Reusable takeaway packaging for food and drinks – scalability of systems towards circularity in Europe.

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Summary / Description

For consumption of food and drinks on the go, huge amounts of plastics are consumed, including takeaway packaging, most often for single use. Across Europe, systems and initiatives for reusable food and drinks packaging are emerging in various types of gastronomical services, such as restaurants, kiosks, coffee shops and cafés. To provide insight into the scalability of reusable food packaging systems both nationally and on the European level, this study was performed with the aim to understand barriers, driving factors and potential for scaling up the systems.

In this study we identified and interviewed companies and initiatives in several European countries that focus their business activities on the value chain of reusable packaging and performed additional literature and desktop searches to gather related findings on the scaling up of such systems. The interviewed companies included in the study stem from eight European countries from which good examples could be found: Belgium, Denmark, Estonia, Finland, Germany, Spain, Sweden, and The Netherlands.

Results show that systems differ to large extent in terms of market offer, type of (return) system, and type of packaging. Many pilots and start-up companies in Europe have offered reusable takeaway packaging, but the question is how to become economically viable and scale up. National funding agencies have put efforts in providing knowledge to practitioners for overcoming this problem. Still, uncertainty remains how a larger break-through of reusable takeaway packaging may be organized and incentivized. To further the scale up of reusable takeaway packaging in Europe some key messages derived from this study are:

- Collaboration across various stages of the value chain is essential for optimizing operational costs and reducing the price of reusable packaging systems. Scaling up these systems can be supported by central actors or authorities providing guidance and facilitation.

- To engage the wider public, reusable packaging systems should be accessible and cost-efficient systems, and with clear incentives and effective information campaigns. The anticipated shift in consumer behaviour will further guide system operators in aligning their services with consumer expectations.

- The environmental and climate impact of reusable packaging systems is fundamentally linked to the organization and context of the system. Efficient systems and return processes, as well as optimized packaging solutions can contribute to the optimization of the systems' impact.

1 Introduction

For consumption of food and drinks on the go, huge amounts of single use packaging and items are consumed, including takeaway plastic packaging, plastic crockeries etc. It is estimated that more than 10 Mton/year plastics will end up in soil, ocean or freshwater (Hoseini and Bond, 2022) with single-use takeaway packaging found in beach clean-ups as one of the top items (Ocean Conservancy, 2021, (UNEP, 2018)). This underlines the need to reduce single-use plastic items which was not in the least demonstrated during the Covid pandemic when sales numbers of SUP increased (European Environmental Agency, 2021). Also, the urge for alternatives to SUP become apparent in upcoming EU legislation with requirements for reusable packaging (European Parliament, 2024). Many cities, companies and researchers have performed trials with more circular or sustainable plastics consumption. Across Europe, systems and initiatives for reusable food and drinks packaging are emerging in various types of gastronomical services, such as restaurants, kiosks, coffee shops and cafés. Handling reusable packaging impacts the whole value chain, such as cleaning services, transport, and redistribution, which may be carried out by different entities. To provide insight into the scalability of reusable food packaging systems both nationally and on the European level, this study was performed with the aim to understand the status, barriers and opportunities for scaling up the systems.

The motivation behind this task is to identify and map selected examples of organisations employing reusable packaging that are or can be scaled to national or EU level. Cities, small businesses, and universities often form testbeds for solutions that could be used on a broader scale (regional or national level) or from which they can learn from each other. Furthermore, it is a motivation to investigate experiences of direct engagement with people (amplify environmental causes, activate younger people, reach broader public), provide a platform, and catalyse awareness and action.

This report is organized in four chapters, starting with the Introduction and methodology in chapter 1. In chapter 2 we provide an overview of the interviewed companies and systems as well as a classification of important parameters of the systems. Furthermore, we have analysed the policy and sustainability aspects of reusable packaging combined with our findings from the interviews which are presented in chapter 3, which is followed by our conclusions in chapter 4.

We have applied a mixed methodological approach in the study. Through initial desktop research we identified companies and initiatives in several European countries that have their business activities within the value chain of reusable packaging. A follow-up interview study provided insights into sustainability aspects of the systems that was further complemented with findings from literature, as well as into barriers, driving factors, and potential for scaling up where relevant. Hygiene and safety aspects are included as part of the social sustainability aspects. Also, an analysis was conducted both at the European and national level, where possible, on definitions, legislation, and regulations for reusable packaging for takeaway food and drinks.

The selection of companies for the interviews aimed to achieve a representative image of activities throughout different European countries as well as including a variety of types of companies in terms of their activities. To differentiate between activities in this respect, the Ellen Mc Arthur Foundation (Ellen MacArthur Foundation, 2019) identified four types of Business-to-Consumer (B2C) models: Return on the go, return at home, refill on the go, refill at home.

1. Return on the go applies to packaging owned by companies, that can be returned at the store or drop-off point, such as collection boxes.
2. For Return at home, the packaging is picked up by a collection service at home.
3. Similarly, for Refill on the go the consumer-owned packaging is filled at a store, using a dispensing system away from home,
4. In case of Refill at home, consumers can refill their reusable packaging at home, for instance through a subscription service.

This report focuses specifically on Return on the go systems, since the desktop research showed that these systems are most prevalent in the market for takeaway food packaging, whereas the other systems are more related to other contexts such as supermarket packaging.

After an initial desktop study for gathering basic information, nine companies were all interviewed in April-May 2024, either online via a Teams meeting or by telephone. One of the companies, Kamupak in Finland has shut down after the study, but we have chosen to include them in the results since they provided relevant information for the study regardless of the status. Another company, Duni in Denmark, has been interviewed but not included in the study since the system was not developed for implementation on the market at the time of the study. The interview questions (see Annex 2) were focused on the types of offerings and the company's role in the value chain and deriving barriers and opportunities for scaling up. The analysis of the results has focused on providing insight into environmental evaluations of systems, consumer related aspects, as well as cost-benefit analyses.

The analysis of the policy on circular economy was performed by a system-oriented approach (Dalhammar et al., 2021) to critically analyse the policies in their context. It was performed as a desktop analysis of the regulatory system of the product and services for take away packaging in the EU, as well as using primary legal sources. The EU regulatory changes on the packaging and packaging waste regulation (PPWR) as well as green claims directive were selected for the initial legislative inventory.

2. Overview systems for reusable take away packaging

2.1 Descriptions of selected companies

The interviewed companies were selected from eight European countries from which good examples could be found: Belgium, Denmark, Estonia, Finland, Germany, Spain, Sweden, and The Netherlands. All information on the companies can be found in Annex 1. Some of the companies are active in several countries, in which case the country of establishment is taken as country of origin. The different types of offers are mapped for the interviewed companies in Table 1.
In the next section, we will provide an overview of the different systems and provide a classification of the systems based on the various parameters described above.
Table 1 provides an overview of the companies and parameters studied. Further details are provided in the Annex I.

Table 1: Overview of the interviewed companies with information on the type of offers, systems and performance

Aspects	Bumerang	FutuREproof	Kamupak	Panter	Red-use	Ringo Eco	Rotake Reusable (Tomra)	Vytal
Geographical scope	Spain	Belgium (Flanders), The Netherlands	Finland and Sweden	Sweden	Belgium (Flanders)	Estonia and Latvia (only events)	Denmark	Available in 17 countries
Available in locations such as	Canteens, hospitals, restaurants, cafes, events	Restaurants	Restaurants, cafes, kiosks, grocery stores, offices, events	Restaurants, cafes, kiosks, office canteens, gas stations, events	Restaurants, cafes, kiosks, events	Restaurants, cafes,- offices, courier systems, events	Restaurants, cafes, kiosks	Restaurants, cafes, kiosks, events
Product scope	Food containers, cups	Food containers, cups	Food containers and cups	Food containers and cups	Food containers, cups, plates, cutlery	Food containers, cups, plates, cutlery	Cups	Food containers, cups, food trays
Material of the packaging	Plastics	Plastics, stainless steel	Mainly polypropylene	Polypropylene	Polypropylene	Mainly polypropylene	Polypropylene	Polypropylene, stainless steel, glass
Return system	Fee system	Deposit system and a fee system (in collaboration with Red-use)	Fee system and deposit system	Fee system and deposit system	Deposit system and a fee system (in collaboration with FutuREproof)	Deposit system	Deposit system	Fee system
Return rate	Aound 99%	Around 99%	>90%	Around 99%	N/A	N/A	N/A	Around 99% (excluding events)
Retention time	About 3-4 days	N/A	N/A	Around 7 days	Around 2-3 weeks	N/A	N/A	About 5 days
Organisation of cleaning	Non centralised cleaning by e.g., restaurants and cafes They offer centralised cleaning for a fee	Non centralised cleaning by e.g., restaurants and cafes They offer centralised cleaning through a partnership with Red-one	Non centralised cleaning by e.g., restaurants and cafes	Non centralised cleaning by e.g., restaurants and cafes They offer a cleaning service through Tingstad	Centralised cleaning service Some restaurants are cleaning the packaging locally	Centralised cleaning service	Centralised cleaning service	Non centralised cleaning by e.g., restaurants and cafes For events, they offer a cleaning service
Pre-wash is required by the consumer	N/A	N/A	No	No	Yes (consumer needs to rinse the packaging)	No	No	Consumers are asked to pre-wash the containers (not obligatory)
Environmental breakeven point	N/A	N/A	Six cycles	Around 10 cycles	N/A	N/A	Six cycles	<10 cycles

2.2 Classification of systems

As evident from the descriptions of companies (see Annex 1), the systems for reusable takeaway packaging differ at least on three aspects which are relevant for the potential scale-up of systems, which are: Type of markets serviced, type of return systems, and type of customer payment system.

Looking at the different types of markets to which companies offer their products and services, a distinction can be made between local, national, or international markets, see Figure 1. Local markets concern mostly cities or regions in which companies directly distribute and service the packaging to local shops, cafes and restaurants or events. At the national and international level, it is mostly the digital system and packaging that is provided whilst the collecting and redistributing is organised through collaborations within the value chain. Some companies are active at different levels and have also developed various offers accordingly.

Figure 1: Overview of the interviewed companies (for more information see Annex 1) offering reusable takeaway packaging for food and drinks on local, national, or international markets (Figure CC by 4-0 CSCP).

Figure 2 provides an overview of the different types of return systems as well as the return procedure. In simple terms, system providers offer two different types of return systems, either a deposit system or a fee system. A deposit system entails that the consumer pays a deposit upfront when the packaging is purchased, which is returned when the consumer returns the packaging. A fee system charges the consumer a fee retrospectively if the packaging is not returned within the packaging providers established return period. In addition, the fee can be divided into one or more payments, for example, the consumer may receive a small reminder fee after two weeks and then pay a larger penalty for the package after one

month. These systems can be named in various ways, such as a library system, which in principle is the same as a fee system.

Some companies have different offers for return systems targeting a temporary occasion, such as events or conferences, and for permanent solutions such as for restaurants and cafes. For example, it is common to have a (temporary) deposit system for specific events, while a fee system is implemented for permanent systems.

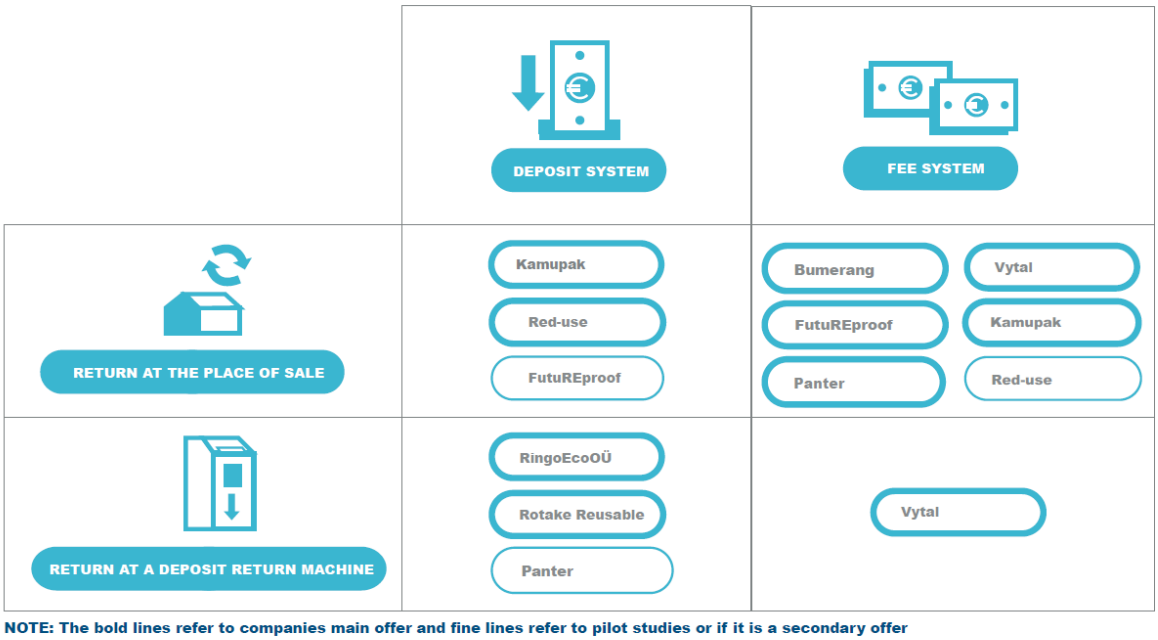

Figure 2: Schematic overview of the interviewed companies' type of return systems for reusable takeaway packaging for food and drinks. Note: companies highlighted in bold lined boxes represent their main business offer (Figure CC by 4-0 CSCP).

Figure 2 shows that the return procedures of the interviewed companies can either facilitate a return at the place of sale system or a return at a return deposit machine. The return-at place of sale system entails that the consumer returns the packaging at one of the locations of the partnering companies (e.g., a restaurant or shop). A return of packaging at a return deposit machine can be placed at the place of sale or elsewhere. In total, six of the interviewed system providers have implemented a return-at the place of sale system. Four of the interviewed system providers provide a return at a deposit machine system, of which two have this as their main offer: Ringo Eco OÜ has a system with various return stations in different cities in Estonia, while Rotake Reusable (Tomra) has placed various deposit return machines throughout the city of Århus.

Regarding customer payment, as mentioned previously most providers apply both type of payment systems depending on the situation. In the case of Kamupak, Vytal and Red-use, both a deposit as well as a fee system is used for return at the place of sale, which return payment directly to the customer's bank card. Two system providers, Ringo Eco OÜ and Rotake Reusable (Tomra), have implemented a deposit system for their return machines. These machines are, according to the system providers, strategically located to enable customers to return the packaging efficiently. Locations are planned according to predicted patterns to which the consumers move around the local area.

Summarizing the classifications, we can see that there are large variations in types of return- and customer payment systems for reusable takeaway packaging depending i.a. on the market context and on the purpose of the system. As such, possibilities for scaling up should also consider these variations. In terms

of policy, incentives for making reusable packaging more cost-efficient are important to consider for upscaling, and related legislation differs per member country of the EU. These aspects are included in our policy analysis of systems applied in European member states. The specifics of policy, business offers, and sustainability aspects related to reusable takeaway packaging will be analysed in the next chapter.

3. Potential for scaling of the systems

3.1 Introduction

In this chapter we highlight sustainability aspects: economic, environmental, and social aspects, related to reusable takeaway packaging and further our analysis of the potential for scaling of the systems and their business models.

A useful terminology for scaling in relation to circular business models is given in the framework of Moore et al who defined three types of scaling in relation to systemic social innovations (Moore et al., 2015). The first one, scaling out, is the generally known notion of reaching out to more people or communities to increase the number of units sold or optimizing the system performance. The second, scaling up, aims to influence institutions by integrating innovative approaches into law, policy, and institutions, which often is directed towards developing new initiatives tailored towards policy change. The third one, scaling deep, is related to qualitative aspects such as changing values and mindsets in society, and to impact cultural aspects. Since reusable takeaway packaging touches upon people's willingness for making sustainable choices while targeting environmental and social values, scaling should also be sensitive to such more systemic changes. Scaling in this respect targets change both regarding formal (scaling up) and informal (scaling deep) institutions, including policy change and consumer habits. These aspects will also be further analysed in the next sections.

3.2 New regulations and ongoing implementation

Recently, many developments have been initiated at European level in the policy area. During 2024, EU reached an agreement on new regulation on packaging and packaging waste regulation (PPWR) (European Parliament, 2024). The PPWR comes in addition to the Single-Use-Plastic-directive (EC, 2019) implemented in Member States, seemingly paving the way for reusable packaging alternatives. PPWR established minimum sustainability requirements for all packaging as a prerequisite to be placed on the market, including plastic packaging, and provided definitions on reusable packaging and systems.

Box 1. New EU-regulation supporting reuse of packaging (EC, 2022) (EU, 2024) (European Parliament, 2024)

The new, proposed provisionally agreed, regulation on packaging and packaging waste (PPWR) aims to greatly reduce packaging waste. Supporting member states to impose higher waste fees through extended product responsibility schemes or taxes on plastic packages waste, are imposed to de-incentivise single use. The regulation will oblige actors to offer the consumers reuse packaging at no higher costs or less favorable conditions than the equivalent sales unit with single-use packaging, article 3328 (b). However, the EU regulation does not forbid single use containers of paper. Organisations will also be obliged to offer customers the possibility of bringing their own containers to be filled with cold or hot beverages or ready-prepared food, article 3228 (a). Those two obligations will be in force late 2027 respectively late 2026. According to the regulation, take-away businesses in 2030 ' endeavour to offer 10% of products in a reusable packaging format must endeavor to sell 10% of food and beverage in re-use packaging'. Micro enterprises are exempt from these requirements.

Reusable take-away packaging actors mention a supportive regulatory system with effective measures for reusable packaging as one of the key tools for a successful business case for reusable take-away packaging. Legislation may for example support reusable packaging by limiting the use of single use packaging and support reusable packaging systems in building economy by scale.

It is further noted that although the new rules to some extent support reusable packaging in the take-away sector it is still unclear how reuse systems may be organised, in practice, at a feasible scale from a regulatory point of view. Member State's future regulation and enforcement of the requirements for reuse systems will be important to this.

Box 2 Definition of 'take-away packaging' as included in the Packaging and Packaging Waste Regulation (PPWR)

Article 3 (2)1)(a): a service packaging filled at attended points of sale, with beverages or ready-prepared food, that is packaged for transportation and immediate consumption at another location without the need for any further preparation, and typically consumed from the packaging.
'Packaging shall be considered reusable where if fulfils the following conditions in PPWR article 10 :1 (a) it has been conceived, designed and placed on the market with the objective to be re-used or refilled; (b) it has been conceived and designed to accomplish as many trips or rotations as possible in normally predictable conditions of use; (c) it can be emptied or unloaded without damage to the packaging, which prevents its re-use; (d) it is capable of being emptied, unloaded, refilled or reloaded while ensuring compliance with the applicable safety and hygiene requirements; (e) it is capable of being reconditioned in accordance with Part B of Annex VI, whilst maintaining its ability to perform its intended function; (f) it can be emptied, unloaded, refilled or reloaded while maintaining the quality and safety of the packaged product and allowing for the attachment of labelling, and the provision of information on the properties of that product and on the packaging itself, including any relevant instructions and information for ensuring safety, adequate use, traceability and shelf-life of the product; (g) it can be emptied, unloaded, refilled or reloaded without risk to the health and safety of those responsible for doing so; and (h) it fulfils the requirements specific to recyclable packaging when it becomes waste set out in Article 6.'

All reusable packaging in the EU must connect to an established system for rotation of the packages, article 26 & 27 PPWR set up specific requirements for such systems for reuse, Annex VI. The person, legal or natural person who manages the reuse system (system operator) manages the circulation and is obliged to report to national authorities on the rotations achieved by the system as well as number of units of reusable or refillable packaging added to the system, number of units of packaging that have been handled by the end-of-life plan. Existing reuse systems already in place within the Member States fulfill this obligation. Member States can also establish an official deposit and return system or license a single system operator responsible for a deposit and return system (or if there are multiple operators, put in place coordination measures). The system operator of such deposit and return system must be a non-profit, independent legal entity and perform roles defined by the regulations of the Member State.

Box 3. Member States implementation of the SUP Directive concerning single-use plastics.

The SUP Directive instructs Member States to take national measures to reduce consumption of single-use plastic cups for beverages and food containers. Additionally, some single-use plastic products are banned by the EU, such as plastic straws, cutlery, and plates (EC, 2019). Member States have chosen different measures to achieve the directive's objectives for a quantitative reduction in the consumption of SUP cups for beverages and food containers by 2026 in comparison to 2022.

Several Member States oblige the HORECA sector to offer reusable packaging at the point of sale to the final consumer (SE, DE, NL, FR), others have set national targets to be fulfilled by the sector (DK, FI, EE) or apply a special tax on non-reusable plastic packaging (ES). The Member States are also obliged to include certain single-use products in their producer responsibility systems for waste management. This may increase the waste management fees for single use packaging.

The provision of information on reusable packaging on usage is targeted in the new directive on Green Claims (EC, 2023). The aim of the EU action regarding green claims is to allow consumers to make their choices based on transparent and reliable information on the sustainability, durability and carbon

footprint of the products. It highlights that market transparency is a tool facilitating uptake of technologically and environmentally superior net zero products. Single use packages may for example be claimed to be 'bio-based', 'compostable', 'recycled content', 'biodegradable' or 'recyclable' without this being the truth, as reusable packages also may be wrongly claimed to be 'reusable'. This parallel regulation (The amendment of Directive 2005/29/EC(EC, 2005)) concerns strengthening EU rules for consumer's reliance on product information regarding sustainability (EC, 2005, 2023). This reduces the possibilities to market single-use packages as sustainable, as life cycle perspectives need to be taken when proving. However, the new rules also limit the market communication on reusable packaging as general environmental claims are forbidden and the claim of reusability must be supported by proven facts.

3.3 Business models (scaling, logistics, supply chain etc.)

Circular business models are widely recognized for enabling businesses to transition from current linear approaches to circular ones. These models span through the entire development process from initial design concepts to the product's End of life. Three elements for implementation of circular business models are defined by EEA (EEA, 2021): (1) circular goals, such as reuse, recycle etc, set by policymakers, (2) business model innovation combined with (3) technical and social innovation. These three elements are most certainly relevant for the implementation of reusable food packaging systems (Bocken, N.M.P. et al., 2014; Joyce and Paquin, Raymond L., 2016).

Many initiatives have started up as pilots and tested novel business models including technical innovations for implementing reusable takeaway packaging. However, many of these initiatives struggle to move beyond the piloting phase, which they mainly attribute to the social acceptance of reusable take-away packaging (see Section 3.5).

Nevertheless, the business model is expected to evolve throughout the scaling phase, as several essential actions throughout the business model will become more economically viable, or a different organization will be required for certain steps. It is expected that this evolution of the business model will be performed in a step-by-step manner through the testing and implementation of optimisations during operations. Several initiatives indicated during the interview that there is currently a need for action-based support to help scale the business models (e.g. regulatory requirements, project support), rather than focusing on additional (theoretical) investigations on how a perfect business model needs to look like.

Activities of companies that handle reusable packaging are depicted in Figure 3.

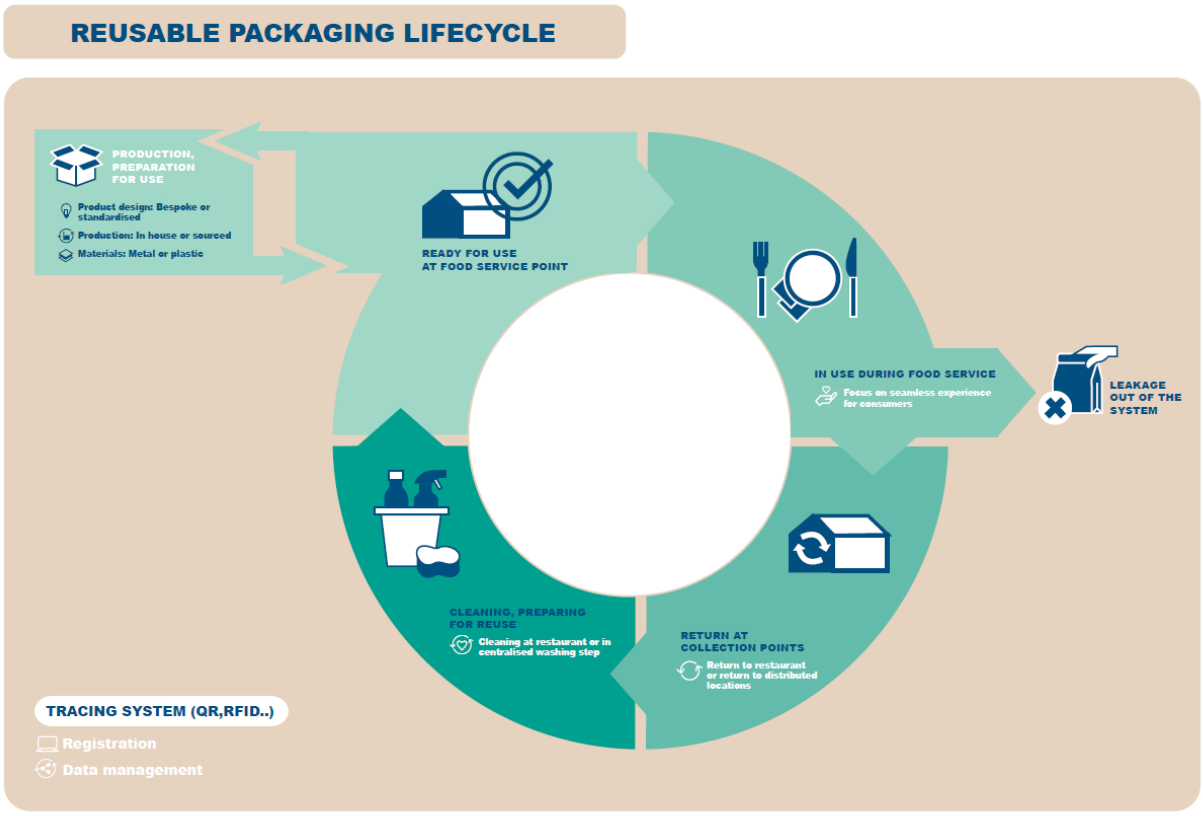

Figure 3: Operational model for return on the go reusable packaging systems for takeaway food and drinks. Source: developed by VITO for ETC/CE, (Figure CC by 4-0 CSCP).

A typical operational model for return-on-the-go reusable packaging systems is depicted in Figure 3. In short, the operational model starts with the development and production of the packaging (system) with the complete requirements of the model in mind in the "Production & preparation for use" step. New packaging products can be distributed to the restaurants, and faulty containers can be collected for repair or recycling.

Once the reusable packaging is distributed to the restaurants, the packaging is "Ready for use @ place of sale" and enters the use cycle as direct food packaging that is given to the food consumer ("In use during food service @consumer"). After use, the consumer is instructed to return the packaging to (a) collection point(s) where the food packaging operator again takes control over what happens to the packaging ("Returned to collection point"). Packaging that is not returned, leaks out of the system and is not able to be reused for a new cycle ("Leakage out of the system").

The operator must design the system towards minimizing this leakage (and product retention time). Once the packaging is returned to the collection point, a washing step is performed before the packaging product can be reused ("Cleaning & preparing for reuse"). After this step, the packaging can be redistributed and/or reused by the restaurant. During the execution of this operational model, the packaging is tracked throughout the different steps through a tracing system that provides control and monitoring options for the operator.

The interviews with the companies that operate reusable packaging systems together with literature reports provide more detailed insights on each of these steps included in Figure 3 that are important to shape and support the further development of the market and the scaling of circular business models. The following subsections list these insights per identified step in the operational model.

Production and preparation for use

Most of the reusable packaging system operators are not designing or producing their own packaging products. The packaging is either developed in collaboration with a partner that develops the packaging or are directly sourced 'off-the-shelf' through retail/wholesale depending on the scale. Only one of the interviewed operators indicated they developed their own packaging.

The operators prefer standardised (non-branded) packaging to enable scaling and efficient circulation (cleaning & preparing for reuse, see further) of the packaging, especially in a situation where central collection and washing occurs. Bespoke packaging for a specific restaurant (chain) is not preferred, but currently supported by most operators to accommodate for current market demand and leverage the learning opportunities it offers for the operations.

Several operators state that bespoke packaging that they use is owned by the restaurant and not by the operator, where standardised packaging is owned by the operator. This preference for standardised packaging for scaling is supported by literature reports that state that standardisation is a key scaling requirement towards large scale operations as economies of scale are very relevant for reusable packaging systems(Ellen MacArthur Foundation, 2023; Zero Waste Europe, 2023).

The preferred material for the reusable packaging for all interviewed operators is plastic polypropylene (PP). Some operators also offer packaging containers made of stainless steel. Literature reports confirm that polypropylene (PP) is a suitable choice for reusable packaging (Zero Waste Europe, 2023; PackBack, 2021; Sun et al., 2021; Gallego-Schmid et al., 2019). Polypropylene (PP) shows a good compromise between durability, low weight, and cost effectiveness for the expected use cycles. Higher quality plastics or steel containers are expected to leak out of the system prior to failure and have a higher chance of leakage, do not necessarily lead to better operation performance and are therefore also not necessarily the most sustainable option under these circumstances as the impact of production of these containers is not compensated for under these circumstances with high leakage.

Monitoring of leakage, packaging distribution and take-back of faulty containers is important towards stockkeeping and controlling smooth operations and is directly connected with the tracing system that all operators have installed (see further).

Ready for use @ place of sale

The places of sale will use the reusable packaging as a one-to-one replacement of single-use packaging for their meals. When the reusable packaging enters a use cycle, all interviewed operators stated to have implemented a registration of the 'in use status' of the packaging (see 'Tracing system').

In use during food service @ consumer

During the usage of the reusable packaging, the consumer enjoys a meal or drinks from a typically more premium food container compared to single use or can transfer the food to other (reusable) tableware such as a ceramic plate or bowl in an identical manner as for single use packaging. An important parameter identified in literature is the packaging container's retention time – to minimise the stocks needed (Zero Waste Europe, 2023). A low retention time is important for an efficient system with fast throughput. A retention time of one week requires 7 times higher total volumes of packaging compared to a retention time of one day.

Return to collection point

The interview responses on the return of the reusable containers showed that the collection of the packaging containers can be organised in (slightly) different manners. Whereas several aspects are always considered as part of an effective collection system, other aspects differed in the collection approaches of the different operators. Upon return of the packaging, a scanning registration is always implemented to register the 'returned' status of the packaging.

The collection processes are either open (accepting many types of reusable packaging from several operators) or closed (only for specific packaging or a specific operator). Literature states that for scaling reusable packaging, the first system is preferred due to the pooling opportunities that can leverage economy of scale benefits for the packaging (Ellen MacArthur Foundation, 2023). The operators indicated that the organisation of collection of the packaging is expected to evolve significantly together with scaling of reusable packaging systems. In a closed system, the packaging can always be returned directly to the restaurant(s) that use the packaging system if the restaurant(s) is performing the cleaning itself (non-centralised washing).

In the current market, this system is prevalent, and the packaging is mostly required to be returned directly to the restaurant. Together with scaling of reusable packaging, also broader collection networks are a focus. For these scaled-up systems a seamless collection of used packaging containers is important. This is most efficiently performed through open systems with geographically strategically distributed, easily accessible (automated) collection points based on shared infrastructure that is available 24/7 to facilitate packaging return and ensure high return rates (Ellen MacArthur Foundation, 2023). An interviewed operator from Denmark stated that their mother company has developed an open collection system with collection machines that can be strategically positioned throughout a city to facilitate collection.

Important aspects for facilitating return of the packaging are lowering the barrier for consumers to return the packaging and optimising the efficiency of packaging return (as specific return trips can significantly offset of the environmental gains from reuse). In this respect, in the latest decade, food delivery companies have facilitated take-away meal service through home delivery. These food delivery companies might also play a role in the facilitation of packaging return according to interviewed operators, but no currently running pilot projects involving food delivery companies for the collection of used containers could be identified.

Leakage from the system

High return rates are very important for an efficient system with continuous available packaging stock at the restaurants. A return rate of 95% corresponds with an average lifetime of 20 cycles per packaging, since statistically, every bowl has leaked out of the system after twenty uses. As a result the packaging lifetime is mostly limited by leakage out of the system rather than defects or wear of the packaging. There is limited incentive to use packaging products with higher quality or higher reusability since they will be overengineered and might lead to increased leakage as the consumer could prefer keeping the packaging for alternative purposes(Zero Waste Europe, 2023).

These return rates are an important factor to monitor during scaling up of reusable packaging systems. Most interviewed operators stated that they currently obtain very high return rates (99%) for the packaging use, but also indicated that the audience that is currently using the reusable packaging system is intrinsically motivated to use and stimulate the development of the system. These return rates are expected to drop if the reusable packaging is implemented in a broader context with less motivated users and a small fraction of leakage will significantly impact the actual lifetime of the packaging containers.

Literature reports state that reaching high return rates must be an absolute priority to achieve an economically feasible system and state a return rate of 95% as a target value for scalable & efficient systems(Ellen MacArthur Foundation, 2023; Zero Waste Europe, 2023).

Cleaning and preparing for reuse

Prior to being reused for food service, the packaging will need to be cleaned appropriately to remove all contaminations and meet the required hygienic standards. Two of the operators indicated to instruct the consumer to remove food remains and rinse the packaging with water before returning, four operators indicated they do not request this. As a result, returned containers can range from being almost fully washed clean up to still filled with food remains at the start of the cleaning process.

The dishwashing step can either be done at the restaurant itself or centralised in industrial washers. Operators stated that at small scale, local washing at the restaurant is typically most efficient economically and ecologically due to the additionally required logistical and operational aspects of the external washing step. Operations of reusable packaging systems at large scale will require industrial washing installations that need to be strategically distributed geographically to limit the cost and environmental impact of logistics to the installation from the collection points, and to the restaurants after washing.

Ideally, these logistic & 'reverse logistic' operations can be combined in the same logistic system. The increased scale will enable feasible logistics and operational setup (PackBack, 2021; Ellen MacArthur Foundation, 2023; Zero Waste Europe, 2023). Interviewed operators from Denmark and Estonia are currently operating in a centralised washing system, whereas other operators are mainly focusing on decentralised washing until the scale has increased to the point where centralised washing becomes more economically beneficial. At larger scale, where focus is on open collection systems, a decentralised washing also the environmental benefit of avoiding additional transport impact is not relevant anymore as a redistribution step is necessary both for centralised and decentralised washing.

Tracing system

The business model of reusable packaging includes the usage of the packaging in an environment out of control for the operator by consumers whose objectives are not connected with the business model of the operator. To operate an effective system of reusable packaging, the operator must set up and operate a traceability system for the packaging containers.

Traceability is required at the level of an individual container. Typically, each container is equipped with a unique identifier, mostly a QR code or RFID sticker that is registered as needed throughout the use cycles. The registration can either be anonymously, to only register whether an item is in use or in stock, or it can be directly linked to an individual user. The latter system requires a more complex software solution but provides the operator with a better toolbox to address retention time and return rate and implement fees no-return or breakage of the packaging. It also centralises the deposit that most interviewed operators use for the reusable packaging and unburdens the restaurant from being required to control the deposit demand and return per packaging.

The software to trace the packaging containers can be operated in the form of an app that the consumer has installed and uses to register the packaging in their name, or it can be stand alone and controlled (and possibly linked to the individual user) by the restaurant providing the reusable packaging container combined with automated scanning in the collection system, without manual input requirements from the consumer.

Next to operational control, the collected data through the tracing system also serves a role in the further development of the system and increase of (logistics) efficiency through advanced data analysis.

Interviewed operators indicated that the current dataflows are insufficient to allow this but have identified this as a business opportunity that will allow them to define opportunities during scaling.

3.4 Economic and financial aspects

In the analysis of economic and financial aspects, we investigated in what part of the value chain the highest costs occur for offering the reusable takeaway packaging system. In the interviews, most companies mention the costs for collection, cleaning and redistributing (incl. personnel costs) of the reusable takeaway packaging, taking the highest share of costs in the system. In the examples in Sweden and Belgium, for instance, a customer without dishwashing facilities is offered the possibility for cleaning services through a partner at a cost.

The biggest issue concerning economy of scale (Feber et al., 2022) are the low costs of single use packaging making it difficult to scale profitable business models for reusable packaging. Several pilots and research studies have been set up to provide knowledge and experience with reusable packaging but other types of (financial) support are needed for the systems to grow and drive behavioral change since the effort for behavior change is not encouraged in this perspective. For this reason, food delivery companies are in most cases not willing to shift towards reusable packaging since the scale is too small and no urgent action is required from a regulatory point of view.

An interviewed company that operates in several European countries has optimized their operations with their technological platform and personal ID tags for the packaging, enabling lower costs. Another interviewed company nudges restaurants to perform the cleaning themselves, thus lowering the price of the packaging system which brings the sales price at similar levels to premium single-use packaging option. A cost-benefit analysis of a system for reusable takeaway containers performed in China (Li et al., 2023) showed that operational cost in a multi-actor network is a key factor for successful implementation and scale up of the system.

Scale-up of the initiatives through financial support of operational costs by a central government is difficult in a market driven economy, thus rather invoking support through restrictions of single-use packaging systems. The available support that is provided by national funding agencies easily gets scattered throughout many relatively isolated initiatives, often on local or small-scale level, and it can prove very challenging to coordinate the development of such a system at larger scale. However, driven by mandatory requirements to provide reusable takeaway packaging at events these instances may provide the right conditions for setting up systems in relatively closed and localized settings that entails small scale of collection and cleaning services with only two-way transportation. In Estonia for example, with such mandatory requirements in place, events are mentioned to be an important part of many of the interviewed organisation’s activities because it provides them with the necessary income to maintain in operations and invest in their return on the go offering with the purpose of becoming profitable towards the future.

Another potential optimization concerns standardization. In the past, examples of reusable systems for other types of products have managed to establish a competitive and viable system that are used by several actors at European level, for instance the system for reusable standardized crates for the retail sector, or reusable glass bottles and standardized crates (Dahlbom and Gustavsson, 2022). The standardization of such crates has proven to be essential for the effective implementation of the systems, however, for the reusable take-away packaging, such standardization has not been accomplished to date.

A report from the Ellen MacArthur Foundation ((Ellen MacArthur Foundation, 2023) emphasises the importance of economies of scale for reusable packaging systems to realise a profitable business model. Based on economical & ecological assessment of 4 different reusable packaging applications, the report

concludes that the economics of mature, efficient return systems can compete with single use for at beverage and personal care applications. Factors that are essential to achieve a competitive system are:

1. a focus on a collaboratively designed return system with
2. standardised packaging (fewer types of non-branded packaging) and
3. shared collection and washing infrastructure at high scale between the different actors in the market.

The report identifies the collection, sorting and cleaning costs as the primary cost drivers of return systems, supporting the input that was obtained by the interviewed initiatives.
An important conclusion of the report is that costs will drop significantly with optimization and scaling, but that for fresh food applications, a higher cost compared to single-use will still be expected at an optimised collaboratively designed system level, where additional enabling conditions have been met to make the economics work. The reports states that enabling conditions can be created through targeted changes in regulation to fully account for packaging end-of-life costs and externalities of single-use packaging, e.g. through (expansion of) EPR and carbon tax legislation.

In summary, the cost of reusable packaging systems is currently not competitive with single-use packaging applications, but they can become competitive through effective scaling and operational optimization of the reusable packaging system, combined with implementation of targeted regulatory actions that account for the actual (environmental) costs of the single-use packaging.

3.5 Social and behavioural aspects

Social values and norms influence behaviour and people's choices in everyday life, and thus are essential to understand in relation to the adoption of reusable takeaway packaging (de Jong and Sondal, 2022). Norms are in turn connected to practical routines and processes since it requires people to reconsider quick and easy food practices along with throwaway packaging (Loschelder et al., 2019).

However, the quick and easy access to takeaway food and drinks do not necessarily concur with extra efforts needed to engage with circular packaging offers. Therefore, some of the interviewed reusable packaging system operators (together with the participating restaurants) are tapping into customers' willingness for making environmentally friendly choices through nudging initiatives such as a reduction of the price of food and drinks when choosing to use a reusable container.

The interviewees mention that clear incentives and a policy for choosing reusable packaging alternatives need to be in place for lowering the threshold for people to choose reusable packaging. In Germany for instance, despite being on the forefront of circular packaging, the market share for reusable packaging is negligible (Gruenewald et al., 2023). Also, the interest in takeaway packaging is mostly coming from consumers with an active interest in environmental aspects in society and does not reflect the general awareness of people making it harder to scale up. It could be more widely spread when regular takeaway restaurants, such as fast-food restaurants, start offering reusable takeaway packaging for their products.

Besides general awareness campaigns, an interviewee mentions factors such as the weather affect the motivation, opportunity, and capability of people to invest time in circular packaging. The positive attitude of younger generations towards environmentally friendly solutions is mentioned as an important driver for the acceptance of circular takeaway packaging.

However, to allow scaling up the systems to people without specific motivation, the threshold for using reusable takeaway packaging should be low and incentives may be needed for them to engage in reusable packaging. Still, it remains uncertain whether the implementation of incentives or penalties related to the use of circular packaging will positively influence acceptance to use and handle circular takeaway packaging.

For plastic shopping bags for which taxes were raised, e.g. in Sweden, such regulations showed a clear effect to reduce the number of plastic bags sold (Romson et al., 2022) . Such economic measures are not in place in all European countries, but are mentioned in the interviews as a necessary measure for achieving higher penetration of the market. Still, some interviewees mention that measures regarding the obligatory offering of reusable takeaway packaging do not have much effect on changing consumers behaviour. For instance, in Sweden, after implementation of the new reusable takeaway packaging regulations in 2024, not much effect can be seen yet, and with information campaigns mostly lacking for informing the wider public (Dalhammar et al., 2020), companies are in fact requesting to provide more of such measures.

The knowledge-action gap is often mentioned as a critical barrier for people to make sustainable choices in practice (e.g. (Nguyen et al., 2019)) and is seen as a key problem in this context since people that are engaged in making these more environmentally friendly choices are willing to invest extra time and effort, while others may be harder to reach out to and engage. Although people are routinely using reusable packaging for self-prepared meals, it is not as common for takeaway meals also because of uncertainties and practical challenges (such as hygienic and logistical aspects) that are faced with pooling systems (Süssbauer et al., 2024) . Similarly, Greenwood et al. found people's willingness increased with reuse systems that people are already familiar with (Greenwood et al., 2021). Making changes in routines is sometimes mentioned as being easier when people find themselves away from daily routines, such as when on holiday or possibly attending events. So, for example, in the case of Estonia with legislation in place for obligatory reusable takeaway packing at events, this could create an opportunity for attracting less engaged people into acting.

Companies will need to develop new business models and routines for marketing and handling reusable packaging, often in collaboration with other entities in the value chain which require new ways of working and coordination between companies. In Belgium, this became apparent as many small pilot initiatives receiving support for starting up circular takeaway packaging all met the same limitations for which they searched support from experienced existing organisations to make scalable business activities possible. Also at a practical level, the circular business model for reusable packaging requires the handling of circular packaging by personnel through different processes than usual in takeaway businesses for taking back, cleaning, and providing packaging to the end-consumer (see Section 3.3). Such changes can both have positive effects for personnel who identify themselves with sustainability aims, but also negative effects for those who are less inclined to spend more time on other activities than the core business of selling takeaway food. Extended producer responsibility ( ) schemes that include take back models for takeaway packaging could also be an important incentive for companies to invest in circular business offers. as mentioned in the interviews.

3.6 Environmental and climate effects of reusable takeaway food and drink packaging

There have been multiple scientific studies performed that calculate the environmental and climate impact of reusable packaging systems compared to single use alternatives using Life Cycle Assessments (LCA), where the impact of all phases of the life cycle are calculated (EC. JRC., 2024; Fetner and Miller, 2021; Hitt et al., 2023; Roy et al., 2023; Gallego-Schmid et al., 2019; Blanca-Alcubilla et al., 2020; Castellani and Cardamome, 2022; Sun et al., 2021). These studies show that the environmental impacts of reusable takeaway food and drink packaging compared to single use applications are fundamentally situation and context specific. Some of these studies state that single-use tableware have significantly higher impact as

reusable plastic tableware (Sun et al., 2021), while other studies show mixed outcomes of which packaging type has the lowest impact, based on the assumptions within the studied context that was modelled (EC. JRC., 2024; Fetner and Miller, 2021; Hitt et al., 2023; Gallego-Schmid et al., 2019; Roy et al., 2023). Other studies show results where the reusable packaging solution showed a higher impact compared to single-use applications in the considered context ((Blanca-Alcubilla et al., 2020; Castellani and Cardamome, 2022). From these studies it can be concluded that the environmental and climate effects of reusable takeaway packaging are very context dependent, and these studies substantiate that there are many different aspects that influence the systems' environmental impact. This section aims to clarify the important parameters that contribute to the final environmental and climate impact of reusable packaging systems and how these parameters influence this impact.

The life cycles of single-use vs reusable packaging solutions are fundamentally different, so the largest contributors to the total environmental and climate impacts also differ. For single-use packaging, the largest contributions to the impact of the packaging are related to the choice of raw materials, the production of the packaging products, and the transportation of the packaging. For reusable packaging, besides these aspects, also other factors influence the final environmental impact of the packaging system such as (additional) logistics, average cycles of use, impact of washing and rinsing. Assumptions for these factors typically determine the final environmental impact of the packaging system and it is crucial to define these assumptions as accurately and objectively as possible to obtain a valuable comparison between the environmental and climate impacts of the different systems.

The impact (categories) of a reusable packaging system can be split up in 2 contributions: Fixed impacts related to the product itself (raw material type, volume, sourcing, end-of-life) and recurring impacts related to the usage in each use cycle (washing, logistics). These recurring impacts are typically lower compared to the fixed impacts. Single-use packaging solutions are only associated with fixed impacts, as they are not used multiple times. Since reusable packaging systems use durable packaging products the fixed impacts are typically higher than single-use packaging solutions, but because they are used multiple times, the fixed impacts are averaged over multiple cycles of use. At low cycles of use, reusable packaging systems will typically show a higher impact per use cycle compared to single-use solutions as the higher fixed impacts are only averaged over a low number of cycles of use. If sufficient cycles of use are achieved for a reusable packaging container, the contribution of the fixed impacts per product use cycle will decrease. At high cycles of use, the largest part of the impact of the packaging system will be directly related to the recurring impacts, which are typically - but not always - lower than fixed impact of single-use applications.

Figure 4 provides a further illustrative visualization of the comparison of the environmental and climate impact of single use packaging versus reusable packaging systems in a graph that plots the impact per use cycle (y-axis) vs the amount of use cycles considered. This shows a typical curve with higher environmental impact for low cycles of use, with a sharp decrease of the impact per use cycle, flattening to a plateau at high cycles of use. In this illustrative example, a break-even point (at which both single-use and reusable packaging have identical impact) is observed in the graph. This break-even point means that if a reusable packaging is used for more cycles before product failure or leakage, the reusable system shows a lower environmental impact as the single-use packaging system per cycle of use. If the reusable packaging is used for less cycles, the single-use packaging system will show a lower environmental or climate impact.

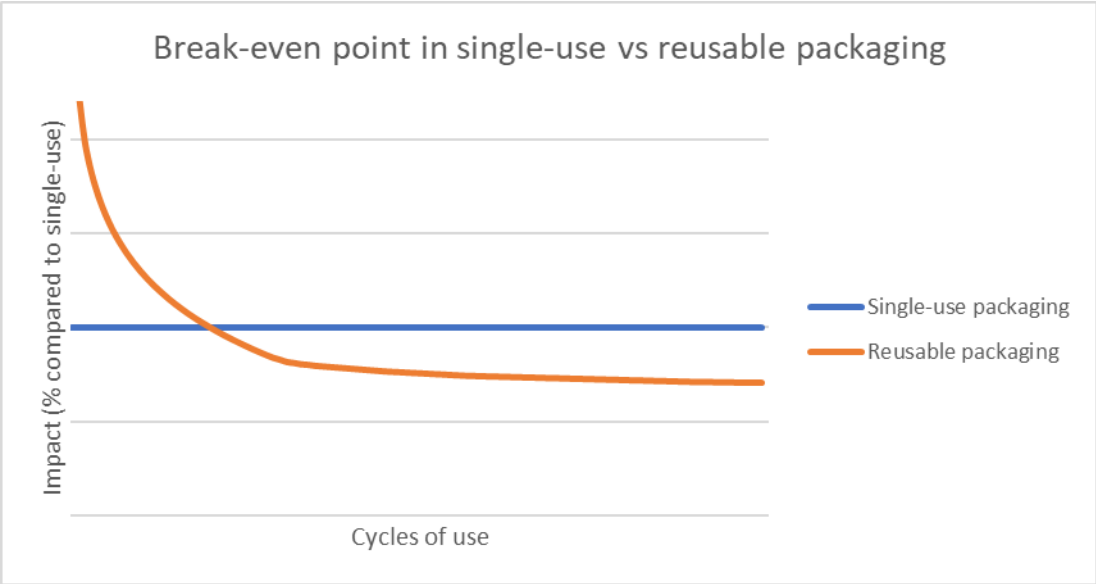

Figure 4: Illustrative Visualisation of a break-even point in environmental or climate impact categories of single-use packaging versus reusable packaging (Developed by VITO for ETC/CE, graphic visualization by CSCP).

Most studies that compare single-use packaging solutions with reusable packaging systems show this trend where under the right conditions, reusable packaging systems show an environmental benefit over single-use packaging. The position of the break-even point is influenced by the performance on the identified factors. Efficient reuse logistics and washing and rinsing activities in combination with a sufficiently high average cycles are important parameters to obtain environmental benefits from a reusable packaging system over single-use packaging solutions. Conscious user behavior is considered as a crucial determining parameter for the environmental and climate impact of a reusable packaging system, represented by the obtainment of high return rates with low-impact transport modes to retail points. (EC. JRC., 2024; Ellen MacArthur Foundation, 2023; Zero Waste Europe, 2023).

4. Conclusions

This study provides an overview of different systems for reusable takeaway packaging across different countries in Europe. The analysis revealed significant differences in market offerings, system types (including return mechanisms), and packaging formats. While many pilots and start-up companies in Europe have offered reusable takeaway packaging, the challenge remains how to achieve economic viability and scale up. National funding agencies have put efforts in providing knowledge to practitioners in overcoming these challenges. However, uncertainty still exists regarding how a broader adoption of reusable takeaway packaging may be organized and incentivized. To support the scaling up of reusable takeaway packaging in Europe, the following key messages are derived from this study:

- **Collaboration within the value chain** to optimize operational costs and minimizing price of reusable packaging systems is seen as essential for systems and can be organised within multi-actor networks. At present the systems face high costs for organisation of collection, transport and cleaning when not optimized for large scale implementation, which is to be considered already in the first stages of setting up systems instead. Facilitating reusable packaging at events may provide important starting points for businesses to expand and scale towards other services and developing systems. Opportunities for further scale-up are to provide guidance to actors on the market with tailored information on the various types of business offers, collaboration with other actors, as well as type of systems that match their specific context.

- For **reaching out to the larger public** and beyond those that already are interested in contributing to a better environment, easy accessible and cost-efficient systems are needed. Through effective information campaigns customers can be engaged to choose reusable takeaway packaging using tailored economic and social incentives. In some countries national regulations with high demands around reuse of packaging, and replacement of single use packaging with reusable packaging rather than paper-based alternatives, are seen as essential driving factors. Targeted regulatory measures that support reusable packaging over single-use for specific applications can contribute towards creating a market that allows existing initiatives to scale in an economically feasible way. The expected resulting change in consumer behaviour is expected to provide further guidance for the reusable packaging system operators to tailor their system towards the consumer expectations.

- **Minimizing environmental and climate impact** of reusable packaging systems is seen as essential and is fundamentally related to the organization and context of the system. To obtain relevant environmental and climate impact benefits, a reusable packaging system must focus on achieving high return rates and rotation cycles, an efficient washing and (re)distribution system combined with standardized packaging containers encompassing tailored eco-design measures. Reusable packaging systems are not automatically preferable for reducing environmental impact. The design and organisation of the system must therefore be setup carefully and preferably backed up by a Life Cycle Assessment study to demonstrate the environmental effects.

List of abbreviations

Abbreviation	Name	Reference
EEA	European Environment Agency	www.eea.europa.eu
EU	European Union	https://european-union.europa.eu
SUP	Single Use Plastics	Directive - 2019/904 - EN - SUP Directive - EUR-Lex (europa.eu)
PPWR	Packaging and Packaging Waste Regulation	resource.html (europa.eu)

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Annex 1 Information on the interviewed companies

Belgium - FutuREproof

Market offering and business model
FutuREproof offers an all-around service solution related to on-the-go reusable packaging.

Geographical scope
The current geographical scope is mainly in Flanders and in cities such as Ghent, Leuven, Kortrijk, Bruges, Mechelen, Hasselt, Antwerpe. The concept is open for franchising as well in other geopgraphical locations. The targeted locations are restaurants.

Reusable packaging
FutuREproof has e.g., several bowl designs, coffee cups, hamburger clamshells, sushi platters in their portfolio. The product scope is continuously expanded in line with restaurant requirements, which are sourced from the retail market. Their packaging is made from plastic and stainless steel.

Return system
FutuREproof developed and uses a library return system that charges a deposit and fine if a packaging is not returned within 3 weeks. If the packaging is returned after more than 3 weeks, the deposit is reimbursed to the consumer. In collaboration with Red-use, FutuREproof also offers a (cashless) deposit system to the restaurants which is reimbursed after the packaging is returned. Each participating restaurant can choose the system that suits them the most. The experience for the restaurants is coherent and uniform in both systems.

Organisation of cleaning services
The restaurants are nudged to perform the washing of the packaging themselves because it is the most effective at the current scale, although centralized, industrial cleaning services are available.

Belgium - Red-use

Market offering and business model
Red-use offers an all-around service solution related to on-the-go reusable packaging.

Geographical scope
The current geographical scope is Flanders. Restaurant offerings are located in Mechelen, Aalst, Hasselt Leuven and Ghent. Company services and events are spread out over Flanders. The targeted locations are restaurants, events, and companies.

Reusable packaging
Red-use offers drinking cups and food service equipment (e.g., plates, bowls, cutlery), which are largely made from polypropylene. Red-use is the owner of the packaging and food equipment. However, the designs are produced in collaboration with a packaging producer, based on their standard designs.

Return system
Red-use has a deposit system which is arranged via an app, where the deposit is transferred back to the user after scanning a QR-code. Red-use is currently testing a new 'library' system in collaboration with FutuREproof for future implementation where after a retention time of 2 weeks, a cost will be set for the consumer, and after 4 weeks, the full deposit will be charged.

Organisation of cleaning services
The consumer needs to rinse the packaging to remove food and sauce remainders. For the restaurants in Mechelen, the containers are picked up and washed in a central washing hub nearby. In the other cities, the restaurants are performing the washing operations in-house.

Denmark – Rotake Reusable (Tomra)

Market offering and business model

Tomra offers an all-around solution related to on-the-go reusable packaging called Rotake Reusable.

Geographical scope

"Rotake reusable system" located in Aarhus, Denmark, is a pilot study conducted by Tomra in collaboration with the local municipality. The reusable packaging is available at shops, coffee shops and restaurants.

Reusable packaging

As of now three sizes of cups suitable for cold drinks and three sizes for hot drinks are provided. They are planning to introduce food containers for cold food next year.

Return system

A deposit system is offered with return of the packaging taking place at one of their 29 return points located in different locations in Aarhus. For example, six are located in shopping malls. The reusable takeaway packaging can be returned at any point (during the three years the project is ongoing) and the consumer will get their deposit back on the bankcard that was used for the transaction.

Organisation of cleaning services

Tomra has developed and implemented a sanitation facility located in Aarhus where all returned packaging is washed and dried. The sanitation process is according to the "Food and safety authorities" standard/requirements.

Estonia - Ringo Eco OÜ

Market offering and business model

Ringo Eco OÜ offers an all-around solution related to on-the-go reusable packaging.

Geographical scope

Ringo Eco OÜ predominantly operates in a couple of cities around Estonia in places like restaurants, offices, courier systems (i.e. systems like Wolt and Uber Eats) as well as events which are carried out nationwide. In Latvia, Ringo Eco OÜ provides their services only at events.

Reusable packaging

The current packaging portfolio consist of various cups, glasses and food container made from mainly polypropylene.

Return system

A deposit system is applied by Ringo Eco OÜ and the public return system/infrastructure in Estonia is mainly located in two cities, but they have return points in a total of three to four cities in Estonia. The reusable takeaway packaging must be registered in the Ringo Eco OÜ app by the consumer before it can be returned to one of the return points. When the package reaches the cleaning facility, the deposit is returned to the customer.

Different systems and fees are charged based on the customer segments. For instance, a loyalty system in which loyal consumers get their money back as soon as they scan the packaging. This is based on a system where customers who have been proven to return their packaging do not have to wait until the packaging is scanned at the washing facility.

Organisation of cleaning services

Ringo Eco OÜ has developed and implemented a sanitation facility located in Estonia where all returned packaging is washed and dried. The sanitation process is according to the "Food and safety authorities" standard/requirements.

Finland - Kamupak[1]

Market offering and business model
Kamupak offers an all-around solution related to on-the-go reusable packaging.

Geographical scope
Kamupaks reusable products can be found in restaurants, cafes, kiosks, grocery stores, events, and offices. They have partners (e.g., restaurants) in both Finland and Sweden.

Reusable packaging
Kamupaks offer three sizes of food containers (0.5 l, 1.2 l, 1.7 l) and two sizes of cups (250 ml, 340 ml) made from polypropylene (PP) or from a biobased and biodegradable option.

Return system
Kamupak has two different return systems in place, deposit system and a library system. The deposit model was introduced at first, but they are currently shifting towards the library model. This means that the consumers can borrow the reusable package without a deposit. The consumer uses the app to borrow the packaging and then you have a certain period of time before it needs to be returned.

Organisation of cleaning services
The cleaning of the packaging is provided by e.g., cafés and restaurants. The customer returns the packaging to one of Kamupak's partners.

Germany - Vytal

Market offering and business model
Vytal offers an all-around tech solution related to on-the-go reusable packaging.

Geographical scope
Vytal's main market is Germany but is also present in 16 other countries. In Austria, France, the Netherlands, Belgium, UK, Switzerland, and Denmark operations offering is in place. They also have franchisees, local entrepreneurs that license Vytal's technology and brand, to provide a local Vytal system. Franchisees are active in Ireland, Norway, Sweden, Mexico Portugal, Dominican Republic, Luxembourg, Hungary, and Poland. The packaging can be used in restaurants, coffee shops etc., and for events, entertainment, and brand industry. The later includes e.g. festivals, cinemas and theme parks.

Reusable packaging
Vytal has a portfolio including cups for cold and hot drinks and food containers for e.g., sushi, burgers, pizza. For events there is a custom made portfolio, that includes e.g., cups for both hot and cold drinks, and food bowls and trays. The packaging is made from e.g., polypropylene, stainless steel and glass.

Return system
Vytal offers a library system in case the packaging is not being returned within 14 days after which the customer will be charged. The Vytal container is then owned by the consumer and can be used privately. A return is no longer possible, otherwise Vytal would become the property owner again. The consumers use Vytal's app to find a suitable return point, which can be e.g., a restaurant. The packaging is returned by using the app and scanning the QR-code of the return station. In the event industry, containers are typically returned directly on site.

Organisation of cleaning services

[1] Kamupak closed down after the interview, and it has not been possible to check the data afterwards.

Vytal's partners are contractually obliged to machine wash all Vytal's. The same rules apply as when washing the dishes for consumption in the restaurant. The consumers are also required to pre-wash the packaging with cold water before they are returned.

Spain - Bumerang

Market offering and business model

A reusable packaging system is offered and tracking of packaging through a digital platform with serialized QR codes and apps for scanning and managing inventories. Also, tailor-made solutions are available with integrations with POS, washing systems and logistics.

Geographical scope

Bumerang is available nationwide in Spainwith more than 200 active clients. Their reusable plastic packaging is available in e.g., restaurants, office canteens, corporates, and hospitals. However, they have shifted their focus to canteens, corporates, and hospitals instead of restaurants and bars moving towards a business-to-business model.

Reusable packaging

Bumerang offers different sizes of food containers as well as cups, which are made from plastic.

Return system

Bumerang applies a fee/penalty system where the consumer is charged a deposit for the packaging if not returned within the time limit.

Organisation of cleaning services

Cleaning is typically performed by the clients. If the company provides cleaning services, they will charge for it.

Sweden - Panter

Market offering and business model

Panter offers an all-around solution related to on-the-go reusable packaging.

Geographical scope

Panter is available nationwide in Sweden and is available in e.g., restaurants, cafes, kiosks, events and office canteens and gas stations.

Reusable packaging

Panter has a collaboration with Tingstad which manufactures and distributes the reusable packaging to all Panters customers. Panter offers different sizes of food containers as well as cups, which are made from polypropylene.

Return system

There is some difference in the return system provided by Panter depending on whether it is utilised at e.g., restaurant compared to at an event. For restaurants a fee system is always applied where the consumer gets a reminder after one week as well as after one month if the packaging is not returned. If the reusable packaging in not returned within a month, the packaging is considered purchased by the consumer and cannot be returned to the system. For events, organisers can choose either a similar fee system as for restaurants, or a system without fees but with an additional charge for each packaging that has leaked out of the system. At an event, the packaging is delivered to as well as picked up and transported to a centralized washing facility by Tingstad. The return system for such activities are based on a deposit system.

Organisation of cleaning services

In general, the cleaning is conducted by Panter's customers e.g., restaurants and cafes. However, through Tingstad a centralised washing service is offered to customers, such as gas stations, that are unable to wash the packaging in-house. In such cases, the packaging is collected and washed by Tingstad.

Annex 2 Interview questions

Interviews were all performed using the questionnaire as depicted in Figure A1.1

Figure A1.1 Interview questions

	Questions
Location & Scope	Can you shortly describe the market offering of your company?
	What is the geographical scope of your operations?
	What is the current product scope of your offering?
	What type of materials are you handling for the reusable packaging?
	What is your target market and why have you selected this specific market?
Business model	Can you shortly describe how your business operational model works?
	What are the factors that determine the success of your business operational model? What is driving the costs?
	How are you organising the return of the packaging? Are you controlling return rates (e.g. deposits) and retention time (e.g. timing on deposit return)?
	What is the deposit that you use? Is this sufficient to cover production & distribution costs of the product?
	How are you organising the cleaning of the packaging? Do you require pre-wash requirements by end-users?
	Do you have an idea of an average rotation cycle number before EOL for your packaging? What factors influence this number?

	Do you focus on bespoke packaging or a pooling approach with standardised designs (e.g. GN shapes)?
	How do you arrange the distribution of your packaging for washing/ to retailers?
	Economies of scale have been identified as highly important for reusable packaging. How do you see the scaling potential of your solution?
	What are the biggest challenges and main barriers that you are confronted with?
	How do you think these challenges and barriers can be resolved (e.g. regulations, support, awareness campaigns,..)
	How do you see the role of the government in the development of reusable packaging systems?
	How do you get information on new regulations on reusable takeaway packaging, is there any specific authority that provides guidance?
	What national regulation on reusable take away packaging are you aware of, and how does it affect your business?
	Do you experience any challenges with current legislations or the information on upcoming regulations? Which?
	Are you actively collecting data from product usage to further optimise your business model?
	Do you see an evolution in consumer behaviour and/or adaptation of reusable packaging?
	Are you driving your system by yourself or do you rely on several partners to cover the required services for your business model? How do you manage partnerships?
Sustainability &	Do you consider the environmental impact of single use packaging as the most determining factor for making the shift to reusables? Are there other drivers for making the shift?

	Did you develop your products yourself? How did you define the optimal packaging (materials, design,..)? Did you consider eco-design guidelines for the selection?
	Do you have insights in the (effective) recyclability of your products? How are you disposing of the defective products?
	Did you perform a Life Cycle Assessment (LCA) of your operational model?
	Do you have insights in the environmental benefits of your operational model?
	Do you know of any consumer research results on the usage of your packaging? Can we get access to that?
	Do you know how many reuse cycles are needed to reach the break-even point on environmental impact compared to single use tableware or packaging?
	What actions in your operating model are causing the highest environmental impacts?

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