options), especially for take-away-only businesses such as food trucks and kiosks, this model may not be suitable for all businesses.

Logistics

Reusable packaging requires the development of a new reverse logistics system which involves changing or adjusting the existing value chain and operational processes, increasing complexity and requiring HoReCa businesses to assume new functions that they may not have experience with.

To tackle this difficulty, there should be a local pooling coordinator (generally a 3PL) to act at scale within a region in order to reduce complexity and reach economies of scale. A standardized system increases logistics

efficiency and environmental performance, and streamlines processes such as programming the packaging weight on a scale for those businesses selling food by weight.

In the case of closed spaces such as schools, campuses, offices and sports facilities, and at events such as festivals, where consumption takes place onsite, it may be easier to implement and run these types of systems as they simplify the return logistics and minimize the impact of transportation.

An app/website owned by the service provider can also be offered to display the network of partnering businesses and drop-off points. Transportation logistics can be implemented to collect each day, in reusable boxes, the containers/cups from all the partners in the network to be washed and redistributed. Used packaging should be picked up for washing as soon as possible to prevent mould, not to take too much valuable space inside businesses, and to keep pooling volumes low. The distance travelled to pick up and clean containers should be minimized through smart logistical systems and planning. Last-mile logistics[4] should be the most energy-efficient, using electrical vehicles – or even, if distances allow, bicycles [19].

One of the most important process steps in a reuse system is the washing of the containers. In general, reusable food and beverage containers, especially ones used for oily or creamy foods, are difficult to wash, creating possible difficulties for businesses that need to ensure a proper washing process for all types of containers used. In order to guarantee food safety and the hygiene of reusable packaging this should be carried out either by the HoRecA business itself (if it has the facilities, which is not always the case) or an external service provider. These operations may be located in the outskirts of the city/region where the system is in place.

Incentives to return

Most systems include a deposit or reward to ensure users return the packaging. Recircle's experience revealed that the deposit is not usually a barrier, and Uzaje has even tested a system with no associated deposit. Another way to encourage users' participation is to offer discounts on future purchases if the package is returned; VYTAL, for example, offers points that can be used towards the next order.[5]

In the HoReCa channel, the volume of daily transactions made by users is especially high. Accounting for deposits on packaging every time it is returned by a user adds an additional step to the checkout processes. This can complicate accounting on revenue transactions, and it also represents a transaction charge for the business if performed electronically. An app to manage the user's deposit can streamline processes (e.g Recircle).

A dense local network of accessible bring-back points should be available, so it is easier for users to return containers. Automated bring-back machines or reverse vending machines (e.g. Greenwins) can improve the user-friendliness of the system, allowing users to bring back containers at their convenience, after closing hours of outlets and avoiding queues. The need for users to return the packaging increases the probability of a new purchase and can function as an opportunity to increase user loyalty to a HoReCa business participating in this network.

Traceability is a major component of these systems, since a stock of cleaned containers is crucial for their success. Asset tracking technology – such as RFID tags inside cups and containers, or barcodes – could track location, and most importantly show how often a cup is being used and washed. This information is crucial to gather data on usage and to help control container lifespan and quality.

[4] In logistics this is the final step of the process, when the package arrives at the user's house.

[5] Marketing strategies such as discounts, vouchers or rewards should not incentivize unnecessary (new) purchases, but rather promote a repeated and adequate use of the system.

Users' role

Users return the containers at a network of local drop-off points created by the reuse-as-a-service provider. This allows users to return containers at their convenience, after closing hours and avoiding queues. As well as returning the container, depending on the system implemented, some businesses require pre-washing or even washing.

In addition, reusable packaging often offers a better food storage solution than single-use packaging, so users can save and store leftovers for longer before returning the container.

Hitchhiking with food delivery services

Currently, delivery services still mainly use single-use packaging in their operations. However, in Barcelona, Glovo is collaborating with local reuse startup Bûmerang to use their reusable food containers with member restaurants. So far more than 70 restaurants have this option available, and the intention is to expand the network. This is part of the pledge Glovo made in 2019 to reach carbon neutrality by the end of 2021. In the pilot phase users must return the containers to a member restaurant, but Glovo believes that in the future delivery partners may be able to pick up from users' homes and drop off at a member restaurant at their next delivery.

The following are the key success criteria to scale up a packaging reuse system for food and beverage take-away:

- **Standardized packaging –** reuse systems need to have only a few product references (types of containers and cups used) and should be standardized (e.g materials used, size, shape) to allow less complex logistics (transportation) and storage, and easy pooling (to be used by several local players).
- **Reuse-as-a-service model:** an external service provider should be responsible for managing and operating a reusable packaging system in a network of HoReCa businesses.
- **Washing –** ensure processes comply with health and safety food regulations such as HACCP.
- **Incentivize return –** have an easy-to-use deposit management system such as a card or an app which can store the deposit paid on joining the system. The card/app can be scanned at checkout avoiding the actual transaction of money.
- **Ease stock management for outlets** – the system needs to guarantee regular deliveries of new/washed cups and containers, in some cases more than once a day.

Case study: Tracking CupClub's vanguard system

System: Return on the go
Operating markets: United Kingdom, United States of America

CupClub is a pioneer returnable cup subscription service for beverages based on a technological system aiming to fully track user food packaging (cups, lids and drop-point cases). Providing real-time operational data through QR code internet of things (IoT) technology, it supports brands and businesses to keep the convenience of take-away without throwaway.

Overcoming challenges

In two years, CupClub has served 530,000 drinks across numerous London offices and university cafés with a record return rate of 95%, with its users empowered by its mobile app to easily find a nearby drop-off point without deposit (in the US there is a €4.38 per item charge to cover the costs if it is not returned within five days).

Its return on the go model consists of delivering 250 to 10,000 clean cups and lids every day in CupClub boxes to outlets, while collecting used ones to ship back to outsourced washing facilities within a 25km perimeter. There is a set-up fee, depending on the technology integration requirement, and an additional €0.2 per served drink on a 24-month contract with a 3-month trial. To improve data accuracy and traceability, the company has replaced the initial RFID code by a QR code printed on the polypropylene (PP) cups and low-density polyethylene (LDPE) lids.

Thanks to the app, operations are optimized by tracking the status and quantity of cups in circulation: this overcomes a challenge usually faced by non-tech reusable schemes, which require a higher volume of containers to respond to equivalent demands. The collected data is also a key strategy for customer engagement, by showing each individual's reduction of energy, plastic, paper and CO_2 levels within CupClub's overall results.

Making an impact

A positive environmental impact is shown in CupClub's first LCA, as the service produces 50% less CO2e[6] than disposable and ceramic cups – including polyethylene (PE) lined, styrofoam (EPS) and compostable (PLA) – over a typical life cycle of manufacturing, cleaning and distribution. The cups are designed to last for a minimum of 1,000 uses, with an optimal use of 250 cycles guaranteed. CupClub achieves environmental benefit over disposable options when used 72 times vs. PE lined single-use cups and 100 times vs. EPS cups and lids [20].

On the horizon

The company's 2021 vision is to scale up across London retailers as well as expanding to two North American cities, after a successful one-month pilot in Palo Alto, California. In this pilot, a result of a two-year project called NextGen Cup Challenge, CupClub obtained a customers' rating of 8.4 out of 10 with a conversion rate of 20% (1 in 5 customers) preferring a reusable solution at street cafés, and 47% at university cafés.

[6] CO2e stands for CO2 equivalent

Case Study – Inspecting Uzaje's centralized cleaning

System: Return on the go
Operating markets: France

Uzaje is not only reframing the take-away reuse system by building an efficient logistic support system with a centralized network of industrial cleaning centres throughout France; it is also creating jobs in the social and solidarity economy (SSE) for social inclusion.

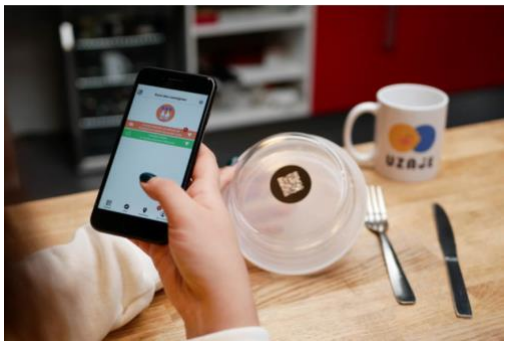
Overcoming challenges

Uzaje resolutely embraced both food and beverage reusable containers (mostly locally sourced glass and stainless steel and a few durable plastics), collecting dirty ones within a 50km to 200km radius (restaurants and food distribution, respectively) for efficiency and carbon footprint reduction. In just 20 months, it has scaled up to a 1,300m^2 industrial cleaning centre serving 50 clients from restaurants, catering services, and 100 clients from food retail and non-food distribution.

The return on the go model offers its clients the option to either hire Uzaje's cleaning and logistic service while keeping container ownership and loss or damage costs, or a full 'rent per service' costing around €0.40/container, which is cheaper than buying a high volume up-front. The set-up fee includes Uzaje's consultancy for technical packaging advice, collection, and cleaning logistics with HACCP inspection and a pick-up box that safeguards dirty containers. The current overall return rate is between 30-90% depending on the client's marketing strategy, as Uzaje believes a deposit scheme could prevent wider customer acceptance.

Making an impact

According to the company's LCA, conducted with the financial support of Ademe & Citeo, its reusable glass container used 8.5 times and with a 90% return rate is more efficient than single-use glass, from an environmental and economic perspective (-59% GHG[7] and -30% overall costs). Reusable glass models are also environmentally competitive vs. single-use r-PET[8] (90% recycled), although the process can still be optimized in terms of logistics and standardized packaging.



For the high-end French fast-food restaurant Daily Pic, which currently recycles over 600,000 used containers per year, Uzaje will help to reduce 100 tonnes of glass each year by reusing 50% of containers, while saving up to 25% water and 75% of energy compared to recycling [21]. In terms of secondary packaging, reusable plastic crates will avoid the generation of 20-30,000 waste cardboard boxes.

The company's new industrial cleaning facility in Neuilly-sur-Marne for the Île de France region has two lnew generation tunnel machines that wash by immersion (bottles) and spray (containers) with a capacity from 3,000 to 4,500 units/hour respectively. Powered by solar panels, the facility has the potential to wash up to 40 million containers per year, avoiding 3,300 tonnes of packaging waste and saving €900,000 in waste management costs.

[7] GHG – Greenhouse gases
[8] Recycled PET

On the horizon

Uzaje plans to open eight additional industrial cleaning centres in France by 2022, and is developing an app to improve packaging traceability and an optional deposit scheme for its clients. The company is also developing a new in-house machine to remove sticky labels from reusable containers more efficiently. Its consultancy vision is to overcome the containers' standardization barrier (by advising clients to purchase the best reusable standardized packaging available), while in the long term it aims to incorporate its outsourced transportation (cyclo-logistics and electric vehicles).

4.2 E-commerce – fashion and accessories

Product groups

The fashion product group is composed of various product types: apparel, footwear, sportswear, formal wear, and accessories. Some items are bulkier than others, and some – like formal wear – may be more sensitive to creasing.

Sector trends

E-commerce has been growing in recent years, comprising 11% of total retail sales in 2019 in Europe, up from 4% in 2010 [22]. After growing at a rate of 12% between 2018 and 2019, initial indications are that e-commerce grew by 31% from 2019 to 2020. COVID-19 accelerated the adoption of online retail across European countries, tripling the annual e-commerce growth rate in line with long-term trends. In 2020, a volume of 10 billion B2C parcels was reached [23]. E-commerce is driven by cross-border purchases, with between 67% and 99% of European shoppers stating they have bought online. Over 70% bought an item from China and just under 40% have bought from the USA [24]. Fashion industry e-commerce alone is valued at over €460 billion annually and is expected to grow at 11.4% annually to reach more than €880 billion by 2025 [25]. Online sales of fashion and accessories represent between 10% and 30% of total retail sales in this category [22], with between 50% to 68% of European e-commerce shoppers having bought an item from this category in 2020 [26]. Spending on online fashion sales, which was declining before the pandemic, is expected only to partially recover.

Single-use packaging and materials

The primary function of packaging in e-commerce is to protect goods in transport and prevent damage [27]. Delivery of faulty goods as a result of poor handling of the package can lead to undesired returns and even waste as products might be deemed not suitable for selling. This often leads to overpackaging and the use of packaging accessories (such as bubble wrap, air pillows or polystyrene chips). The importance of packaging varies significantly by product category in this channel as some goods are more damageable in transport than others. The overpackaging of fashion items in e-commerce represents 23% of total parcel weight [22]. Securing goods in transit is also a key element in reducing theft and ensuring traceability, and can be achieved by using technology such as RFID or barcodes. The impact of e-commerce packaging is limited, in comparison to the total amount of packaging placed on the European market every year (in the Netherlands, for example, it is estimated that e-commerce packaging represents just 3% of the total packaging weight on the market [28]).

The most common packaging types used in e-commerce for fashion are self-sealing plastic envelopes,[9] and kraft boxes.[10] Garments are often shipped in primary packaging (used as protection during transport from the manufacturer to the brand/retailer), with fashion items typically being shipped in individual polybags [29] and shoes in kraft boxes.

Reuse system alternatives

The main packaging reuse **implementation strategies** are presented below.

Packaging design and material

To be suitable for e-commerce of fashion items, which are sensitive to handling and transport, reusable packaging should be made of a protective material, lightweight, flexible, resizable, sealable, durable and washable. Packaging should also allow for some way of being secured (closed off with a secure plastic tag like Hipli, or with the courier's label like Repack) and to trace the goods in transit (Hipli started by using an RFID tag

[9] Low density polyethylene (LDPE) mailers, also known as polybags
[10] Kraft paper or paperboard is more resistant than other paper types

but has now changed to a simple barcode to minimize the environmental impact of materials). E-commerce packaging is also often used to repack and return goods, and should therefore open and close easily (Hipli opted for a zipper while Repack uses velcro). E-commerce packaging does not require a lot of differentiation, as packaging formats are typically optimized for logistics. There is potential for reusable packaging to be standardized for the various product categories that are sold by online marketplaces (e.g. books, fashion, shoes, cosmetics). There is also high potential for using recycled materials (fabric, synthetic, plastic).

An important point is that this packaging is often the first physical contact online users have with a product, and it therefore serves an important function in the user experience as a means for brands to execute their marketing strategies. By using reusable packaging, brands and online retailers can enhance this experience and have a positive impact on user satisfaction while showing concern about their environmental footprint.

Ownership

In this case, the system owner transfers the ownership of the packaging temporarily to the online retailer who leases the packaging to ship the goods, and potentially acquire additional services.

Logistics

E-commerce trade happens at an international level. Even European retailers will typically fulfil orders from only a few central locations. Scaling up packaging reuse solutions thus involves multiple return points in each country or international returns to logistics centres, which typically represent a higher operational cost.
However, in the context of online sales of fashion items there is a high return rate. Reusable packaging may provide a better user experience than if users have to use torn single-use packaging to return items, or pay for their own packaging. Retailers can then reuse the same package for a new shipment, thus reducing overall packaging costs.

Packaging logistics is a critical operation in e-commerce fulfilment, which is driven by speed and efficiency. If it results in longer lead times, reusable packaging may compromise adoption. Large online retailers ship thousands of parcels a day, making it harder for reusable packaging stock management to meet market requirements. The same is true for fulfilment from retail stores.

However, due to the high level of specialization of these operations, these logistics can be leveraged to be used and scaled up by reuse systems. In this system, packaging is shipped to the retailer's warehouse or fulfilment centre, after which it is used in the same ways as single-use packaging. Packaging can then be returned by mail, picked up by courier from the user or dropped at a PUDO, to be shipped to cleaning centres where it is checked, cleaned and put back into the system. Packaging returned to the retailer with an order return can be cleaned and re-used to send a new order. Cleaning is relatively easy (gentle rubbing with mild soap), and it can be performed centrally by the reusable packaging provider or by the retailer/fulfilment centre. However, since these are additional activities, they do require additional process steps that take time and resources. A cleaning station, storage and human resources are needed wherever the packaging is returned to.

Incentive to return

At face value, the price of reusable packaging is generally higher than single-use, especially compared to polybags, and this cost (or part of it) is usually passed to the user. However, a study concluded that users are willing to pay for a more sustainable delivery method in e-commerce. This varies by country between 22% (Finland) and 42% (Germany) [26].

In fact, companies presenting users with an option to use reusable packaging minimize the non-return rate. Offering it as a free option to the user maximizes the acceptance (Hipli in France reports an 89% acceptance rate by users when it is offered free, and 55% when it is offered at €1). Instead of a deposit scheme, a reward system

can be an alternative way to encourage users to return packaging (RePack uses a voluntary reward system from retailers to users, which can consist of a voucher or a discount on a future purchase, or a charity donation).

As well as the options mentioned above, reusable packaging is also suitable for subscription and rental services that require the return of an item after use, increasing user loyalty to the system/brand.

Users' role

Reusable packaging for e-commerce does not differ much in its actual use from single-use. However, users have to be willing to ship back the reusable packaging. Packaging can be returned by post, returned by courier (e.g. with the next delivery, returned to store, or returned to another network return point. For exchanges/returns to (re)sellers, users can use the packaging in the same way as they already do with single-use packaging.

What about primary packaging for fashion?

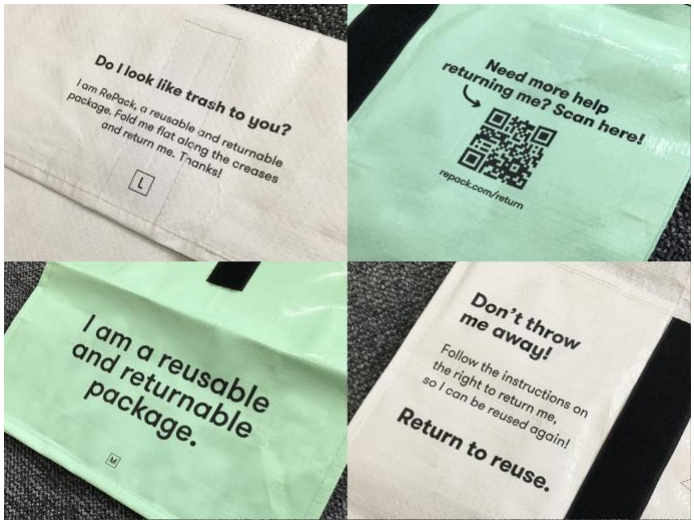
Clothes and shoes are packed in primary packaging for shipping between manufacturing locations and retail stores and consumers' homes. For apparel, each item is typically covered in a clear plastic bag (polybag) to avoid moisture and condensation damage and creasing during transport. The items are then removed from the primary packaging to be hung in retail shops. For online channels, many retailers also remove the bags for a better user experience. While hundreds of billions of polybags are estimated to be produced for the fashion industry every year [29], a reusable solution is not very applicable at present as the vast majority of manufacturing sites are located in Asia.

High-value shoes made of materials that can be easily damaged in transport are typically packed in cardboard boxes. These boxes make transport and warehouse logistics more efficient, and can be optimized to be made from kraft recycled and recyclable paper, thus minimizing their environmental impact. While some brands have managed to design and use shoe boxes that can act as transport boxes in an e-commerce channel, the majority of online fashion purchases include more than just a pair of shoes. The average number of items in an online order for the fashion category in Europe is between 2.8 and 3.2. In fast fashion, shoes are often bought with other items, which does not allow the primary packaging (shoe box) to be the transport packaging.

The following are the key success criteria for scaling up a packaging reuse system for the fashion product category in e-commerce:

- **Protective, lightweight and flexible packaging materials –** to minimize shipments, transport space, environmental impact and costs. A few standardized sizes, to allow a snug fit and protect the goods, and minimize transport costs.
- **Security –** like single-use packaging, reusable packaging must be tamper-proof and minimize shipment loss. Courier stickers can be used to secure and close packaging to minimize the use of additional materials, but for smaller items like accessories a zipper may be needed.
- **Ease to user –** the packaging return processes must be streamlined and available in a dense network of return points at common locations such as pick-up/drop-off points, supermarkets, cafés and mailboxes.
- **High return rate –** Products with a high order return rate, such as fashion, make it easier to set up such a system, as reusable packaging can be used to return orders, thereby also returning the packaging to the retailer/logistics provider.
- **Reverse logistics –** for this distance to be minimized, it is key that packaging can be returned to multiple locations across Europe, ideally within each country. For it to be economically viable, it is important that existing logistics channels are leveraged (postal systems, couriers, PUDOs) and that packaging fits existing reverse logistics (e.g. letterbox size). When empty, both Repack's and Hipli's packages are foldable to envelope-size so that they can easily be returned via the postal system.
- **Clear system instructions –** until the system is mainstream and everyone knows how to use it, instructions must be clear and visible on the packaging. Repack recently implemented a new packaging design with

clearer instructions on how to return packaging. Additionally, systems can supply retailers with communication and integration kits for websites (Hipli and Repack).



Credits: Repack

Omni-channel packaging return

CTT Correios de Portugal (a mail operator offering a national delivery service) is piloting a reusable packaging system with a few merchants whereby users can return the packaging to the courier when receiving the delivery, at a post office, and via mailboxes. The mail operator runs the reusable packaging system, thus controlling packaging return operations [30].

Case study – Unfolding Repack's success

System: Return on the go and *Return from home*
Operating markets: Europe and USA

RePack is much more than reusable packaging to reduce waste in e-commerce. It is a pioneering solution to close the loop in three steps: standardized delivery packaging, return through a reward system, and effective cleaning to put it back in circulation.

Overcoming challenges

RePack's reusable postal velcro-sealed bags, made with recycled (polypropylene) plastic, were inspired by the Finnish bottle deposit return system (DRS). Since 2011, the innovative solution has scaled up across Europe and North America, and has been adopted by more than 150 apparel brands and retailers.

The challenge was to find the most appropriate material, size and format to match e-commerce clients' requirements. RePack's waterproof packaging is made in China in three different colours and sizes (up to 6, 21 and 45 litres), and is designed to fold down to letter size when empty, so it can be returned by simply posting it into a mailbox, anywhere in the world, for free. It's made to last at least 20 cycles, and is currently achieving up to 80% return rates.

The Return on the go system is a voluntary scheme for brands (costing around €3.50 per cycle to retailers) for the packaging's delivery and return to the cleaning and resupply hub in Estonia, that can be used to generate vouchers (even on returned purchases) or charity donations. RePack's partner stores have two business models for its return: they either send the package back to a centralized facility, or close the loop through a rental-based scheme by which they ensure its in-house cleaning and reuse.

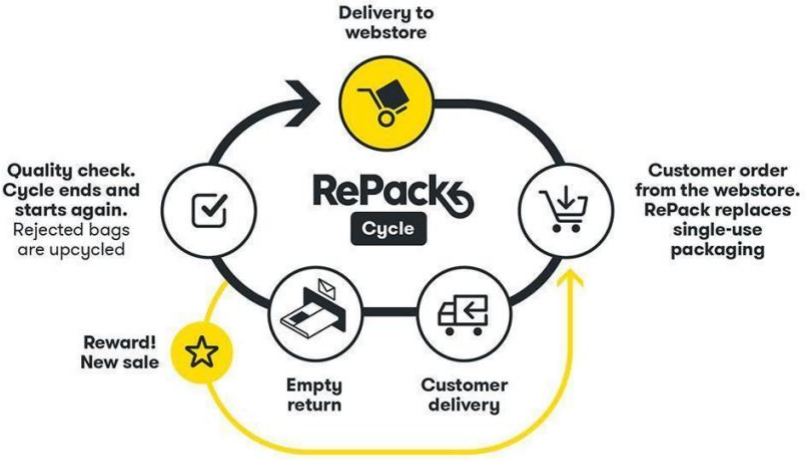
Making an impact

In the company's LCA, RePack states it can reduce the carbon footprint by up to 80% compared to disposable packaging and 96% on e-commerce packaging waste, achieving breakeven in its carbon and waste footprint after its second use. Moreover, manufacturing a small plastic bag has a 50% higher footprint than returning a RePack: 36g of CO_2 emission per shipment is roughly equivalent to an email with a large attachment [31].

RePack's Net Impact Report also shows that this (small) start-up creates many new jobs compared to its revenue, while the reusable package makes use of postal services, a key element of societal infrastructure.

On the horizon

RePack is planning to decentralize its cleaning facilities (currently in Estonia) across Europe to improve its CO_2 efficiency. In fact, it has partnered with La Poste, the largest postal service company in France, for a 9-month project called 'French Loop', which aims to reduce the distance travelled by each RePack by ensuring the local reconditioning of used packages within French borders.
The company has also started working with e-commerce logistics providers which now distribute the packaging directly to online retailers.


Delivery to webstore
Customer order from the webstore. RePack replaces single-use packaging
Customer delivery
Empty return
Reward! New sale
Quality check. Cycle ends and starts again. Rejected bags are upcycled
RePack
Cycle

4.3 Large retail – household care

Product groups

The household care product category is composed of different product types: laundry care, surface care, dishwashing, maintenance products and bleaches [32]. Distribution of product category sales by value is as follows: laundry care 47.5%, surface care 21.7%, dishwashing 15.2%, maintenance products 13.5% and bleaches 2.1% of the 2019 market value [33]. Many of these products mainly consist of water, with only a small volume of so-called 'active ingredients' [34]. In 2019, more than 19.5 billion units of household care products were sold. The 15.6 billion units registered under the Charter for Sustainable Cleaning accounted for 71.8kg of packaging per thousand user units.

Sector trends

In 2019, the household care market was €30.2 billion and grew by 2%, with particular growth in laundry (2.3%) and surface care (2.1%). Products are sold mostly through grocery retailers (85%), pharmacies and drug stores (9%).

Single-use packaging

The products above are sold mostly in plastic bottles of varying sizes. The most common types are HDPE and PET [35]. Packaging quality is key to avoiding product leakage and ensuring safe and correct dosage, and it has been optimized for different applications and to meet different requirements in terms of regulation.

The industry has been exploring different ways to reduce the environmental impact of its packaging, from incorporating more recycled material, to improving material efficiency in packaging, to piloting in-store refills (Ecover). Compaction of the product (e.g. higher concentration), tablets and parent packaging all contribute to the reduction of material use, but are not sufficient in themselves to move towards a circular economy without waste.

Reuse system alternatives

Different packaging reuse **implementation strategies** are presented below.

Packaging design and materials

Key characteristics of the packaging are durability to endure a number of cycles of use, transport and cleaning; and the ability to be stacked or collapsed to reduce transportation costs and environmental impact in reverse logistics. The packaging should also disclose ingredients, especially hazardous ones. Product classification may trigger special rules on packaging, covering the use of child-resistant fastenings and tactile warnings of danger [36].

When filled, the packaging must allow for a label to be stuck on it. Following a standardization approach, packaging should still accommodate a removable element of differentiation between brands, since in this category (as with any other FMCG[11]) packaging plays an important role in getting the user to buy the product at the retailer: brand recognition and loyalty are key elements for these companies [7]. Packaging materials can play a role in durability, and user experience and engagement. Some companies use steel packaging for a premium feel (e.g Loop), but Polypropylene or HDPE may be good alternatives.

[11] FMCG: Fast-Moving Consumer Goods are products that sell quickly at relatively low cost. These goods are also called consumer packaged goods (CPG).

Ownership
Refill in store models leave the packaging responsibility to users. In this case, cleaning is the users' responsibility, and manufacturers do not control the conditions to ensure the product use guidelines are followed. In centralized refill models, ownership of the packaging is left with the manufacturer.

Logistics
Refill in store models require dispensing stations/walls in store (investment levels vary depending on the dispensing technology), storage space for wholesale refill containers and empty packaging, and increased restocking times. This presents a challenge since physical retail is driven by profitability per square metre of shop floor, and in some European countries, especially in cities, this is limited. Retailers are therefore reluctant to dedicate space to storing empty refillable containers or refill dispensers.

However, by setting up a centralized refill system where manufacturers can recover, clean, refill and label the same packaging (used for a variety of household product references), selling it prefilled in retail shops means business as usual for retailers on the shop floor and when it comes to restocking. Also, retail logistics are the same for many product groups (household care, beverages, personal care, etc.), with retailers focusing on restocking self-service linears and check-outs, with human resources being minimized in store.

Packaging can be shipped directly to manufacturers' factories, but given the location of these in Europe this might not be efficient for all countries. Alternatively, decentralized filing and cleaning units (in large containers/jerry cans) located at shorter distances from consumption can act as a capillary network, reducing transport.

Incentives to return
Deposit or reward systems may help encourage users to bring the package back. Given that it's a recurring buy product, in order to build loyalty a reward on a next purchase or the offer of more sustainable products can be effective. Incentives for retailers should also be applicable to support the recovery processes. In addition, these systems allow users to take only the quantity they need, preventing waste and often meaning they pay the same or a lower price per litre (e.g Algramo in Chile). Brands and retailers can also use technology-driven solutions such as RFID tags (e.g. Algramo) to identify consumption habits and to continuously improve the system's operations and features.

Users' role
The adoption of refill in store systems has been shown to stagnate over time [37] as the systems require users to change their habits and take back the packaging at the time of purchase, and to perform an extra operation in store. Convenient and user-friendly return operations, with pre-packaged products being readily available in a simple shop front or which use advanced dispensing technology (automated and with sensors), may improve the usability of these systems.

Success criteria

The following are the key success criteria for scaling up a packaging reuse system for the household care product category in large retail:

- **Durable, stackable and standardized packaging –** durable packaging to maximize life cycle and the number of uses, stackable packaging to minimize transport volume, standardized packaging to allow for quicker return cycles and smaller pooling volumes.
- **Safety and hygiene –** inspection and cleaning logistics are important for compliance with product-specific legislation and to avoid leakage and cross-contamination.

- **Incentive for return –** in general, the system works best with a deposit on the packaging. The packaging return processes must be simple, streamlined and available at or close by familiar locations such as supermarkets and municipal collection points. Deposits, rewards or discounts on future purchases for the successful return of a package can promote user loyalty.
- **Minimize reverse logistics distance –** to minimize the impact of reverse logistics transport, it is key that packaging is returned to multiple locations across Europe, ideally within each country.
- **User education –** until the system is mainstream and everyone knows how to use it, instructions must be clear and visible on the label and in store so that reusable packaging is not confused with (single-use) recyclable packaging.

Case study – Levering refill and reuse for mainstream markets

System: Return on the go

Operating markets: Europe (and worldwide)

Reuse models in retail for household care will not have a one-size-fits-all solution: given the multiple different products, alternative offers are needed to encourage 'bottle for life' usage, either by refilling at home (concentrated version in reduced packaging to be diluted with water) or refilling on the go (dispensing systems in stores). Refill and return from home models are also expanding, allowing brands to create refillable versions of their current single-use products, to reduce waste in a circular ecosystem.

Since 2019, a few UK-based retailers have started trials of gravity-based dispensers and automatic machines offering Ecover detergents in 100% post-user recycled plastic bottles and Unilever's Persil in QR-coded reusable aluminium or stainless-steel bottles in touch-free refill stations.

Overcoming challenges

Retail's slow uptake of centralized cleaning systems may soon be accelerated by Loop, an online and physical store facility developed by TerraCycle, that has engaged with major retail players in France and the UK to offer delivery and pick-up of both products and empty reusable packaging, while taking care of reverse logistics, cleaning, sanitation and redistribution. Loop's return from home and on the go models charge companies a membership fee according to packaging durability, washability and LCA (only allowing packaging that can be reused or recycled into the same product). Customers pay a deposit to incentivize the return of empty packages, which they can drop in a collection area at the store through a QR-code-based app, and collect a refund within seven days [10].

Making an impact

Algramo is tackling the 'poverty tax', the extra fee included in smaller packages that should be more affordable for lower-income users, but in fact cost up to 30-40% more than larger packaging. Operating internationally, this Chile-based start-up sells 'by the gram' as a refill from home model using mobile electric tricycles and reusable packaging equipped with a hidden RFID tag, offering a 'sustainable consumption credit' on the next purchase (10% discount on average) when packaging is reused.

In 2020, Algramo partnered with Unilever for the South American market to scale the number of tricycles, and has also created an app for a touchless refill system in which the settings are controlled by customers through their own mobile devices – a significant advantage in the context of COVID-19. Algramo is expanding to Europe, where it is looking for implementation (retail) partners.

Making it small

Unilever has also launched a refill at home model for its brand product CIF, as a concentrated formula to be diluted in water: CIF Ecorefill (it uses 75% less plastic, 97% less water is transported, and 87% fewer trucks are needed on the road compared to a traditional 700ml bottle).

On the horizon

Subscription and pick-up services are a must to create brand loyalty and provide information about customer needs while tracking reusable packaging and pick-up boxes in circulation for efficiency in logistics and scaling up. These brands are also planning to expand in Europe as a result of an increased demand from customers for more conscious solutions.

5. Potential to scale up reuse for key product groups

5.1 Environmental and economic assessment

The environmental impact and economic savings for the potential scaling up of packaging reuse systems across Europe was estimated for each of the product categories. The tables below show the system characteristics that were compared between a reusable system and a single-use alternative for each of the product groups, to perform the LCA.

Reusable system	Single-use system
Polypropylene; 79g; 16% recycled, end of life in Europe	Polypropylene; 43g; 16% recycled, end of life in Europe
Extrusion thermoforming manufacturing in China	Extrusion thermoforming manufacturing in China
90% return rate; 100 use cycles	
Washing centre 20km from user	
Packaging cost €1.80/unit	€0.39/unit

Table 1: HoReCa food containers reusable and single-use system characterization summary

Reusable system	Single-use system
Polypropylene cup, 49.3g; low-density polyethylene lid, 22.03g; 90% recycled, end of life in Europe	Paperboard cup, 10.2g; corrugated sleeve, 3.7g; polystyrene lid, 3.4g; Polyethylene liner, 1g; not recycled, end of life in Europe
Injection moulded cups and lids Manufacturing in Europe	Calendering for the cup and injection moulding for the lid Manufacturing in Europe
90% return rate; 132 use cycles	
Washing centre 20km from user	
Packaging cost €1.59/unit	€0.25/unit

Table 2: HoReCa beverage containers reusable and single-use system characterization summary

Reusable system	Single-use system
Polypropylene packaging, 55 g; zip: nylon 1g, polyester 3g and POM 6g; thread, 0.4g; End of life in Europe, not recycled	LDPE, 15g; 16% recycled, end of life in Europe
Plastic film extrusion manufacturing in China Assembly in China	Plastic film extrusion manufacturing in China
90% return rate; 30 use cycles	
e-commerce warehouse 500km from user; washing centre 275km from e-commerce warehouse	
Packaging cost €2.10/unit Package return by mail €1.30/unit	€0.28/unit

Table 3: E-commerce fashion packaging reusable and single-use system characterization summary

Reusable system	Single-use system
HDPE, 102g; 16% recycled, end of life in Europe	HDPE, 48g; 16% recycled, end of life in Europe
Blow moulding manufacturing in Europe	Blow moulding manufacturing in Europe
90% return rate; 100 use cycles	
Bulk supply from brand manufacturer 581km to central warehouse Average distance from retailers to a washing centre 20km one way	
Packaging cost €4.79/unit	€0.15/unit

Table 4: Large retail household care packaging reusable and single-use system characterization summary

Three scenarios for scaling up packaging reuse systems across Europe, for the four product groups analysed as per Table 6, based on reuse targets for 2027 and 2030:

	2027	2030
Scenario 1	10%	20%
Scenario 2	20%	50%
Scenario 3	50%	75%

Table 6: Scenarios for scaled-up reusable packaging system targets

Taking this into account, in the subsequent sections the potential environmental and economic impacts across all product groups are presented.

HoReCA: food containers

A reuse system has nearly 13 times less impact than a single-use one. If scaled, a packaging reuse system could save:

		Scenario 1		Scenario 2		Scenario 3	
Criteria	**Equivalence**	**2027**	**2030**	**2027**	**2030**	**2027**	**2030**
Waste to landfill	Full truck load 8t	240	537	479	1,343	1,198	2,014
Energy	Average household energy consumption per year	21,937	42,251	43,873	105,628	109,683	158,441
Water consumed	Olympic pools	567,364	1,034,209	1,134,728	2,585,522	2,836,820	3,878,284
Materials	Full truck load 8t	40,480	87,586	80,960	218,964	202,400	328,446
Climate change	CO_2 absorbed per year by a mature tree	13,289,956	28,316,423	26,579,912	70,791,056	66,449,779	106,186,585

Table 8: Environmental impact for main criteria equivalence for scale-up scenarios for food containers

Reusable packaging systems for food containers can be quite profitable and still deliver economic savings for their users (HoReCa). Even savings of just €0.01 between the total cost of single-use compared to reusable packaging would be significant for retailers across all three scale-up scenarios.

	Scenario 1		Scenario 2		Scenario 3	
	2027	**2030**	**2027**	**2030**	**2027**	**2030**
Savings	€926,495,444	€2,111,967,476	€1,852,990,887	€5,279,918,691	€4,632,477,218	€7,919,878,036

Table 9: Economic savings for retailers using a reusable system for scale-up scenarios for food containers

HoReCA: Beverage containers

A reuse system has around four times less impact than a single-use one. If scaled up, a packaging reuse system could save:

		Scenario 1		Scenario 2		Scenario 3	
Criteria	**Equivalence**	**2027**	**2030**	**2027**	**2030**	**2027**	**2030**
Waste to landfill	Full truck load 8t	200	439	401	1,098	1,002	1,647
Energy	Average household energy consumption per year	262,484	575,271	524,969	1,438,177	1,312,422	2,157,265
Water consumed	Olympic pools	69,779	152,930	139,557	382,324	348,894	573,486
Materials	Full truck load 8t	578,165	1,267,129	1,156,330	3,167,822	2,890,826	4,751,733
Climate change	CO_2 absorbed per year by a mature tree	9,153,634	20,061,454	18,307,268	50,153,634	45,768,169	75,230,452

Table 10: Environmental impact for main criteria equivalence for scale-up scenarios for beverage containers

Reusable packaging systems for beverage containers can be quite profitable and still deliver economic savings for their users (HoReCa). With savings of €0.12/unit between the total cost of single-use compared to reusable packaging overall savings would be significant across all three scale-up scenarios. The economic savings derived for retailers are also significant across all three scenarios:

	Scenario 1		Scenario 2		Scenario 3	
	2027	**2030**	**2027**	**2030**	**2027**	**2030**
Savings	€928,746,402	€2,035,476,116	€1,857,492,804	€5,088,690,290	€4,643,732,011	€7,633,035,434

Table 11: Economic savings for retailers for scale-up scenarios for beverage containers

E-commerce: fashion

A reuse system has nearly three times less impact than a single-use system in the e-commerce fashion category. If scaled up in Europe, a packaging reuse system could save:

		Scenario 1		Scenario 2		Scenario 3	
Criteria	**Equivalence**	**2027**	**2030**	**2027**	**2030**	**2027**	**2030**
Waste to landfill	Full truck load 8t	14	47	28	116	69	175
Energy	Average household energy consumption per year	2,828	9,513	5,657	23,783	14,141	35,674
Water consumed	Olympic pools	47,612	160,147	95,224	400,369	238,061	600,553
Materials	Full truck load 8t	3,732	12,552	7,463	31,380	18,659	47,070
Climate change	CO_2 absorbed per year by a mature tree	2,338,956	7,867,279	4,677,912	19,668,197	11,694,780	29,502,295

Table 12: Environmental impact for main criteria equivalence for scale-up scenarios for e-commerce packaging

Although reusable packaging systems for e-commerce fashion can be profitable, they cannot yet compete with the prices of the most used single-use packaging (polybags). This is mainly due to the costs of individually returning one unit of packaging to the washing centre, which can amount to more than the cost of acquiring a new reusable packaging unit. From the online retailer's point of view, at face value, using reusable packaging would account for €2.43 of additional cost. The model may be more dependent on users contributing, to prevent merchants from having to bear the cost alone. In a recent study on e-commerce in Europe, between 22% and 42% of shoppers indicated they would be willing to pay extra for a sustainable delivery method. In the Praxpack project, a pilot study from Tchibo in Germany concluded that 63% of users would be willing to contribute to the costs of reusable packaging. A study by RePack concluded that a merchant shipping 250,000 orders a year could reduce its packaging costs by 40% a year, if users had an option to choose RePack and pay for its use.[12]

Large retail: household care

A reuse system has around 12 times less impact than a single-use one. If scaled up, a packaging reuse system could save:

		Scenario 1		Scenario 2		Scenario 3	
Criteria	**Equivalence**	**2027**	**2030**	**2027**	**2030**	**2027**	**2030**
Waste to landfill	Full truck load 8t	19	41	38	103	96	154
Energy	Average household energy consumption per year	15,505	33,199	31,010	82,998	77,525	124,497
Water consumed	Olympic pools	120,650	258,335	241,300	645,838	603,250	968,758
Materials	Full truck load 8t	12,534	26,837	25,067	67,092	62,668	100,639
Climate change	CO_2 absorbed per year by a mature tree	5,503,516	11,784,118	11,007,031	29,460,296	27,517,578	44,190,444

Table 13: Environmental impact for main criteria equivalence for scale-up scenarios for household care packaging

With a healthy gross margin (estimated), at a selling price to the manufacturer of €0.15, a reusable packaging system for household care could still realize economic savings of €0.10/unit, which would result in significant savings across all three scenarios.

	Scenario 1		Scenario 2		Scenario 3	
	2027	**2030**	**2027**	**2030**	**2027**	**2030**
Savings	€150,160,100	€321,522,556	€300,320,200	€803,806,390	€750,800,500	€1,205,709,585

Table 14: Economic savings for retailers for scale-up scenarios for household care

[12] 'The Business case for reuse', Repack. Based on a retailer shipping 250,000 orders annually, with a 25% user return rate and a €100,000 annual cost of single-use packaging. Introducing reuse as an option, and assuming 15% of users choose it and pay €3.95, would reduce packaging costs by 40%.

5.2 Social assessment and job creation

Reuse systems present opportunities for single-use packaging manufacturers to focus on reuse-as-a-service models, and for the emergence of new businesses such as centralized cleaning and logistics which by operating at scale can decrease the cost and guarantee hygiene standards. In turn, this drives the creation of new jobs.

Based on available data, the reuse systems studied can promote the creation of 50 FTE[13] jobs in warehouse and transportation services (when dealing with 120,000 units/day). These new jobs would also require the acquisition of new skills and knowledge, increasing the level of professional competences and the development of new careers in the local community.

Taking into consideration possible new employment opportunities, the job creation potential was also assessed for the three scale-up scenarios across all product categories.

	Scenario 1		**Scenario 2**		**Scenario 3**	
	2027	**2030**	**2027**	**2030**	**2027**	**2030**
Jobs created	93	245	185	613	462	920

Table 15: Estimation of job creation potential for scale-up scenarios for all product groups

[13] Full Time Equivalent Jobs

6. Main business and environmental drivers for reuse

The main drivers of the environmental and business cases are aligned with each other, and are the following:

- **Number of reuse cycles** – the benefits of a reusable packaging system can only be fully realized if the reusable packaging is maintained in the system for as long as possible. The higher the number of uses, the lower the costs and the lower the environmental impact of the production of the packaging. Materials used in the packaging should be durable and ensure the quality of reuse, so the number of uses can be maximized.
- **Return rate and losses** – when the return rate is low, or the level of damaged packaging is high, the environmental impact of the reuse system increases. Systems must ensure that packaging is correctly returned, and that users have incentives to do it.
- **Transportation distances** – from the point of supply to the point of consumption. The longer the transport distances to return packaging in the reusable system, the higher its environmental impact. Shorter distances tend to favour reusable packaging. Environmental impact can be reduced when using clean energy in vehicles.
- **Scale** – the more units are processed through a system, the higher the efficiencies and the lower the unit cost across all phases (production, transportation, cleaning). More efficient processes generally offer higher environmental benefits.
- **Standardization** – can also play a significant role in achieving scale and driving efficiencies by improving interoperability, reducing investment costs for the design of systems, and fostering quicker market penetration, resulting in less risk for businesses.

Investment needs

The initial investment needed to set up a reusable packaging system is a hurdle [7] which may deter both small and large players from coming into this space. The main investment categories include warehousing space (for storing, cleaning, inspection, maintenance); packaging recovery infrastructure (such as reverse vending machines in supermarkets or drop-off boxes in restaurants); transport vehicles for collecting, delivering or pooling the reusable packaging in the system; reusable packaging washing/cleaning equipment (washing, cleaning, drying machines); and software/app to manage user engagement and manage deposits.

The role of technology

Technology can facilitate the implementation of reuse systems, driving adoption and helping to monitor use: asset tracking technology such as barcoding and RFID tags helps track packaging containers in real time, allows monitoring of cycles and helps prove the business case (e.g. CupClub); digital apps can support engagement with the user, facilitate deposit and reward systems (e.g. Recircle), and enable contactless operations (e.g. Algramo); dispensing technology, such as automated dispensers with sensors, can ease processes and drive safety. Standardization can support automation in logistics to drive further efficiencies. Nonetheless, if used in retail, technology can hinder the business case for both the owner of the system and retailers when it represents an additional investment per retail unit. Some brands (e.g. Ecover) have reverted to more simple manual technology (e.g. pressure and gravity-assisted dispensing units) [38].

In addition, the reusable packaging pool is also considered a capital investment. This is the number of packaging units required to keep a reusable packaging system running. As the pool needs to allow for the time taken for the return logistics, cleaning, seasonal peaks in volumes, damages and losses in the system [39], it must be significantly larger than the number of packaging units required for the immediate and current product supply at any point in time. Its size will vary depending on the distance the containers have to travel, the speed at which the products are consumed, the speed at which the packaging is returned by users, and the turnaround time required to prepare the packaging for a new cycle [7]. As an example, the Dutch DRS needs seven times more beer bottles to operate than are consumed in an average week [18].

Investment in communication with actors along the value chain is also needed, to ensure the system runs smoothly and that the environmental and economic benefits are realized.

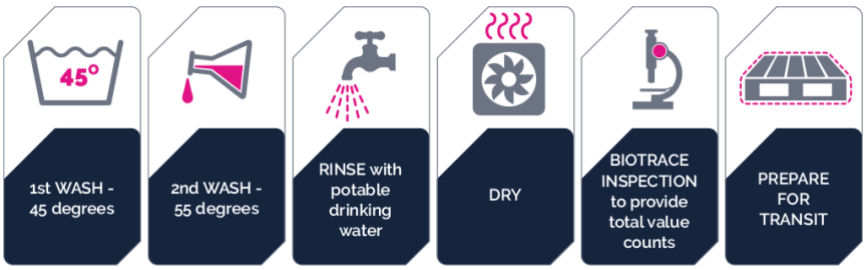
In Table 16, some estimates of the levels of investment needed for certain key aspects of the system are illustrated. Although the requirements are not exactly the same for all product categories, some infrastructures such as cleaning/washing facilities can be shared in some categories, thus facilitating the circular business case around infrastructure and other technology to advance recovery and reuse [40]. Previous investments in reuse infrastructure are likely to promote reuse systems [41]. Leveraging B2B reuse models, such as recovery, reposition and wash centres, can facilitate implementation and reduce the investment needed for B2C models [18].

Category	Investment estimates
Cleaning	Industrial washing equipment: between €125,000 and €300,000 Small bottle washing: €25,000
Recovery	Reverse vending machine €3,000
Technology	Technology development and maintenance €200,000
Transport	Electric truck: €100,000
Warehousing	Storage space/hall for the washing line: between €125,000 and € 400,000

Table 16: Estimated level of investment per category[14]

It's a lot about the cleaning

From a simple rub with a mild soap (RePack) to a two-stage wash with clean rooms (Packaging Services Europe), there is a lot to be said about cleaning and washing processes. Their optimization is a crucial element for making a compelling business case. According to Packaging Services Europe, a great deal of optimization can be achieved by standardizing packaging formats and processes, which enables the scaling up of operations, cost savings, and positive contributions to environmental impact. While in some channels washing processes and equipment exist (e.g. dine-in HoReCa outlets generally have washing for plates and cutlery), these may not be adapted for containers.



Washing process for reusable containers[15]
Credits: Packaging Services Europe

[14] Source: Anonymized data from various reusable packaging businesses in Europe
[15] Packaging Services Europe: https://packagingserviceseurope.co.uk/pallet-washing/

Of course, a single company may decide to set up its own reuse system, and in some circumstances this may be the only option, but generally the cost-efficiency and sustainability of a reuse system is improved when more companies collaborate. At a small scale this could be a cooperative of a few restaurants at neighbourhood level that decide to collectively purchase reusable packaging, accept returns at different locations, and manage the system together. In principle, the more actors that join a common reuse system, the more efficient the use that is made of assets and infrastructure (e.g. washing facilities) and the higher the environmental benefits of reuse.

Reuse systems (at least for cleaning food and beverage containers) are generally best implemented at regional level to shorten the supply chain and minimize transport distance, but the overall management of reuse-as-a-service systems may work at the (inter)national level, creating a collective approach to tools (e.g. apps), protocols and communication strategies. The benefit of this is that there is no need to reinvent the wheel at each location, and scaling can more easily be achieved through replication.

At this stage it is inevitable that various different initiatives will be created and will start experimenting at local level and at some point even competing at national level. This creates a dynamic ecosystem where eventually the most successful thrive. At the same time, it may not be efficient if there are dozens of reuse initiatives in the same sector using different packaging formats, as well as different logistics and cleaning processes, and this would also bring additional complexity for users. Standardization of certain basic aspects of reuse systems (particularly packaging formats), at national and even European level, would facilitate processes.

7. Scaling up reuse systems through standardization

One of the main challenges in the market nowadays is the high level of differentiation in packaging product design in terms of format, material type and additives (e.g. colouring). This not only reflects the wide diversity of products on the market and varying levels of performance requirements, but it also reflects marketing needs as each brand wants to distinguish itself from the others. However, different packaging formats make it more difficult to scale up a reuse system.

In a reuse system, most of the operational costs are due to the reverse logistics, handling, washing and distribution, which have a higher complexity than single-use packaging. In order to minimize these costs, efficiency is essential: this can be achieved through automated processes and standardized packaging and systems. This means packaging has to comply with specific dimensions which facilitate stacking and easy transport, processing and washing with industrial equipment. There is nevertheless still the opportunity for differentiation between brands, by using different colours, labels or other details of design.

The German Perlenflasche is an iconic example of standardized reusable design for water and soft drinks, which can be reused around 50 times. Another example of standardized sizing for refills are the beer bottles in the Netherlands (see text box below).

The Dutch Brown Retour Bottle (Bruine Nederlandse Retourfles)
In the Netherlands, the refillable brown beer bottle has existed since the 1980s. The standardized bottle was created as a solution to the high cost of beer packaging: the voluntary scheme is collectively managed by the beer producers, and now represents a large share of the market.16 The reuse cycle is as follows: brewery, retailer, user, DRS machine, back to the brewer, removal of old labels, cleaning, quality control, refill, redistribution etc.
The DRS glass bottles are of high quality and can be refilled around 20-40 times, which minimizes the CO2 footprint of the bottle. To ensure the continuity and quality of the BNR pool of bottles, there are a number of rules for production, sale and reuse. The bottle size and shape are standardized at the national level: content (30cl or 5cl), thick glass (1.4mm), UV-resistant brown colour, 207mm high.
The advantage of the BNR is that the user can return the bottle in any supermarket, even if it does not sell the specific brand. The bottles are simply returned in the crates of another brand.

It is important to understand the difference between standardization through an official standardization committee and simply having a common format, or following commonly agreed guidelines. In the first case, technical standards are developed for products, services or systems, by CEN or national standardization bodies. These are developed by various stakeholders through consensus, and are usually not publicly available (they need to be purchased). In the second case, formats or dimensions are specified by certain market actors, but without an official status. This means that not everybody may agree with them. In both cases common characteristics can be defined, such as the packaging's dimensions to facilitate processing and operations, thus lowering implementation and operational costs.

A clear set of technical rules makes collaboration between actors in the value chain easier (and also across sectors). However, in the case of 'official' standardization, it would be easier to scale at (inter)national level; although at international level standards in the EU would also need to be harmonized because standards can be different in each country.

[16] Lindeboom Bierbrouwerij, Budelse Brouwerij, Bierbrouwerij AB InBev, Gulpener Bierbrouwerij, Heineken Nederland, Grolsche Bierbrouwerij and Royal Swinkels Family Brewers.

So the question is, to what extent can packaging format be standardized to scale up reuse systems? Beverage and meal containers, e-commerce packaging and detergent bottles do not have to be available in a wide variety of shapes and sizes. They simply have to be functional, which can be accomplished through a standardized format that is optimized to fit a reuse system.

Standardization for reusable food packaging (July 2020, KIDV [43])
The National Institute for Sustainable Packaging in the Netherlands (KIDV) has explored the potential of standardization in primary reusable food packaging to enable the transition to reusable packaging systems in the food industry. A number of requirements were formulated for the most efficient and effective cleaning and reverse logistics: PolyPropylene as preferred material, heat resistance for cleaning (85°C), separable and universal lid, nestable, and the use of light colours. A square or rectangular shape is preferred for stacking and transportation. Reusable packaging design should avoid deep edges, grooves or narrow holes as these can become blind spots for cleaning machines and will be difficult to dry.
Many packaging and logistics companies offer secondary packaging which conforms to European standards (EN), but complies with Gastronorm* sizing on the inside. It could be useful to produce reusable primary food packaging according to Gastronorm sizes that fit in EN crates.
**The standard is derived from the Europallet. Gastronorm is a common standard used in the preparation, storage and transport of food.*

For food packaging, the National Institute for Sustainable Packaging in the Netherlands (KIDV) has performed a study to identify design elements that could be standardized for reuse. An in-depth study on standardization of reusable packaging for e-commerce and household products would also be useful to identify functional and non-functional requirements. However, even if such blueprints existed, not all producers would automatically follow them. That's where EU legislation comes into play.

Besides packaging format, other aspects of a reuse system could also be standardized, or at least facilitated by common norms and guidelines. These could apply for instance to the deposit system, to make it reliable; to the washing process, to limit the environmental impact related to water, energy and material consumption; to raise operators' and customers' confidence about fulfilling minimum standard requirements to ensure high levels of hygiene and durability. Moreover, guidelines on the chemical composition of materials for reusable packaging could ensure the use of safe materials (especially for food contact).

EU legislation and standards

The European Packaging and Packaging Waste Directive 94/62/EC (amended in 2018) obliges Member States to meet targets for the recovery and recycling of packaging waste, but also requires packaging to comply with 'essential requirements' which include the minimization of packaging volume and weight, and the design of packaging to permit its reuse or recovery. It requires the implementation of measures to prevent packaging waste in addition to preventative measures, which may include measures to encourage the reuse of packaging.

The EU standard EN 13429 on packaging reuse specifies these essential requirements. According to the standard EN 13429, packaging is classified as reusable packaging on the basis of its principal suitability for the purpose. However, it would be insufficient to speak of reusable packaging without referring to the *system* in which it is embedded. Therefore, as this position paper by ECOS and ANEC explains, the EU standard has several shortcomings:

- It does not require the need for reuse or refill logistics and infrastructure.
- It does not specify minimum durability requirements to achieve a minimum number of trips or rotations.
- It does not contain a test method for the verification of durability requirements.
- It allows the use of hybrid systems, where both the refill and the reusable packages may be used as single-use packaging.

Consequently, the standard does not provide a clear-cut technical specification, but relies on the judgement of the user as to whether a certain package is deemed reusable and for how long: this is clearly not sufficient.

Catalysing systemic change: from B2B to B2C
Reuse systems in B2B packaging are already tackling logistics inefficiencies and achieving economic benefits. The wider the adoption of standardized reusable transport packaging, the more benefits it can create (individual adoption, single-industry pooling as service, multi-industry pooling as service, and the paradigm shift to a 'physical internet'). Shared logistics packaging could help to reduce the cost barrier attached to reverse logistics models by creating an open infrastructure for new business models to utilize. The modular dimensions that define B2B shipments (e.g. pallet dimensions) could set the boundary conditions for standardization of primary product packaging [34].

Conclusions

Harmonization in packaging types and dimensions, or 'universal' packaging formats, can foster a wide acceptance of such packaging formats as they can be used by different companies along the value chain. This means that standardization offers opportunities to reduce operational costs, create economies of scale, and maximize the environmental benefits of reusable packaging systems. Optimized and universal dimensions for packaging facilitate logistics, handling, cleaning and refill. Standardization can also allow for a varying degree of customization of packaging (e.g. through labelling), to enable brand differentiation and thus acceptance by companies. While its dimensions would be standardized, the packaging's label, colour, transparency, texture, and other design details which affect its general look and 'feel' could still vary. Although the most specific designs could not be exchanged for reuse between brands, they could be washed and transported using the same washing and logistics systems thanks to their standardized dimensions and overall shape.

Nationwide deposit return systems for beverage packaging have benefited greatly from standardization (e.g. standardized formats for beer bottles). For specific niche products EU standards on reuse systems may not always be feasible, and national standards and guidelines could be better suited. However, for fast-moving consumer goods that are mass-produced and found across the EU (particularly soft drinks, but also other items analysed in this report), CEN standards at EU level could be developed and harmonized. National standardization bodies can already create standards that are less prescriptive and do not stifle innovation, but still provide useful guidance to operators.

However, the most basic need of all is a clear definition of *reusable*. There could even be a label to distinguish reusable from single-use packaging.[17] By definition, packaging should only be labelled as reusable if it is reused multiple times for the same purpose within a reuse or refill system. In any case, it is important to revise the existing standard EN 13429 to incorporate requirements regarding the overall system (reuse/refill logistics and infrastructure; minimum durability requirements to achieve the maximum number of trips/rotations; test methods; exclusion of hybrid systems).

At the same time, it is important to understand that many reuse systems are still in an experimental phase and there are many different ways to organize the various building blocks (e.g. deposit system, logistics and communication), depending on the means and context of the initiative. Guidelines could be developed by public institutions at national level (based on national best practices and expertise) on aspects that are more difficult to standardize at international level, but require some adaptation to the local/regional context.

[17] In France, Reseau Consigne members use a pictogram to mark the reusable items: http://www.reseauconsigne.com/pictogramme-national-rapportez-moi-pour-reemploi/

8. Conclusions and policy recommendations

This study presents insights regarding the basic elements of a reuse system for packaging for different product groups in different channels. There is clearly a lot of potential for reusable packaging, but reuse systems face many challenges in practice as a result of the linear economy context in which they have to operate. This chapter outlines policy measures through which governments can support reuse initiatives to overcome these challenges, not only by creating enabling conditions through policies and regulations but also through other instruments. Most of these measures would have to be implemented at national or local level, but the EU also has an important role in leading the reuse transition through – for instance – target-setting, the PPWD, and guidance for EPR schemes.

Packaging and Packaging Waste Directive (PPWD)

To achieve the objective that all plastic packaging and single-use plastic products placed on the market should be reusable "where possible" and in any case recyclable by 2025, the essential requirements have to be formulated more specifically in order to provide sufficient technical guidance to producers. Most importantly, control and enforcement on the ground should be improved so that the PPWD can be more than just a list of intentions. It is essential that Member States put in place accountability mechanisms and penalties that are sufficiently dissuasive to prevent non-compliance.

Bans on single-use packaging

In principle, unnecessary and unsustainable single-use packaging (not only plastics, but all materials) should not be allowed on the market. This would force businesses to invest in reusable packaging systems.

This can be achieved through a phased approach that first focuses on the sectors where single-use packaging can easily be substituted by reusables. As a first step, the use of single-use packaging for onsite consumption should be banned in the HoReCa sector, but also for government buildings and public institutions (e.g. schools). Secondly, single-use packaging should be banned at public events and festivals as it is in the region of Flanders, Belgium. In some cases, frontrunner municipalities can lead the way by imposing a ban at local level (e.g. Geneva in Switzerland banned most single-use plastics, including cups and food containers).

As for out-of-home consumption (take-away and delivery), it should be made mandatory to offer users a reusable option. In Germany, operators of a restaurant or café that offers food or drinks to go will be obliged from 2023 to offer reusable packaging in addition to environmentally friendly disposable packaging. There will be an exemption for small businesses with five employees or fewer and a shop area of no more than 80m^2. The reusable version may not be smaller or more expensive than the disposable packaging, but a deposit may be added. In addition, the reusable containers must be taken back by the respective company after use. Besides reusable containers, in the CAEP, the EU committed to proposing an initiative to replace single-use tableware and cutlery with reusable options in food services.

A ban on single-use packaging for e-commerce and household care is less likely in the short term, but for these product groups it can also be made mandatory to offer a reusable alternative. Furthermore, reuse targets will help to establish reuse systems.

Waste reduction and reuse targets (both national and EU level)

At the moment, there are only *binding* recycling targets for packaging at end-of-life, rather than reduction and reuse targets. Although the European Plastic Pact aims to reduce virgin plastic products and packaging by at least 20% (by weight) by 2025, with half of this reduction coming from an absolute reduction in plastics,[18] the

[18] This refers to reduction of 'unnecessary' plastic, without increasing use of other materials and/or generating unintended consequences. Absolute reduction can be achieved in a number of ways, including through reuse/refill systems.

signatories do not cover the entire market and there are no enforcement mechanisms to ensure the target is reached.

Most efforts, including EPR schemes[19] and Plastic Pacts at national level, focus on recycling and quick wins. However, to steer the circular economy in the right direction it is essential that the EU and national governments adopt ambitious and legally binding reduction and reuse targets for the packaging industry. To be in line with ambitions for a circular economy,[20] the total amount of virgin plastic packaging placed on the market should decrease by 25% by 2025 and 50% by 2030. Another option is a quantitative limit, or cap, on the amount of single-use packaging material put on the market, to force companies to avoid single-use packaging.

In addition, binding reuse targets create a safe environment for investments by SMEs and larger corporations in reuse systems and infrastructure [43]. They also prevent them from simply replacing SUPs with disposable products made from other materials. Different targets should be adopted for different product groups, because each of them has its own potential, market dynamics and challenges. We propose the following percentages for the share of the market covered by reusable packaging:

- Drinking cups: at least 75% by 2030
- Take-away and delivery meal containers: at least 50% by 2030
- Household care products (laundry care) distributed by large retailers: at least 20% by 2030.

For e-commerce packaging, users should be given the option at checkout. Although based on our research the business models seem to be viable, the cost of the reusable alternative is much higher to the retailers, thus making it difficult to scale up without users contributing to the packaging cost. Research is needed to establish a feasible target, as the business model is not yet economically viable without this user contribution.

Setting enabling conditions for reuse at national level
As of 1 January 2020 in Romania [43], market operators who place packaged products on the market have been required to sell a minimum of 5% of their goods in reusable packaging. Furthermore, the percentage may not be less than the average percentage achieved between 2018 and 2019, and there should be an annual increase by 5% until 2025. As a result, at least 30% of user packaging on the Romanian market should be reusable by 2025. Retailers will be required to give users the opportunity to choose reusable packaging and return it to the point of sale (with the exception of retailers with a small sales area).
In France, a new law is being debated which should make it easier for shoppers to refill their own reusable containers in supermarkets when buying dry products like rice, pasta, cereals and beans. The new law would mean large supermarkets in France must dedicate 20% of their surface space to food refill stations by 2030. After being passed by parliament the law still has to be passed by the senate. If passed, it will apply to shops of more than 400m^2. It will not apply to off-licences, wine shops, cosmetics stores or perfume shops, in which it is more difficult to sell products as refills.

At EU level, the revision of the PPWD should integrate concrete reduction and reuse targets. At national level, new legislation should be enacted to formalize these targets, like in the French law on the circular economy, but existing EPR agreements and Plastic Pacts should also be updated. Most importantly, government monitoring is needed to keep track of the level of reuse and the effectiveness of measures implemented by the industry, while non-compliance should lead to effective sanctions. In addition, large retailers should be obliged to devote a share of their shelves to refill stations selling unpackaged goods.

[19] At national level there are often formal packaging agreements between the national government and producers' responsibility organisations specifying binding requirements for packaging producers.
[20] Based on the EU Plastic Pact, "aiming to reduce virgin plastic products and packaging by at least 20% (by weight) by 2025, with half of this reduction coming from an absolute reduction in plastics": https://europeanplasticspact.org/targets/

Financial support

Given the challenging business case for reuse and the time it takes to reach a break-even point, it is often difficult for entrepreneurs to access financing to cover the initial (upfront) investments in, for instance, a stock of reusable containers or industrial washing systems. In order to address this obstacle for businesses, government agencies could provide soft loans[21] or create innovative funding schemes such as convertible loans or grants for reuse businesses. At the local level, municipalities could provide local businesses with financial support to develop and implement reuse pilots. These financial support measures should of course set clear requirements for environmental and economic performance, while stimulating the scaling-up and harmonization of systems.

In addition, government support for R&D programmes is also still needed to develop and improve reuse systems. The UK Research and Innovation competition developed a grant programme to support collaborative projects for refill infrastructure projects, as part of the UK Circular Plastics Flagship Projects grants. The German Federal Ministry of Research has funded a PraxPack long-term research collaborative programme to develop and test business models for reusable packaging solutions in online retailing. And a pilot test showing that the reuse of bottles in the wine sector is technically feasible and more environmentally friendly was funded by Life Program. The outcomes and insights of these national and European programmes should be combined and shared across the EU.

Fiscal measures

In order to remove the economic advantage that single-use packaging currently has vis-a-vis reusables, environmental costs should be internalized in the price of single-use packaging in line with the 'polluter pays' principle. It is simply too cheap to produce and waste single-use packaging, which means reusables can seldom outcompete single-use packaging. To improve the business case for reusables, more economic disincentives for single-use packaging are needed. This can be achieved through a tax or levy on single-use packaging, like the latte levy. Such a levy should be at least €0.20 per unit and be visible to the user in order to have an effect. The revenue generated could be used to support innovative reuse systems. Another way to encourage reusables through fiscal measures is to recognize capital investments for reuse systems as environmental measures that are eligible for tax rebates.

Extended producer responsibility (EPR)

EPR schemes are an important instrument to make producers pay for environmental costs, firstly by obliging them to cover the cost of waste collection and treatment. With the implementation of Article 8 of the SUPD, producers will also be obliged to cover the clean-up costs of certain packaging litter as well as awareness-raising measures. It is essential that these costs are determined based on an objective methodology that takes into account all costs related to the end-of-life disposal of (single-use) packaging, from collection infrastructure and transport to recycling.

Currently, there are many EPR schemes across Europe that are all organized in a different way. EU guidelines for EPR schemes should include requirements for EPR schemes to take into account reduction and reuse targets. At least 10% of the EPR budget should be earmarked to be invested in the development and scaling-up of reuse systems.

Furthermore, EPR mechanisms can be improved to promote design for reuse. This can be achieved through eco-modulation (differentiation) of fees so that producers of reusable packaging pay less.

[21] A soft loan is a loan with no interest or a below-market rate of interest. Also known as 'soft financing' or 'concessional funding,' soft loans have lenient terms, such as extended grace periods (Investopedia, 2021).

The Ellen MacArthur Foundation has also recently released a position paper, signed by more than 100 businesses across the packaging value chain, including brands, retailers and packaging manufacturers, calling out for EPR schemes for packaging as a means to fund the scale-up of circular activities with packaging.

DRS systems for reuse

Deposit return systems for beverage containers are increasingly being adopted in EU countries, which is a positive trend [44]. Although these are currently mostly geared towards recycling, they can also be deployed for reuse. The logistical systems for DRS can be used for different packaging types, such as glass, plastic and aluminium, and shared between recycled and reusable packaging. Member States should incentivize the efficient use of infrastructure for both systems, and the European Commission can formulate guidelines building on best practices.

Information dissemination and collaboration

Government agencies should provide information services to support stakeholders with the practical implementation of reuse systems, for instance through guidelines as described in the previous chapter. A good example is the public agency OVAM in Belgium which offers useful information and reports on reusable catering material for event organizers and municipalities.

Also, communities of practice on reusable packaging funded by packaging waste management contributions, such as those established by the KIDV in the Netherlands, can be useful for different actors (e.g. supermarkets, brand owners, service providers, start-ups, research institutes and NGOs) to collaborate and exchange information on the challenges and opportunities for reusable packaging. Such communities could launch pilots on reusable packaging, organize events, publish reports and create tools for key aspects, which can be of great value in the transition phase.

9. Study limitations

The authors of this study tried to create the most complete and informative document possible, taking into consideration the scope and objectives set out. However, the study presents different limitations which are described below for transparency purposes.

Due to the lack of data at the time of performing the prioritization of product groups for the different criteria within each channel, the classification was performed mostly on the basis of the knowledge of the consultants. Although this is a limitation of the study, the application of a multicriteria decision analysis made the process systematic and therefore more reliable.

A simplified quantitative study was used to estimate the potential for improvement of the reusable systems on environmental, economic and social levels. Where possible, data used was based on published LCAs from reusable packaging systems currently in operation from known organizations and following equivalent methods (i.e. Cup Club and Hipli). Although precision and consistency were pursued as much as possible, several assumptions were made because data was either confidential, inconsistent or unavailable.

The study focused on analysing the worst-case scenario for the reuse system and the best case for the single-use system, in order to ensure that where positive results arose, it meant that with a higher level of certainty it could be affirmed that reuse systems are a promising solution.

Data on packaging units consumed in each product group is not readily available (at European level), so assumptions had to be made based on the best data proxy.

Economic data was harder to assess and modulate as i) some systems have very small, non-scaled operations, or are wary of sharing data on business-critical processes such as reverse logistics and cleaning costs; and ii) in

some cases there were no examples to base data on (e.g. household care). This may impact the results and make less positive business cases in some product groups.

Investment was not taken into consideration in the assessment of the business case for reuse, as neither was the investment in single-use packaging (such as moulding and blowing equipment).

The economic impact of incentives for return (deposit or reward) were not considered in the design of the systems as there are different alternatives available, and there is a question over who incurs the cost (retailer/ manufacturer, reusable system provider). Although deposits are mainly used to ensure the packaging is returned to the system by the user, retailers/manufacturers may incur costs in the processing of electronic transactions, which may be avoided with a digital wallet system. Moreover, reward is often implemented as a discount on a subsequent purchase, driving loyalty and additional sales which would have to be accounted for. Nonetheless, there is a need for incentives for all actors in the value chain to design successful systems.

Needless to say, although European averages were used, there are sometimes significant differences in terms of population density, warehousing space cost, or even wages that have an impact on the business and environmental case of reuse systems in certain settings or Member States.

A sensitivity analysis of the LCAs was not conducted in this study. When implementing reusable packaging systems, undertaking sensitivity analysis can support decision-making in terms of determining thresholds that should be met to ensure reusable systems are made environmentally friendly.

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