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*Innovative solutions to over-packaging and single-use plastics, and related microplastic pollution (IA)*

## **BUDDIE-PACK**

**Business-driven systemic solutions for sustainable plastic packaging Reuse schemes in mass market applications**

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**Report on the Set-up of alternative value chain for Reuse**

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## D4.2 : Report on the Set-up of alternative value chain for Reuse

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## Acronym description

3PLs	Third-Party Logistics
B2B	Business-to-Business
B2C	Business-to-Consumer
BiB	Bag-in-Box
CBA	Cost Benefit Analysis
cPET	crystallised polyethylene terephthalate
EFSA	The European Food Safety Authority
EoL	End-of-life
GA	Grant Agreement
HORECA	Hotel Restaurants Catering
KPIs	Key Performance Indicators
LCA	Life Cycle Analysis
PBT	Polybutylene terephthalate
PE	Polyethylene
PET	Polyethylene terephthalate
PPWR	Packaging and Packaging Waste Regulation
PRO	Producer Responsibility Organisation
QR	Quick Response
R&D	Research and Development
RFID	Radio Frequency Identification
rPBT	Recycled Polybutylene terephthalate
RPP	Reusable Plastic Packaging
RVM	Reverse Vending Machine
WP	Work Package

## Executive Summary

The BUDDIE-PACK project, funded under the Horizon Europe program, is focused on developing sustainable, business-driven solutions for reusable plastic packaging (RPP) in mass-market applications. This report (D4.2) explores various aspects of alternative value chains for RPP management, concentrating on identifying key value chains and the roles of different stakeholders. It provides a comprehensive stakeholder mapping, detailing their interests and the value created by reusable packaging throughout the supply chain. Additionally, the report examines the requirements of various actors in establishing reverse logistics systems and covers essential logistics management areas such as collection, transport, cleaning, storage, redistribution, shared infrastructure, and end-of-life (EoL) management. These insights are crucial for improving efficiency, sustainability, and collaboration in packaging management.

The project's goal is to create scalable and efficient reverse logistics systems that engage all the key **stakeholders across the supply chain** while ensuring both economic and environmental sustainability. High return rates, short retention times, and clear incentives for consumer participation are critical for success. Stakeholders involved in the value chain, whether directly or indirectly, play vital roles in enabling reuse and its logistics. Depending on their business models, different operational adjustments are expected as they transition to RPP.

**Reverse logistics** require a well-structured system to efficiently collect, clean, and redistribute reusable packaging. Depending on the volume and hygiene requirements, cleaning can be performed either in-house or by professional facilities. To keep packaging in circulation, stakeholders must collaborate on shared infrastructure, which helps reduce costs and ensures seamless operations. Logistics strategies are tailored to five key use cases: meat-skin packaging (B2B), catering packaging (B2B), home care refill packaging (B2C), take-away packaging (B2C), and ready-meal packaging (B2C). Each use case has specific requirements based on usage patterns, return mechanisms, and consumer involvement.

To support the long-term viability of reusable packaging, **end-of-life (EoL) strategies** must be carefully managed. The EoL process significantly affects the overall environmental impact and the economic viability of reusable packaging. Closed-loop recycling, as outlined in Regulation 2022/1616, presents an opportunity for high-quality material recovery. Segregating materials at collection points improves recyclability, reduces contamination and increases economic value. Additionally, **Extended Producer Responsibility (EPR)** schemes incentivize businesses to adopt reusable packaging by lowering financial contributions for sustainable alternatives, ultimately fostering both environmental and economic sustainability across the packaging value chain.

**Scalability** is a crucial factor for success, with B2B markets offering immediate opportunities due to controlled return logistics, while B2C models depend on consumer engagement and infrastructure readiness. To expand adoption, economies of scale, behavioural adaptation, regulatory support, and technological advancements must be leveraged.

In conclusion, BUDDIE-PACK lays a solid foundation for transitioning from single-use to reusable plastic packaging. By integrating structured reverse logistics, engaging stakeholders, and aligning with regulatory frameworks, reusable packaging systems can become both economically viable and environmentally sustainable, contributing to the European Union's broader circular economy goals.

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## Introduction

The BUDDIE-PACK project aims to develop business-driven systemic solutions for sustainable plastic packaging Reuse schemes in mass market applications. This report focuses on the *set-up of alternative value chains for Reuse*, including collection, reverse logistics, washing, storage, redistribution, and the end-of-life (EoL) organisation of the packaging.

The objective of this report is to provide a comprehensive overview of scenarios for all five use-cases within Buddie-Pack:

- Catering packaging (B2B)
- Meat-skin packaging (B2B)
- Take-away packaging (B2C)
- Refill home care packaging (B2C)
- Ready meal packaging (B2C)



Figure 1: Reverse logistics of reusable packaging (in green)

### Key conditions for Reuse systems

The conditions for effective Reuse systems have already been identified across several studies (Zero Waste Europe, 2023). They include:

- System infrastructure: drop-off networks, return logistics, washing facilities, redistribution, item tracking, consumer refunds - and employee training;
- Good governance: clearly defined rules concerning its functioning, requirements and standards for packaging design, usage, collection, washing, storage, handling, filling, and elements that can control the proper operation and performance of the system;

- Packaging design: durability, interoperability and safety need to be ensured from the design phase, which can guarantee that packaging can be used as many times as possible for the same purpose. The interoperability can be enhanced by 'universal' designs that enable acceptance of packaging across different Reuse schemes;
- Systems at scale: achieving economies of scale is essential for efficiency and to prevent burden-shifting;
- Minimum viable population density: reuse packaging systems operate most efficiently in urban areas with a sufficient population density, rather than in more dispersed communities;
- Consumer engagement: returning packaging is key element to reverse logistics and can be enhanced through incentives, marketing strategies, and education.

All the above are parameters to take into account to ensure the system operates efficiently, provides economic benefits for operators, and is convenient and easy to use for the end users.

### Optimizing Buddie Pack Reuse systems

To determine the right scenarios for all five Buddie Pack cases, this report will specify the key denominators for (reverse) logistics, such as system efficiency, and system variables.

**Efficiency** is paramount when establishing reverse logistics, requiring a balanced focus on both environmental and economic sustainability. Critical success factors that enable reverse logistics are:

- **High return rates:** Ensuring packaging is consistently returned by users without loss. A return rate of over 95% is recommended to maintain a viable system.
- **Low retention times:** Packaging is returned as quickly as possible. This allows a smaller pool size of assets.
- **Minimum rotations:** an average of 10 rotations before EoL by the fifth year of operation. Those minimum return rates and rotations determine Reuse performance, taking into account a transition phase of 3 to 5 years. A more specific minimum number of rotations for reusable packaging in different materials and packaging categories will depend on the specific set-up.
- **Traceability:** Enabling efficiency and control over packaging at all times through real-time data, and, in some cases communication with users (e.g. sending reminders to return packaging).
- **Incentivizing for collection:** Providing incentives is a central strategy to encourage user participation and increase returns. For more insights on different incentivization models and their implications for consumer behaviour, please read report D2.3.
- **Efficiency in Operations:**
  - Integrate reverse logistics with existing forward logistics systems.
  - Maximize space efficiency by using stackable, nestable, or foldable packaging.
- **Standardized packaging**
  - Simplify collection processes through consistent packaging standards.
  - Facilitate cleaning and Reuse with uniform packaging designs.

This report builds on the insights from previous deliverables, such as D1.2 and D4.1, to develop alternative value chains for all Buddie-Pack packaging applications. This involves designing logistics systems that ensure reusable assets are efficiently returned from the point of consumption to the start of the cycle, ready for Refill or Reuse.



## System variables

Generally, different variables influence reverse logistics. This report will do a deep dive into these variables to explain differences and identify the best options for different packaging formats.

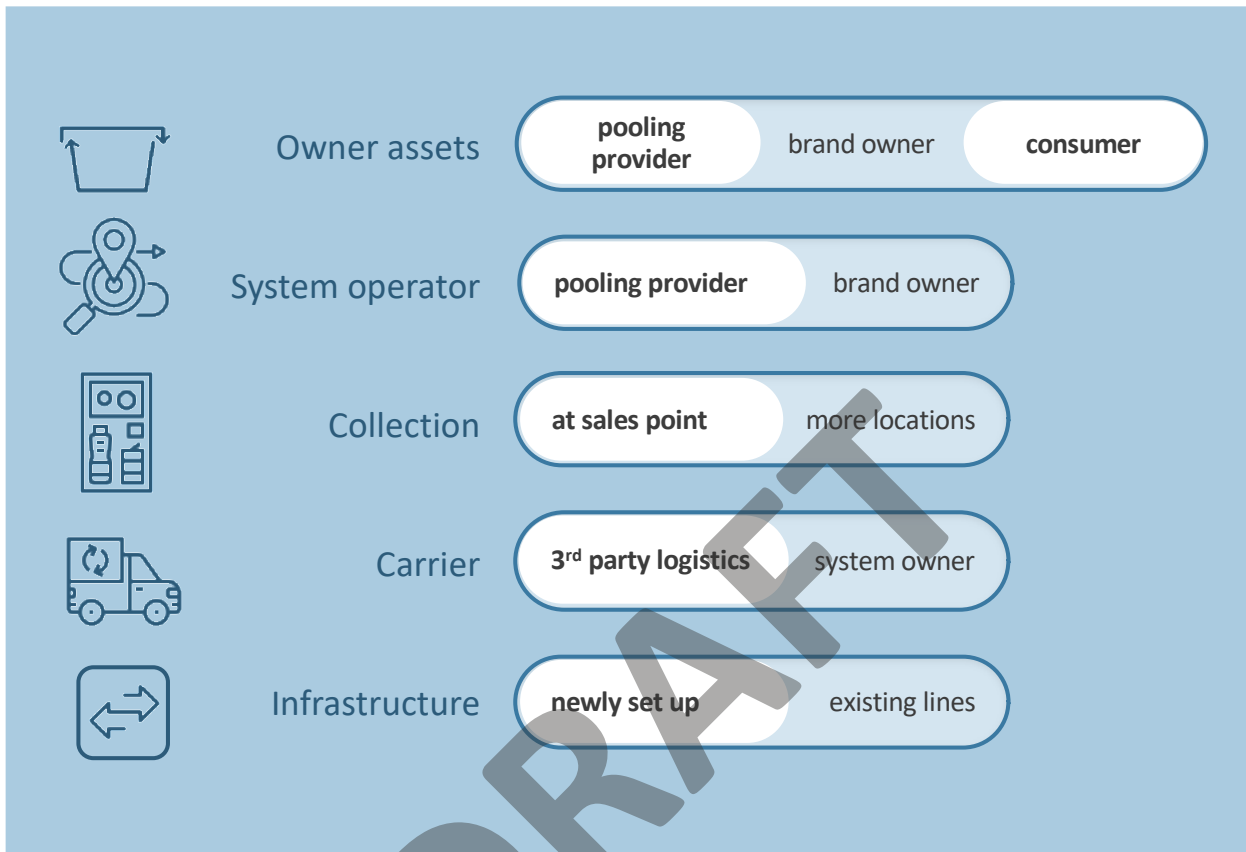


Image 2: Variables of reverse logistics

### Stakeholder involvement

This report identifies key stakeholders linked to reusable and refillable packaging and their roles in enabling Reuse systems. It examines how their interests contribute to enhancing the value of packaging across its entire lifecycle. Furthermore, it explores stakeholders' specific requirements for establishing an effective reverse logistics system.

### The theory of setting up reverse logistics

The report unpacks crucial elements relevant to the organisation of reverse logistics zooming in on all steps from collection to transport, to washing, to the involvement of social economy organisations.

### Setting up reverse logistics for the Buddie-Pack use cases:

Lastly and as a practical exercise, this report sets up the reverse logistics for all Buddie-Pack use cases. This includes EoL pathways and opportunities for scalability.

## 2. Value chain identification & the role of stakeholder

In this chapter, the value chain of reusable packaging, the packaging journey, is identified by describing all stakeholders and entities involved. Furthermore, their interest in adding value to reusable packaging is explored.

### 2.1. Stakeholder mapping

The image below shows an overview of all stakeholders and entities. It distinguishes between stakeholders already participating in the existing value chain and those that will be newly integrated when transitioning to a Reuse model. While new stakeholders are typically aligned with circular business models, existing ones may need to adjust their operations to accommodate Reuse practices. This requires changes in their business model possibly causing supply chain disruptions and the need to adjust processes. Central for organizing and internalizing these new structures is a well-developed change management plan.

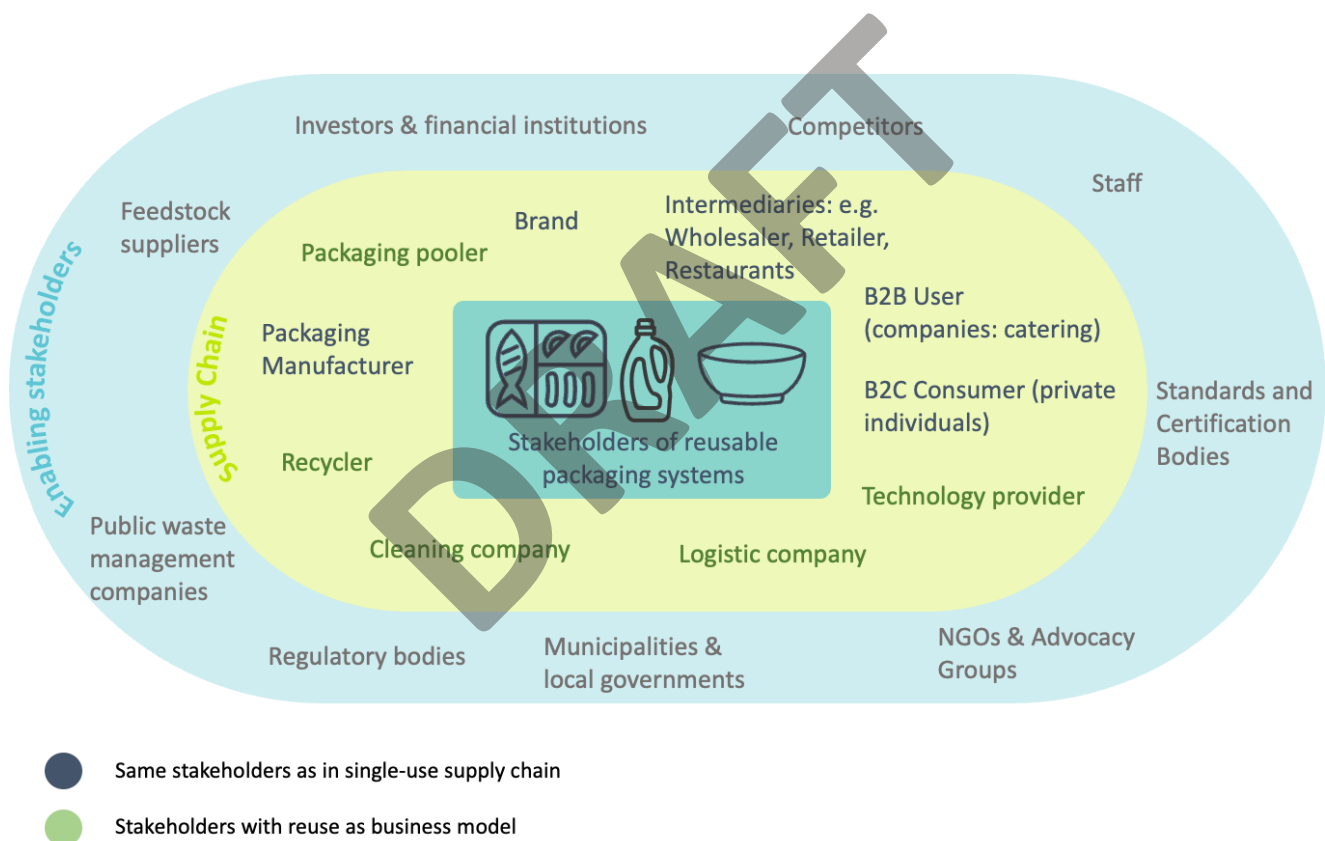


Image 3: Stakeholder map

#### List of stakeholders and potential impacts on their supply chain activities:

This section describes what listed stakeholders/entities need to change in their operations to accommodate Reuse.

##### **Packaging manufacturer:**

- Set up contracts with recyclers and users for closed-loop recycling.
- Change operations when producing different packaging with new features. This includes changes in packaging design(e.g. ajust to design standards for interoperability of reuse

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systems), material selection, labelling, storage, and handling procedures. It will also require (advanced) tracking systems, like RFID (Radio Frequency Identification) tracking for bulk logistics and automated inventory management.

- Implement a completely new packaging line, if necessary, which would involve significant operational changes.

**Brand owner:**

- Adjust filling lines.
- If the brand owner owns their packaging, redesign it for Reuse and adjust inventory and supply chain management (same changes as for the packaging manufacturer).
- Adjust labelling and return instructions.
- Set up incentivizing systems for packaging returns, including financial incentives, emotional appeals, clear instructions and communications, and convenient return options.
- Establish an education and communication strategy for handling reusable packaging for clients and end users.
- Enable tracking in the data management system.

**Retailer, Wholesaler:**

- Provide a collection point for take-back of packaging and interim storage of dirty packaging until pick-up for cleaning.
- Enable tracking in the data management system.
- Handle deposits.
- Integrate packaging into loyalty, reward, or penalty systems (optional).
- Train staff.
- Maintain service areas for Refill stations or bulk supplies.
- Communicate with consumers.

**B2B Users (e.g., catering companies):**

- Establish procedures for packaging return, such as designating intermediate storage space and defining staff responsibilities.
- Pre-clean packaging if required for transport.
- Enable tracking in the data management system.
- Establish a pick-up schedule for cleaning (can be integrated with tracked data in the data management system).
- Set up an internal accountability system to prevent loss or misuse of packaging. Clearly indicate which teams or departments are responsible for using and returning packaging.
- Track and report environmental impact.

**Competitors:**

- Collaborate in areas such as:
  - Agreeing on standard packaging formats with co-branding.
  - Sharing logistics and making joint investments in cleaning and tracking infrastructure.
  - Standardizing the deposit system.

**Staff:**

- Support consumer education and communication by:
  - Explaining the reusable packaging system.
  - Guiding customers in using Refill stations or return points.
  - Promoting and explaining incentives.
- Operate, maintain, and restock Refill machines.
- Handle returned packaging, including:
  - Incentive management.
  - Pre-washing.

- Packaging condition control.
- Tracking and intermediate storage of returned packaging.

All of these responsibilities require specific and regular staff training.

#### **B2C Users (Consumers):**

- Return packaging.
- Refill manually if not pre-filled.
- Depending on the system:
  - Pay a deposit.
  - Download an application and/or connect a bank account.

#### List of stakeholders directly involved in supply chain activities:

These stakeholders already base their business models on Reuse activities and thus do not need major changes in their operations.

#### **Packaging Pooling companies:**

- Manage and provide reusable packaging inventory.
- Coordinate distribution and organize returns.
- Monitor packaging usage and lifecycle- collaboration with technology providers, identifying areas for improvement.
- Offer brandable yet standardized packaging formats (R&D, investments).
- Partner with cleaning facilities.

#### **Technology providers:**

- Enable tracking to measure the ecological and economic impacts of reusable packaging.
- Establish data collection platforms.
- Provide analytics and reporting tools.
- Enable integration with other systems (e.g., logistics and cleaning company databases) for streamlined data sharing and coordination.

#### **Logistics companies:**

- Optimise and integrate forward- and reverse logistics.
- Offer damage-free transport.

#### **Cleaning companies:**

- Sub-contract logistics companies for the pick-up of used and redistribution of cleaned packaging.
- Inspect packaging and conduct quality control. This as well determines the EoL of packaging.
- Wash and dry reusable packaging.
- Enable integration with other systems (e.g., logistics and cleaning company databases) for streamlined data sharing and coordination.

#### **Recyclers**

- Agree on closed-loop recycling.
- Take-back source-segregated materials.
- Provide feedback on material durability and recyclability to pooling companies to support design improvements for future packaging.
- Report recycling rates and material recovery metrics to help stakeholders meet sustainability goals and reporting requirements.

**Enabling stakeholders and entities:**

This section describes the roles that listed stakeholders/entities can play in supporting the implementation of reusable packaging.

**Feedstock suppliers:**

- Supply of recycled feedstock from closed-loop systems.

**Investors & financial institutions:**

- Invest in reusable packaging and infrastructure.
- Fund-related research to support business cases and innovation.

**Standards- and certification bodies:**

- Monitor and evaluate the implementation of the Reuse system.
- Track progress.
- Set standards for official Reuse systems including guidelines, KPIs, and definitions.
- Set standards
- Establish food-grade certification for feedstock from reusable packaging.
- Certify effective Reuse schemes and penalize greenwashing attempts.

**Regularity bodies:**

- Enable Reuse systems through supportive legislation, such as financial support via EPR, setting of mandatory Reuse targets, and universal labelling and standards.

**Municipalities and local governments:**

- Integrate Reuse in city and regional infrastructure and policies.
- Support in the implementation through incentivising behavioural change for local businesses and communities.
- Promote Reuse through local communication campaigns.

**Public waste management companies:**

- Facilitate reverse logistics by integrating it into existing logistics or build synergies of scale.
- Broaden offer and integrate with portfolio.






**NGOs and advocacy groups:**

- Provide educational campaigns to support implantation by informing about the impact of Reuse systems, how they work, and opportunities, such as cost-effectiveness.
- Share stories of best practices to inspire and create momentum.
- Amplify public pressure.

## 2.2. Stakeholders interest in reusable packaging creating value throughout the supply chain

This section highlights the interest of various stakeholders who create value for reusable packaging throughout the entire value chain, from production to end-of-life.

For more information on how stakeholders can benefit from reusable packaging read D4.1 Chapter 6 where drivers to improve profitability are discussed.

Stakeholder	Added value throughout the supply chain					
	Interest	Design 	Production 	Distribution 	Use 	End-of-Life 
<b>Manufacturers</b>	<ul style="list-style-type: none"> <li>• Reduced packaging costs</li> <li>• Ensured product quality</li> <li>• Meet sustainability goals</li> </ul>	Using sustainable materials and efficient production processes	Cost-effective production methods, production at scale	Producing packaging that withstands multiple uses	Reaching Product safety and compliance with regulations	Facilitating recycling or repurposing processes
<b>Retailers</b>	<ul style="list-style-type: none"> <li>• Reduced packaging costs</li> <li>• Reduced waste</li> <li>• Meet sustainability targets and image</li> <li>• High consumer acceptance</li> <li>• High return rates</li> </ul>	Offering appealing and functional packaging to attract consumers	Reducing packaging costs and waste	Efficiently managing inventory and logistics	Providing a positive consumer experience	Implementing take-back programs and promoting recycling

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<b>Private Consumers (B2C)</b>	<ul style="list-style-type: none"> <li>• Convenient shopping</li> <li>• Cost-effective pricing</li> <li>• Reduced environmental footprint</li> </ul>	Convenient, durable, and aesthetically pleasing designs	Choosing brands that offer reusable packaging	Transparency of supply chain	Ease of use, functionality benefits	Having easily accessible return options
<b>Business Users (B2B)</b>	<ul style="list-style-type: none"> <li>• Stable revenue streams</li> <li>• Reduced environmental footprint</li> <li>• Innovation opportunities</li> </ul>	Business needs and standards	Bulk production and cost-effective solutions	Suitable for large-scale distribution and industrial handling	Durability and functionality for maximisation of use (sturdy)	Implementing efficient recycling or repurposing processes to minimize waste
<b>Logistics Companies</b>	<ul style="list-style-type: none"> <li>• Efficient logistics (last and shortest ways possible)</li> <li>• Minimized empty return trips</li> </ul>	Designing for efficient transportation and handling (e.g., stackability)	Reducing transportation costs and ensuring packaging integrity during transit	Managing the distribution network, and optimising delivery times and costs through smart route planning	Ensuring packaging is easy to handle and store during transit	N/A
<b>Washing Companies</b>	<ul style="list-style-type: none"> <li>• Resource efficiency</li> <li>• Increased demand for cleaning services</li> <li>• Compliance with hygiene and safety standards</li> </ul>	Designing for easy cleaning and sanitization	Using efficient and eco-friendly cleaning processes	Managing the logistics of collecting and returning cleaned packaging	Maintaining packaging quality and trackability	Ensuring cleaning processes are sustainable and support the lifecycle of reusable packaging

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<p><b>Recycling Companies</b></p>	<ul style="list-style-type: none"> <li>• High-value content, recyclability</li> <li>• Reduced sorting costs</li> </ul>	<p>Receiving packaging that is easy to disassemble and recycle</p>	<p>Processing materials efficiently and profitably</p>	<p>Ensuring materials are sorted and transported effectively</p>	<p>Providing recycling services to consumers and businesses</p>	<p>Ease of disassembly maximizing material recovery</p>
<p><b>Governments</b></p>	<ul style="list-style-type: none"> <li>• Reduced Plastic waste and related CO<sub>2</sub> emissions</li> <li>• Strong national industries</li> <li>• Local job creation</li> </ul>	<p>Setting regulations and standards for sustainable packaging design</p>	<p>Enforcing production standards and providing incentives for sustainable practices</p>	<p>Support the development of return infrastructure</p>	<p>Minimum Reuse standards for an increased use of reusables</p>	<p>Implementing policies and programs to support recycling and waste reduction</p>

Table 1: Influence of interest of stakeholders on packaging throughout the life cycle

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### 2.3. Analysis of stakeholder needs when setting up reverse logistics

This chapter explores the expectations and practical/logistical needs of key stakeholders involved in post-use packaging management, including logistics companies, cleaning facilities, recyclers, and end-users. It examines what these stakeholders expect from the Reuse system and how their needs influence the organization of the value chain to facilitate and optimize reverse logistics.

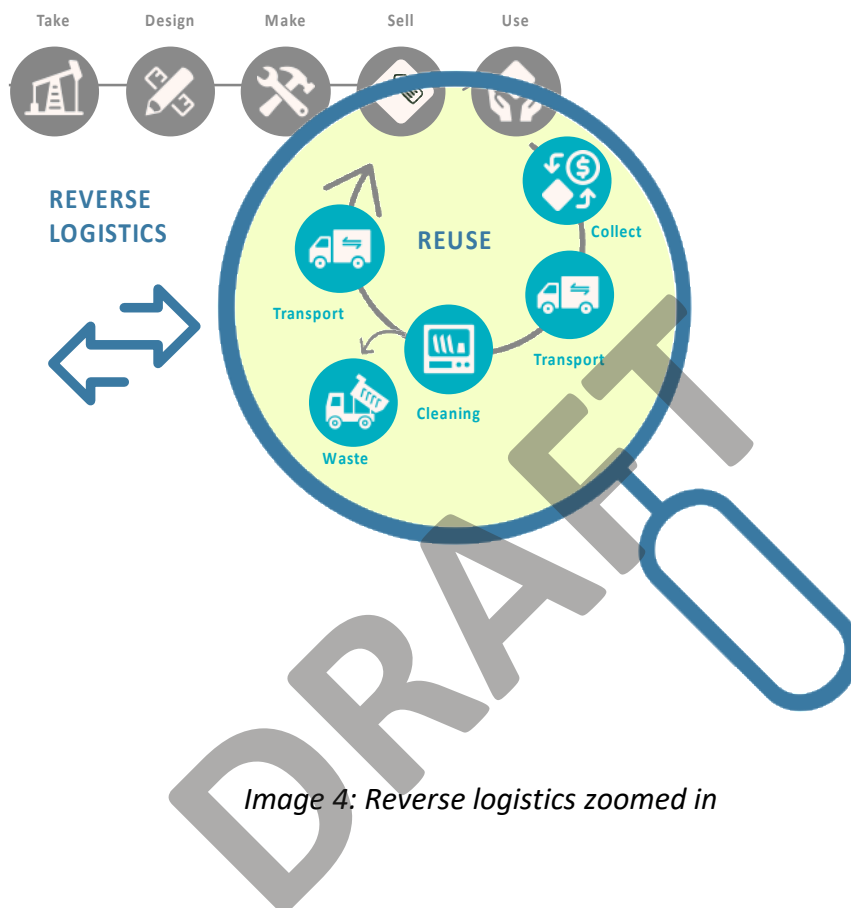


Image 4: Reverse logistics zoomed in

#### End-users (Retailers, Consumers)

End-users, including both retailers and consumers, play a crucial role in the success of reusable packaging systems. Their primary needs include cost neutrality or economic benefits, convenient return options, accessible information, and incentives that encourage participation in sustainable practices.

#### Consumers:

- Standardized return locations and processes – Easily accessible and consistent return points and procedures.
- Convenient collection options – Return choices that integrate seamlessly into daily routines (e.g., home pickup, in-store drop-off, workplace returns).
- Incentives for participation – Reward programs that encourage engagement in the reusable packaging system.
- Portable packaging design – Lightweight, easy-to-carry packaging for convenient returns at designated drop-off locations.

**Retailers:**

- Automated returns with minimal labor requirements – Streamlined systems to reduce staff workload.
- Clean returns – Measures to prevent contamination of store floors and storage spaces.
- Clear handling and return instructions – Simple guidelines for storage, processing, and reuse to minimize errors and contamination.
- Collaboration with logistics partners – Cost-effective solutions for efficient reverse logistics.
- Transparent cost structures – Clear frameworks (e.g., a universal deposit system) for managing returns effectively.

**Logistics companies**

Logistics providers play a crucial role in ensuring the efficient movement of reusable packaging across the supply chain. Their primary needs include minimizing transportation costs, reducing environmental impact through optimized routes and load consolidation, and leveraging advanced tracking systems to monitor packaging status and location in real time.

- Standardized packaging formats – Consistent sizes and shapes to enable efficient stacking, storage, and handling across various transport modes.
- Reliable collection and return systems – Timely and predictable schedules to minimize idle times and maximize resource utilization.
- Clear labelling and tracking standards – Unified protocols for seamless integration across different logistics partners.
- Proximity to cleaning and sorting facilities – Streamlined access to reduce travel time, operational costs, and environmental impact.
- Flexible volume management – Infrastructure capable of handling fluctuating demand through collaborative planning, real-time tracking, and predictive modelling.
- End-to-end data visibility – Live data access across stakeholders for accurate tracking, forecasting, and proactive issue resolution.

**Cleaning**

Cleaning providers ensure that returned packaging meets stringent hygiene standards and is ready for reuse. Their key needs include predictable workflows, standardized packaging designs and materials, and efficient cleaning protocols to ensure seamless and cost-effective operations.

Aspects to meet their needs are:

- Scalable volumes with predictable return cycles –
  - Access to live data to forecast incoming volumes and types, optimizing resource planning.
  - Reliable return schedules to prevent stockpiling and workflow disruptions.
- Proximity to distribution points – Strategically located cleaning facilities to minimize transport costs and turnaround times.
- Transparency on packaging condition – Insight into packaging status upon arrival to anticipate sorting needs.
- Automation-ready washing processes – Regular, forecasted returns to support:
  - Standardized packaging formats for seamless processing.
  - Automated handling through packaging designs optimized for machine loading.
  - Bulk deliveries to maximize efficiency.

- Standardized materials for streamlined washing – Different materials require distinct cleaning methods, so consistency is essential:
  - Industry-wide washing protocols to meet hygiene standards.
  - Harmonized packaging materials for the same packaging types.
  - Automated sorting compatibility through standardized labelling (e.g., RFID tags, QR codes).

### Recyclers

Recycling providers manage the end-of-life stage for packaging materials, ensuring efficient processing and reintegration into the supply chain. Their key needs include clean, standardized materials, clear end-of-life identification, stable end markets, and coordinated disposal timing to maximize recycling efficiency and minimize waste.

- Supply chain resilience – Reliable access to clean, high-quality, contaminant-free packaging materials.
- Bulk delivery for speciality materials – Ensuring financial viability through large-scale collection and processing.
  - Manufacturer partnerships to support closed-loop recycling with secure end markets and off-take agreements.
- Clear labelling – Standardized identification of material compositions for priority processing.
- Standardized materials – Consistency across packaging types to simplify recycling and improve efficiency and increase volumes.
- Recyclability-focused design – Early involvement in packaging design to ensure compatibility with recycling processes.

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### 3. Logistics for packaging management

The logistics of reusable packaging systems are significantly influenced by whether they operate as open-loop or closed-loop systems and whether they serve B2B (business-to-business) or B2C (business-to-consumer) markets. Open-loop systems involve packaging that moves across multiple, often decentralized, stakeholders, requiring extensive coordination and infrastructure for collection and return. In contrast, closed-loop systems function within a controlled network, making tracking and retrieval simpler and more predictable. Meanwhile, B2B operations typically involve bulk movements of reusable packaging between businesses, enabling streamlined logistics and cost efficiencies. On the other hand, B2C systems rely heavily on consumer participation, necessitating widespread collection points, communication campaigns, and incentives to ensure returns. These variables shape the complexity and cost of reusable packaging logistics. This emphasizes the importance of considering these factors—B2B vs. B2C and open-loop vs. closed-loop—when designing logistics systems to ensure efficiency, effectiveness, and sustainability.

#### Key differences between open and closed loop systems and the impact on logistics

Closed-loop system reusable packaging	Open-loop system reusable packaging
<b>Definition</b> Reusable packaging is circulated by a system operator or a cooperating group of system participants without changing the ownership of the packaging.	<b>Definition</b> Reusable packaging circulates amongst an unspecified number of system participants. It can also entail that the ownership of the packaging changes at one or more points in the Reuse process.
<b>Impact on logistics</b> <ul style="list-style-type: none"> <li>• Packaging follows a more-or-less predictable cycle (quantities and returns).</li> <li>• Easier to track and manage as it involves a defined network.</li> <li>• Basic tracking tools are often sufficient.</li> <li>• Tailored to specific organizational needs.</li> </ul>	<b>Impact on logistics</b> <ul style="list-style-type: none"> <li>• Involve multiple stakeholders, locations, and industries, making reverse logistics more complex.</li> <li>• Need for centralized or third-party networks for collecting, cleaning, and redistributing packaging.</li> </ul>
<b>Use-cases</b> <ul style="list-style-type: none"> <li>• Catering packaging</li> <li>• Meat-skin packaging</li> <li>• Canteen packaging</li> </ul>	<b>Use-cases</b> <ul style="list-style-type: none"> <li>• Refill detergent packaging</li> <li>• Take-away packaging</li> <li>• Ready meal packaging</li> </ul>

Table 2: Key differences between open and closed loop systems and the impact on logistics

For more information on open- and closed-loop systems please read D4.1.

#### Key differences between B2B and B2C for reverse logistics

Aspect	B2B Reverse Logistics	B2C Reverse Logistics
<b>Stakeholders</b>	Businesses, manufacturers, suppliers, distributors, and logistics providers.	End consumers and retail businesses (sometimes intermediaries like 3 <sup>rd</sup> party logistics).
<b>Volume and Scale</b>	High-volume returns (bulk shipments).	Low-volume, individual returns from consumers.

<b>Complexity</b>	Coordinated, systematic, and often integrated with supply chain operations.	Varied, often inconsistent returns linked to consumer behaviour and incentivizing schemes.
<b>Handling Requirements</b>	Focus on cost-efficiency, tracking, and quality control for Reuse.	Focus on convenience, consumer satisfaction, and simplified processes.
<b>Transport and Logistics</b>	Scheduled returns, backhauling, and pooling systems.	Ad-hoc returns through drop-off points, mail services, or courier systems.
<b>Technology Use</b>	Advanced systems like RFID tracking for bulk logistics and automated inventory management.	Simple tracking (QR codes or barcodes), consumer-facing apps.
<b>Key Drivers</b>	Cost reduction, sustainability, and supply chain efficiency.	Consumer experience, brand loyalty, and regulatory compliance.
<b>Revenue Impact</b>	Cost recovery through repair, Reuse, or recycling within supply chains.	Costs are managed through restocking fees, refurbishing, or exchanges.
<b>Examples</b>	Returnable pallets/crates in retail, automotive parts logistics.	Returnable beverage bottles, e-commerce returnable mailers.

Table 3: Key differences between B2B and B2C for reverse logistics


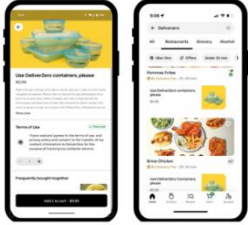




### Complexity of logistics



- Closed-Loop + B2B:** Simplest logistics setup with predictable, controlled returns and lower operational costs.
- Closed-Loop + B2C:** Slightly more complex due to reliance on consumer compliance, but manageable within a defined system.
- Open-Loop + B2B:** Requires coordination across broader networks, increasing transportation costs and tracking challenges.
- Open-Loop + B2C:** Most complex and costly, as packaging retrieval spans diverse locations, relies on consumer behaviour, and requires widespread infrastructure.

### 3.1. Collection and transport

After use, empty packaging must be returned for cleaning and redistribution. Logistics companies and professional cleaning facilities often manage the pickup of accumulated empty packaging as part of their service, which is typically more straightforward in closed-loop and B2B systems. Since packaging in these systems is used in bulk or within a controlled environment, it is easier to collect from a single location. In contrast, open-loop and most B2C systems require consumers to return packaging from home themselves, making convenient drop-off solutions essential for ensuring the sustainability and efficiency of reverse logistics. Easily accessible return options help prevent packaging loss and maintain consumer engagement with reuse systems. To enhance convenience, return points should not be limited to specific stores or companies but should instead be widely available in places where people shop, work, travel, and spend leisure time. Providing well-placed, easily accessible return solutions is key to supporting an effective reusable packaging system. The table below outlines various strategies for facilitating packaging returns.

Return scheme	Technology/ logistical solution	Description	Example
<p><b>Return from home</b></p> 	<p>Scheduled pick-up services – optimal via electric vehicles or bike fleets</p>	<p>Consumers can schedule home pick-ups online. This allows zero extra effort for the consumer to drop off packaging.</p> <p>Efficient last-mile solution providers with an all-electric fleet can offer same-day delivery and pickup, which can be used across various consumer and enterprise verticals, including retail, food and DTC. These can be linked to distribution centres, or nano fulfilment centres to place goods closer to the consumer and reduce delivery times.</p>	<p><a href="#">Uber eats with Deliver Zero</a></p>  <p><a href="#">Same-day delivery and pick-up- Gently</a></p> 
	<p>Return with next order</p>	<p>Packaging is returned- and exchanged every time a new product in reusable packaging is delivered. This works for subscription models as well as for food delivery services that are used regularly. This option is often combined with return-on-the-go options to allow consumers to return packaging at any time.</p>	<p><a href="#">Modern Milkman</a></p> 
<p><b>Return on the go</b></p> 	<p>Reverse Vending Machines (RVM)</p>	<p>Reusable packaging can be returned via RVMs suitable for bottles which are available in many supermarkets for returning bottles.</p>	<p><a href="#">Einfach Mehrweg</a> has developed reusable packaging that is compatible (sizing) RVMS from e.g. <a href="#">TOMRA</a>, <a href="#">Sielaff</a>, <a href="#">Re Deposit</a>, and <a href="#">Trautwein</a>.</p> 

D4.2 : Report on the Set-up of alternative value chain for Reuse


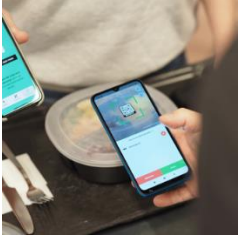


	<p>Smart bins</p>	<p>RVMs made for different-sized reusable packaging, often placed in crowded areas such as train stations, parks and sidewalks. Bins recognise the packaging via a QR code scanner and confirm the return via an app. To lower barriers for consumers who may be reluctant to download an additional app for packaging returns, some solution providers have developed smart bins that allow app-free returns, making the process more accessible and user-friendly.</p>	<p><a href="#">Packback</a></p> 
	<p>Drop-off points</p>	<p>Consumers can return reusable packaging at various drop-off points in cafes and restaurants which take part in the joint Reuse scheme. Consumers can find those locations via an app which provides a map with nearby drop-off locations.</p>	<p><a href="#">Vytal</a></p> 
	<p>Return via mail</p>	<p>This is particularly suitable for e-commerce packaging, where consumers can post their empty packaging for return.</p>	<p><a href="#">Repack</a></p> 
	<p>Drones</p>	<p>Drones are used in China for fast meal delivery, bypassing street traffic and significantly reducing delivery times. They could also be used for packaging collection, especially in crowded or hard-to-reach areas like parks and rooftops. This provides convenient drop-off points for take-out and on-the-go consumption. Additionally, drones offer an efficient solution for rural areas, reducing the need for long-distance pick-up truck routes.</p>	<p><a href="#">Meituan</a></p> 

Table 4: Existing technological and logistical solutions for the return of reusable packaging

Another factor to consider is the transaction cost of packaging. Whether using a deposit or a library system, money must be refunded. These models are further discussed in Report 4.3, which explores business models for the use cases.

### 3.2. Cleaning

Cleaning reusable packaging is essential for maintaining hygiene, ensuring product safety, and prolonging packaging lifespan. The choice between in-house cleaning and using a professional facility depends on factors such as operational scale, cost, and industry-specific needs.

#### A. In-house cleaning

In-house cleaning means companies own and operate on-site professional cleaning setups. This includes professional washing equipment such as industrial washing machines, as well as trained staff to comply with any cleaning hygiene standards.

Advantages:

- **Cost Savings:** For smaller operations, in-house cleaning can be more cost-effective as it eliminates the need for outsourcing.
- **Quick Turnaround:** In-house cleaning can reduce the time required to return packaging to the supply chain, enhancing operational efficiency.

Disadvantages:

- **Initial Investment:** Setting up an in-house cleaning facility requires significant investment in equipment, training, and maintenance.
- **Compliance and Quality Control:** Ensuring compliance with industry standards and maintaining consistent quality can be more complex without specialized expertise.

#### B. Professional cleaning facilities

Professional cleaning facilities are specialized third-party services that handle the cleaning and maintenance of reusable packaging or materials. These facilities are managed by external service providers with expertise in large-scale cleaning operations and often include packaging pick-up services.

Advantages:

- **Expertise and Specialization:** Professional facilities possess specialized knowledge and equipment to handle various types of reusable packaging, ensuring the cleaning process preserves the integrity of the packaging.
- **Scalability:** These facilities can handle large volumes, making them ideal for companies with extensive operations.
- **Regulatory Compliance:** Professional cleaners are well-versed in industry regulations, ensuring effective compliance with standards.

Disadvantages:

- **Logistics:** Coordinating the transportation of packaging to and from the cleaning facility can add complexity and cost.



### When to use in-house cleaning, when to use professional cleaning facilities?

The main factors for deciding whether to go for in-house cleaning or professional cleaning facilities are costs, logistical effort, and hygiene standards.

**In-house cleaning** makes most sense in situations where companies handle smaller volumes of reusable packaging. Existing cleaning infrastructure such as industrial dishwashers in cafes and take-away restaurants can be used for in-house cleaning.

Furthermore, in-house cleaning makes sense where packaging needs to be quickly cleaned and returned to the supply chain.

Making use of **professional cleaning** makes sense for companies with high volumes of often fast-moving reusable packaging and for packaging that requires extra stringent hygiene standards such as fresh meat- and fish packaging. Lastly, cleaning is a cost factor. If setting-up and maintaining in-house cleaning outweighs the benefits, outsourcing professional cleaning should be considered.

### 3.3. Shared infrastructure

The establishment of reverse logistics for reusable packaging is crucial for achieving sustainable supply chain management. Collaboration among industry players is essential to setting up effective systems, as integrating efforts across sectors can streamline the collection, sorting, and redistribution of reusable packaging. Key factors for success include aligning standards, sharing investments in infrastructure, and developing innovative tracking technologies.

Currently, reverse logistics is seen as a bottleneck for businesses transitioning to reusable packaging due to the lack of large-scale infrastructure and the significant investment needed. Without a robust system, returning packaging can be inefficient, costly, and challenging.

Many startups in the reusable packaging sector struggle because they attempt to build standalone infrastructures, unable to achieve the scale and efficiency needed to compete with single-use systems. Shared standards and infrastructure could offer a solution, allowing companies to pool resources for logistics and packaging management, reducing costs and encouraging broader adoption. Therefore, investment in shared infrastructure is key.

Examples of both investors and governments investing in the development of reusable infrastructure:

#### Government initiatives:

- **European Union's Horizon 2020 Program:** The EU has been actively funding projects that promote the circular economy, including reusable packaging. Horizon 2020, one of the largest EU research and innovation programs, has allocated significant funds to projects that develop sustainable packaging solutions and the necessary infrastructure for their implementation. This includes grants for research into new materials, systems for collection and Reuse, and technologies to track and manage reusable packaging.
- **France:** has set national reuse targets for packaging. To support implementation, the national PRO responsible for packaging waste management, CITEO, provides grants and subsidies to businesses and municipalities for the installation of public return bins and washing centers. This financial support helps cover both the purchase and installation of necessary equipment, as well as the operational expenses of running these facilities.
- **Netherlands:** The Dutch government funds "Moonshot" projects, which, among other things, provide funding for the installation of public return bins and the expansion and upgrading of

professional cleaning facilities. These projects involve collaboration between the government, businesses, and research institutions.

#### Private Investors:

- **Closed Loop Partners:** This investment firm focuses on building the circular economy. They fund projects that develop recycling infrastructure and reusable packaging systems, working with companies to scale sustainable solutions.
- **Circularity Capital:** invests in businesses developing infrastructure for reusable packaging, such as collection, cleaning, and tracking systems that serve multiple brands. By funding scalable solutions and fostering collaboration, they help reduce costs and make reusable packaging competitive with single-use models.

#### Resources for companies to set-up reverse logistics for reusable packaging

The organisation of setting up shared reverse logistics in an efficient way that allows the pooling of services and resources can be a logistical challenge and requires a good overview of potential partners and the industry. To support this, platforms where solution providers can offer their services and connect with packaging providers can be very helpful, such as:

- [Planet Reuse](#) (Europe focused)
- [New Reuse Alliance](#) (Europe focused)
- [Value4Pack](#) (EU focus)
- [Circular Economy Club](#) (international)
- [Mehrwegverband](#) (for Germany)
- [La Librairie](#) (France)



## 4. Logistics for Buddie Pack use cases

The following section outlines the logistics for the specific Buddie Pack use cases to ensure a clear understanding of the adjustments needed to implement reusable packaging systems effectively. This includes identifying the packaging journey, cleaning and transportation requirements for the developed reusable packaging formats, and the roles of stakeholders and partners involved in each step. It is important to note that the logistics described in this chapter focus on potential market rollouts and differ from those used in the pilot phase. Thus, the logistics setup follows a more theoretical approach and does not represent the packaging management of the large-scale demonstrations, which are based more on the availability of consortium partners than on practical considerations.

For each use case, a flowchart is created to illustrate the packaging journey and the roles of stakeholders. The flowchart uses colour-coding to distinguish different elements of the process:

- **Light blue** represents the manufacturing and EoL phases of the packaging. These phases are not explored in detail in this section, as they fall outside the scope of the regular packaging cycle. Additional information on the EoL for each use case can be found in chapter 3: *EoL Pathways for RPPs*.
- **Grey** highlights the sections of the value chain that remain unchanged when transitioning to reusable packaging.
- **Green** identifies new chain elements that must be introduced to enable Reuse or Refill systems.

### 4.1. Meat-skin packaging

<p><b>Use-case:</b> Meat- skin trays</p> 	<p><b>Pilot location:</b> Ireland</p> 	<p><b>Details:</b></p> <ul style="list-style-type: none"> <li>• Brand owned packaging</li> <li>• B2B</li> <li>• Secondary packaging: yes</li> <li>• Incentive system: library</li> </ul>	<p><b>Min. requirements:</b></p> <ul style="list-style-type: none"> <li>• Min. cycles from LCA: 7</li> <li>• Min. cycle from CBA: 8</li> </ul>
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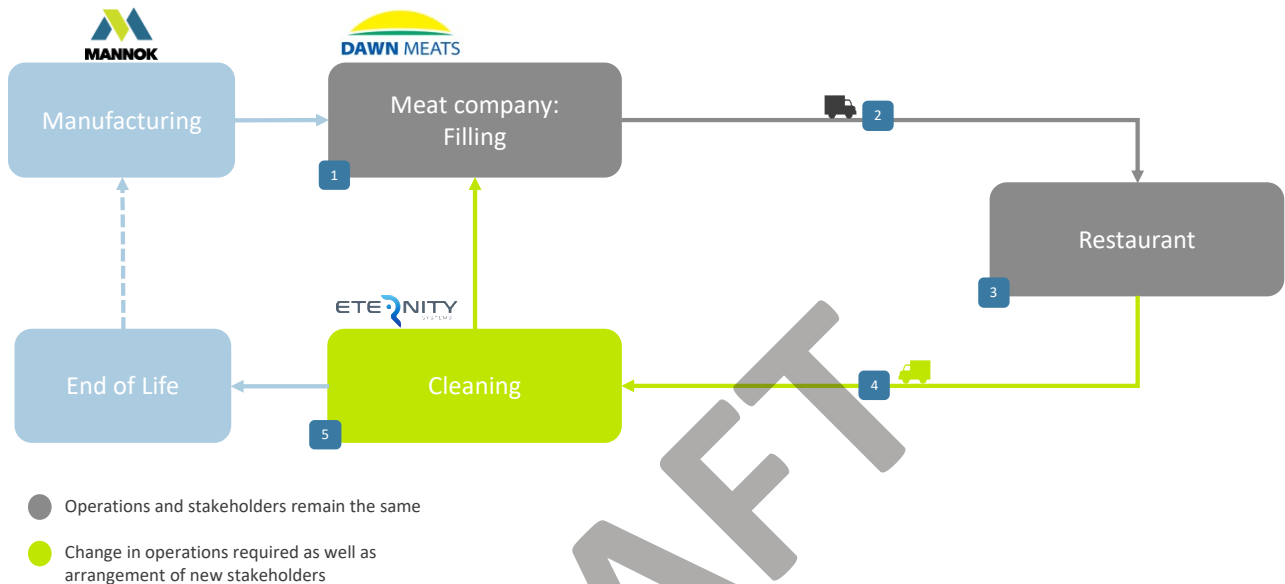


Image 5: Reverse logistics B2B meat skin packaging

- 1) Filling:** Reusable meat-skin trays are packed with steaks and sealed using single-use film at the meat production facility. The individual packs are then placed in reusable, trackable secondary packaging, which also doubles as temporary storage for empty, used trays.  
**Stakeholder:** Brand owner (Dawn Meats).  
**Responsibilities:** Inventory management, storage, filling
- 2) Distribution:** Packs are distributed to restaurants (e.g. pubs and fast-food chains).  
**Stakeholder:** Brand owner (usual sub-contractor).  
**Responsibilities:** Transport (signing off quantities of packaging at delivery and pick-up).
- 3) Usage:** Restaurants cool-store packs until use. After the packaging is emptied, the kitchen staff pre-rinses the packaging according to protocol and stores empty packaging in the secondary packaging box for collection. Broken reusable trays must also be collected for washing. Staff needs to be trained to not discard broken packaging. These will be separated for recycling upon inspection by the cleaning service. The film is discarded in the MSW.  
**Stakeholder:** Restaurant staff.  
**Responsibilities:** Scanning full packaging upon arrival, scanning empty packaging upon departure, rinsing off packaging after use, and intermediate storage of used packaging in secondary packaging.

- 4) **Return:** The packaging is regularly collected for cleaning within a timeframe that ensures hygienic standards and prevents problematic bacterial growth.  
**Stakeholder:** Brand owner (usual sub-contractor).  
**Responsibilities:** Transport (signing off quantities of packaging at delivery and pick-up).
- 5) **Cleaning:** At professional washing facilities, the packaging is inspected and thoroughly cleaned according to established washing protocols. Any packaging that fails to meet the quality standards is removed from circulation.  
**Stakeholder:** Professional cleaning facility (Eternity Systems).  
**Responsibilities:** Scanning packaging on arrival, inspecting, cleaning, inspecting again, and sorting packaging for recycling.

### 4.2. Catering packaging

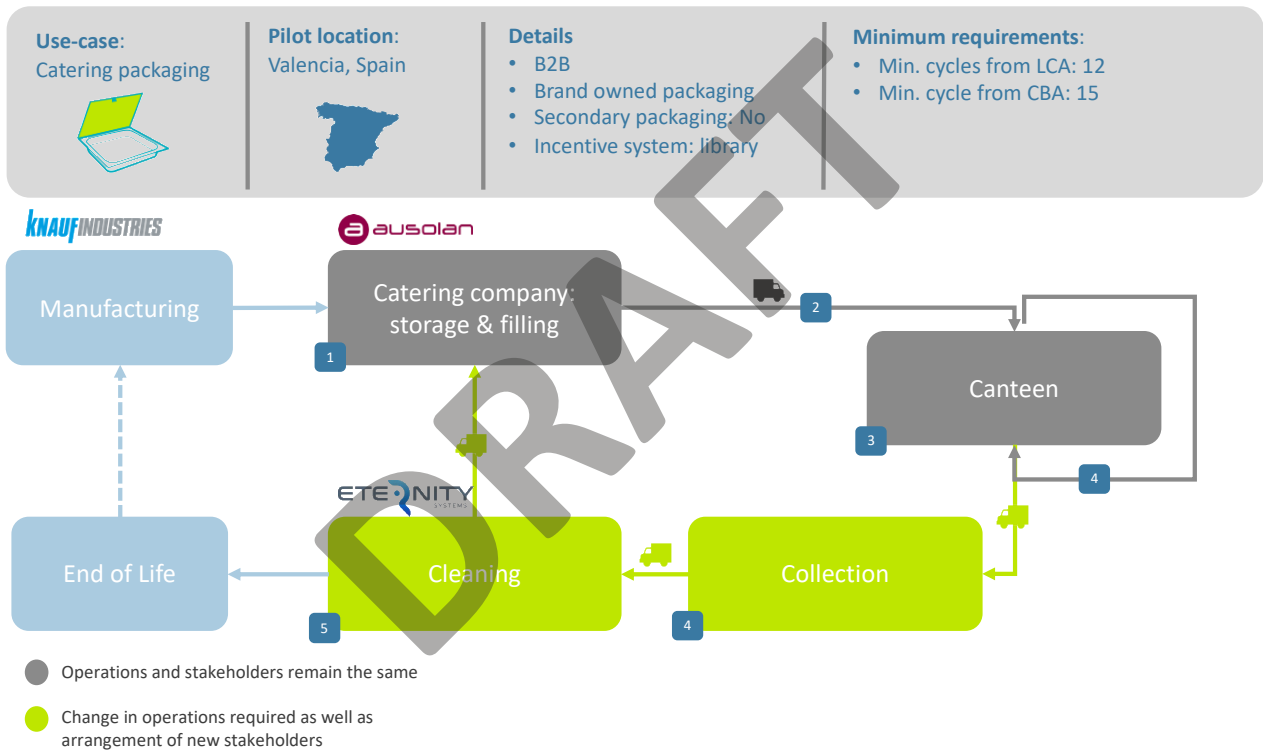


Image 6: Reverse logistics B2B catering packaging

- 1) **Filling:** The caterer prepares meals, which are filled into multi-portion or single-portion trays.  
**Stakeholder:** Catering company (Ausolan).  
**Responsibilities:** Manage inventory, filling packaging.
- 2) **Distributions:** Meals are freshly prepared daily and distributed to multiple canteens.  
**Stakeholder:** Producing company (usual sub-contractor of caterer).  
**Responsibilities:** Transport, signing off quantities of packaging at delivery and pick-up.
- 3) **Usage:** Food is heated in the packaging. Depending on the format, food is either transferred to plates (for multi-portion trays) or served directly in reusable single-portion trays. The packaging remains within the canteen and is returned directly to the kitchen staff after the meal.

In the future, and outside the pilot, single-portion trays might leave the canteen when food is served in rooms e.g. bedridden consumers. In that case, nursery home staff will take care of the return of packaging to the canteen.

**Stakeholders:** Canteen staff and consumers.

**Responsibilities:** Rinsing packaging after use. Scanning full packaging arriving, scanning empty packaging leaving.

- 4) **Return:** Used packaging is emptied and stored in secondary containers without pre-washing. These containers are picked up daily for professional cleaning.

**Stakeholder:** Same as distribution.

**Responsibilities:** Same as distribution.

- 5) **Cleaning:** At the professional washing facility packaging is checked, if broken sorted out, and then washed. After washing the packaging is returned to Ausolan. Alternatively, setting up an in-house washing street might make financial sense for Ausolan due to the high volumes and daily returns of packaging.

**Stakeholder:** Professional cleaning facility (Eternity Systems).

**Responsibilities:** Scanning packaging on arrival, inspecting, cleaning, inspecting again, and sorting packaging for recycling.

### 4.3. Home care packaging

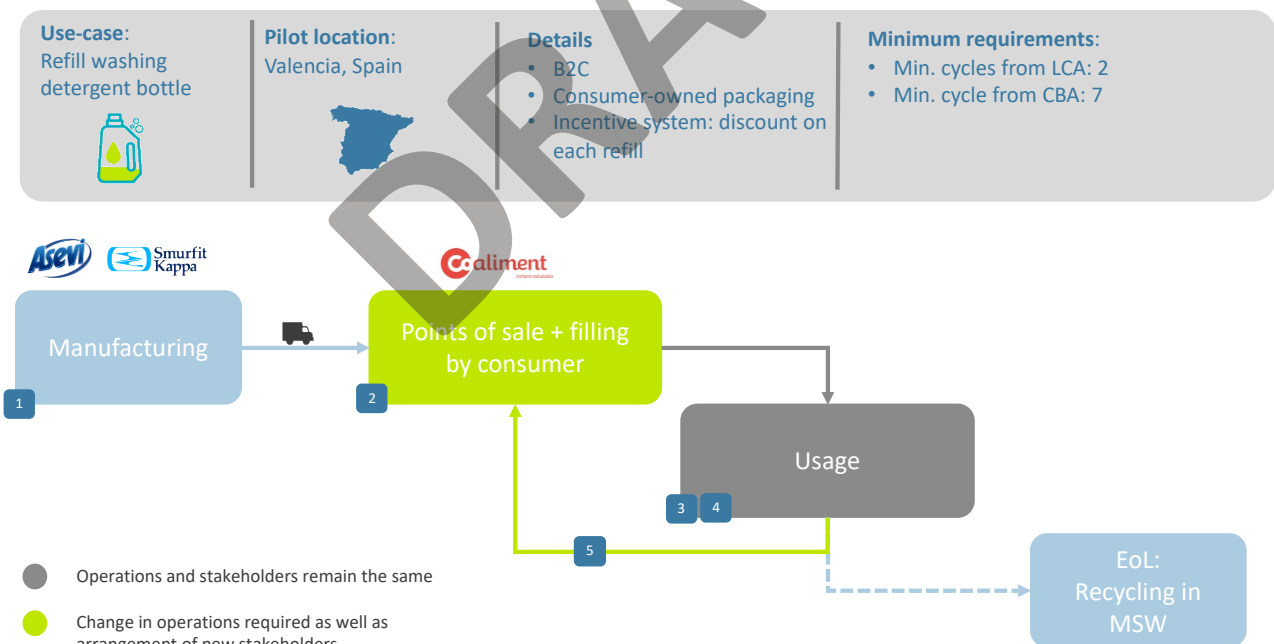


Image 7: Reverse logistics B2C home care packaging

- 1) **Distribution:** The detergent producer manufactures both the refillable rigid bottles as well as the detergent. Detergent is filled in (10 litre) Bag-in-Boxes (BiB). Empty refillable bottles and filled BiBs are delivered to supermarkets. There, the BiB is attached to an automated dispensing machine and empty bottles are placed on the shelf for consumers to access via self-service.

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**Stakeholder:** Detergent producer (Asevi), reusable bottle producer (Asevi), BiB producer (Smurfit Kappa).

**Responsibilities:** Manufacturing refillable bottles, filling BiB with detergent, and delivering to supermarkets.

- 2) **Filling:** Consumers purchase an empty bottle from the shelf and fill it at the dispensing machine.

**Stakeholder:** Consumer, supermarket staff, dispensing machine provider (Kellec).

**Responsibilities:** Staff must inform consumers on how to operate the dispensing machine. All staff must be educated to assist consumers when needed and to take care of cleaning and refilling the machine once bulk packaging is empty. The dispensing machine provider must conduct regular maintenance checks on the machine.

- 3) **Usage:** The full bottle is taken home by consumers and used until empty. Once empty, they can take their bottle to the store and refill it.

**Stakeholder:** Consumer.

**Responsibilities:** Refilling.

- 4) **Cleaning:** Between refills consumers rinse bottles at home. There is no professional cleaning necessary.


**Stakeholder:** Consumer.

**Responsibilities:** Clean at home (rinse).

- 5) **Return:** Consumers do not return the bottle, but keep the bottle after every refill. Once the consumer wants to have a new bottle, they discard their old bottle in the municipal solid waste where it will get filtered out and recycled.

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### 4.4. Take-away packaging

<p><b>Use-case:</b> Canteen packaging</p>	<p><b>Pilot location:</b> France</p> 	<p><b>Details</b></p> <ul style="list-style-type: none"> <li>• B2C</li> <li>• Pooling packaging</li> <li>• Secondary packaging: no</li> <li>• Incentive system: library</li> </ul>	<p><b>Minimum requirements:</b></p> <ul style="list-style-type: none"> <li>• Min. cycles from LCA: 17</li> <li>• Min. cycle from CBA: 28</li> </ul>
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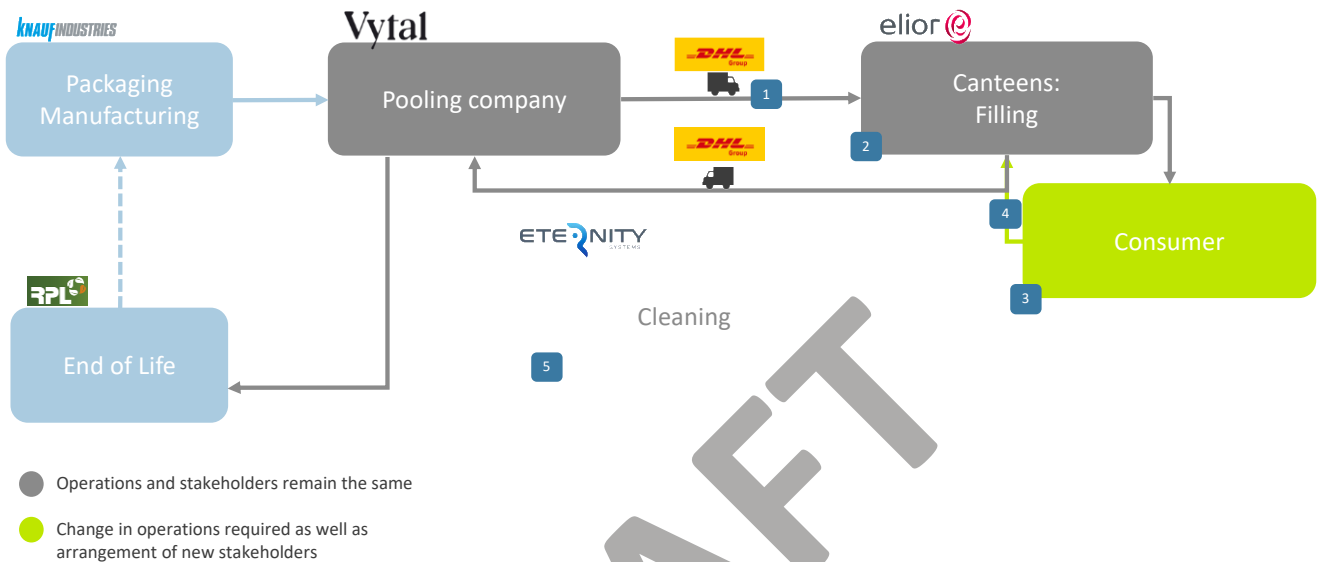


Image 8: Reverse logistics B2C take-away packaging

- 1) Distribution:** The packaging pooler delivers empty packaging to canteens and restaurants, tracking stock levels and automatically supplying new packaging or collecting excess packaging. This ensures that restaurants and canteens do not need to manage packaging inventory themselves.  
**Stakeholder:** Packaging pooler (Vytal).  
**Responsibilities:** Managing inventory, monitoring packaging, working on areas for improvement.
- 2) Filling:** When reusable packaging is selected by consumers, the take-away food is filled into the reusable packaging.  
**Stakeholders:** Consumers, canteen and restaurant staff.  
**Responsibilities:** Staff: filling packaging, explaining to consumers the concept of reusable packaging incl. instructions for downloading the app.  
 Consumers: downloading the app and sharing bank details for deposit.
- 3) Usage:** Consumers take the packaging with them. They can either take it home or consume it on the spot. Consumers eat out of packaging with or without heating.  
**Stakeholder:** Consumer.  
**Responsibilities:** Carefully handle packaging.
- 4) Return:** Packaging can be returned at any of the restaurants and canteens that use the pooling system. Packaging is returned at the cashier or via a return box. The box is emptied every evening by staff and the packaging is scanned and marked as returned in the system.  
**Stakeholder:** Staff, consumer.

**Responsibilities:** Staff: emptying return boxes and checking out every packaging individually for consumers to unlock their deposit. Staff washes packaging or prepares it for pick-up for external washing.



Consumers: must return packaging in time to unlock deposit. Return points can be identified via app.

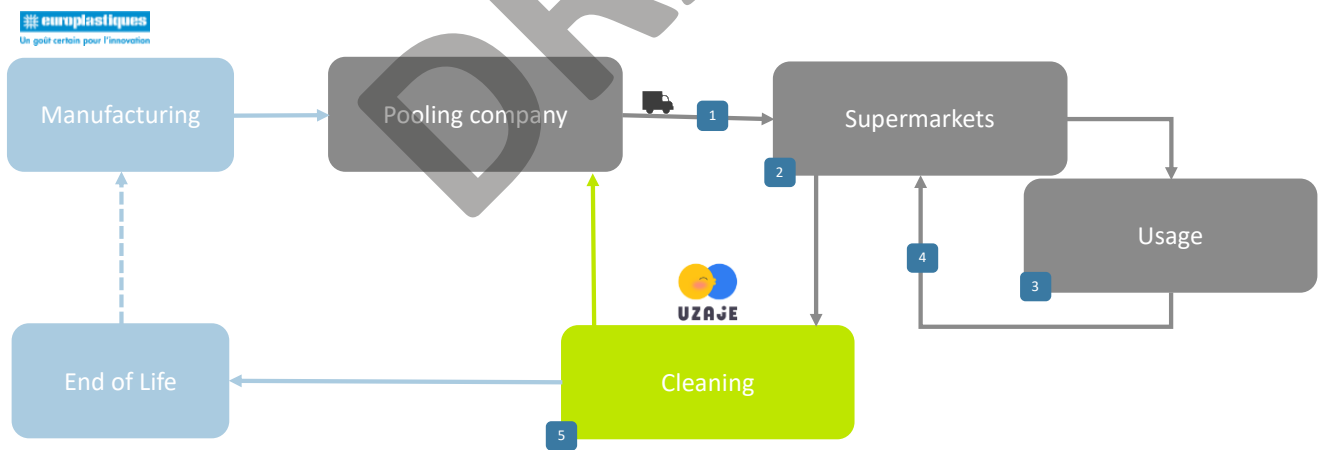
- 5) **Cleaning:** Depending on the return point, the packaging is cleaned in-house in restaurant kitchens or sent to professional washing facilities (highlighted in light green as an alternative option). The staff of restaurants or cleaning centres decide via visual inspection whether packaging cannot be reused anymore. Once packaging has reached its EoL (determined by the kitchen staff), it is collected in a separate bin. Once a minimum of 10 packages have been sorted out, Vytal picks it up and sends it to a recycler.

**Stakeholder:** Professional cleaning facility (Eternity Systems) or canteen/ restaurant kitchen staff.

**Responsibilities:** Scanning packaging on arrival, inspecting, cleaning, inspecting again, and sorting packaging for recycling.

### 4.5. Ready meal packaging

<p><b>Use-case:</b> Take-away supermarket packaging</p> 	<p><b>Pilot location:</b> France</p> 	<p><b>Details</b></p> <ul style="list-style-type: none"> <li>• B2C</li> <li>• Pooling packaging</li> <li>• Secondary packaging: yes</li> <li>• Incentive system: deposit</li> </ul>	<ul style="list-style-type: none"> <li>• Min. cycles from LCA: 11</li> <li>• Min. cycle from CBA: 20</li> </ul>
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- Operations and stakeholders remain the same
- Change in operations required as well as arrangement of new stakeholders

Image 9: Reverse logistics B2C ready-meal packaging

- 1) **Distribution:** Supermarkets rent reusable packaging from a packaging pooling company. Each month, supermarkets estimate their packaging needs and request the necessary stock, which is delivered by the packaging pooler.



**Stakeholders:** Supermarket staff / packaging pooling company.

**Responsibilities:** Managing inventory, monitoring packaging, identifying areas for improvement.

- 2) **Filling:** At the supermarkets, the packaging is (pre)filled at delicatessens with items such as salads, meat, or fish.  
**Stakeholder:** Supermarket staff.  
**Responsibilities:** Pack food under hygienic conditions, label food with best-before dates, and explain the reuse concept to consumers.
  
- 3) **Usage:** At the check-out, a deposit is paid for the reusable packaging. Packaging is taken home. The food can be either cold-stored or pre-heated as needed.  
**Stakeholder:** Consumer.  
**Responsibilities:** Choosing reusable packaging options, agreeing to pay a deposit, and handling packaging appropriately.
  
- 4) **Return:** Consumers return the packaging to the supermarket, either through a reverse vending machine (RVM) or directly at the fresh counter, depending on the store. Upon return, they receive a coupon, which can be redeemed as a shopping voucher or for cash at the cashier.  
**Stakeholder:** Consumer.  
**Responsibilities:** Pre-washing packaging at home, returning packaging to partner supermarkets, redeeming refunds.
  
- 5) **Cleaning:** Returned packaging is temporarily stored in secondary boxes, which are picked up and sent to professional washing facilities.  
**Stakeholder:** Professional cleaning facility (Eternity Systems).  
**Responsibilities:** Scanning packaging on arrival, inspecting, cleaning, inspecting again, and sorting packaging for recycling.

#### 4.6. End-of-Life Pathways for RPPs

The reference document for the management of the end-of-life (EoL) of packaging is the Packaging and Packaging Waste Regulation (PPWR)<sup>1</sup>. This regulation applies to any packaging waste, including reusable packaging, whether it is packaging intended for consumers or business activities (including the HORECA sector<sup>2</sup>). It is important to emphasize that reusable packaging and single-use packaging (SUPs) must therefore meet the same requirements with regard to their EoL.

However, an important distinction must be made: SUPs and RPPs are used in different contexts. While SUPs can be either household or business packaging, RPPs must, according to Article 3 of the PPWR, be placed on the market as part of a system for Reuse.

A system for re-use means organisational, technical or financial arrangements including deposit and return systems that ensure that packaging is collected for re-use. Consequently, RPPs are not owned by consumers, but always remain the responsibility of the businesses in charge of the system for Reuse.

<sup>1</sup> [https://environment.ec.europa.eu/topics/waste-and-recycling/packaging-waste\\_en](https://environment.ec.europa.eu/topics/waste-and-recycling/packaging-waste_en)

<sup>2</sup> Accommodation and Food Service Activities according to NACE Rev. 2 – Statistical classification of economic activities

Thus, RPPs are to be considered as packaging for business activities and will therefore follow the sorting and recycling practices in force for professional packaging, not for household packaging.

In BUDDIE-PACK a distinction must however be made for refillable bottles used in the case of a Refill system (ASEVI use case). In this case, the container is owned by the consumer and is consequently considered household packaging. As indicated in deliverable 4.1 there are two options. The “business as usual” option, where the packaging is collected together with the other household packaging waste. Option 2: a “take-back” scheme incentivizing the consumer to bring the packaging back to a collection point where it will be collected separately from other packaging waste. We will distinguish between these two types of collection systems as the quality of the recycling might significantly differ.

### **Current value chain for the EoL of plastic RPPs**

To date, there is no value chain specifically organized for the recycling of RPPs. RPPs must comply with the same requirements as SUPs. Even when they are separately collected, their recycling is not done in separation, mainly because volumes of RPPs put on the market remain too low to date. Consequently, RPPs may be mixed with other types of professional packaging, including non-food packaging. In other cases, food contact RPPs are sent to sorting centres where they are mixed with household waste streams. In both cases, mixing EoL RPPs with other waste potentially contaminates the waste stream and reduces its market value.

### **An opportunity to create high-quality waste streams**

Currently, reusable packaging (RPP) is primarily treated as standard packaging, meant to be collected and recycled through systems designed for single-use packaging. However, RPP offers a significant, yet underutilized, opportunity for higher-value recycling by being used within a Reuse system.

As outlined in deliverable D4.1, quality control occurs after cleaning in the Reuse cycle. At this stage, some packaging is discarded for recycling because it no longer meets quality standards. The resulting waste stream is clean (source-segregated), making it ideal for high-quality recycling. By keeping RPP separate from other packaging, this eliminates costly sorting steps and prevents cross-contamination. As a result, RPPs can be sent directly to recycling centres as a high-quality waste stream, provided the volume is sufficient. Additionally, maintaining separation ensures material traceability, builds trust within the value chain, and enhances the value of recycled materials.

### **RPPs: an opportunity for closed-loop recycling**

Regulation 2022/1616 allows recycling solutions within closed and controlled product loops to be considered compliant with food-contact recycling standards. This applies to all types of polymers. The requirements are: (i) waste streams must be chemically uncontaminated, (ii) materials must be made from a single polymer used under the same conditions, (iii) packaging must come from a closed and controlled product loop, and (iv) collection directly from consumers is excluded.

The RPPs of VYTAL canteen containers, AUSOLAN, and DAWN MEATS meet these criteria. According to Regulation 2022/1616, the resulting recycled materials could, in principle, be authorized for manufacturing new RPPs, provided they are used for the same purpose and under the same conditions as those in the recycling scheme.

**RPPs: a contribution to achieving the recycled content target of the PPWR**

The opportunity to recycle RPPs in a closed-loop scheme also enables their reintegration as recycled material in new food packaging. In this way, RPPs could contribute towards meeting the targets of Article 7 of the PPWR on Minimum recycled content in plastic packaging. By 2030, contact-sensitive packaging made from plastic materials other than PET will have to integrate 10% of recycled materials and 25% by 2040.

**RPPs: packaging addressing EPR sustainability criteria for lower financial contributions**

Article 45 of the PPWR stipulates that packaging producers must implement extended producer responsibility (EPR) in accordance with the requirements set out in Directive 2008/98/EC. The core purpose of EPR is to ensure that packaging waste is separately collected, sorted, and recycled within established infrastructure using proven processes in a controlled operational environment, thereby enabling recycling at scale. A key objective of EPR is to eliminate barriers within the internal market, create a level playing field for the industry, and promote packaging sustainability.

To facilitate and finance recycling value chains, EPR schemes impose fees on packaging producers, with eco-modulation applied to incentivize the use of more sustainable packaging. By 1 January 2028, the European Commission will adopt delegated acts to establish a framework for modulating financial contributions that producers must pay to comply with their EPR obligations. This modulation will be based on the sustainability of the packaging, including recyclability performance grades and reusability. Eco-modulation adjusts waste management fees according to the environmental impact of packaging, ensuring that more sustainable solutions are financially rewarded.

France has already implemented eco-modulation within its EPR scheme for packaging, offering reduced fees to producers that introduce reusable packaging. Similarly, high-value recycled materials from reusable plastic packaging (RPPs) will allow producers to benefit from both their reusability and high-quality recyclability. This will minimize EPR fees, creating a competitive advantage over single-use packaging (SUPs) and further incentivizing the transition towards more sustainable packaging solutions.

**Applications to the BUDDIE-PACK use cases**

Based on the value creation opportunities identified above, recommendations are made for each BUDDIE-PACK use case to modify sorting and recycling value chains and enhance the economic value of RPPs at their end of life.

**VYTAL – Canteen container (PBT) with lid (PP)**

Packaging type: Professional - HORECA

System for Reuse: Yes

Recommendation to improve the collection of EoL RPPs: EoL RPPs must be collected separately and kept separate from any other waste until recycling. PBT containers and PP lids must be collected separately and constitute two different waste streams.

Closed and controlled chain: Yes. The RPPs are used e.g. in canteens. RPPs do not leave the premises where they are used and remain under constant control of trained staff.

Recycling: PBT containers and PP lids can theoretically be recycled in closed loop (provided that the requirements for a closed and controlled chain can be demonstrated to the EFSA

with enough substantiated data: the other option would be a recycling of the same quality as the takeaway containers – see below).

#### **VYTAL – Takeaway container (PBT) with lid (PP)**

Packaging type: Professional - HORECA

System for Reuse: Yes

Recommendation to improve collection of EoL RPPs: EoL RPPs must be collected separately and be kept separate from any other waste until recycling. PBT containers and PP lids must be collected separately and constitute two different waste streams.

Closed and controlled chain: No. The RPPs leave the premises of the takeaway, and as such are considered to be collected from consumers.

Recycling: Closed-loop recycling is not possible. However, due to the purity of the waste stream, PBT containers and PP lids can be recycled into recycled materials of reliable, stable and high properties, which automatically significantly increases their economic value. rPBT can be used e.g. in technical applications in the electric & electronic sectors. rPP can be used e.g. for non-food contact packaging, automotive, and sports applications.

#### **AUSOLAN – Single portion catering trays (PBT) with lid (PP)**

Packaging type: Professional - HORECA

System for Reuse: Yes

Recommendation to improve the collection of EoL RPPs: EoL RPPs must be collected separately and kept separate from any other waste until recycling. PBT containers and PP lids must be collected separately and constitute two different waste streams.

Closed and controlled chain: No. Especially when used in nursing homes, there is a risk that when the trays are given out to the end-consumers, they might be contaminated with chemicals (e.g. medication). As such it must be considered that RPPs are collected from consumers and do not comply with the “controlled chain” requirements.

Recycling: Closed-loop recycling is not possible. However, due to the purity of the waste stream, PBT containers and PP lids can be recycled into recycled materials of reliable, stable and high properties, which automatically increases their economic value. rPBT can be used e.g. in technical applications in the electric & electronic sectors. rPP can be used e.g. for non-food contact packaging, automotive, and sports applications.

#### **AUSOLAN – Multi-portion catering trays (cPET) with lid (cPET)**

Packaging type: Professional - HORECA

System for Reuse: Yes

Recommendation to improve the collection of EoL RPPs: EoL RPPs must be collected separately and kept separate from any other waste until recycling. cPET containers and

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lids can be collected together. It must be noted that mixing opaque black cPET into the mixed household waste stream may disturb the existing recycling streams for PET trays. cPET trays might be wrongly identified in sorting and recycling centres as standard PET. Following Recyclclass guidelines, cPET has low compatibility with PET.

Closed and controlled chain: Yes. Food from multi-portion trays is transferred onto plates prior to being served. Consequently, multi-portion trays remain under the supervision of trained staff and are not contaminated by other products.

Recycling: cPET containers and lids can theoretically be recycled in a closed loop (provided that the requirements for a closed and controlled chain can be demonstrated to the EFSA with enough substantiated data).

#### DAWN MEATS – Meat reusable trays (PETg) with high-barrier PE-based lidding film

Packaging type: Professional

System for Reuse: Yes

Recommendation to improve the collection of EoL RPPs: EoL RPPs must be collected separately and kept separate from any other waste until recycling. It must be noted that mixing opaque white PETg into the mixed household waste stream may disturb the existing recycling streams for PET trays. PETg might be wrongly identified in sorting and recycling centres as standard PET. Following Recyclclass guidelines, PETg has low compatibility with PET.

Closed and controlled chain: Yes. Trays are used in B2B. Once packed, the meat is transported to distribution centres, which then supply it to various restaurants and large kitchens. The trays are promptly rinsed and stored in grouped (secondary) packaging containers that prevent cross-contamination in the kitchen environment. These containers are regularly collected by a specialised cleaning service. In those conditions, the meat trays can be considered as being part of a closed and controlled chain.

Recycling: PETg containers can theoretically be recycled in a closed loop (provided that the requirements for a closed and controlled chain can be demonstrated to the EFSA with enough substantiated data).

#### ASEVI – Refillable bottles (PE)

Packaging type: Household

System for Reuse: No

Recommendation to improve collection of EoL RPPs: In the current situation refillable bottles would be collected through the household waste stream (municipal waste stream) and recycled with other PE rigid containers. Despite the design for recyclability carried out in BUDDIE-PACK (white colour, no inks, stickers, sleeves), the resulting recycled materials would be plastics with properties only able to comply with applications of lower value. Incentivizing a 'take-back scheme' would facilitate closed-loop recycling. Here the bottles are used for detergents and therefore do not have to comply with Regulation 2022/1616.

A ‘take-back scheme’ would enable the creation of a stream solely composed of refillable PE bottles, and as such of high purity. However, attention must be paid to the potential misuse of PE bottles by consumers such as using for products other than detergents. This may prevent high-quality recycling.

Closed and controlled chain: No. Refillable bottles are collected from consumers.

Recycling: PE refillable bottles collected separately will constitute a stream of high purity with the potential of producing high-quality recycled PE, i.e. able to be reprocessed for similar applications (i.e. detergents) as virgin materials.

**In conclusion**, custom sorting after the cleaning stage to create pure and uncontaminated waste streams should be a general recommendation for all types of RPP. This best practice enables high-quality recycling and enhances the value of the resulting materials, even if compliance with food contact regulations is not always achievable through closed and controlled chains.

A SWOT analysis of value chains modified following previous recommendations to achieve greater value of RPPs is proposed:

Strengths	Weaknesses
<ul style="list-style-type: none"> <li>Collected waste streams do not need to be sent to sorting centres, they can be shipped directly to recycling centres.</li> <li>Traceability of the waste streams and the recycled materials.</li> <li>High-quality recycling is enabled in certain cases through closed-loop recycling.</li> <li>Added economic value due to high-quality recycling, pure streams, reliable properties, and traceability.</li> </ul>	<ul style="list-style-type: none"> <li>The modified value chain requires specific logistics to collect and ship waste to recycling centres.</li> <li>During the transition period, RPP waste streams will be of low quantities, putting strain on the economic performance of the collection and recycling schemes.</li> </ul>
Opportunities	Threats
<ul style="list-style-type: none"> <li>Regulation 2022/1616 enables the recycling of RPPs as a suitable technology for food contact, provided that the recycling process occurs within product loops that operate in a closed and controlled chain.</li> <li>PPWR 2030 recycled content targets in contact-sensitive packaging other than PET.</li> <li>Reduce EPR financial contributions for recyclable RPPs.</li> </ul>	<ul style="list-style-type: none"> <li>Difficulties in demonstrating EFSA compliance with recycling in a closed and controlled chain (Regulation 2022/1616).</li> </ul>

Table 5: SWOT analysis of recycling solutions RPPs

## 4.7. The role of social economy organisations

The Social and Solidarity Economy (SSE) prioritizes social and environmental goals over profit maximization. It includes a range of organizations and enterprises focused on social inclusion, equity, and sustainable development. These include cooperatives, fair trade organizations, non-profits, and social enterprises, all guided by principles of solidarity, democratic governance, and collective ownership.

### SSE structures to enable plastic recycling

Most common SSE structures are non-profit associations. In the plastics recycling sector, many focus on sorting, repairing, or dismantling end-of-life products (e.g., Emmaüs, Envie) but rarely engage in grinding, a crucial step for producing high-quality recyclates. Grinding is commonly performed at industrial level and does not include manual labour. An exception is [TRIVEO](#), which is a for-profit company in the SSE sector, offering high-quality grinding services in recycling. Triveo provided this report with relevant information on the opportunities of SSE organisations for reusable packaging for sustainable EoL solutions.

TRIVEO provides high-quality industrial recycling by collaborating with competing companies to dismantle and grind plastic products that would otherwise end up in landfills. This work ensures a sustainable end-of-life solution for complex plastic waste. TRIVEO operates five grinding lines and can manually separate parts made from different materials or plastic grades, processing 115 tons of plastic annually. To maintain quality, incoming materials must be sorted and cleaned:

- **“Sorted”**: Each container must contain only one thermoplastic grade, or for assembled parts, only the same product type.
- **“Cleaned”**: Free from contaminants such as oil, food residues, or chemicals. Materials can be packaged in plastic, metal, or cardboard containers, on pallets, in big bags, or skips.

TRIVEO offers a pathway to employment for individuals in rehabilitation. For this, TRIVEO partners with AIRE, a rehabilitation association that supports individuals in returning to work, including in plastics recycling. Each year, AIRE employs over 25 people in these activities, with 30% securing high-skilled jobs or training afterwards. During their time at TRIVEO, individuals receive social support and various training, including plastics recognition. In some cases, TRIVEO offers permanent contracts to fully reintegrate individuals.

### Enabling recycling of smaller volume batches and special materials

TRIVEO's unique cost structure allows it to recycle plastic products that are not financially viable for larger companies. Labour costs are reduced through government aid for rehabilitation associations, and TRIVEO relies on recycling partners for accounting, HR, and sales. These savings make it possible to recycle smaller volume batches efficiently. The availability of a flexible workforce further supports the processing of smaller quantities. To obtain better prices for small quantities, TRIVEO often stores materials to consolidate volumes before grinding.

### Supporting recyclability of reusable packaging (RPP)

The recyclability of RPPs enhances their sustainability. Due to the smaller quantities and use of innovative materials (e.g., Tritan), recycling of reusables can be costly. Companies like TRIVEO are key by offering solutions for recycling small quantities and speciality plastics.

Some recommendations to improve RPP recycling include:

- **Standardization of materials:** Use consistent materials to increase volumes and avoid diversifying plastic grades.
- **Avoid adding additional material elements:** Due to the low weight of RPPs, adding materials like labels, RFID chips, inserts, bi-injection, or multilayers should be avoided, as manual separation would be economically unfeasible. Large volumes would be necessary to justify the investment in specialized equipment.

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## 4.8. Scalability of Buddie-Pack use cases

This chapter looks into the scaling potential of the reusable packaging use cases, examining both the market opportunities they present and the critical factors required to achieve widespread adoption. It goes beyond surface-level insights to explore the broader conditions — economic, logistical, technological, and cultural — that influence scalability. This chapter aims to provide a comprehensive roadmap for unlocking the full potential of the Buddie Pack reusable packaging applications.

Key areas of focus include:

- **Market potential:** Identifying the industries and segments where reusable packaging can create the most impact, considering factors such as consumer demand and operational feasibility.
- **Scalability enablers:** Aspects like infrastructure, partnerships, technological innovations necessary, and policies to support scaling efforts.
- **Systemic challenges:** Addressing the limitations and risks associated with scaling, such as consumer behaviour and costs.

For more information read *D4.4 Recommendations for replicability factors and drivers for the 6 packaging categories*.

### Reusable meat-skin packaging (B2B)

#### Market potential:

- Fast-food chains, in particular, present a significant market for reusable meat-skin packaging where meat products are used in high volumes. This enables short retention times which can greatly support the business case for reusable packaging.
- Generally, the B2B meat wholesale market has high potential for the uptake of reusable meat-skin packaging.
- The US market, with its high meat consumption, presents significant scaling potential, in addition to the European market.
- The developed tray is also suitable for other food applications such as the fresh fish market.
- The format could also be used in the B2C market, although a shorter lifetime is predicted as the appearance of the packaging will play a larger role, meaning packaging will be phased out earlier due to cosmetic damage.

#### Scalability enablers:

- Existing distribution networks for meat products can be leveraged for the return and redistribution of reusable packaging.
- A digital platform and traceability according to common standards, as in PR3 (the Global Alliance to Advance Reuse), will create efficiencies in logistics, costs and return rates.
- A sound cleaning protocol will allow seamless handling of fresh meat products and a smart tracking system for quality control of packaging.
- Standardized solutions for reusable packaging across similar applications will facilitate uptake by users, through easy recognition and participation.

#### Systemic challenges:

Costs:

- In D4.1. reusable meat-skin packaging was not able to compete with the price of single-use meat-skin packaging, partially due to high cleaning costs. Economies of scale could help to drive down cleaning prices. It helps, that companies such as Dawn Meats serve a big market such as fast-food restaurants, which indeed could lever economy of scale for reusable meat-skin packaging.

- Ecomodulation fee for reusable packaging should be adopted in national EPR schemes to create financial incentives in the market for reusable packaging.

#### Behavioural change:

- Kitchen staff require training to understand how to properly handle reusable packaging. Visual step-by-step instructions in kitchens are useful. To ensure compliance, this needs to be as convenient and as simple as possible.

### Refill detergent packaging (B2C)

#### Market potential:

- EU legislation prescribes “from 1 January 2030, final distributors with a sales area of more than 400 m<sup>2</sup> are encouraged to dedicate 10% of that sales area to Refill stations for both food and non-food products” (PPWR).
- The format holds lots of opportunities to be used for other product homecare applications such as fabric softener and non-aggressive cleaning supplies.
- Partnering with retail chains enables larger rollouts. Furthermore, partnering with other home-care brands for multi-brand Refill stations with shared packaging allows scaling beyond own product range.

#### Scalability enablers:

- There are also opportunities to tackle the online market for pre-filled bottles for doorstep delivery.
- To avoid even more packaging, the bulk packaging (BiB) can also be designed to be reusable/refillable.
- In collaboration with dispensing machine providers, large-volume Refill canisters can be attached to the back-end of machines. This would allow larger volumes and avoid lifting by staff, which is legally restricted in many EU countries, commonly between 15kg for females and 25kg for men.
- Explore opportunities for taking back packaging at EoL for source-segregated waste. This can be facilitated through collection via manual collection or reverse vending machines in retail stores. This makes particular sense in regions where RVMs for return of packaging are common, as consumers understand and accept the concept of deposits and packaging return. Returns should only be enabled after x amount of Reuse cycles to optimise sustainability.
- Standardized solutions for reusable packaging across similar applications will facilitate uptake by users, through easy recognition and participation.
- A digital platform and traceability according to common standards, as in PR3, will create efficiencies in logistics, costs and return rates.

#### Systemic challenges:

##### Costs:

- Costs for setting up Refill infrastructure with automated dispensing machines make better financial sense on a large scale. This means small-scale rollouts will be challenging to finance.
- Single-use pricing of packaging will need to be charged a higher ecomodulation fee, to create financial incentives in the market for reusable packaging.

##### Behavioural change:

- Explore whether in-store Refill or Prefill works better and adjust to the consumer preferences.
- Communicate about easy, safe and leak-free / drip-free Refills, including visual marketing or demonstrations of successful implementation.
- Make Reuse the standard, for a multitude of brands. Remove the single-use option or make it more expensive.
- Clear communication and engaging marketing is essential, like in any product launch.

### Reusable catering packaging (B2B)

#### Market potential:

- Countries with the most elderly homes in Europe are Germany, Belgium, France, Italy, and The Netherlands, making them interesting locations for the larger roll-out of reusable plastic catering trays (Statista, 2025).
- Furthermore, there is huge potential for other canteen settings that order multi-portion meals from office complexes to school- and university canteens.
- Within Buddie-Pack the catering packaging is established as a brand-owned packaging. However, there might also be a business case for catering companies to pool packaging, reducing upfront investments for caterers.

#### Scalability enablers:

- Within Buddie-Pack dirty packaging is picked up at canteens and sent to professional cleaning facilities. However, most catering companies already have professional cleaning lines on-site, which would allow them to clean packaging in-house saving external cleaning costs.
- Standardized solutions for reusable packaging across similar applications will facilitate uptake by users, through easy recognition and participation.
- A digital platform and traceability according to common standards, as in PR3, will create efficiencies in logistics, costs and return rates.

#### Systemic challenges:

##### Costs:

- Single-use pricing of packaging will need to be charged a higher ecomodulation fee, to create financial incentives in the market for reusable packaging.

##### Behavioural change:

- There are minimal friction points for staff when handling packaging, which is beneficial for scalability. Their involvement is mainly limited to scanning reusable packaging in and out — a simple task that, while additional, can be easily integrated into their routine with practice.

### Reusable take-away packaging (B2C)

#### Market potential:

- The take-away food market is growing rapidly (global CGAR 4% for take-away containers) with an increasing consumer preference for sustainable packaging solutions (Outlook Planet Desk, 2024).
- Urban areas are most suitable due to the high density of take-out restaurants and therefore short return routes.
- Partnerships with delivery services.
- Partnership with supermarkets for self-service salad bars.

#### Scalability enablers:

- Extending public infrastructure to return options via public smart bins can ease the return process.
- Shared collection, logistics and cleaning facilities will create efficiencies and reduce costs. Same goes for a digital platform and traceability according to common standards, as in PR3.
- Partnerships with retailers to enable returns via manual collection or RVMs in-store.
- Standardized solutions for reusable packaging across similar applications will facilitate uptake by users, through easy recognition and participation.
- Clear communication about system and incentivizing scheme will help to boost uptake and return rates.

#### Systemic challenges:

**Costs:**

- Single-use pricing of packaging will need to be charged a higher ecomodulation fee, to create financial incentives in the market for reusable packaging.

**Behavioural change:**

- Staff engagement in actively promoting reusable packaging options in-store is a key success factor in scaling the use of reusables.
- Food services should offer take-away only in reusable packaging to steer consumer behaviour.
- Clear communication and engaging marketing is essential, like in any product launch.

**Reusable ready meal packaging (B2C)****Market opportunities:**

- Opportunity for to-go supermarkets that offer ready meals to switch to reusable packaging. Due to their strategically smart locations in city centres or train stations, consumers can easily return packaging at the same location/in-store.
- Both supermarkets with fresh counters and the producers of ready meals can adopt reusable packaging, covering a wide range of retail outlets and products.
- The packaging can serve a wide range of food applications, from pre-cooked meals to fresh foods.

**Scalability enablers:**

- Return options through existing manual collection or RVMs in supermarkets.
- Shared collection, logistics and cleaning facilities will create efficiencies and reduce costs. Same goes for a digital platform and traceability according to common standards, as in PR3.
- Encompassing waste fees of single-use packaging.
- Seamless integration with existing concepts like self-service salad bars.
- Standardized solutions for reusable packaging across similar applications will facilitate uptake by users, through easy recognition and participation.
- Clear communication about system and incentivizing scheme will help to boost uptake and return rates.

**Systemic challenges:****Costs:**

- Depending on the product, sealability with single-use film (e.g. for fresh fish and meat) should be considered. This would require further packaging development.
- Single-use pricing of packaging will need to be charged a higher ecomodulation fee, to create financial incentives in the market for reusable packaging.

**Behavioural change:**

- Staff need to adapt to handle returns of packaging: educate through training programs to facilitate understanding and acceptance of change. Include protocols in cleaning manuals.
- Clear communication and engaging marketing is essential, like in any product launch.

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