RECOUP | Leading a more circular plastics value chain

Buy-Use-RETURN

REUSABLE PACKAGING COLLECTION PATHWAYS

PREPARED BY
RECOUP

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RECOUP is the UK's leading independent authority and trusted voice on plastics resource efficiency and recycling. As a registered charity, supported by our members, RECOUP aim to:

Inspire collaboration by connecting the whole plastics value chain
Lead the continued development of a plastic circular economy, resource efficiency, recycling and reuse
Educate the public and businesses on all aspects of plastics recycling and resource efficiency

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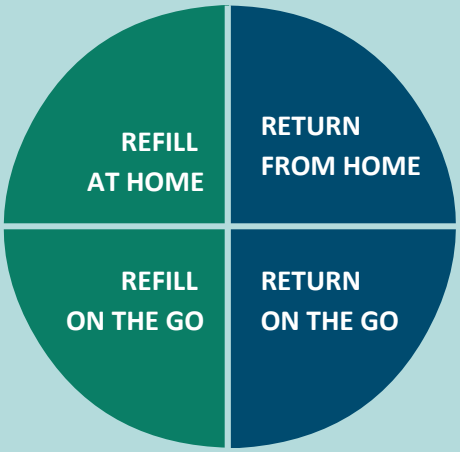
Returnable packaging collection options

The reusable packaging arena has seen an impressive amount of new developments in recent years, driven by the demand of the public, commercial and governmental focus on packaging sustainability. There is a good understanding of reusable packaging design and material requirements [1] and a variety of efficient washing solutions for different reusable packaging systems (e.g. Blue Planet Washing Solutions[2], Again[3]), however availability, cost and effectiveness of return logistics systems still often becomes a barrier for adoption of reusable packaging at scale.

This document explores the landscape of different reverse logistics solutions available and their suitability for returnable packaging systems.

Returnable packaging is the type of reusable packaging that is owned and serviced by the reuse system. The user returns the packaging to the reuse system after it is used to be cleaned and used again. This type of packaging falls under the Ellen MacArthur Foundation 'Return from Home' and 'Return on the Go' categories. [4]



Reuse Categories according to Ellen MacArthur Foundation

This report looked at different ways to collect returnable packaging from the user and assessed them on six parameters: operational cost, initial investment, environmental impact, behaviour change, social impact and policy changes. The assessment is qualitative (low, medium, high) and based on the information currently available from research, returnable packaging trials, case studies and modelling. We extrapolated some findings about recycling systems to represent reuse where it was applicable.

- **Operational cost** -The cost of the every day operations of return systems, e.g. electricity, consumables, transportation to the hubs, and labour cost.
- **Initial investment** -Initial costs of new equipment and infrastructure necessary for the system.
- **Environmental impact** -The estimated environmental impact of the system, including carbon emissions and other impacts on the environment e.g. pollution, litter etc.
- **Behaviour change** - How much the user is expected to change their behaviour to be able to use the system.
- **Social impact** - How the use of the system helps to strengthen the community connection and benefit the community.
- **Policy changes** - What level of legislative change is necessary for the system to function.

Returnable Packaging Collection Pathways

RETURN ON THE GO

- Reverse vending machines
- Smart bins/smart collection points (tech - enabled)
- Kiosks/on-the-go bins (no tech)
- Shops/businesses
- Community-based co-operative network
- Post, courier
- Universal reuse collection points

RETURN FROM HOME

- Co-ordinated with product delivery(backhaul)
- Kerbside collection system
- Automated collection (robots/drones)
- Universal reuse-specific collection system
- Co-ordinated with other deliveries

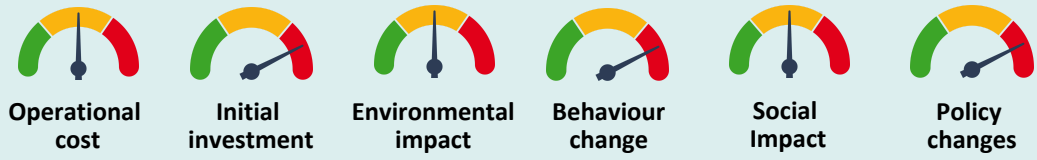
Return on the go:

Users return the packaging at a store or drop-off point.

Reverse vending machines (RVM)

- **Collection points:** Reverse vending machine for reuse. Publicly or privately managed.
- **Packaging format:** A variety of predefined formats e.g. bottles, jars etc.
- **Location:** Major retail spaces and other community spaces with high-traffic areas, such as train stations.
- **Washing and logistics:** The service provider collects packaging from the RVM and transports it to logistic hubs and cleaning facilities.
- **Deposit:** The user may pay a deposit when purchasing the product in returnable packaging. The deposit is refunded when the packaging is returned via the collection machine.
- **The user:** Initial rinsing of the packaging and delivery to the collection points.
- **Closed/open-loop system:** RVM can also be used for reuse in smaller-scale closed-loop environments.

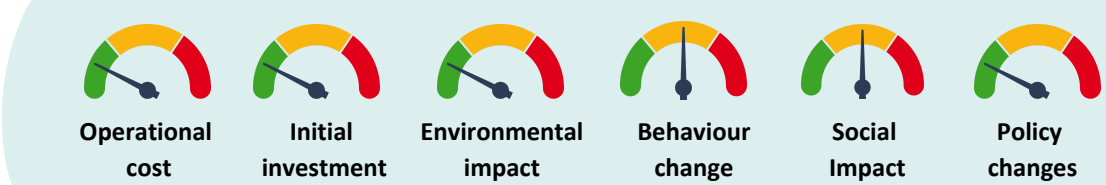
TOMRA Reuse



Shops/businesses

- **Collection points:** Collection point on the shop floor e.g. collection box, or over-the-counter collection point
- **Packaging format:** Depending on the product, cups, bottles, flexible packaging.
- **Location:** Place of original purchase.
- **Washing and logistics:** The collection points are serviced by service providers, providing logistic and reconditioning services.
- **Deposit:** The user may pay a deposit when purchasing the product in returnable packaging. The deposit is refunded when the packaging is registered as returned in the shop.
- **The user:** Initial cleaning of the container, e.g. emptying the liquid and bringing the packaging to the collection points.
- **Closed/open-loop system:** Closed-loop

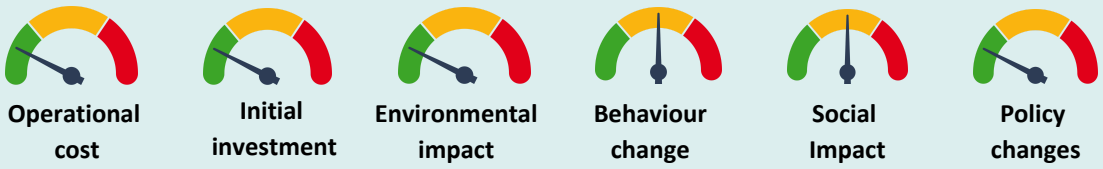
Reposit



Kiosks/on-the-go bins (no tech)

- **Collection points:** Simple kiosk/on-the-go bin, not tech-enabled.
- **Packaging format:** Depending on the product and the system, it can be cups, trays, pots, or flexible packaging. If a deposit is involved, packaging might be enabled with tech.
- **Location:** Areas of heavy traffic, e.g. supermarkets, shopping centres.
- **Washing and logistics:** The collection points are serviced by specialised companies, providing logistics and reconditioning services.
- **Deposit:** The user may pay a deposit when purchasing the product in returnable packaging. The deposit is refunded when the packaging is registered as returned during sortation at the logistics hub.
- **The user:** Initial cleaning of the container, e.g. emptying the liquid, bringing the packaging to the collection points.
- **Closed/open-loop system:** Closed-loop, open-loop.

Petaluma Cup



Smart bins/smart collection points (Tech-enabled)

- **Collection points:** A collection container (e.g. bin, box) for the collection of returnable packaging is enabled with technology to register the return of items e.g. QR/RFID scanning/ container recognition technology to avoid contamination/enable refund payment.
- **Packaging format:** Cups, tubs, trays and pizza boxes enabled with relevant technology.
- **Location:** Strategically placed for convenience and high traffic, depending on the system
- **Washing and logistics:** The service provider collects packaging from the collection point and transports it to logistic hubs and cleaning facilities.
- **Deposit:** The user may pay a deposit when purchasing the product in returnable packaging. The deposit is refunded when the packaging is registered as returned by the collection point.
- **The user:** Initial cleaning of the container, e.g. disposing of remaining food via the food waste collection route and return of the container to a collection point.
- **Closed/open-loop system:** Closed-loop, open-loop.

CauliKiosk

Post, courier

- **Collection points:** The post box serves as a collection point; alternatively, packaged and pre-labelled items are given to the post staff over the counter.
- **Packaging format:** Defined by the product and company offering the service: box, bottle, and flexible formats. Packaging is usually posted in bulk.
- **Location:** Post office, post box.
- **Washing and logistics:** The company selling the product provides prepaid postage labels for returns. The company either provides the washing and further logistics themselves, or it is passed to an external provider.
- **Deposit:** If the user paid a deposit when purchasing the product in returnable packaging, the deposit is refunded when the company receives the packaging.
- **The user:** Initial cleaning of the container, e.g. emptying the liquid and posting the packaging.
- **Closed/open-loop system:** Closed-loop.

Miniml refills, Splosh

Operational cost | Initial investment | Environmental impact | Behaviour change | Social Impact | Policy changes

Community-based co-operative network

- **Collection points:** Variety of simple collection points, bins, containers, bags, over-the-counter collection.
- **Packaging format:** Depending on the product and the system, can be cups, trays, pots, flexible packaging, can be standard for the community (e.g. Shrewsbury Cup)
- **Location:** The return collection points are located in community hubs (e.g. schools, community centres, libraries, GP practices, workplaces) for easy access and community connection.
- **Washing and logistics:** The service provider is supported by the community, e.g., a shared reusable packaging pool managed by local organisations and community groups, and utilises the washing capabilities of the partners.
- **Deposit:** The user may pay a deposit when purchasing the product in returnable packaging. The deposit is refunded when the packaging is registered as returned by the collection point/collection staff.
- **The user:** Initial cleaning of the container, bringing the packaging to one of the collection points.
- **Closed/open-loop system:** Closed-loop, open-loop.

Terra cycle type collections

Operational cost | Initial investment | Environmental impact | Behaviour change | Social Impact | Policy changes

Universal reuse collection points

- **Collection points:** A vast network of standardised and recognisable collection points exclusively dedicated to returnable packaging collection. Packaging from any supermarket, takeaway, or shop can be placed in the same distinctive type of collection point.
- **Packaging format:** An inventory of standardised formats is used across different brands and product types. Packaging is easily recognisable e.g. logo or specific colour across all reusable systems. All returnable packaging from any supermarket, takeaway, or shop can be returned to any collection point.
- **Location:** Retailers, community locations, heavy traffic areas, work places.
- **Washing and logistics:** The service provider collects packaging and transports it to a logistic hub and cleaning facility. The logistic system is exclusively tailored to the collection of items for reuse at scale and can be privately or publicly managed.
- **Deposit:** The user may pay a deposit when purchasing the product in returnable packaging. The deposit is refunded when the packaging is registered as returned by the collection point(if tech-enabled), automated register system or during sorting at the logistic hub.
- **The user:** Initial cleaning of the container, e.g. emptying the liquid and delivering packaging to the collection point.
- **Closed/open-loop system:** Closed-loop, open-loop.

The universal system has not been implemented or trialled yet.

Operational cost | Initial investment | Environmental impact | Behaviour change | Social Impact | Policy changes

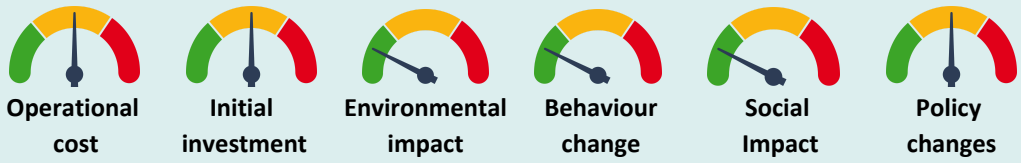
Return from home:

Packaging is picked up from home by a collection service.

Co-ordinated with product delivery/ Backhaul

- **Collection vehicles:** Returnable packaging is collected with the next order by the company delivery vehicle.
- **Packaging format:** Easily recognisable returnable packaging. Packaging is returned to the same retailer.
- **Collection:** Synchronised with a new delivery.
- **Washing and logistics:** Retailers can manage the washing and further logistics themselves or delegate to a washing and logistic service provider.
- **Deposit:** The user may pay a deposit when purchasing the product in returnable packaging. The deposit is refunded when the packaging is registered as returned by the delivery driver, automated register system in the vehicle or during sorting at the logistic hub.
- **The user:** Responsible for initial rinsing of the packaging if needed. The user hands the packaging to the delivery driver.
- **Closed/open-loop system:** Closed-loop.

Ocado



Kerbside

- **Collection vehicles:** Returnable packaging is collected by waste management vehicles either in the specialised compartment or co-mingled with other packaging items, depending on the type of the system.
- **Packaging format:** Standardised, easily recognisable returnable packaging. Packaging from any supermarket, shop, take-away can be returned.
- **Collection:** Returnable packaging is collected from the doorstep/kerbside.
- **Washing and logistics:** After arriving at the material recovery facility (MRF), reusable packaging is sorted and transported to a washing or reconditioning facility.
- **Deposit:** The user may pay a deposit when purchasing the product in returnable packaging. The deposit is refunded when the packaging is registered as returned by the collection device's automated register system or during sorting at the logistic hub.
- **The user:** Responsible for initial rinsing of the packaging. The user places the packaging in the specialised reuse bin or co-mingled with recyclable items.
- **Closed/open-loop system:** Open-loop.

Podback, Flexcollect

Automated collection e.g. robots, drones

- **Collection vehicles:** Returnable packaging is collected by automated devices such as robots, self-driving cars, drones and delivered to the logistic hubs.
- **Packaging format:** Can be both a standardised system or packaging/product-specific system.
- **Collection:** The packaging should be left in a specific place that is easy to reach and service for the collection device.
- **Washing and logistics:** The automated device collects packaging and transports it to logistic hubs, from there it is collected by returnable packaging service providers and transported to cleaning facilities.
- **Deposit:** The user may pay a deposit when purchasing the product in returnable packaging. The deposit is refunded when the packaging is registered as returned by the collection device's automated register system or during sorting at the logistic hub.
- **The user:** Responsible for initial cleaning of the packaging and returning it by making ready for collection.
- **Closed/open-loop system:** Open-loop.

Co-op robots

Operational cost | Initial investment | Environmental impact | Behaviour change | Social Impact | Policy changes

Universal reuse-specific collection system

- **Collection vehicles:** Vehicles that are standardised and easily identifiable, e.g. colour or logo, should be dedicated solely to the reuse system for collecting all returnable packaging.
- **Packaging format:** An inventory of standardised formats is used across different brands and product types. Packaging is easily recognisable e.g. logo or specific colour across all reusable systems. All returnable packaging from any supermarket, takeaway, or shop can be collected by the same distinctive type of vehicle.
- **Collection:** Schedule or on demand.
- **Washing and logistics:** The service provider collects packaging and transports it to a logistic hub and cleaning facility. The logistic system is exclusively tailored to the collection of items for reuse at scale and can be privately or publicly managed.
- **Deposit:** The user may pay a deposit when purchasing the product in returnable packaging. The deposit is refunded when the packaging is registered as returned by the collection vehicle driver, automated register system or during sorting at the logistic hub.
- **The user:** Responsible for initial cleaning of the packaging and returning it by either booking a collection or leaving at the door for collection on schedule.
- **Closed/open-loop system:** Open-loop.

This system has not been trialled or implemented

Operational cost | Initial investment | Environmental impact | Behaviour change | Social Impact | Policy changes

Coordinated with other product deliveries

- **Collection vehicles:** Every commercial delivery has the capacity and responsibility to collect returnable packaging, even if the packaging is from different products and providers.
- **Packaging format:** An inventory of standardised or semi-standardised formats is used across different brands and product types. All returnable packaging from any supermarket, takeaway, or shop can be collected by any vehicle delivering goods.
- **Collection:** Co-ordinated with other deliveries.
- **Washing and logistics:** The delivery vehicles collect packaging and transports it back to their logistic hubs, from there it is collected by returnable packaging service providers and transported to cleaning facilities.
- **Deposit:** The user may pay a deposit when purchasing the product in returnable packaging. The deposit is refunded when the packaging is registered as returned by the collection vehicle driver, automated register system or during sorting at the logistic hub.
- **The user:** Responsible for initial cleaning of the packaging and returning it by handing to the delivery driver.
- **Closed/open-loop system:** Open-loop.

This system has not been trialled or implemented

Operational cost | **Initial investment** | **Environmental impact** | **Behaviour change** | **Social Impact** | **Policy changes**

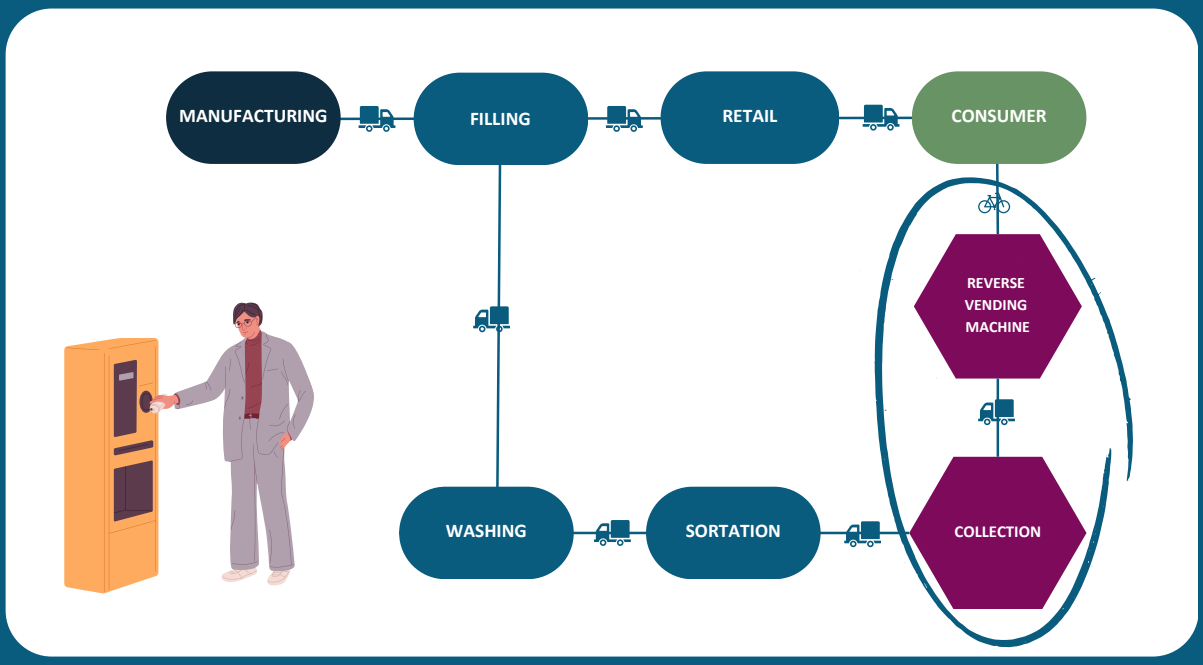
Deposit Return Schemes (DRS) and Reuse

In the next two sections, we will look into the challenges and benefits of two collection models: **kerbside collection of returnable packaging** and collection of returnable packaging via a network of reverse vending machines supported by a **deposit return scheme for reuse**. These two systems have the greatest potential for scaling up the collection of reusable packaging. We are exploring what can be learned from most successful collection systems for recyclable packaging and how this can be applied to returnable packaging to optimise the costs, environmental footprint and build on consumer habits.

DRS for reuse can be a driver in making returnable packaging successful by supporting infrastructure development and behavioural changes. The diagram below shows the system map for collection of returnable packaging via reverse vending machine.

Benefits:
High return rates, low contamination, traceability

Challenges:
Initial and running costs, behaviour change



Technology is available and ready to service reuse.

Reverse vending machines (RVM) designed for the collection of reusable packaging can benefit reusable packaging systems by providing traceability, high return rates, low damage and contamination rates, and deposit processing.

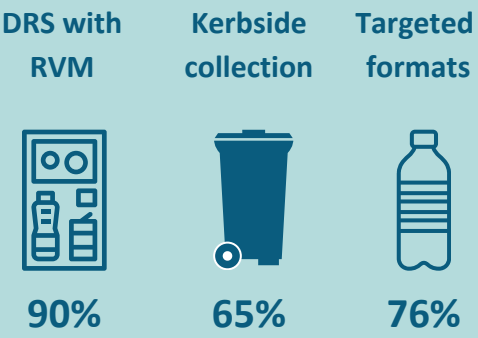
For example, the recognition technology of one of the providers of RVM for reuse is capable of 360° instant recognition, shape recognition, full container detection and barcode recognition. [5] The ability of the return point to interact with the reusable packaging technology assets (RFID, QR etc.) can not only simplify the return of the deposit but also help to maintain the traceability of the container throughout the supply chain. The development of a digital payment system also allows the return of deposits directly to a consumer card or device, removing the additional step of cash or coupon return[6]. The machine can process up to 100 containers per minute and accept several types of pre-defined containers.

Reverse Vending Machines for Reuse:

- **Process up to 100 containers per minute**
- **Refund deposit**
- **Detect several types of pre-defined containers**

It is important for RVM for reuse to maintain the integrity of collected containers, while for recycling, the material can be compacted for efficient transportation, which sometimes can limit the use of the same RVM for both operations. Dual RVM servicing reuse and single-use containers would benefit the settings where two machines are not financially and environmentally feasible.

Collection rates & quality of material are higher with DRS.



Collection rates for different collection modes (recycling)

DRS systems with the use of RVM demonstrate significantly higher collection rates for collected items (90% and up to 98%[7]) against general collection (for household recyclable packaging) rates that usually do not exceed 65% (Germany) [8] and even specified collection rates for target items - 76% collection rate for PET bottles in the UK[9]. High collection rates are vital for a successful returnable packaging systems, suggesting that utilising DRS and RVM might be beneficial. The quality of material collected via RVM is also considerably higher than that collected kerbside. RVMs generally allow limited formats, e.g., bottles, so that there is minimal contamination and interaction with other waste streams during transportation and sorting, supporting the traceability of reusable packaging. In comparison, kerbside material can come with a contamination rate of over 15%, e.g. due to food waste contamination.[10] A network of RVMs will also benefit reuse on the go.

Consumer behaviour will require development of new habits.

Participating in reuse using RVMs requires a different set of behaviours from the citizen compared to their default interaction with one-way packaging. The customer is responsible for rinsing the packaging, storing the items and transporting reusable assets to the nearest collection points, most commonly back to the store. While there are limited reusable packaging formats, e.g., bottles, available, the behaviour change might be relatively easy, especially as it is encouraged by the refund of a deposit. However, for a scaled-up reuse system, where at least 30% of packaging is represented in a reuse format, consumers can be expected to arrange reverse logistics for over 22 and up to 66 items[11] of only plastic packaging per week.
A typical UK household uses approximately 8.6kg of packaging (all materials, not only plastics) per week [12]. This amount of packaging for reuse can be difficult for sustainable transport modes such as cycling or walking. It can multiply the challenges of the mentioned return efficiencies and storage requirements.

The process of returning packaging will have to be developed and designed with the reality of citizens lifestyles for the system to work at scale. The deposit on packaging and environmental drivers on its own will not be sufficient for the systemic transition.

Consumers from communities where DRS for recycling has been established, can find it easier to transition as there is no significant difference in behaviour. For example, Germany introduced two reuse formats: bottles (PET and glass) and glass jars and are planning on trialling plastic pots[13] to be returned in a very similar ways to containers for recycling in 2025; the consumer just needs to make sure they return it to the correct RVM.

Consumers' motivation towards packaging return to RVM

I don't have time

19%

I have no space at home to store the continers

46%

I don't trust the system

41%

I order my groceries online, I never go to the store

30%

I live to far from the closest store

38%

Adapted from https://www.repository.cam.ac.uk/items/2b6cbda8-43cb-4457-ad68-724d610a5261

22 plastic packaging items per week
are to be returned to the store by the average consumer.
(if 30% of packaging switched to reuse)

DRS for reuse needs sound legislative support to be successful.

Legislation that sets up the deposit system for reusable containers is the foundation for the success of returnable packaging, and it can be combined or built on the DRS for recycling single-use containers. The Deposit Scheme for drinks containers (England and Northern Ireland) Regulations 2025 came into force in January 2025.[14] DRS for recycling and DRS for reuse can complement each other and benefit from shared infrastructure, technology and administration costs.

Legislation to scale up reuse:

- DRS for Reuse
- EPR supporting reuse and reuse infrastructure
- Reuse targets

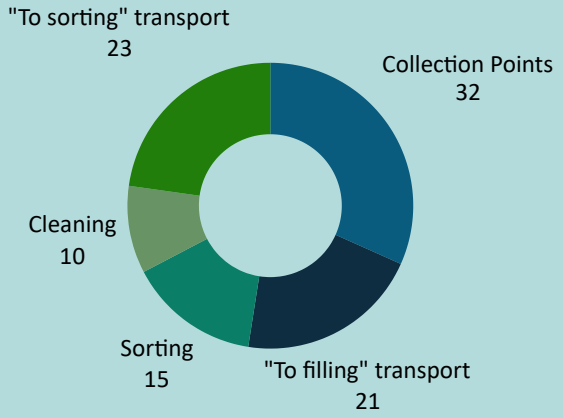
5% of French EPR fees are directed to developing and supporting reuse infrastructure

Extended Producer Responsibility (EPR) for packaging collected kerbside can encourage reuse adoption by increasing the cost of single-use items and funding infrastructure which can potentially serve reuse formats. EPR has the potential to incentivise reusable packaging further in the future by reduced fees or exemptions. Circular economy/ refill targets provide additional drivers to the adoption of reuse [15]

The high initial cost is compensated by system efficiency.

DRS, with the use of RVM, requires a significant initial investment unless it is developed based on an already existing system for recycling. **The annual cost of loaning and operating a RVM is £8651**, and the annual cost of manual takeback per store is £1462. Alternatively, **the purchase and set up of a RVM is estimated at £32,700 per unit.** The average estimation of the number of RVMs needed is 1 RVM per 1900 people or 36749 RVMs to cover the UK. [16]

The impact of various life cycle stages on the cost of the return system, %



The cost of collection points such as RVM for the returnable bottle system in a collaborative approach scenario contributes 32% to the total system cost (69% of it are OPEX costs, 31% CAPEX costs)

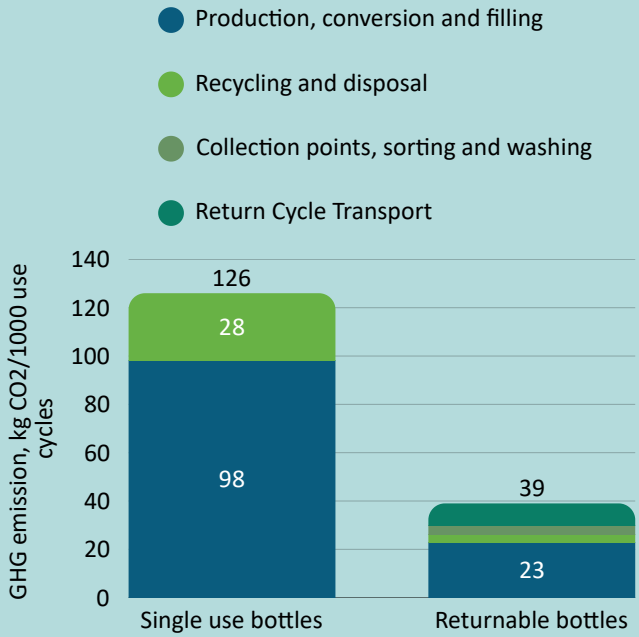
Adapted from figure 16, EMF, Unlocking reuse revolution

Key direct costs of RVM systems can include: 1. Set up and re-labelling costs 2. Reverse vending machines (RVMs) for reuse 3. Manual take back where machines cannot be used 4. Logistics including logistic hubs 5. Technology including software, counting centres, and administration. Washing and reconditioning are separate steps outside of this reports scope.

Well-established DRS systems optimise environmental impact by maintaining high return rates and minimising contamination.

The main environmental benefits delivered by the collection of reusable packaging via DRS is the increased capture of the returnable packaging allowing more use cycles. Lower contamination rates allowing returnable packaging to be washed at milder conditions reducing the impact of water and electricity usage. Returnable packaging systems also help to reduce litter. Collection points, **sorting and washing contribute to 16% of total GHG emissions of returnable system**[17] , however they benefit the success of the whole system. According to Circular Economy Portugal study, **scaling up reuse in Europe to 20% can deliver 1.3 million of CO2 emission savings, 10 million in resource use and 3.5 billion of water in 2027** (sectors modelled: take away, e-commerce and household care). [18]

GHG emissions



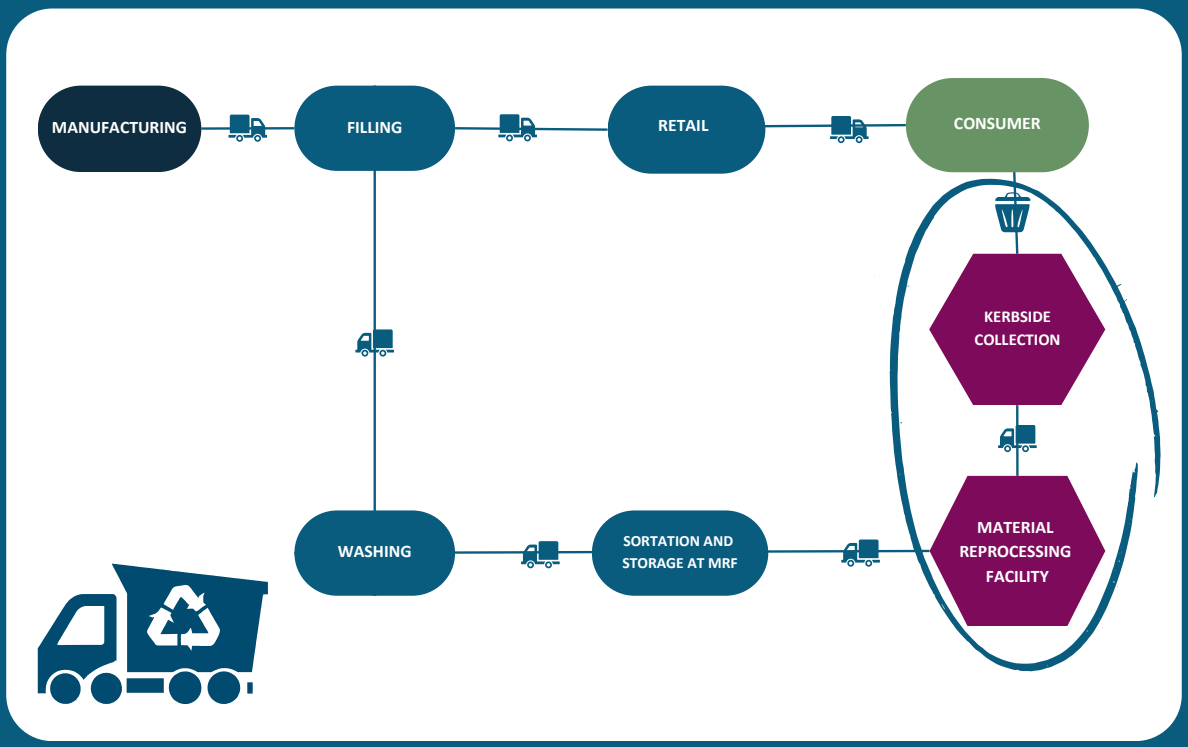
Adapted from figure 6, EMF, Unlocking reuse revolution

Kerbside collections and reuse

Kerbside collection of returnable packaging could be viewed as a preferable option by consumers, retailers and logistic providers. The UK already has a well-established infrastructure for the kerbside collection of household packaging for recycling, but would this infrastructure also be able to incorporate reusable packaging?

Benefits: builds on existing infrastructure and existing consumer habits: reduced cost and impact

Challenges: return rates , contamination, adaptation of the infrastructure



With the Ellen MacArthur Foundation research stating that nearly 30% of the costs for returnable packaging systems stem from reverse logistics infrastructure, including collection points[19], this could be a route to avoid some of these additional cost burdens. This approach would challenge traditional waste and resource management models but could represent a solution to take advantage of existing infrastructure.

Consumers already know how to recycle, but is it enough for returnable packaging systems?

Establishing new consumer habits, such as bringing packaging back to the store or booking a home pick-up, is challenging.

It has been shown that consumers see recycling and reuse as interlinked activities, the collection of reusable packaging at kerbside would therefore be a welcome extension of recycling collections for consumers. Recycling is a well-established habit with collection rates for recyclable packaging ranging from 55 to 78%[20]. However, this is insufficient to support a reuse system's optimal functioning. For the economics of the reuse system to work, return rates over 95% are recommended[21], while 80% is often enough to reach an environmental break-even point.[22]

Return rates for the optimal returnable packaging system

£ **95%**

80%

It is worth noting, that some systems suggest that the environmental break-even point can be reached at as low as a 51% return rate [23]. However, the user behaviour towards returnable containers might differ from that towards recyclable for a few reasons:

1) Returnable containers might have a deposit attached to them, which the user might be able to recover via an app or digital DRS system. Deposit/penalty is a strong driver for increasing return rates.

2) The environmental benefits and material value of returnable containers might be easier for the user to grasp. Durability might signal that the item has a value for reuse, and returning the item means that it does not end up in the environment as waste or litter.

3) For well-recognised target formats such as recyclable PET and HDPE bottles, the collection rates are significantly higher than for other formats: 76% for PET and 78% for HDPE compared to 39% for pots, tubs, and trays. [24] This suggests that a higher-than-average collection rate can be achieved if the reusable assets are easily identifiable and recognisable to all users. The kerbside collection rates achieved by recyclable PET bottles in the Czech Republic - 82% [25] and Belgium - 85% [26] would be sufficient to support a returnable system if that were in place.

A Digital Deposit Return System (DDRS) allows consumers to recover deposits on returnable packaging using a mobile app or online platform, eliminating the need for physical machines. Users scan a unique QR code or barcode on packaging, return it via kerbside collection or designated drop-off points, and receive their deposit refund digitally. This modern approach improves convenience, increases return rates, and integrates seamlessly with existing waste collection systems.

Retailers have limited capacity to handle returns at scale.

Return-to-store reuse models assume highly dedicated consumers and require significant investments in reverse vending machines (up to **£30K per unit** if purchased)[27] and retail space. It is estimated that approximately **5m2 of retail space** is required for RVM set-up. The revenue loss if this space is taken from all major supermarkets and shops can be close to **£71m annually**[28]. If the market share of reusable packaging rises, these demands will grow dramatically. Kerbside collection would relieve financial and space pressure on retailers to manage returns, allowing them to focus on upstream innovations and broader consumer adoption.

Collection and sorting systems have the potential to incorporate reuse.

Recyclable plastic packaging is currently collected from households at the kerbside utilising bins, bags and boxes for either co-mingled or source-separated collections of material.
How reusable packaging could be collected alongside this would need to be trialled and tested to determine if it could be co-mingled with recyclables, collected by the same vehicle and later separated during sorting or would need a separate collection container and potentially vehicle or at least compartment of the collection vehicle. Whether reusable packaging is collected from kerbside separately to recyclable material or as part of a co-mingled collection it will require a level of sorting. Tracking and tracing technology would have a key role to play in this to provide insight into the provenance of the packaging and its intended onward reuse journey. Whether reusable packaging can be technically sorted alongside single-use packaging and what modifications would be required for sorting of both together requires further investigation. Modern AI-equipped sorting robots have up to **95% efficiency of targeted product recognition.** They can be trained to pick up reusable packaging if co-mingled with recycling, with **up to 70 picks/minute**. The technology can sort materials with high accuracy, e.g. distinguish food-contact from other household packaging, and have a precise quality control function. [29]

Modern AI-equipped sorting robots have up to 95% efficiency of targeted product recognition.

The average contamination rates for dry recycling streams are over 15% [30], with typical contaminants being food waste, hygiene products and textiles. How this level of contamination can be managed in reusable packaging applications needs to be researched.
There is also a need to assess the economic feasibility of this scenario.

Costs vary depending on the adjustment needed and population density.

The cost of household single-use packaging collection ranges from £15 per household per year

for co-mingled collection in highly urban areas to £90 for kerbside sort collection in very rural areas, with an average cost of the collection being £50-60 per household [31]. The introduction of reusable packaging to the collection system offers a promising avenue for cost reduction, making it a financially beneficial option.

Kerbside collection of returnable packaging will most likely require additional investment in research and innovation to adjust the system to the new reusable stream. This will include potential alteration of vehicles, new collection vessels such as reuse bins or bags, a digital system to register reusable assets if a deposit is applied, and a screening and sorting system to decrease contamination.

Co-mingled collection in highly urban areas	£15
An average cost of the collection	£60
Kerbside sort collection in very rural areas	£90

Environmental impact depends on system efficiency.

Incorporating returnable packaging into the kerbside recycling collection system can deliver environmental benefits if the potential of an existing system is maximised with minor adjustments. On the other hand, high contamination and low return rates, if not mitigated, can result in loss of packaging from the system and application of more intensive cleaning methods, bringing environmental impact up.

Conclusion

The aim of this work is to analyse returnable packaging collection pathways to identify the most feasible scenarios and outline directions for further research and collaboration. Experience shows that reverse logistics is often the most significant barrier to the success of returnable packaging systems. By creatively utilising the insights and capabilities of existing collection systems for recyclable packaging, we can lay a strong foundation for advancing reusable systems.

We can optimise both environmental impact and financial requirements by leveraging existing resources, such as kerbside collection or networks of reverse vending machines. The kerbside system and the Deposit Return System each have specific benefits and can complement each other, addressing different sectors or packaging formats.

The following page provides a comparison of the two pathways, followed by a list of areas that require further research and trialing. RECOUP is open to collaboration to promote the adoption of reuse, so please don't hesitate to contact us with any questions or ideas for projects and collaboration.

RETURN ON THE GO DEPOSIT RETURN SCHEME			RETURN FROM HOME KERBSIDE COLLECTION
High (80-90% on average and up to 98%) [32]	98%	PREDICTED RETURN RATES	80%	Moderate (60%; but varies 20-80% by region and material)
Minimal due to RVM recognition system	LOW	CONTAMINATION	HIGH	Significant (over 15% contamination average)[33]
Returning items to collection points	MODERATE	CONVENIENCE FOR HOUSEHOLDS	HIGH	Collected from home
Limited by RVM settings and dimensions, different machine needed for different format/material	LOW	FORMAT COVERAGE	HIGH	Broad - Can accept any reusable packaging in circulation
£10–£30/year (targeted, efficient system)[34]	£30	COST PER HOUSEHOLD	£60	£50–£60/year (broader but less efficient system).[35]
New infrastructure is resource-heavy; a high collection rate and low contamination reduce environmental impact.		SUSTAINABILITY		Existing infrastructure minimises resource use, and contamination with a lower return rate can increase the environmental impact.
High (if specifically built for reuse) Low (if built on existing DRS for recycling)		INITIAL INVESTMENT		Low (if maximise the use of collection for recycling) High (if built for reuse collection only)
High-density areas, limited packaging formats, food contact applications		SUITABILITY		Medium and low-density areas, a broad range of formats, less sensitive applications

Areas for further exploration

What combination of various collection models would be suitable for the market, considering factors like different product sectors and geographical locations?

Are less convenient but more efficient systems competitive? Can we expect the consumer to do more for the sake of environmental benefits?

REUSE

How can policies enhance the effectiveness of returnable systems? Is there a need for new policies, or should they be integrated into Extended Producer Responsibility (EPR) or Deposit Return Schemes (DRS)?

The changes that would be required to enable current kerbside collections to incorporate returnable packaging.

The packaging formats that are best suited for various collection models.

The impact of technologies such as robotics, automation, and AI sorting on transforming the reusable packaging system.

£

Financing of new collection systems.

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