

R3PACK

REDUCE, REUSE, RETHINK PACKAGING

D7.2 R3PACK Business Plan

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TABLE OF CONTENTS

EXECUTIVE SUMMARY.....4

1- MARKET ANALYSIS.....6

2 - PART A / REUSE

 I / VALUE CHAIN20

 II / BUSINESS MODELS30

 III / RISK ASSESSMENT & MITIGATION35

3- PART B / SUBSTITUTION

 I / VALUE CHAIN42

 II / BUSINESS MODELS50

 III / RISK ASSESSMENT & MITIGATION54

4- ROADMAP59

CONCLUSION63

EXECUTIVE SUMMARY

Each EU citizen generates over 36.1 kg of plastic packaging waste per year*, making packaging a key lever for reducing environmental impacts and advancing circular economy objectives in Europe. R3PACK (“Reduce, Reuse, Rethink PACKaging”) addresses this challenge through two complementary approaches:

- **Reuse**, by developing return, washing and redistribution loops for standardised reusable packaging;
- **Substitution**, by exploring alternatives to complex plastic formats through recyclable, fibre-based packaging solutions.

This deliverable (D7.2) presents a **business and exploitation framing** of the R3PACK project results. It does not aim to provide an investment-ready business plan, but rather to assess the conditions under which the solutions explored within the project could be further developed, scaled up and replicated at European level. The analysis reflects the actual maturity of the solutions and is grounded in the practical experience generated during the project.

D7.2 builds primarily on the outcomes of the demonstration and validation activities conducted under WP5, as well as on the decision-support framework developed in D5.3. It also draws on external references, including publicly available market data and institutional sources such as ADEME, to contextualise the findings and inform the exploitation perspectives.

The **analysis confirms a growing interest across the value chain** for both reusable packaging systems and fibre-based substitution solutions, driven by regulatory developments and environmental objectives. However, the two approaches present different levels of maturity and face distinct deployment challenges.

For **reuse**, R3PACK demonstrates that implementation in real retail conditions is feasible and compatible with existing industrial and distribution structures. The main barriers relate to economic competitiveness with single-use packaging, requiring higher volumes, shared logistics and washing infrastructures, interoperable information systems and clearer governance frameworks to enable large-scale deployment.

For **substitution**, the project highlights tangible technical progress for certain product categories, particularly dry and semi-dry foods, while confirming that current fibre-based solutions are not yet competitive at scale. Higher material costs, reduced packaging speeds and remaining performance limitations continue to constrain short-term market uptake.

Overall, D7.2 shows that R3PACK has primarily contributed to clarifying feasibility conditions and reducing uncertainty around innovation pathways. The project provides a structured basis to support informed decision-making by industrial actors, policymakers and other stakeholders involved in the transition towards more circular packaging systems.

Structure and key learnings of the deliverable

This deliverable follows a progressive structure, moving from market context to exploitation perspectives, and reflects the different maturity levels of reuse and substitution solutions explored within R3PACK.

Market analysis

This section sets the context by reviewing market trends, regulatory drivers and external references, including publicly available data and institutional sources such as ADEME.

Key learning: Market interest in circular packaging solutions is growing, but adoption remains strongly constrained by cost competitiveness, industrial readiness and regulatory clarity.

Reuse – value chain, business models and risks

This part analyses the reuse value chain, from packaging design and filling to return, washing and redistribution, based on the operational experience gained during the R3PACK demonstrations. It also examines the associated business models and identifies the main risks and mitigation levers.

Key learning: Reuse is operationally feasible, but economic viability depends on massification, pooled logistics and washing infrastructures, interoperable IT systems and coordinated governance.

Substitution – value chain, business models and risks

This part focuses on fibre-based substitution solutions, analysing their value chain, economic implications and associated risks, based on industrial trials and technical validations carried out within the project.

Key learning: Substitution shows promising technical progress for selected product categories, but current solutions remain costly and not yet competitive at scale.

Roadmap and exploitation perspectives

This section outlines possible development, scale-up and replication pathways beyond the project timeframe, taking into account technical, economic and regulatory constraints.

Key learning: There is no single deployment trajectory; reuse and substitution require differentiated, category-specific pathways.

Conclusion

The conclusion synthesises the main findings and positions R3PACK as a project that has reduced uncertainty around circular packaging pathways rather than delivered ready-to-market solutions.

Key learning: The main value of R3PACK lies in supporting informed decision-making for future investments and policy choices.

1 - MARKET ANALYSIS

REGULATORY CONTEXT

The entry into force of the Packaging and Packaging Waste Regulation (PPWR) on **11 February 2025**, with application starting from **12 August 2026**, marks a decisive step in the European transition toward a circular packaging economy. Replacing the former Directive 94/62/EC, the PPWR sets binding and harmonised targets across all Member States. Combined with **the Single-Use Plastics Directive (EU) 2019/904** and the **French AGECE Law (Loi Anti-Gaspillage pour une Économie Circulaire, 2020)**, it establishes a comprehensive regulatory framework aimed at reducing single-use plastics, increasing reuse, and introducing large-scale recycling obligations by 2035.

Key Quantitative Objectives and Legal Framework:

- **2020 – National Ban and Plastic Reduction (Loi AGECE)**
France's *Loi n° 2020-105 du 10 février 2020*, supported by its *implementing decree n° 2021-517 of April 29, 2021*, sets a **20% reduction target for single-use plastic packaging by 2025** compared to 2018, with **10% of this reduction achieved through reuse**. It initiates a progressive **shift from single-use plastics to reusable or alternative materials** offering equivalent environmental performance.
- **2025 – Harmonised European Framework (PPWR)**
The *Packaging and Packaging Waste Regulation (EU) 2024/1781* replaces Directive 94/62/EC. It establishes **binding reuse obligations** and allows **plastic substitution** only when alternatives such as paper or cardboard are **recyclable at scale and environmentally justified**. Reuse and prevention take precedence over material switching.
- **2027 – First Reuse Milestone (AGECE Decree 2022-507)**
Producers and distributors must ensure that **at least 10% of packaging placed on the market is reusable**, marking the first operational step toward large-scale reuse systems in France. This obligation is progressive and depends on company size, with larger operators required to comply first.
- **2030 – EU Reuse and Substitution Standards (PPWR)**
By 2030, the PPWR requires **10% of beverage packaging** to be **reusable** and all packaging to meet **design-for-reuse and recyclability criteria**. Substitution from plastic to paper is valid only if it **reduces overall environmental impact**.
- **2040 – Full Transition Objective (PPWR and Loi AGECE)**
The PPWR sets EU-wide targets for **40% reusable beverage packaging** and a **15% reduction in packaging waste per capita** by 2040, reinforcing Europe's circular economy ambition.
In parallel, France's **Loi AGECE** aims to **phase out single-use plastic packaging by 2040**, establishing a complementary national trajectory aligned with EU objectives.

Strategic Implications for R3PACK:

These targets provide both **regulatory pressure and market opportunity** for circular packaging. R3PACK's focus on **fibre-based substitution** and **scalable reuse** models directly supports the achievement of these European milestones, positioning the consortium's innovations as key enablers of compliance and competitiveness within the EU's 2040 sustainability framework.

TRANSITION PATHWAYS IN PACKAGING

Packaging represents nearly **40 % of total plastic consumption in Europe***, amounting to more than **20 million tonnes of plastic used each year***. Most of this is designed for **single use**, and despite improvements in collection and sorting, **less than half of plastic packaging waste is effectively recycled**, while the rest is landfilled, incinerated, or leaks into the environment. This heavy dependence on fossil-based, disposable materials contributes to **greenhouse gas emissions, resource depletion, and marine pollution**, while exposing industries to increasing **regulatory and supply risks**.

To address this, two complementary solutions are emerging. The first is **reuse**, which extends the lifespan of packaging through multiple use cycles, supported by systems for collection, washing, and redistribution. The second is **substitution**, which replaces non-recyclable or multi-layer plastic packaging with **cellulosic (fibre-based) alternatives** that are recyclable and compliant with food safety standards.

Both approaches directly support the objectives of the **EU Packaging and Packaging Waste Regulation (PPWR)** and reinforce broader **market trends towards circularity and resource efficiency**. Reuse limits material demand and waste generation, while substitution provides an immediate, lower-impact alternative for categories not yet suited to reuse. Together, they form the two main pillars of the shift away from single-use plastic packaging.



#massification #foodsafety
#standards #washing



#plasticfree #fibre
#functionalization #innovation

MARKET TRENDS

The packaging industry in Europe is experiencing a profound transformation driven by consumer expectations, regulatory pressure, and corporate sustainability commitments. These dynamics are creating both opportunities and challenges for the adoption of reusable and fibre-based packaging solutions.

Consumer demand for sustainability is steadily increasing. Recent surveys indicate that 24% spontaneously mention reuse as a lever for more sustainable consumption*. Furthermore, 17% state that reusable packaging would actively encourage them to purchase a product*. These figures demonstrate both a strong demand for systemic change and a readiness to adapt purchasing habits, provided the solutions remain convenient, affordable, and transparent. **Acceptance levels vary across product categories.** For **reuse**, consumers respond positively to disruptive packaging formats for dry goods (e.g. snacks, biscuits), where the concept of reuse is visible. In contrast, for certain everyday liquid products such as oils or syrups, the shift remains less perceptible and not yet embedded in consumer habits. However, the beverage sector stands as an exception: in Europe, reuse systems for drinks are historically well established and remain the most recognised and accepted by consumers. For **substitution**, consumers respond positively to dry goods (e.g. chips, savoury and sweet biscuits) as well as unprepared fruit and vegetables. However, the paper material is less favourably regarded for liquid or semi-liquid products (e.g. soup, milk, juice, yoghurt) as it is considered by consumers as more fragile, with a higher risk of leaks or damage to the packaging. It should also be mentioned that consumers are demanding transparency in fresh goods packaging (salad, grated carrots, grated cheese etc.), to ensure freshness and product quality, with a minimum requirement for a transparent window.

Corporate commitments are accelerating the transition. Several multinational food and beverage companies have joined or launched initiatives to reduce plastic waste and integrate reuse models:

- **R3PACK (EU Horizon Europe project)** – brings together around 20 partners including Carrefour, Cooperative U, and major food manufacturers, testing reusable packaging loops and fibre-based alternatives.
- **Loop (operated by TerraCycle)** – piloted with Carrefour in France, Tesco in the UK, and Carrefour in Belgium, providing consumers with reusable versions of branded products.
- **Reuse in France (Citeo, French eco-organisation)** – supported by manufacturers and retailers to accelerate the standardisation of reusable packaging and develop regional washing/collection infrastructure.
- **Mehrweg initiatives in Germany** – with beverage and dairy producers, where deposit-refund systems are well established and provide valuable insights for scaling reuse in other EU countries.
- **European Brands Association (AIM)'s HolyGrail 2.0 project** – although focused on recyclability, it shows how industry-wide collaborations can set standards, which could be replicated for reuse.

These voluntary commitments often go beyond regulatory requirements and act as a market pull for innovative packaging solutions. Retailers in particular are experimenting with deposit-return systems, refill models, and dedicated shelf space for reusable products, gradually familiarising consumers with new habits.

Economic drivers are also reshaping the market. The cost of virgin plastics is expected to rise further due to eco-modulation of EPR fees and environmental taxation, while fibre-based materials are gradually becoming more competitive thanks to economies of scale and technological improvements. However, **at present fibre-based alternatives remain significantly more expensive** than conventional food packaging, making it difficult for companies to move beyond pilot testing into large-scale demonstrations. Similarly, **reuse remains more expensive** today due to **higher production cost** than single-use and **extra loop-related costs**. However, these reuse economic challenges could be overcome in the long term thanks to **higher volumes, investment in production and washing lines** and significant **increase in consumer adoption**

Innovation and industrial adaptation are at the core of current trends. Packaging manufacturers and machine producers are investing in R&D to ensure machinability of paper-based materials on existing industrial lines and of standardised reusable formats. Washing companies are also developing new protocols to guarantee high washing performance for plastic packaging.

Finally, the market remains highly **fragmented and characterized by ongoing experimentation**. Many pilot projects are currently running at national or regional level across Europe, supported by Horizon Europe, national innovation funds, or EPR organizations. This diversity of initiatives demonstrates the strong momentum but also underlines the need for harmonisation, standardisation, and cross-sectoral collaboration to scale solutions effectively.

Overall, the trend is rising : the packaging market in Europe is moving away from single-use plastics and towards **circular, resilient, and consumer-centric packaging systems**, where R3PACK innovations can play a decisive role.

BARRIERS	DRIVERS
High initial costs and low margins	Strong EU and national regulation (PPWR, AGECA), rising EPR fees and plastic taxes
Difficulty in translating this growing interest into tangible changes in consumption behaviour	Growing consumer interest for sustainable packaging
Lack of harmonised standards and infrastructure	Corporate and retailer commitments to circularity
Slow industrial adaptation and complex logistics, and need for R&D in practical solutions	Technological progress in fibre and reuse systems

Table 1: Main barriers and drivers transitioning towards reuse and substitution

MARKET POTENTIAL FOR REUSE

This part of the report present quantitative insights into the market potential of reuse for selected R3PACK product.

First, the analysis includes the **current market shares of R3PACK manufacturer partners in the European market**, which provide a baseline for assessing the relevance and scalability of reuse schemes.

Second, projections from the French Environment and Energy Management Agency (**ADEME**, “potentiels de réemploi”) are used to estimate the **expected share of sales in reuse by 2027 and 2040**, highlighting the medium and long-term potential across the EU.

Finally, based on R3PACK pilots, the **observed share of sales in reuse vs. single-use in 2025** will be presented.

R3PACK’s share appears **higher than ADEME’s projections**, which can be explained by several factors:

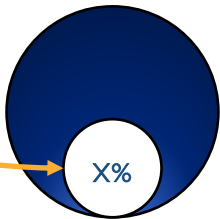
- I. the small-scale nature of the experiment,
- II. the possibility that a large proportion of consumers who purchased reusable products were unaware that they were reusable products, and
- III. The fact that the observation period was limited to specific months (Sept–Nov 2024, Feb 2025, and Apr–May 2025). Data from other periods were excluded because of missing reference data on single-use sales.

These limitations call for a cautious interpretation of the results.

GRAPH LEGEND

R3PACK’s manufacturer’s turnover / European market’s turnover for this category (source: Statista)

MARKET SIZE



Market share of the manufacturer in Europe (in terms of turnover)

Number of UVCs sold in the R3PACK reusable version / Total number of UVC sold for single use + R3PACK reusable version: Sept–Nov 2024, Feb 2025, and Apr–May 2025.

SHARE OF SALES IN REUSE 2025 **X%**
(R3PACK PROJECT)

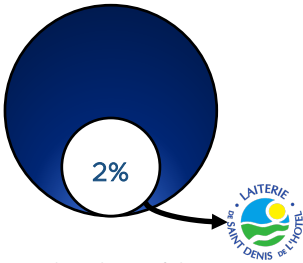
PROJECTION SHARE OF SALES IN REUSE	2027	X%
	2040	X%

‘Potentiels de développement du réemploi des emballages par secteur’ study, ADEME 2023



JUICE

MARKET SIZE



Market share of the manufacturer in Europe (in terms of turnover)

SHARE OF SALES IN REUSE 2025 (R3PACK PROJECT)

33%

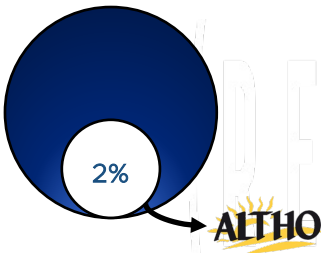
PROJECTION SHARE OF SALES IN REUSE (total category)	2027	5-10%
	2040	10-15%

Number of UVCs sold in the R3PACK reusable version / Total number of UVC sold for single use + R3PACK reusable version: Sept–Nov 2024, Feb 2025, and Apr–May 2025.



CHIPS

MARKET SIZE



Market share of the manufacturer in Europe (in terms of turnover)

SHARE OF SALES IN REUSE 2025 (R3PACK PROJECT)

12%

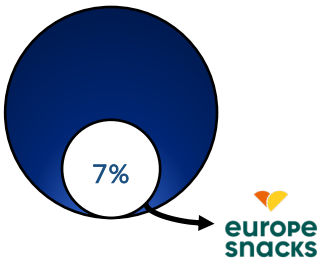
PROJECTION SHARE OF SALES IN REUSE (total category)	2027	5-10%
	2040	10-15%

'Potentiels de développement du réemploi des emballages par secteur' study, ADEME 2023



TORITALLA, FLIPS

MARKET SIZE



Market share of the manufacturer in Europe (in terms of turnover)

SHARE OF SALES IN REUSE 2025 (R3PACK PROJECT)

17%

PROJECTION SHARE OF SALES IN REUSE (total category)	2027	5-10%
	2040	10-15%

The Horizon Europe project includes other product categories than those presented above. However, during the demonstration, it was not possible to collect sales data for these categories for several reasons:

- For some, there were no single-use sales during this period to analyse the market share of reuse
- For others, they were not on the shelves during the demonstration phase.

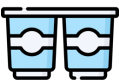
Nevertheless, it is interesting to share the data provided by ADEME concerning reuse projections for these other categories of R3PACK products.



PREPARED SALAD

Including 

PROJECTION SHARE OF SALES IN REUSE (total category)	2027	5-10%
	2040	15-35%



YOGHURT

Including  

PROJECTION SHARE OF SALES IN REUSE (total category)	2027	5-10%
	2040	10-15%



MILK

Including  

PROJECTION SHARE OF SALES IN REUSE (total category)	2027	1-5%
	2040	1-5%



CATERING TRAY

Including  

PROJECTION SHARE OF SALES IN REUSE (total category)	2027	5-10%
	2040	15-25%



CUT VEGETABLES

Including 

PROJECTION SHARE OF SALES IN REUSE (total category)	2027	1-5%
	2040	5-10%

*'Potentiels de développement
du réemploi des emballages par
secteur' study, ADEME 2023*

Preliminary insights from the R3PACK's pilot activities indicate that the **highest-performing** product categories in terms of **share of sales** are currently **cider, juices, and syrups**. These results, however, should be interpreted with **caution**. In the case of cider and syrups, the reusable and single-use packaging formats were visually very similar, which may have generated consumer confusion and artificially inflated reuse uptake. In parallel, the **French REUSE initiative**, supported by CITEO, is already deploying large-scale reuse infrastructure first for **beverages** in glass bottles—a category that performs comparatively well in other European markets and benefits from mature bottle-washing systems, which are currently more established for glass than for plastics.

Moreover, R3PACK's experiment showed a **strong interest of consumers** also for **non-beverage** products such as dry goods and dairy products. In addition, national projections from ADEME suggest a significant **long-term market potential**, particularly for dry goods, where reusable formats such as biscuits and crackers could represent up to 50% of product sales by 2040.

Taken together, R3PACK's results indicate that, when consumers are provided with a **sufficiently broad and accessible range of reusable product** options, a substantial share of them are willing to adopt reuse. Under such favourable conditions, the projections suggest that the **regulatory targets** set at European level **could be approached**—if not achieved—in the longer term. Nevertheless, significant **challenges remain** (increase volumes, reaching high return rate via consumer engagement, R&D on plastic and washing) before reuse systems can deliver environmental and economical benefits.

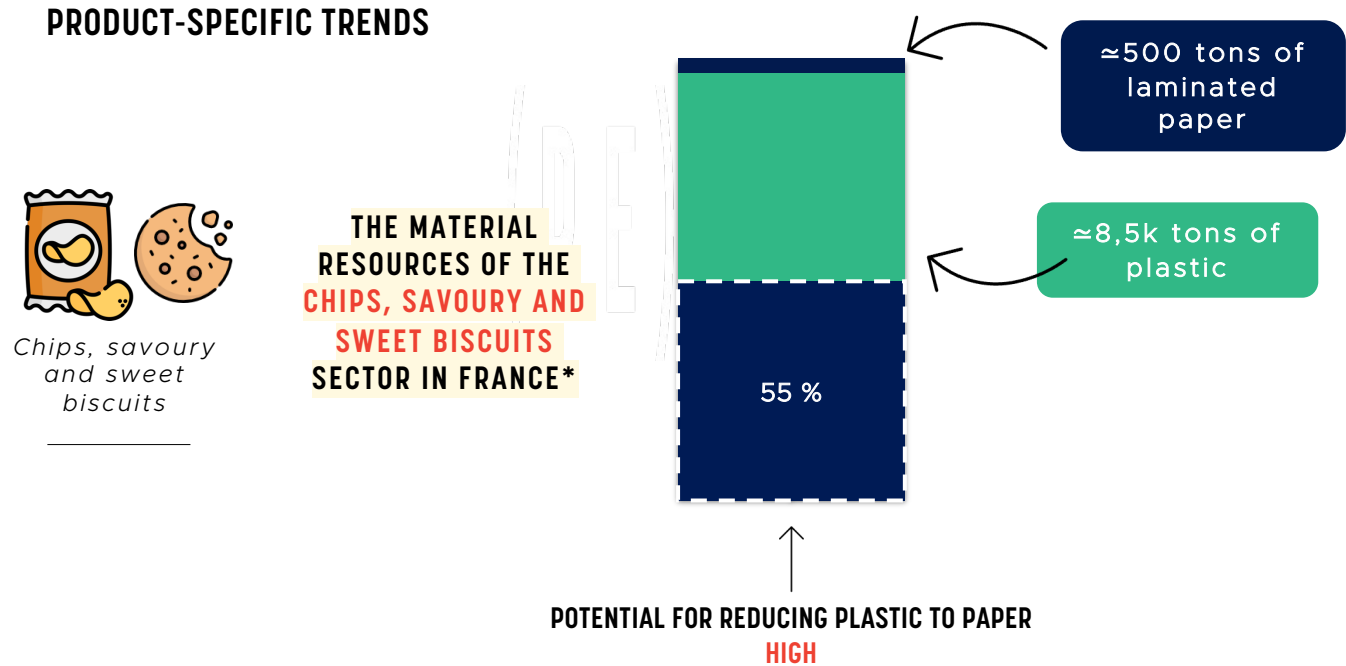
Consumers must be encouraged via economical incentive and clear communication to **return all types of reusable packaging**, to ensure high return rates and closed-loop efficiency. In this context, **awareness campaigns, clear deposit information, and in-store visibility** will be crucial to sustaining participation and unlocking the full economic and environmental benefits of reuse. **Without a significant improvement** in consumer behaviour, it is unlikely that economic actors will commit to widespread reuse in distribution networks, which is a prerequisite for compliance with future regulatory obligations.

These are essential levers to unlock the full market potential of reuse and to transition from isolated pilots to effective, system-level adoption.

POTENTIAL FOR SWITCHING FROM PLASTIC TO PAPER PACKAGING

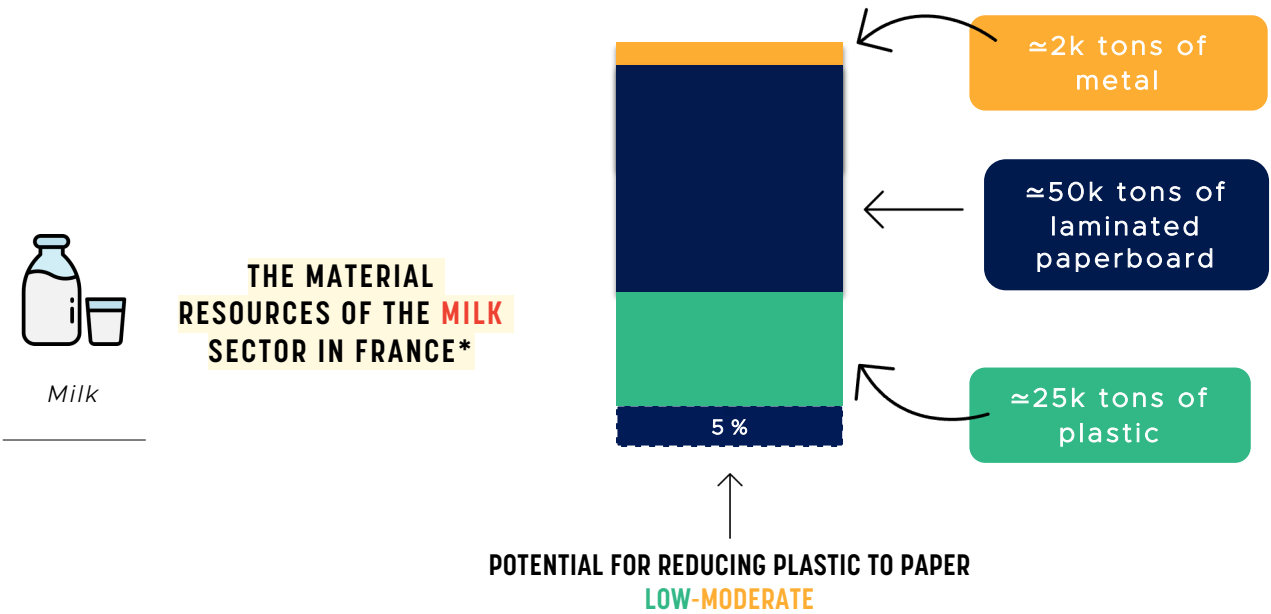
The market potential for fibre-based packaging substitution is being driven by regulatory momentum (PPWR 2025/40 targets), strong retailer engagement, and consumer demand for lower-plastic alternatives. The R3PACK deliverables and the French 3R sector synthesis show that fibre-based materials are now technically validated for several dry/moderately humid food segments, or those with short shelf life, i.g. chips, sweet and savoury biscuits and margarine dough. However, challenges remain for high-moisture or modified atmosphere / under vacuum products or those requiring transparency (dairy, meat, salad, cheese, etc.). France provides a representative benchmark for the EU food market, given to its similar product mix and regulatory environment.

PRODUCT-SPECIFIC TRENDS

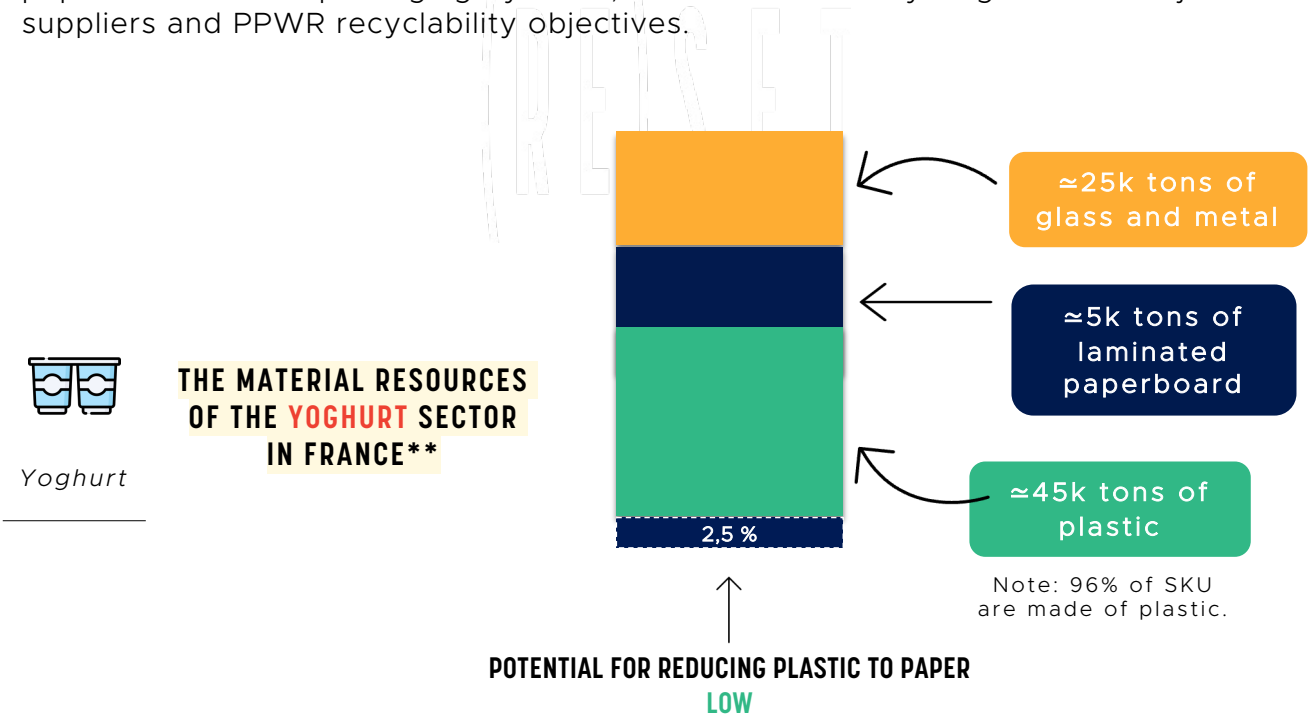


For **chips and savoury biscuits categories**, there are many challenges involved in covering a wide range of products: high **grease content**, the need for strong **oxygen and moisture barriers**, ensuring high sealing quality on tubular sachets, and machinability on high-speed lines. For **sweet biscuits**, shelf life and aroma retention are still below those of plastic equivalents, requiring improved barrier solutions. Furthermore, these products packaged in flexible packaging require low paper weights, making compliance with the PPWR more complicated, as it demands increasingly high levels of the majority material (paper) in the composite structure.

In the next few years (2025–2030), R&D should focus on **high-barrier paper laminates and hybrid coatings** to improve the paper ratio, sealing, and barrier properties. Sweet biscuits are likely to see an **earlier commercial rollout**, while chips and savoury snacks will follow later once **barrier stability and line compatibility** are achieved.



Current cartons **already contain ~75% fibre**; the challenge is reducing plastic and aluminium foil layers while maintaining light and moisture protection. Ongoing innovation in bottle/carton paper formats aims to further increase the paper share in milk packaging by 2030, in line with industry targets from major suppliers and PPWR recyclability objectives.



Transitioning from FFS plastic cups to pre-formed or even FFS paper cups requires significant investment in industrial line changes and faces sealing/hygiene limits. **Hybrid paper-plastic pots** are expected to become mainstream by **2030**, with **recyclable pots with a very high fibre content** achievable by **2040**, as barrier solutions and FFS line compatibility reach full industrial maturity.

COMPARABLE INITIATIVES - REUSE



France - ReUse Project – Glass and reusable packaging deposit scheme (France)

A large-scale initiative led by **Citeo** to reintroduce deposit-return systems for glass bottles and jars in several French regions (Brittany, Normandy, Hauts-de-France). The project tests operational models for return logistics, washing, and consumer engagement.



France – Loop x Carrefour

Loop is a reuse service provider with 27 partner brands and almost 400 products in around 300 Carrefour stores and a few Monoprix outlets. The distributor manages collection and storage until the items are picked up by Loop (approximately once a month). Loop sorts and stocks packaging before sending it for washing.



France – Buddie Pack

BUDDIE-PACK is an EU project creating reusable plastic packaging for food and home-care goods. It tests six business cases across catering, takeaway, retail, and detergents, comparing on-site vs. home return systems to optimise safety, traceability, and consumer adoption of reuse models.



Germany – National deposit system (“Pfand”)

A mature deposit-return system for beverage bottles and cans, operating nationwide since the early 2000s. It combines reuse (glass/PET bottles) and high-performance recycling.



Belgium – Emerging reuse initiatives

Belgium has a strong EPR framework (Fost Plus, Valipac) focused mainly on recycling, but reuse initiatives are growing. Hundreds of millions of bottles are collected annually. Besides, major retailers (Albert Heijn, Carrefour, Colruyt, Delhaize, Lidl, Aldi) have joined forces to test standardised reusable packaging for fresh products.



Denmark – Aarhus reuse pilot

Denmark is one of the most advanced Nordic countries in developing urban reuse models. In 2024, the city of Aarhus launched a municipal reuse system for takeaway cups and food containers, supported by TOMRA and local cafés. The project integrates digital deposit-return, automated collection points (RVMs), and washing loops coordinated at city scale. It demonstrates that high return rates and strong consumer engagement can make reuse viable even for “on-the-go” packaging.

COMPARABLE INITIATIVES - SUBSTITUTION

redysign



European Union – REDYSIGN Project – (10/2023 – 09/2027) – Financing CBE-JU – 13 partners – 7 European countries

Major European Research and Innovation action which focuses on the development of several resource-efficient processes dedicated to the production and circularization of a biobased, recyclable, and smart fibre-based packaging (FBP) alternative for fresh meat distribution as a substitute for current non-circular multi-plastic solutions.



Flanders, Interregional – BeFORE Project – Barriers for Recycling (03/2025 – 03/2027) – Financing BMWK – 6 partners

This is the continuation of the REPAC² project coordinated by Pack4Food with the Flanders' FOOD ecosystem. Development of new recyclable high-barrier materials for contact-sensitive primary packaging (ex: coffee, tea, dry pet food, chocolate, meat), including paper substrates. Objective: to improve design for recycling and barrier performance.

(RE)SET...COSMETICS
PULP IN ACTION



France – Pulp in Action Project – (01/2022 – Present) – 13 partners + FEBEA

A collaborative R&D programme aimed at replacing plastic in cosmetic packaging with cellulose fibres. The objective is to develop a cellulose fibre-based packaging solution that can be deployed on an industrial scale and meets the requirements of cosmetic products in terms of quality of use, barrier properties and formula preservation (water resistance, formula stability, etc.), while ensuring packaging recyclability.

Cepi
RENEWABLE
RECYCLED
RESPONSIBLE
EUROPEAN PAPER



European Union – Confederation of European Paper Industries (Cepi)

Association representing the pulp, paper, and board industry across Europe. It brings together national federations from 18 countries, covering about 90% of European paper production. Its mission is to promote a climate-neutral, competitive, and circular bioeconomy through sustainable forest-based products. Cepi advocates for policies supporting recycling, renewable raw materials, and innovation in fibre-based packaging, as well as industry data, sustainability indicators, and guidance to align EU regulations with sector decarbonisation goals.



4ever
green



European Union – 4evergreen Alliance – (since 2019, launched by Cepi)

A cross-industry alliance of over 100 members representing the entire lifecycle of fibre-based packaging from forests to producers, designers, brand owners and recyclers. Together they share expertise to develop tools, protocols and guidelines for an even more sustainable sector. The goal is to reach a 90% recycling rate for fibre-based packaging by 2030.

2 – PART A / REUSE



Funded by
the European Union

This project has received funding from the European Union's Horizon Europe Research and Innovation Programme under Grant Agreement No 101060806.

PART A - REUSE

// VALUE CHAIN

R3PACK REUSE ECOSYSTEM

A **reuse loop** relies on the collaboration of several actors working in sequence. **Packaging manufacturers** design durable and reusable containers; **machine producers** adapt filling and sealing lines; **food and beverage industries** integrate reusable formats into production. **Retailers** manage deposit-return systems and consumer communication, while **collectors and sorters** coordinate reverse logistics and traceability. Finally, **washing companies** ensure hygiene and safety before packaging re-enters circulation. Together, these actors create a connected system where collaboration and data sharing make reuse operationally and economically viable.

#Packaging manufacturers



#Food and beverage manufacturers



#Retailers



#Collectors / Sorters



#Washing companies



R3PACK REUSE LOOP

In R3PACK, food products are packaged by **food manufacturers** in **deposit-based reusable containers** (glass or PP). These products are then delivered to retailers (Carrefour, Système U), who sell them to consumers with a **visible deposit fee** listed separately on receipts. Consumers return empty containers in-store via **Reverse Vending Machines (RVMs)**.

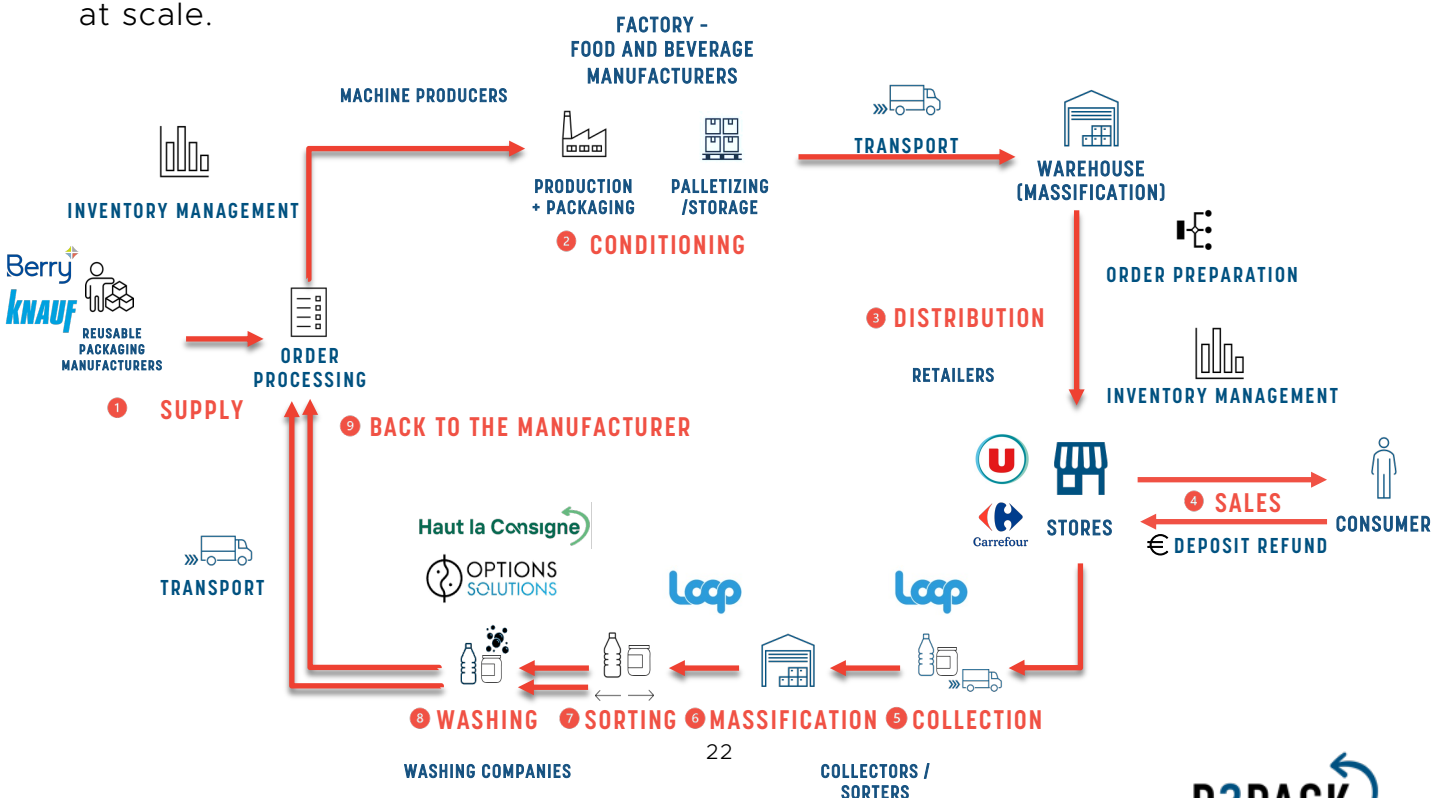
Returned packaging is collected by **Loop**, the reuse operator, which manages **sorting, massification, deposit refunding, and logistics**.

Containers are sent to specialised **washing facilities** (Haut la Consigne for glass, Options Solutions for plastic) where they undergo inspection, washing, and microbiological/allergen safety checks.

After quality validation, clean containers are **returned to the food manufacturers**, who refill them with new products. This closed loop allows packaging to circulate multiple times instead of being discarded after one use.

Financial flows mirror the physical ones: deposits are billed by manufacturers to distributors, charged to consumers, and reimbursed when packaging is returned. Data on sales, returns, losses, and washing performance are monitored by Loop and shared within the consortium.

Through this system, R3PACK demonstrates a **full industrial reuse value chain**: from design and production, to consumer use, to collection, washing, and redistribution, testing both economic viability and consumer acceptance at scale.



CROSS-VALUE CHAIN SYNERGIES

The transition to reusable packaging requires **close coordination across the entire value chain**. Unlike single-use models, reuse depends on the cooperation of all stakeholders — from packaging manufacturers to retailers — to ensure packaging durability, efficiency, and consumer trust.

At the design stage, **packaging manufacturers** and **food producers** must co-develop **standardised and washable formats** that remain compatible with filling and sealing lines. Early collaboration avoids technical barriers and reduces costs by aligning materials, sealing systems, and labelling with both industrial and washing requirements.

Machine producers enable integration by adapting equipment for heavier, reusable containers and validating performance under real industrial conditions. Their collaboration with manufacturers ensures production continuity while maintaining hygiene and speed.

Downstream, **retailers, collectors, and washers** form the backbone of the reuse loop. Retailers manage deposit-return systems and consumer awareness in stores. Collectors coordinate reverse logistics, sorting, and transport, while washers guarantee hygiene, traceability, and quality before redistribution to producers. Efficient coordination between these actors — supported by shared data and logistics — is critical to reduce costs and environmental impact.

By collaborating, all actors share investments, optimise infrastructure, and accelerate learning curves. Manufacturers secure steady demand, retailers strengthen consumer loyalty, and service providers gain new business opportunities.

Ultimately, as experimented through R3PACK's project, the viability of reuse depends on **systemic collaboration between all actors of the value chain**. The close cooperation at R3PACK between manufacturers, distributors, washers and packaging manufacturers enabled the development of 2 standardized reusable packaging.

By testing fully standardised packaging formats across multiple actors, R3PACK showed that harmonisation is not only feasible but also essential to achieving scale. **Standardised packaging** significantly optimises logistics, thereby **improving environmental and economic models**, which is an essential lever for promoting reuse on a large scale.



PACKAGING MANUFACTURERS

ROLE

Packaging producers enable the reuse value chain by designing durable containers (glass, plastic) that can withstand multiple reuse cycles while ensuring food safety, machinability, and consumer acceptance.



CHALLENGES

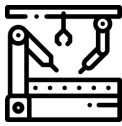


INVESTMENT NEEDED

R&D & DESIGN	Developing standardised reusable packaging formats that meet safety, machinability, and consumer expectations	Prototyping, moulds, and certification to ensure safety and performance.
MATERIAL ADAPTATION	Ensuring durability and performance across 20–50 reuse cycles, maintaining sealing integrity, hygiene, and allergen safety.	Use of stronger resins and reinforced designs, validated through repeated washing/durability tests.
TRACEABILITY	Designing and producing packaging that enables traceability	Adapt the lines to incorporate traceability elements (QR/Rfid..)
COLLABORATION COSTS	Engaging in a co-construction approach with multiple industrial players for shared packaging formats.	Coordination time and resources for cross-company co-design and alignment on technical specifications.
LEGAL & STRATEGIC	Training legal teams on the impacts of reuse, such as drafting shared contracts and liability clauses.	Training legal teams, updating contracts, and adapting models for shared ownership and responsibilities.

OPPORTUNITIES

- **Market Leadership:** Position themselves as frontrunners in reusable packaging innovation, supporting manufacturers in meeting PPWR reuse targets.
- **New Product Lines:** Develop and supply standardised reusable formats adaptable to several manufacturers and retailers, creating scalable market demand.
- **Regulatory Advantage:** Offer solutions that help client brands reduce exposure to eco-modulated fees and plastic taxes.
- **Value Chain Integration:** Strengthen partnerships with manufacturers, ensuring long-term contracts and co-development opportunities.



MACHINE PRODUCERS

ROLE

Machine producers enable reuse by adapting filling, sealing, and labelling equipment to handle durable containers while maintaining industrial efficiency and hygiene standards. They ensure reusable packaging integrates seamlessly into existing production lines.



CHALLENGES



INVESTMENT NEEDED

ENGINEERING & DESIGN	Adapting existing filling, sealing, and labelling machines to handle heavier, rigid reusable containers.	Redesign of filling and sealing modules, reinforced handling systems, and format adjustments.
R&D INVESTMENT	Investing in R&D to meet new reuse and hygiene requirements, including material compatibility and detection systems.	Development and testing of components for reusable packaging (sensors, sealing jaws, hygiene systems).
QUALITY-CONTROL INTEGRATION	Developing and integrating quality-control equipment to ensure packaging integrity and cleanliness over multiple cycles.	Purchase or modification of inspection systems (camera, leak, or cleanliness detection).
MAINTENANCE & SUPPORT	Adjusting after-sales service and maintenance cycles for new machine configurations.	Evolution of service programs, spare parts, and technician training for new reuse systems.
MARKET ADAPTATION	Risk of losing market share if adaptation to reuse is delayed compared to competitors.	Strategic investments to stay competitive through new product lines and partnerships.

OPPORTUNITIES

- **Market Expansion:** Open new segments by providing reuse-ready machinery to food and beverage producers.
- **Innovation Leadership:** Position as key technology providers for the circular packaging transition.
- **Service-Based Revenue:** Develop retrofit, maintenance, and technical service offers.
- **Regulatory Alignment:** Benefit from increased demand under PPWR reuse targets.
- **Partnerships & Standardisation:** Collaborate with packaging and food industries to co-develop interoperable equipment.



FOOD AND BEVERAGE MANUFACTURERS

ROLE

Food and beverage manufacturers are central to reuse loops, as they integrate reusable containers into production lines while ensuring food safety, product integrity. Moreover, they have an important role to play into consumer engagement and education through communication (on-label and general brand communication).



CHALLENGES



INVESTMENT NEEDED

TRAINING & CHANGE MANAGEMENT	Training internal teams (quality, sales, marketing, IT, legal) for the transition to reuse.	Workshops to align internal teams and procedures with reuse operations (5 - 20K/team trained).
LINE ADAPTATION	Adapting filling and sealing lines to handle heavier reusable containers and processes such as unfolding, labelling, and sealing.	Equipment upgrades, calibration, and downtime during pilot tests (10K - 2M€).
LOGISTICS & SERVICES	Developing partnerships with washing and deposit-return operators to ensure consistent loop performance.	Payments to washing and operators (sorting, traceability, transport) and coordination costs (50-300K€).
IT & TRACEABILITY	Implementing packaging traceability systems and managing stock flows between new and reused packaging.	Deposit invoicing systems, VAT compliance, and monitoring of reusable packaging stock (new vs. returned) (10K - 200K€).
PACKAGING PROCUREMENT	Collaborating with other producers on standardised reusable formats while maintaining product differentiation.	Purchase of standardised reusable containers and washable labels, lids, and spare parts.

OPPORTUNITIES

- **Brand Reputation:** Enhance credibility and align with consumer expectations for sustainability.
- **Regulatory Readiness:** Anticipate PPWR reuse targets and reduce exposure to EPR fees and plastic levies.
- **Consumer Loyalty:** Strengthen customer trust and repeat purchases through deposit-return schemes.
- **Cost Efficiency Over Time:** Achieve long-term savings as costs are spread across multiple reuse cycles (10–30 loops).
- **Value Chain Leadership:** Position as frontrunners in shaping standardised packaging formats with retailers, logistics, and washers.



RETAILERS

ROLE

Retailers are the direct interface between reusable packaging systems and consumers. They ensure visibility, accessibility, and proper management of return flows in stores, playing a pivotal role in consumer acceptance and large-scale adoption.



CHALLENGES



INVESTMENT NEEDED

INFRASTRUCTURE & SERVICE FEES	Integrating deposit–return systems in stores (RVMs, manual collection) and managing Loop logistics operations.	Purchase or rental of RVMs (+ floor space cost), in-store collection points, plus Loop fees covering collection of returned packaging.
COMMUNICATION MATERIALS	Communicating clearly with consumers to avoid confusion between reuse and recycling.	Design and purchase of point-of-sale materials and signage explaining deposit amounts, return procedures, and reuse benefits.
STAFF TRAINING & OPERATIONS	Training and mobilising store staff to install and maintain in-store communication	Time and resources for staff education, handling, and management of reuse processes.
CONSUMER ENGAGEMENT CAMPAIGNS	Engaging consumers actively through in-store campaigns to promote reuse behaviour.	Organisation of in-store events and awareness campaigns to explain the project, answer customer questions, and encourage participation.

OPPORTUNITIES

- **Consumer Loyalty:** Encourage repeat visits through deposit-return incentives and eco-engaged shopping experiences.
- **Brand Image:** Strengthen sustainability leadership and align with CSR and PPWR commitments.
- **Differentiation:** Stand out from competitors by offering innovative, environmentally responsible packaging options.
- **Shared Value Creation:** Enhance value for both national brands and private-label products.
- **Regulatory Advantage:** Reduce exposure to future EPR fees and plastic levies by complying early with reuse targets.



COLLECTION AND SORTING OPERATORS

ROLE

Collectors and sorters, ensure the operational backbone of the reuse loop by managing the reverse logistics, sorting, traceability, and redistribution of reusable packaging between retailers, washers, and producers. They guarantee that packaging flows remain efficient, safe, and circular.



CHALLENGES



INVESTMENT NEEDED

LOGISTICS INFRASTRUCTURE	Organising the full logistics chain, from in-store collection to transport to washers.	Purchase and maintenance of containers for packaging, and vehicles; operational coordination across multiple retailers and locations.
SORTING OPERATIONS	Sorting packaging by material and sending them to the appropriate washing facilities.	Manual sorting during pilots, plus investment in automation (scanners, RFID/QR tools) for scale-up.
TRACEABILITY & REPORTING	Ensuring traceability and providing regular reports to manufacturers and retailers.	IT systems and dashboards to collect data and share performance reports with partners.
NETWORK EXPANSION	Expanding the reuse offer with retailers by adding new products and packaging types.	Staff time and coordination costs to extend reuse loops with retailers and integrate new products.
TRAINING & POS MAINTENANCE	Training in-store staff to maintain and update POS materials and deposit signage.	Training in-store staff.

OPPORTUNITIES

- **Core System Role:** Position as an essential operator in the reuse value chain, managing logistics and traceability across sectors.
- **Service Diversification:** Offer multi-client, multi-material services, optimising operations through shared loops.
- **Data Value Creation:** Develop digital traceability tools as value-added services for brand and regulatory reporting.
- **Scalability:** Achieve economies of scale and reduced per-unit costs as return volumes increase.
- **Reputation & Partnerships:** Strengthen collaboration with major retailers and producers as trusted circular logistics partners.



WASHING COMPANIES

ROLE

Washing companies ensure the hygiene, safety, and reusability of packaging by cleaning and inspecting returned containers before redistribution. They are essential to maintaining food safety standards and enabling the circular flow of packaging.



CHALLENGES



INVESTMENT NEEDED

PROTOCOL DEVELOPMENT	Developing and validating washing protocols with producers to ensure safety across materials (microbiology, allergens, adhesives, labels).	Joint R&D and testing with producers to define washing protocols and quality controls (residues, odours, ...)
EQUIPMENT ADAPTATION	Adapting processes for different packaging materials (glass, plastic) and contamination levels.	Investment in washing lines (plastic washing), drying systems, and material-specific components.
LOGISTICS COORDINATION	Managing logistics and coordination with collectors for regular packaging inflow.	Operational costs to synchronise deliveries with collectors and maintain steady washing throughput.
TRACEABILITY & REPORTING	Monitoring performance and providing traceability data to manufacturers and retailers	IT tools and quality checks to record washing cycles, breakage rate and share hygiene data.
ENERGY & RESOURCE EFFICIENCY	Scaling up capacity while optimising water, energy, and detergent consumption.	Expenses for water treatment, heating, and detergent optimisation to meet sustainability targets.

OPPORTUNITIES

- **Core Value Chain Function:** Become certified service providers ensuring hygiene and safety for reusable packaging.
- **Market Growth:** Increase washing volumes as reuse expands across products and retailers.
- **Operational Excellence:** Optimise resource use and reduce costs through water and energy efficiency.
- **Digital Services:** Provide traceability and hygiene reporting as value-added services.
- **Strategic Partnerships:** Collaborate with manufacturers and collectors to co-design packaging optimised for washing.

PART A - REUSE

II / BUSINESS MODELS

PROFITABILITY OF REUSE MODELS COMPARED TO SINGLE-USE PACKAGING

The profitability of reuse models depends on multiple operational and market variables, but evidence from R3PACK demonstrations and European studies shows that reuse can become **economically competitive** against single-use packaging when implemented at sufficient scale and under certain conditions.

Economic dynamics of current Reuse model vs. Single Use

Today, reuse models involve **higher upfront costs** compared to single-use systems. Indeed, reusable packaging are more expensive, production cost are higher as the speed of production is slower and new costs are added concerning the reuse loop: washing, collection, sorting, transport.

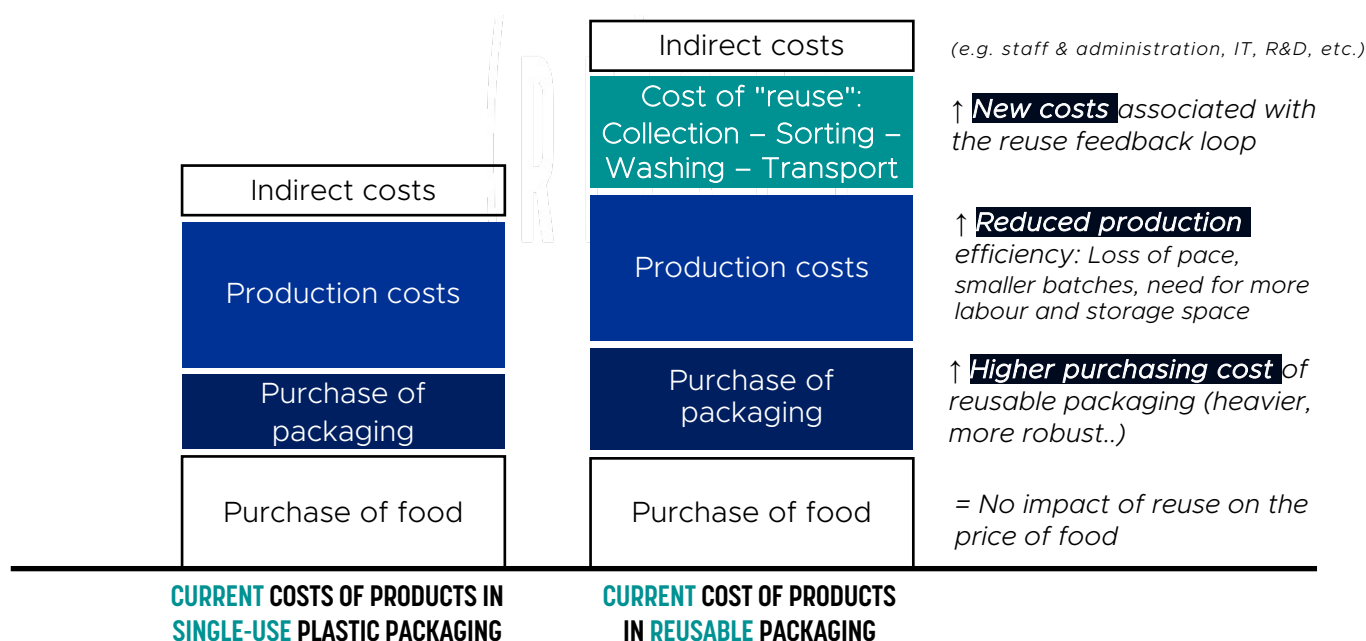


Figure 2: Current costs breakdown for products in single use vs. reusable packaging

Today, **reuse** products **remain more expensive** than their single-use version, however it is necessary that reuse remains affordable for all consumers and even economically attractive. Indeed, **affordability** determines adoption for consumers as economic motivation is top 2 reason cited* to switch to reuse in R3PACK in-stores interview.

Thus, efforts must be directed towards **optimising reuse and production costs** to **reach price parity** with single-use (excluding the deposit) or a **lower price** than single-use.

PROFITABILITY OF REUSE MODELS COMPARED TO SINGLE-USE PACKAGING

Optimisation of economic REUSE model

Studies conducted by **Zero Waste Europe & Searious Business** demonstrate that reuse systems can achieve return on investment within **3–4 years** for PP food containers take-away packaging and **2–3 years** for secondary transport systems under favourable conditions (high return rates, shared infrastructure).¹ The **Ellen MacArthur Foundation's** report “Unlocking a Reuse Revolution” provides quantitative evidence that **returnable packaging can achieve cost parity with single-use alternatives after approximately 20–50 reuse cycles** (which is extremely challenging to achieve) when operational loops are optimised. The study highlights that **efficiency in collection, washing, and logistics** is crucial to lowering the cost per use, while **system scale, material durability, and loss rates** strongly influence economic performance. In other words, **cost competitiveness could be achievable**, but it depends on reaching sufficient reuse cycles and maintaining high operational efficiency to amortise initial investments effectively.²

Key economic drivers to improve cost effectiveness:

1. **Return rate and rotation** – High return rates (>80%) thanks to high consumer engagement and multiple reuse cycles lower the cost per unit.
2. **Standardisation** – Common packaging formats across brands and retailers enable pooled logistics and shared washing infrastructure.
3. **Geographical density** – Shorter transport distances and centralised washing hubs reduce operational costs.
4. **Digitalisation** – QR/RFID-based traceability improves efficiency, loss prevention, and consumer reimbursement accuracy.
5. **Policy incentives** – Eco-modulation, plastic taxes, and deposit-return regulations (PPWR, AGEC) make single-use less competitive over time.

FUTURE, PROFITABILITY OF REUSE MODELS COMPARED TO SINGLE-USE PACKAGING

Once the **reuse model** is fully deployed—for example through increased packaging volumes, optimized logistics, strong user engagement, high return rates, and a large number of reuse cycles—the associated **costs can be reduced**. In this context, expenditures related to production, reuse-loop operations, and packaging procurement are expected to decrease. Conversely, for **single-use systems**, a progressive **increase in the cost of virgin materials** is anticipated over the coming decades, further reinforcing the economic relevance of scalable reuse solutions.

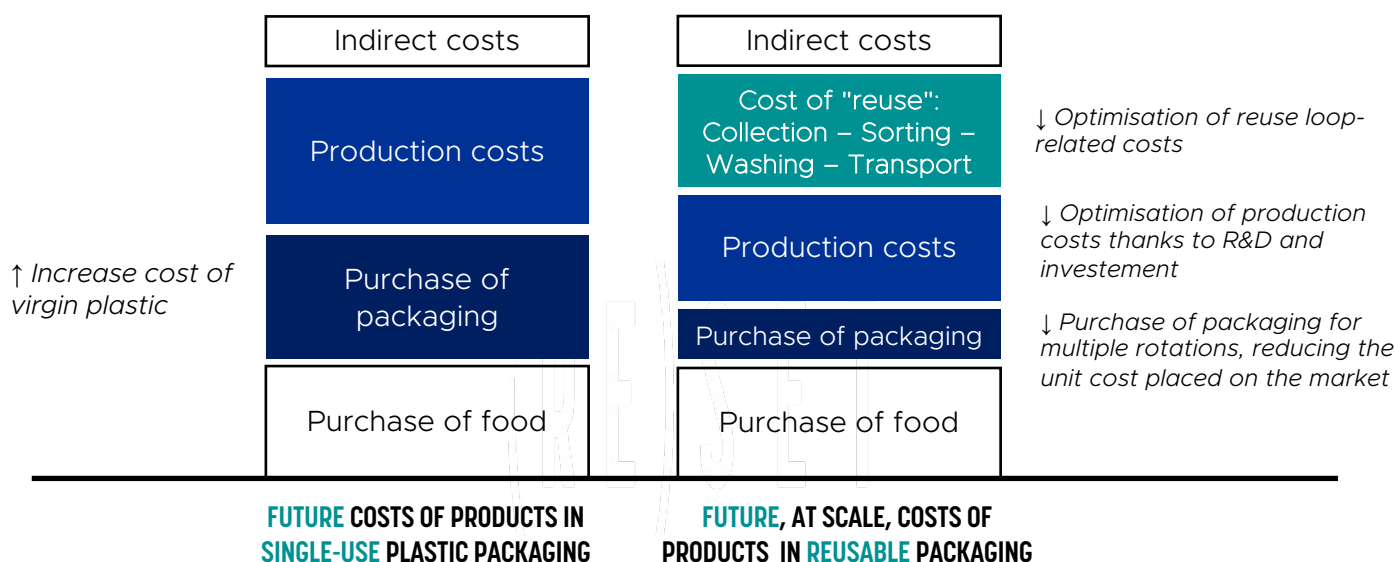


Figure 3: Future possible costs breakdown for products in single use vs. reusable packaging

Moreover, reuse reduces exposure to **resource volatility**: it limits dependency on virgin plastics and mitigates risks related to material scarcity or price fluctuations — challenges that will intensify as plastic packaging faces higher Extended Producer Responsibility (EPR) fees and stricter environmental taxation under EU regulations.

In summary, while reuse systems require **significant upfront investments** and coordination to optimize the model, if all levers are implemented (high return rates, packaging standardisation, and supportive policy incentives, etc) reuse **could achieve cost-efficiency** and thus enable even greater consumer engagement.

Reuse beyond food packaging and possible synergies

The economic challenge of reuse extends beyond the food sector. **Cosmetics, household cleaning products, e-commerce and HORECA** may encounter similar obstacles when implementing reuse projects. If reuse becomes more widespread in these sectors, **synergies** could be found to improve the economic model of the system and enhance environmental benefits.

SWOT ANALYSIS OF THE R3PACK REUSE MODEL

Based on the economic, technical and social analysis conducted within R3PACK, the SWOT analysis below summarises the current positioning of reuse models.

STRENGTHS	WEAKNESSES
• Potential to reduce dependence on virgin and single-use plastic • Collaborative, multi-stakeholder approach (retailers, manufacturers, washers, logistics operators) • Demonstrated interoperability between retailers within pilots • Standardisation of packaging formats demonstrated through R3PACK and other reuse pilots • Complete, operational ecosystem tested at pilot scale (manufacturers, distributors, washers, logistics) • Positive consumer engagement when reuse is visible and clearly explained	• High initial investment and higher operating costs compared to single-use packaging • Strong dependence on high return rates to reach economic viability • Long R&D timelines for washing protocols, plastic resins and industrial optimisation • Limited in-store reuse offer, restricting consumer adoption • Consumer confusion between reuse and recycling • Need for dedicated deposit management systems and IT developments
OPPORTUNITIES	THREATS
• Growing consumer interest in reuse solutions • Improved brand image and potential customer loyalty linked to return systems • Expansion of shared reuse infrastructures enabling economies of scale • Regulatory frameworks increasingly favourable to reuse (at EU and national levels) • Development of harmonised standards for reusable packaging and washing processes • Potential improvement of the economic and environmental performance balance through scale-up	• Regulatory fragmentation or delays in PPWR implementation slowing investments • Economic models still partially dependent on public subsidies • Lack of large-scale, general communication on reuse • Limited or no environmental benefit for reuse in certain product categories • Lack of harmonised washing standards, especially for plastic packaging • Contractual and multi-stakeholder complexity (ownership, liability, food safety responsibilities)

PART A - REUSE

III / RISK ASSESSMENT & MITIGATION

RISK ASSESSMENT & MITIGATION

TECHNICAL RISKS & MITIGATION STRATEGIES



MAIN RISKS	MITIGATION STRATEGIES
Packaging durability issues may occur, such as breakage, deformation, or leakage, after several reuse cycles, compromising food safety and consumer trust.	• Select appropriate materials for reusable packaging. • Conduct extensive R&D and pilot testing to validate the durability and safety of reusable packaging under real-world conditions.
Incompatibility with existing industrial lines can lead to operational inefficiencies, increased downtime, or the need for costly equipment modifications.	• Hold co-design workshops with all value-chain actors to maximise packaging compatibility at every stage. • Conduct R&D to improve the compatibility of existing lines when reuse is on a small scale and, on a larger scale, develop machines designed for reuse.
Inefficient or unsafe washing processes may fail to fully remove microbiological or allergenic residues, creating food safety risks.	• Develop and certify washing audit grids that can be based on D3.3 and standard washing protocols with microbiological and allergenic tests, to ensure hygiene and compliance with European standards.
Loss of traceability can arise from damaged QR or RFID tags, resulting in missing data and reduced visibility along the reuse loop.	• Implement robust digital traceability systems using QR or RFID technology, with redundancy measures to prevent data loss.
Lack of packaging standardisation across producers and retailers can increase costs, limit scalability, slow adoption at the European level and increase environmental impacts.	• Encourage the joint development of standard packaging between manufacturers • Need for European standards to certify the reusability of packaging.

RISK ASSESSMENT & MITIGATION

ECONOMIC AND FINANCIAL RISKS & MITIGATION STRATEGIES



MAIN RISKS	MITIGATION STRATEGIES
High initial investment costs for all stakeholders and strong risks perceived at early stage may limit the ability of some actors to enter or scale reuse schemes.	• Seek grant financing opportunities to fund early-stage reuse investment or adaptation of existing infrastructure from pilot to scale-up until reaching a more viable system. • Promote co-investment mechanisms to share infrastructure and financial responsibility among stakeholders. • Begin with controlled pilot loops to test economic viability, reduce upfront risks, and progressively optimise operational costs.
Slow consumer adoption or limited geographic coverage can lead to low return rates, delayed returns, and unoptimized logistic model.	• Ensure price parity, making reusable products at least as affordable as single-use options. • Strengthen communication on the reuse model and its environmental benefits to build consumer appeal. • Enhance convenience, simplifying both the purchase of reusable packaging and the return process.
High logistical expenses , including transport, sorting, and storage of reusable packaging, may reduce economic competitiveness compared to single-use alternatives.	• Design standardized packaging to optimize the logistical model • Significant increase of reuse packaging volumes and so return rate via increase of reuse offer in-store and consumer engagement

RISK ASSESSMENT & MITIGATION

ORGANISATIONAL AND OPERATIONAL RISKS & MITIGATION STRATEGIES



MAIN RISKS	MITIGATION STRATEGIES
Lack of coordination between value chain actors (manufacturers, retailers, collectors, washers) can lead to inefficiencies, inertia in project management, delays or chain disruptions in the execution of the loop.	Establish a formal governance model defining clear roles and responsibilities between all actors.
Limited washing or logistics capacity may create bottlenecks during scale-up, causing operational disruptions and higher service costs.	Prepare contingency plans for logistics and washing capacity, including backup providers and flexible storage options, to prevent disruptions during scale-up.
Complex management of packaging inventories, including the balance between new and reused stock, may result in supply inconsistencies or losses.	- Use packaging traceability through reliable data models and traceability systems (e.g. RFID chips) - Improve the interconnection of information systems between actors in the chain
IT system incompatibility between partners can hinder traceability, data reporting, and the overall monitoring of reuse loops.	Develop shared digital tools and interfaces to ensure interoperability of IT systems and transparent data exchange.
Insufficient staff training or resistance to change can slow operational adoption and compromise quality or safety procedures.	Implement comprehensive staff training programmes across functions (production, logistics, retail, quality) to ensure operational readiness.

RISK ASSESSMENT & MITIGATION

REGULATORY AND LEGAL RISKS & MITIGATION STRATEGIES



MAIN RISKS	MITIGATION STRATEGIES
Unclear liability allocation between producers, retailers, and service providers in the event of contamination, product damage, or loss of packaging can create legal uncertainty.	• Develop clear contractual frameworks early in the project defining liability, ownership, data sharing, and responsibilities across partners.
Delays in the implementation or harmonisation of the EU Packaging and Packaging Waste Regulation (PPWR) may lead to inconsistent requirements across Member States.	• Maintain continuous dialogue with regulators at EU and national levels to align reuse models with forthcoming PPWR provisions.
Limited recognition of reuse systems within Extended Producer Responsibility (EPR) frameworks could reduce financial incentives for industry adoption.	• Work with EPR scheme administrators to integrate reuse within existing reporting and fee structures, ensuring fair treatment compared to recycling.
Complex regulatory compliance for food contact materials (FCM) in reusable packaging, especially for recycled plastic and new coatings or plastics, may delay material approvals and market authorisations.	• Collaborate with certification bodies to validate materials and washing processes for FCM compliance and ensure safe market placement.
Contractual complexity in multi-actor models — involving shared ownership, data exchange, and operational liability — may slow the deployment of reuse partnerships.	• Involve legal experts and industry associations to support contract drafting and the development of standardised terms for multi-actor reuse operations, ensuring full compliance with competition law.

RISK ASSESSMENT & MITIGATION

SOCIAL AND BEHAVIOURAL RISKS & MITIGATION STRATEGIES



MAIN RISKS	MITIGATION STRATEGIES
Low consumer participation in deposit-return may limit packaging return rates and threaten economic viability and decrease environmental benefits.	• Introduce loyalty and incentive programmes (e.g. discounts, eco-bonuses) to reward consumer participation and improve return rates as explained in D2.2. • Develop marketing program to strengthen consumer engagement and appeal for reuse.
Confusion between reuse and recycling systems can create misunderstandings about deposit processes and discourage participation.	• Communicate the difference between recycling and reuse and the advantages of each. • Ensure consistent and visible signage across retailers showing deposit prices, return instructions, and packaging types accepted.
Negative perceptions of hygiene or product safety in reused containers may reduce consumer trust, particularly for perishable or liquid foods.	• Communicate hygiene guarantees and certifications prominently on packaging and marketing materials to reinforce safety perceptions and ensure regular collections to limit potential odours.
Reputational risks may arise if operational incidents (e.g. hygiene failures, missing deposits) occur.	• Implement targeted consumer information campaigns, both in-store and online, explaining the principles and benefits of reuse clearly.
Inconsistent communication between retailers and brands can lead to fragmented messaging and weaken the overall visibility of reuse initiatives.	• Establish a unified communication framework across participating retailers and brands to ensure coherent, recognisable messaging at EU level.

3 – PART B / SUBSTITUTION

PART B - SUBSTITUTION

1 / VALUE CHAIN

R3PACK SUBSTITUTION ECOSYSTEM

SHORT-TERM & LONG-TERM

Substitution relies on the collaboration of several actors working together, in different routes : **short-term** and **long-term**. **Experts, material providers, converters and packaging manufacturers** design sustainable paper-based packaging solutions being compliant with PPWR regulation and specifications of food manufacturers; **machine producers** accompany food industries to adapt or change their packaging line (additional module, sealing etc.); **food industries** validate paper-based solutions on their production line (aging, quality control, adjustment of production speed). Trade negotiations between manufacturers and **retailers** enable to validate the economic viability of deploying the substitution solutions in stores. A partner supports the project to verify the **end-of-life** of the solutions developed (recycling, composting).

#Experts / #Material providers



not included in the value chain presented in this deliverable as part of the long-term route (no in-store deployment target)

#Packaging suppliers / #Converters



#Food manufacturers



*NB: Candia is R3PACK's official signatory member. However, it is part of a larger group, Sodiaal, therefore the selection of packaged products to be considered within the project will be extended to the affiliated brands Yoplait and EntreMont

#Retailers



#Recycling / #Composting



R3PACK SUBSTITUTION

VALUE CHAIN

SHORT-TERM

In R3PACK, technically validated **paper-based packaging solutions** are developed by **converters** and then supplied to **food manufacturers** for food products packaging. These products are delivered to retailers (Carrefour, Système U), who sell them to consumers.

The value chain of paper-based packaging solutions is **almost identical to that of conventional packaging solutions**, with the difference that it ends up in different recycling mills. It should be mentioned that collection, sorting and recycling stages are highly dependent on the country.

The **end of life** of these paper-based packaging materials can also vary depending on their composition, but also on the maturity of infrastructure in the country, i.e. compost-type waste collection and presence of industrial composting plants.

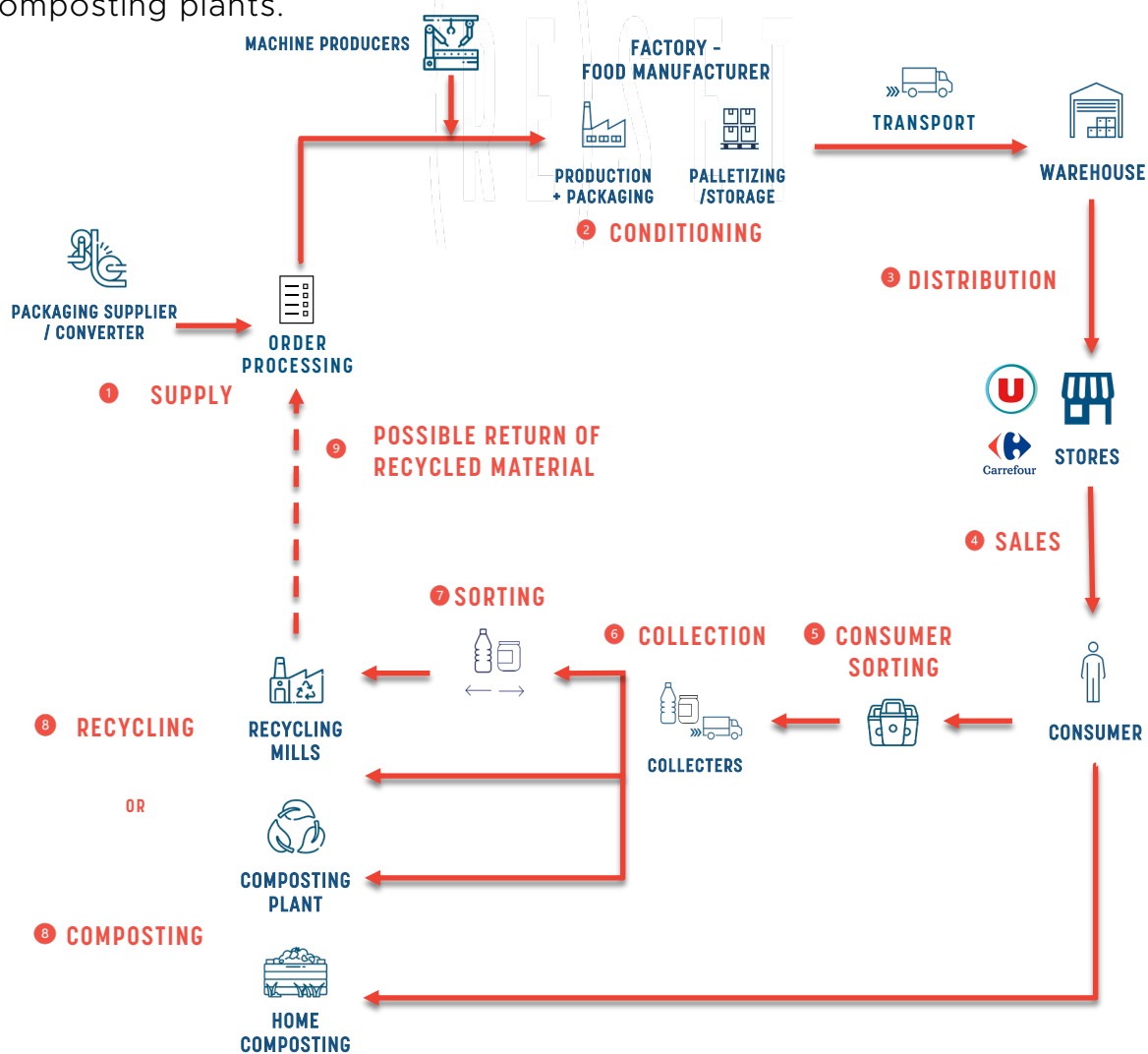


Figure 4: Fiber-based value chain



PACKAGING SUPPLIERS / CONVERTERS

ROLE

Packaging suppliers and converters play a central role in developing and industrialising paper-based packaging to replace plastic. They ensure that new materials meet functional, machinability, and recyclability requirements while maintaining food safety compliance, consumer acceptance and cost efficiency.



CHALLENGES

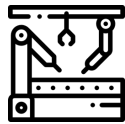


INVESTMENT NEEDED

R&D TESTING	Achieving barrier and sealing performance to preserve the product, while maintaining recyclability of the final packaging.	Development of « plastic-free » solutions, testing of multilayer structures, validating recyclability and product shelf-life.
INDUSTRIAL ADAPTATION & TESTING	Ensuring machinability (runnability, sealing, speed rate) on existing industrial packaging lines.	Adjustment of equipment parameters, investment in sealing jaws or appropriate equipment.
MATERIAL & PROCESS	Managing higher fiber-based material purchase (2 to 5x more expensive than plastics), higher production costs (lower production rates) and limited economies of scale.	Increase volumes to optimise purchasing cost through economies of scale. Adapt the production line to improve production rates.
COMMUNICATION & MARKETING	Building customer trust and consumer acceptance.	Product testing with manufacturers, transparent claims and co-design sessions to align expectations.
CERTIFICATION & COMPLIANCE	Complying with evolving regulations (PPWR), not always harmonised between different countries.	Food safety testing, recyclability certification (CEPI), and adaptation to varying national interpretations.

OPPORTUNITIES

- **Innovation leadership:** Position as frontrunners in bio-based, recyclable and even compostable materials, gaining competitive advantage under EU PPWR.
- **Market growth:** Growing demand from FMCG and retailers for compliant, fibre-based packaging solutions.
- **Collaborative standardisation:** Opportunity to co-develop EU-level standards for barrier, machinability, and recyclability.
- **Economic advantage (long-term):** Rising taxes on single-use plastics and eco-modulation will progressively improve cost competitiveness.
- **Brand and sustainability value:** Enhanced reputation through visible environmental progress and compliance with circular economy targets.



MACHINE PRODUCERS

ROLE

Machine producers are responsible for adapting packaging and filling lines to handle new fibre-based materials. They ensure that industrial machinery maintains speed, sealing integrity, and hygiene standards, despite the physical differences of paper-based solutions.



CHALLENGES



INVESTMENT NEEDED

R&D & ENGINEERING	Ensuring machinability and sealing efficiency for fibre-based solutions to ensure packaging line speed	Development and testing of new sealing jaws, cutting tools, and tension controls adapted to stiffer and more insulating substrates.
MAINTENANCE & RETROFIT	Managing dust generation, wear, and maintenance linked to paper substrates	Replacement of moving parts, filters, and cutting parts; settings in vacuum and pressure systems.
TECHNICAL	Incompatibility with the packaging industrial line due to the presence of metal (aluminium) within the packaging structure	Updating detection sensors by remote-controlled or a change of position, while guaranteeing FCM compliance.
SERVICE & INTEGRATION	Supporting clients through customised retrofitting and process adjustments	Engineering time for client-specific adaptations, on-site calibration, and operator training.

OPPORTUNITIES

- **First-mover advantage:** Early expertise in fibre-compatible machinery creates new market segments and preferred supplier status.
- **New retrofit market:** Strong demand for modular upgrade kits enabling existing lines to process fibre-based films efficiently.
- **Collaboration with converters and brands:** Co-development of “machine-material” packages offering turnkey substitution solutions.
- **Alignment with EU industrial policy:** Eligibility for green innovation funding (Horizon Europe, national circular industry programmes).
- **Smart Automation Leadership :** Become reference suppliers for AI-optimised packaging lines, offering predictive maintenance and automated calibration for fibre materials.



FOOD MANUFACTURERS

ROLE

Food manufacturers are central to validate the substitution solutions, as they integrate them into their production lines while ensuring machinability, product preservation and compliance with consumer expectations. They are responsible for filling, sealing, and distributing products in paper-based packaging, while balancing costs.



CHALLENGES



INVESTMENT NEEDED

R&D AND TESTING	Guaranteeing food safety, shelf-life, and barrier performance equivalent to plastics.	Test food product shelf-life and packaging integrity
OPERATIONAL	Managing logistics and storage constraints (fragility, humidity sensitivity)	Installation of humidity control systems, dedicated storage for paper-based packaging, additional training for handling and stock management.
ECONOMIC	Purchase of more expensive paper packaging and adapting production lines to process such materials	CapEx for equipment upgrades, calibration, and downtime during trials with paper-based materials.
COMPLIANCE & CERTIFICATION	Complying with regulatory changes and recyclability standards	Recyclability testing (CEPI / Aticelca standards), food-contact safety for PPWR conformity.
MARKETING & COMMUNICATION	Managing consumer perception and communication around “plastic-free” claims	Redesign of packaging visuals, claims validation to avoid greenwashing, consumer testing to measure acceptance and impact on brand equity. Organise communication campaigns

OPPORTUNITIES

- **Brand reputation and leadership** : Fibre-based packaging enhances credibility by visibly reducing plastic use and meeting consumer expectations for sustainability.
- **Regulatory readiness** : Compliance with PPWR and anticipate substitution targets.
- **Collaboration with packaging value chain** : Opportunity to co-develop standardised packaging formats and harmonised recyclability certifications with converters and retailers
- **Cost parity by 2030**: As material costs should decrease and production efficiency improves, fibre packaging could become cost-competitive, especially in high-volume SKUs.
- **Expanded market access** : Early adoption supports entry into new sustainability-oriented distribution channels and private-label partnerships.



RETAILERS

ROLE

Retailers are the direct interface between paper-based packaging and consumers. They ensure visibility, accessibility and desire in stores, playing a pivotal role in consumer acceptance and large-scale adoption.



CHALLENGES

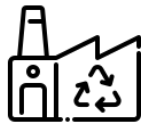


INVESTMENT NEEDED

PROCUREMENT & SUPPLY CHAIN	Ensuring supply stability and packaging quality across product categories.	Testing and approving new suppliers; managing potential disruptions in product availability.
OPERATIONAL	Managing shelf-life and specific constraints for fresh and perishable products.	Adjusting storage conditions and merchandising for non-transparent or moisture-sensitive packaging.
MARKETING & COMMUNICATION	Dealing with consumers confusion between recyclable and compostable materials.	In-store clear communication campaigns, redesign of shelf labels, training store staff to inform customers about recyclability.
PRICING & MARGIN	Higher purchasing price for fibre-based packaging (2–5× plastic); managing the price differential and perception of added cost.	Need for marketing narratives to justify value; pilot promotional budgets to test consumer acceptance.

OPPORTUNITIES

- **Sustainability leadership** : Strengthen brand positioning as a sustainability frontrunner. Consumer trust and loyalty: Fibre packaging reinforces positive brand perception. Attract and retain the expanding segment of consumers for whom environmental responsibility is a key determinant in their purchasing decisions
- **Compliance and risk reduction**: Early adaptation to PPWR requirements reduces exposure to future EPR and plastic tax increases.
- **Differentiation**: Opportunity to align fibre packaging with retailer-owned brands’ eco-design strategies, boosting competitiveness and CSR alignment.
- **Collaborative innovation with suppliers**: Lead co-design initiatives with converters and manufacturers, helping standardise recyclable formats and reduce overall costs.



RECYCLING MILLS

ROLE

Recycling mills’ key role is to adapt existing deinking, pulping, and screening processes to handle the new generation of functionalised papers — including coatings, barriers and hybrid structures — without compromising recyclability or process efficiency, to validate the true circularity of fibre-based packaging.



CHALLENGES



INVESTMENT NEEDED

PROCESS ADAPTATION	Managing new coated and functionalised papers and fluctuating material composition in recycling streams.	Upgraded pulping and dispersion units to separate barrier layer(s) from fibres; need for flexible process settings; additional chemical and energy use during cleaning stages.
SORTING	Precise detection to avoid waste and avoiding disturbers and contamination from multilayer or mixed fibre-polymer packaging.	Upgrading screening and flotation systems; installing optical sensors or AI-based detection to identify non-recyclable materials.
EFFICIENCY & QUALITY CONTROL	Maintaining fibre yield and paper quality despite coating residues.	Loss of fibre recovery rates (–5 to –10%) and reduced brightness or strength in recycled pulp; need for continuous quality monitoring.
CERTIFICATION & COMPLIANCE	Compliance with stricter recyclability standards (CEPI / PPWR).	Testing of material compatibility under standard recyclability protocols.

OPPORTUNITIES

- **Expansion of recyclable feedstock:** Growing demand for fibre-based packaging increase the available tonnage of recyclable materials, improving mill utilisation rates.
- **Technological upgrading and innovation:** Opportunity to modernise recycling lines with AI-assisted process control and advanced filtration systems, boosting efficiency and yield.
- **Strategic partnerships:** Collaboration with converters and retailers to define recyclability-by-design guidelines ensuring compatibility of new packaging with recycling infrastructure.
- **Regulatory incentives & eco-modulation:** Mills recycling certified recyclable packaging will benefit from inclusion in “recycling-at-scale” reporting under PPWR.
- **Environmental and market leadership:** Enhanced visibility as a circular economy leader, providing low-carbon recycled fibres to meet the EU demand for sustainable packaging.

PART B - SUBSTITUTION

II / BUSINESS MODELS

ECONOMIC COMPETITIVENESS OF PAPER-BASED PACKAGING COMPARED TO PLASTIC

Manufacturers face significant financial and technical barriers to adopting fibre-based packaging. **High material costs, combined with slower production rates**, make paper-based solutions considerably **more expensive** than single-use plastics. For example, **moulded cellulose trays can cost up to five times** more than their plastic equivalents. In addition, rigid formats such as trays or pots often require dedicated moulds or machinery, representing substantial upfront investments that many manufacturers cannot justify individually. Economic constraints such as minimum order quantities—whether exceeding or falling below a manufacturer’s production needs—further limit the feasibility of transitioning to fibre-based formats.

These increased material and operational costs directly **affect profit margins**, particularly in low-priced product segments where even slight cost increases per unit can have a significant impact. As illustrated by the financial analysis (Figure 5) of savoury biscuits, even higher-margin categories **experience reduced profitability** when switching from plastic to paper packaging.

On the consumer side, although a moderate price increase (as indicated in D2.2) may be acceptable by consumer due to perceived improvements in quality and convenience, retail prices must remain affordable for large-scale adoption.

Overall, while demand for sustainable packaging continues to grow, fibre-based solutions **must become more cost-competitive** with plastics if widespread market uptake is to be achieved.

Current cost analysis of paper-based packaging & case study

A financial comparison between plastic and paper packaging for savoury snack sachets is detailed just below, considering not only raw material costs but also the production and packaging processes.

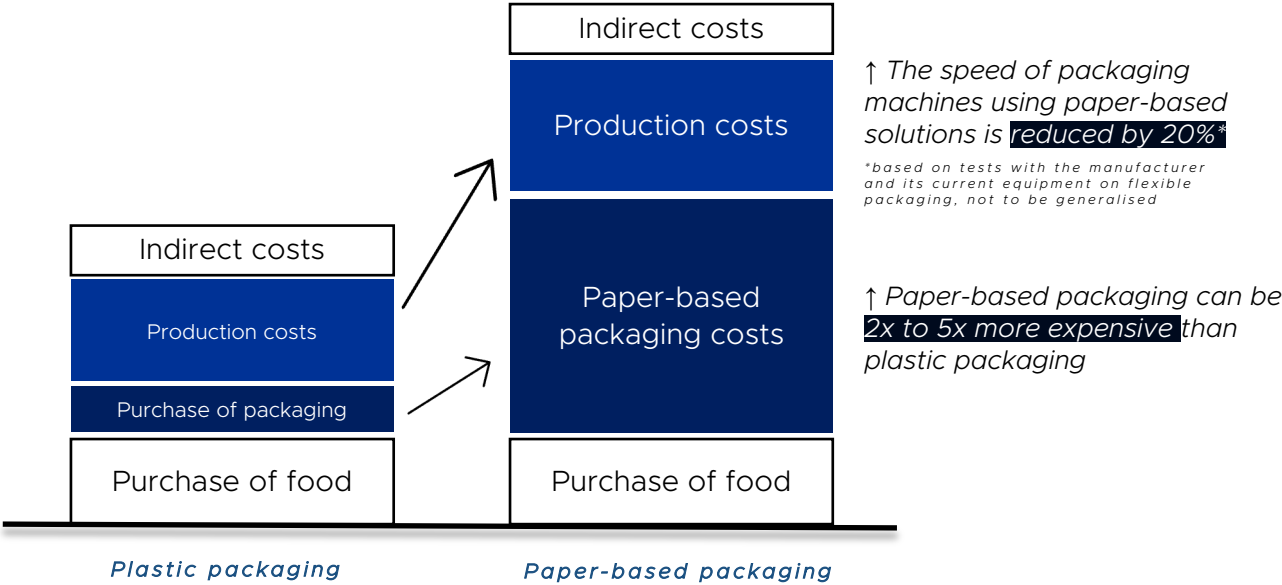


Figure 5: Current costs breakdown for products in plastic vs. paper-based single-use packaging

The total unit cost for plastic packaging, including purchase of packaging, production, and packaging processes, is currently 0.04 € per sachet for OPPmet and represents around 15% of the whole product. In contrast, paper packaging raises this cost to 0.12 € per sachet, driven by more expensive materials and the operational inefficiency caused by an estimated 20% slowdown in production speed.

This cost escalation reduces distributor (if the industrial margin stays the same) margins substantially: from 180 € to 103 € per 1,000 units, equating to a 45% decrease.

With an estimated annual sales volume of 2,9 million sachets, the distributor’s gross margin decline is estimated at 222,000 €. The manufacturer margin, typically around 10% of the B2B selling price, is also expected to contract due to these increased costs and operational inefficiencies to limit the decrease of the distributor margins. The results are summarized in Table 1 :

Metric	Plastic	Paper	Difference
Total Unit Packaging Cost	0.04 €	0.12 €	+0.08 €
Distributor Margin per 1,000 *	180 €	103 €	-77 €
Total Annual Volume	2.9 million units	-	-
Estimated Annual Distributor Margin	779,000 €	557,000 €	-222,000 €

Hypothesis ; increase of material purchase cost, increase of production rates du to 20% slower rates, impact on retailers margins

Table 2 : Key Business Impact (rounded)

Perspective at large scale

On a larger industrial scale, packaging costs are **expected to decrease**, while production **efficiency** and competitiveness will rise, driven by **economies of scale**, cheaper paper-based materials, and the optimisation of conversion technologies. As illustrated in the following figure, the combination of lower material prices, higher line speeds, and increased demand for efficient and recyclable fibre-based packaging could progressively balance the current cost gap between paper and plastic, paving the way for broader market adoption.

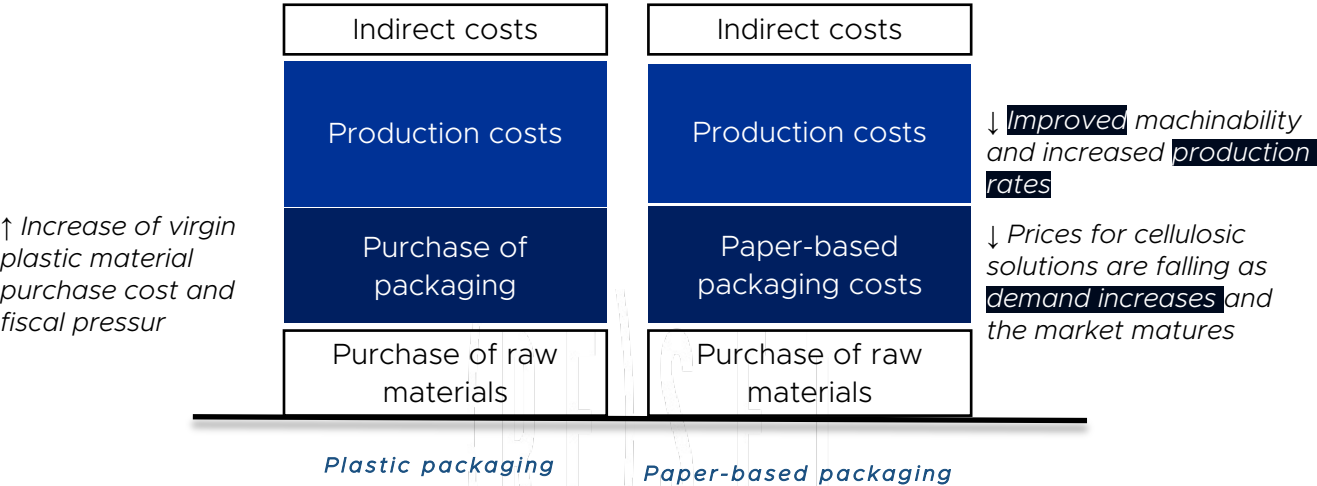


Figure 5: Future possible costs breakdown for products in plastic vs. paper-based single-use packaging

In addition, paper-based long-term competitiveness could also improve due to regulatory and fiscal measures reshaping market economics. For example, in France, the progressive rise in eco-contributions on single-use plastics will increase cost pressure on plastic, thereby enhancing the economic attractiveness of paper-based alternatives.

Over time, this regulatory pressure, combined with higher production volumes, faster machine speeds, and improved material performance, could reduce the unit cost of paper packaging.

PART B - SUBSTITUTION

III / RISK ASSESSMENT & MITIGATION

RISK ASSESSMENT & MITIGATION

TECHNICAL RISKS & MITIGATION STRATEGIES



MAIN RISKS	MITIGATION STRATEGIES
Insufficient barrier (oxygen, moisture) and sealing performance compared to plastics , leading to reduce shelf-life and product integrity, or even packaging integrity (possible grease stains in the 3-ply sealing zone of tubular packaging).	Invest in continuous R&D for more sustainable barrier products and multilayer paper-based structures ensuring recyclability and food-contact safety.
Machinability issues on industrial filling and sealing lines (tearing, poor sealing, reduced speed).	Adapt machine parameters and components, i.e. sealing jaw, temperature, pressure, cutting systems, to control and optimise sealing and line efficiency for paper substrates.
Recycling incompatibility due to barrier layer or multilayer structures that disrupt pulping and fibre recovery.	- Conduct R&D to find barrier coatings that do not hinder the recyclability of packaging. Standardise recyclability protocols with recyclers and EPR systems (e.g., CEPI/Aticelca tests) to ensure design-for-recycling compliance.
Material fragility and humidity sensitivity causing deformation or leakage during logistics and storage which may lead to deterioration of the product during transport.	Implement controlled storage and logistics conditions, such as humidity monitoring and optimised palletisation. Conduct R&D to improve the strength of packaging and provide better barriers.
Inconsistent quality and supply of fibre-based materials across suppliers and regions, affecting industrial performance.	Develop long-term partnerships with converters and suppliers to harmonise quality standards, share material data, and secure consistent feedstock for scale up

RISK ASSESSMENT & MITIGATION

ECONOMIC AND FINANCIAL RISKS & MITIGATION STRATEGIES



MAIN RISKS	MITIGATION STRATEGIES
High initial production costs of fibre-based materials compared to plastics (2–5* higher), due to limited scale and more complex materials.	• Increase volumes and improve the efficiency of production lines to increase throughput and thus reduce production costs. • Establish long-term contracts between converters, manufacturers and retailers to reduce raw material costs.
Significant CAPEX for industrial adaptation, including adapting production lines to paper packaging, and material qualification tests.	• Access public and private funding (Horizon Europe, national eco-innovation programmes, green investment funds) to support CAPEX and de-risk early-stage deployment.
Market uncertainty and slow demand uptake, as brands and consumers are still testing fibre packaging acceptance and performance.	• Explore new ways to promote sustainable packaging to facilitate its adoption by the market. • Implement cost-sharing models with brand owners and retailers, distributing financial responsibility for innovation, testing, and market entry.
Volatility in raw material prices (pulp, starch, bio-based coatings), which can affect cost stability and competitiveness.	• Establish forward supply agreements for pulp and bio-based coatings to stabilise prices and secure feedstock availability.
Longer return on investment (ROI) periods, particularly for SMEs, due to the significant upfront costs and uncertain regulatory timeline and scope.	• Develop diversified business models (eco-premium products, licensing of barrier technologies, recycling partnerships) to ensure resilience and quicker payback periods.

RISK ASSESSMENT & MITIGATION

REGULATORY AND LEGAL RISKS & MITIGATION STRATEGIES



MAIN RISKS	MITIGATION STRATEGIES
Evolving and fragmented regulatory landscape in the EU, with different national interpretations of PPWR, FCM, and recyclability criteria before full harmonisation.	Engage proactively with regulators and industry associations (European Commission’ discussion groups, 4evergreen, national authorities) to anticipate compliance requirements and influence harmonised standards.
Uncertainty around the implementation timeline of the PPWR and associated reuse/recyclability obligations, which may delay investment decisions.	Implement robust regulatory monitoring systems, including third-party certification for recyclability, food safety (FCM), and labelling claims.
Complex food contact compliance for fibre-based materials using new sustainable materials, requiring extensive toxicological and migration testing.	Invest in material R&D validated under EU-recognised testing methods (JRC, BfR, EFSA), ensuring alignment with future FCM updates.
Risk of greenwashing or misleading claims, as communication on “plastic-free”, “biodegradable”, or “recyclable” claims is increasingly monitored by authorities.	Develop transparent communication protocols to substantiate environmental claims, reducing reputational and legal risks (aligned with EU Green Claims Directive).
Extended Producer Responsibility (EPR) and eco-modulation fees may evolve unpredictably, affecting the financial viability of substitution models depending on national fee structures.	Integrate EPR and eco-modulation scenarios into business planning to anticipate fee variations and maintain economic competitiveness under multiple national systems.

RISK ASSESSMENT & MITIGATION

SOCIAL AND BEHAVIOURAL RISKS & MITIGATION STRATEGIES



MAIN RISKS	MITIGATION STRATEGIES
Perception of lower product quality or premium pricing due to fibre-based packaging design, creasability, more complex printability and reduced transparency.	• Use behavioural insights and co-design sessions with consumers to refine design, usability, and value perception; communicate environmental performance using certifications (EU Ecolabel, FSC).
Consumer resistance to change, especially for products where packaging aesthetics, transparency, or perceived freshness are key purchasing factors.	• Launch consumer awarness campaigns highlighting fibre packaging benefits, recyclability, and environmental impact through in-store visibility, online communication, and clear on-pack labelling.
Limited consumer understanding of the differences between “recyclable”, “compostable”, and “bio-based” packaging, leading to confusion and mis-sorting.	• Develop clear and harmonised communication tools and collaborate with NGOs or consumer associations to validate claims and improve public trust.
Workforce adaptation challenges in production, logistics, and retail — staff require new skills for handling, storing, and communicating about paper-based packaging.	• Training programmes for company and retail staff to manage new materials correctly (storage humidity, labelling, sorting) and inform customers accurately.

4 - ROADMAP



Funded by
the European Union

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TRANSITION ROADMAP : FROM R&D TO MARKET INTEGRATION

The roadmap outlines the progressive transition toward large-scale adoption of **circular packaging models**, structured into four key implementation periods:

1. **R&D phase** is dedicated to material innovation, performance validation, and feasibility studies.
2. **Experimentation phase** where technical and logistical adjustments are tested under real conditions within a limited perimeter and consumer acceptance is evaluated.
3. **Industrial scale-up** focuses on expanding production capacity, optimising costs, and strengthening supply chain integration by expanding the scope and reinforcing consumer engagement.
4. **Integration and generalisation phase** aims for full market adoption, standardisation, and harmonisation across the value chain.

This stepwise approach reflects the time, financial investment, and continuous R&D efforts required to transition effectively from single-use plastic packaging to sustainable reuse and substitution solutions.

The following roadmaps are based on knowledge, interviews with stakeholders in the value chain, and results from tests and field experimentation conducted as part of the R3APCK project. They represent a projection of what the implementation of reuse and substitution solutions could look like in the coming years.

This projection will need to be updated in light of regulatory developments in the coming years. To ensure that regulations best facilitate the adoption of sustainable packaging, the R3PACK project proposes regulatory recommendations in deliverable D7.3.

Finally, these changes towards sustainable packaging solutions require significant financial investment from actors in the value chain (manufacturers, machine manufacturers, distributors, operators, etc.) to cover all the investments needed between the R&D and scale-up phase to achieve economically and environmentally viable models. Value chain players therefore need financial support from public authorities (at national and/or European level) to scale up these sustainable solutions.

REUSE ROADMAP FOR REDUCING SINGLE-USE PLASTIC PACKAGING

	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10
THEMATIC AREA	R&D PHASE (YEARS 1-2)		PILOT EXPERIMENTATION (YEARS 2-4)		SCALE-UP PHASE (YEARS 4-6)		INTEGRATION & GENERALISATION (YEARS 6-10)			
PACKAGING DEVELOPMENT	- Design of standardised reusable formats (plastic, glass). - Validation of food safety & washing compatibility. - LCA and material durability testing.		- Industrial pilots with producers/retailers. - Optimisation of design, sealing, labelling, and traceability systems. - Harmonisation of packaging design across industry players.		- Large-scale perimeter (increase in the number of products and shops). - Continuous improvement of packaging.		- Market-wide standardisation of packaging families at EU level. - Full interoperability between reuse stakeholders.			
ADAPTATION OF PRODUCTION TOOLS	- Feasibility studies for line adaptation (filling, sealing, IT). - Identification of required machine modifications.		- Integration of first process adjustments. - Use of a pilot line for small volumes of packaging.		- Optimisation of high-speed lines for reusable packaging. - Conducting R&D on reuse by machine manufacturers		- Investing in packaging lines dedicated to reuse. - Machine manufacturers offer a range of machines entirely suited for reuse.			
WASHING OPERATIONS	- Definition of hygiene and microbiological standards. - Tests on packaging selected. - R&D on processes to validate washing protocols.		- Washing of packaging from experimentation (real conditions) - R&D on washing efficiency		- Investment on plastic washing lines. - Scale-up of multi-client washing hubs near logistics centres.		Harmonised EU washing certification scheme on glass and plastic.			
SUPPLY CHAIN & LOGISTICS	- Select the players in the value chain - Validate the logistics model, the information and financial flows. - Test the loop to validate the cost, lead time and return rate - Identify bottlenecks and optimisation levers		- Deploy multiple operational loops, optimise routes - Conduct a technical-economic study to identify levers at scale - Strengthen data governance		- Adapt the logistic network to larger volumes (capacity, dedicated hubs, pooling) - Automate selected steps (sorting, preparation) - Integrate advanced digital tools (forecasting, real-time traceability)		- Cross-country interoperability and efficiency optimisation. - Optimize overall efficiency : cost, CO2 per rotation, service level - Generalize pooling model across brands & retailer			
CONSUMER & MARKET INTEGRATION	- Development of communication & engagement strategies. - Prepare consumer studies to be carried out during the pilot phases.		- Set up in-store communication. - Conduct consumer studies to identify levers for optimising communication. - Organise in-store events for consumers and training sessions for staff to raise awareness of reuse.		- Update communication using the identified optimisation levers. - Standardise reuse messages for consumer communication materials.		Adoption of reuse by consumers as the norm.			

SUBSTITUTION ROADMAP FOR REDUCING SINGLE-USE PLASTIC PACKAGING

	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9	YEAR 10
THEMATIC AREA	R&D PHASE (YEARS 1-2)		PILOT EXPERIMENTATION (YEARS 2-4)		SCALE-UP PHASE (YEARS 4-6)		INTEGRATION & GENERALISATION (YEARS 6-10)			
PACKAGING DEVELOPMENT	- Research on materials, their combination and new technologies to improve: 1) barrier performance (liquids, grease, oxygen, humidity), 2) the contribution of transparency to paper material 3) paper ratio 4) biobased content 5) composting / biodegradation. - First validation of food product integrity and machinability (aging, sealing tests).		- Industrial pilots with low barrier or dry products (crackers, biscuits, crisps, prepared fruits and vegetables). - Improvement of coatings and sealing reliability. - First recyclability and compostability tests under PPWR standards.		- Extension to medium-barrier products (grated cheese, yoghurt, semi-dry food). - Integration of transparent or hybrid paper structures for visibility. - Real-world testing in sorting facilities. - Support and accompany industrialisation of effective barrier materials and technologies.		- Mature fibre-based portfolio adapted to most food categories. - Fully recyclable and industrially validated materials. - Widespread market availability supported by harmonised EU sorting and recycling infrastructure.			
ADAPTATION OF PRODUCTION TOOLS	- Research focused on high-speed, efficient industrial machinery adapted to flexible and rigid paper-based packaging (ex: form-fill-seal configuration for yoghurt). - Early testing of sealing jaws, tension controls, and sensors.		- Installation of pilot retrofit kits on existing plastic lines. - Pilot trials on form-fill-seal equipment with paper substrate - Training of maintenance teams and operators. - First AI-assisted monitoring for sealing quality and waste reduction.		- Large-scale equipment retrofitting and optimisation for paper packaging speed and waste control. - Integration of new vision and sealing systems adapted to paper stiffness.		- Standardisation of fibre-ready equipment across the industry. - Reduced maintenance costs and convergence toward hybrid lines handling both paper and plastic.			
CONSUMER & MARKET INTEGRATION	- Consumer testing for acceptance of opaque or translucent packaging solutions for fresh products. - Market analysis of willingness to pay for eco-friendly formats. - Brand communication strategy development.		- Launch of first in-store tests with ready food products. - Adjustments to design and communication to improve perception and handling.		- Market penetration in mainstream categories supported by improved aesthetics and transparency features (salad, cheese, prepared fruits and vegetables). - Retailer partnerships for category-wide substitution.		- Fibre-based packaging becomes a market norm. - Brand value reinforced by full alignment with consumer expectations and sustainability commitments.			

VII / CONCLUSION

CONCLUSION

This deliverable brings together the **strategic, technical, and economic elements required by all stakeholder** of the value chain to support the transition toward circular packaging systems in Europe. The analysis shows that both **reuse models and fibre-based substitution** offer encouraging pathways to reduce single-use plastic if deployed under the right conditions. However, **various and complex challenges remain** to reach economically and environmentally sustainable models. Reuse systems show strong potential only when high return rates, shared logistics, standardised formats and strong consumer engagement are achieved. Fibre-based solutions offer faster adoption for some food categories where machinability, barrier performance, and recyclability are validated.

In addition, it also provide a **roadmap** for the development of circular packaging. Early steps require consolidating pilots, strengthening technical performance, and aligning stakeholders on governance models if not national and international planification. In the medium term, industrial integration, cross-sector partnerships and consumer education and engagement become essential to reach cost parity. At scale - with coherent regulatory frameworks, widespread and harmonized communication and mature infrastructure - reusable and fibre-based packaging could coexist as complementary and realistic solutions.

Across all scenarios, the key determinants of success are the ability of market actors to coordinate around **stable rules, harmonised standards and, and efficient infrastructure**. Likewise, **consumer engagement** remains central to the success of all scenarios. Uptake increases most significantly when consumers perceive a **clear economic benefit**, supported by **environmental** advantages and solutions that are **convenient**. Communication strategies that clearly convey these benefits, combined with large product ranges that reach critical mass and affordable options or direct financial incentives, are essential to accelerate the widespread adoption of new behaviors.

The actual economic model, both for reuse and substitution, confirms that **dedicated financial supports**—such as investment in R&D activities, as well as in production infrastructure and consumer— is required to assist the various stakeholders to shift toward more sustainable packaging solutions.

Overall, this deliverable provides keys for action that should ensure the evolution of sustainable packaging from a promising innovation to common practice across the single market.