FEFCO Corrugated Packaging x Circul'R

Circularity in Action & Strategic Blueprint for the Corrugated Board Industry

Executive Summary



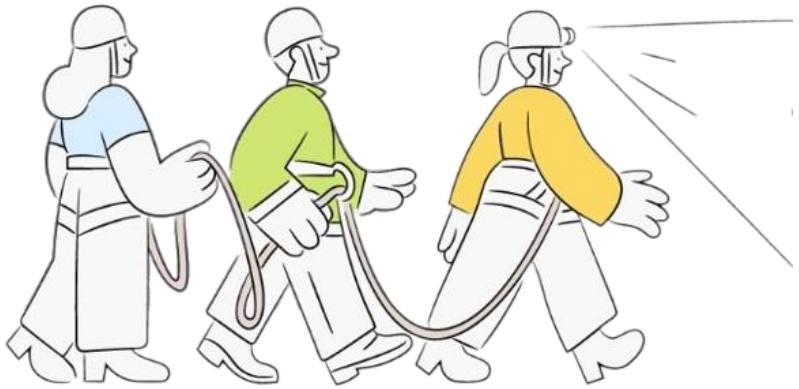
JAN - SEP 2026

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Study Context & Disclaimer



This study was developed between **January and September 2026**.

The objective of the project is to evaluate the circular model of corrugated cardboard through an aggregation and assessment of existing industry documentation. This includes a strong focus on **recycling** while taking a broader perspective on the overall circular system.

The analysis is grounded in documented **impact analyses** and **stakeholder input**, aiming to identify the **strengths and gaps of the circular model**. Documents leveraged for the analysis were mostly provided by FEFCO (please see *methodology*, *caveats* across cases, and Appendix - *bibliography*). The document highlights areas where additional data or methodological work may be required (please see Appendix - *proxies*).

A third-party review is planned to ensure the analysis's robustness and objectivity.

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Executive Summary

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Advancing FEFCO's strategic objective

on corrugated cardboard circular performance and policy credibility through this report



Assessing the **circularity** of corrugated cardboard's recycling loop

Provide an **evidence-based** assessment of corrugated cardboard's recycling loop, considered alongside alternative packaging solutions.



Defining the **tipping points** for optimal circularity

Determine the conditions under which packaging delivers **optimal circularity performance** and identify opportunities for future development.



Position the sector in policy and market debates

Deliver a **fact-based output for FEFCO members** and to inform EU policy debate, supporting harmonised European criteria grounded in verifiable industrial data

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A data-driven and industry-backed study on corrugated cardboard circularity

INPUTS

50+ **Documents** analysed

5 **Interviews** with industry experts

15 **Stakeholder consultations** with FEFCO leadership & members

SCOPE

3 **Case studies** determined

(B2C e-commerce, B2B Transport, B2B Food & Beverage) to assess the circularity performance of corrugated cardboard across specific use cases, including, for each:

- Mapping their value chains & key industry data
- Identification of priority alternative packaging scenarios

EVALUATION

9 **Categories of KPIs developed**

- Environmental performance
- Operational & Functional performance
- Policy alignment

11 **Key Performance Indicators (KPIs)**

across the above categories used to measure corrugated cardboard circularity, and compare it to the alternative scenarios

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Definition of 3 corrugated cardboard use cases and their alternative reuse scenarios…



#1 E-COMMERCE PACKAGING



#2 TRANSPORT PACKAGING (EXCL. F&B)



#3 FOOD & BEVERAGES (F&B)

SCOPE

- Delivery of goods from the producer or retailer directly to the consumer
- Focus is on the **B2C** segments of e-commerce only
- **~7% of total production** (in m²)*A

- Transport purposes (FMCG*B, logistics, long lasting goods etc.) excluding F&B
- Focus is on **B2B**, secondary & tertiary
- **~29% of total production** (in m²)*A

- Corrugated packaging for food & beverage, including fresh produce, dairy, processed food and beverages
- Focus is on **B2B** only
- **~51% of total production** (in m²)*A

ALTERNATIVE SCENARIO

Reusable shipping boxes, briefs and crates, rigid or flexible, in **fibre-based** (paper, corrugated) **or plastic**

Reusable plastic crates (RPC) HDPE/PP

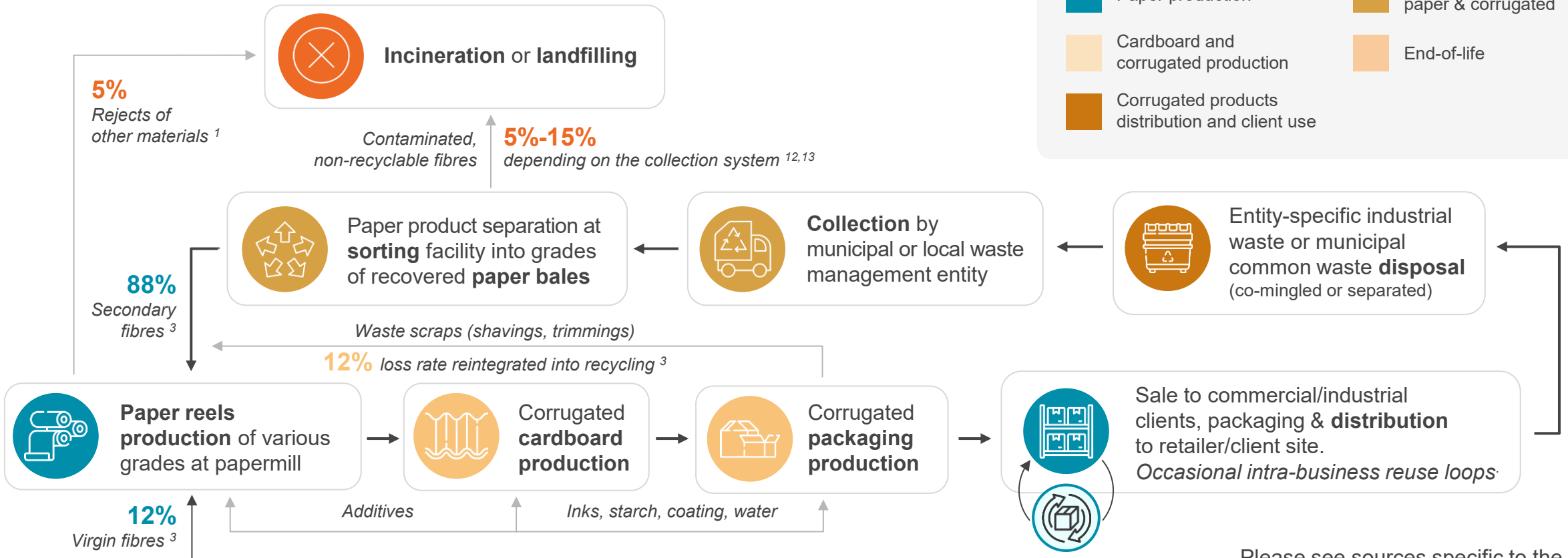
Reusable plastic crates (RPC) HDPE/PP

NOTE Alternative scenarios reflect current "as-is" performance. Sensitivity analysis modelled specific directional scenarios (e.g., recycled or bio-based content, reuse-loop maturity) as estimates - actual future performance may still diverge as R&D and innovation continue.

* A: of around 49 billion m² of corrugated products manufactured each year in EU (see source n°2 in the appendix). The three cases represent ~87% of the European corrugated market; the remaining ~13% relate to the categories “paper products” and “other products excl. sheets”| B: Fast-Moving Consumer Goods (FMCG)

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…To determine **value chains** and associated key industry data …



*Please note that this is a **simplified version** of the B2B Transport value chain; the full versions are available for the respective cases studies*

Please see sources specific to the executive summary on page 15

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3 key findings confirm corrugated circularity, complementary reuse potential, and structural limits of plastic alternatives

Corrugated cardboard operates a mature circular model

The KPI analysis shows that corrugated cardboard operates a **mature, high-performing, and competitive** circular system today in Europe.

Accordingly, **corrugated outperforms alternative scenarios** on overall circularity across all three use cases assessed.

These results should be read in the context of a comparison between a mature system and emerging alternatives still under development (e.g. the range of reusable e-commerce solutions).

Plastic crates carry an environmental disadvantage

Reusable plastic crates (RPC) - considered the alternative scenario to corrugated cardboard in the B2B Transport and Food & Beverage case studies - currently present a environmental disadvantage (fossil-based material, recycled content rates, lifecycle emissions, end-of-life treatment).

To date, the lower environmental performance and evolving policy alignment (recycling at scale and a financially viable secondary material market), are **not offset by RPCs reuse and their competitive operational performance.**

Packaging recycling and reuse function credibly in parallel

Results across use cases and materials confirm that no single model fits all applications, and that reuse and sustainable recycling are **complementary**.

In the B2C e-commerce case, performance varies notably depending on the material (plastic compared to fibre-based, along with their associated properties).

Plastic crates may deliver superior performance in certain applications not covered in detail in this study.

* Circularity performance and maturity are assessed using the KPI scoring system developed in this study. Confirming an improvement potential would require dedicated company-specific circularity assessments.

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Key finding **#1**: Corrugated cardboard operates a mature **circular** model

The corrugated cardboard baseline scenario outperforms the alternatives across all three case studies.

Baseline total scores (/5)

E-COMMERCE (B2C)

3,9 vs **3,2** (alternative)

TRANSPORT (B2B)

4,3 vs **2,1** (alternative)

FOOD & BEVERAGE (B2B)

4,1 vs **2,1** (alternative)

The circular model for corrugated cardboard is **fully operational today**, not a prospective future pathway compared to reuse alternatives in development.

Corrugated cardboard achieves very strong environmental scores in Europe, driven by:

- 88% **recycled content** (on average) [1,2,3]
- Favourable 95% bio-based, certified **material origin** [3]
- Low incineration or landfill as **end-of-life treatment** (12%) [4,8]
- Lower **environmental impacts** than the studied alternative reusable packaging in B2B contexts* [4,6]

Moreover, the strong global results are underpinned by:

- A well-established **EU recycling infrastructure**
- Short and efficient **distances** between production and end-of-life treatment [4]
- A **mature secondary market** with **efficient collection systems** for paper & cardboard implemented across the EU, even with discrepancies across countries or case studies, reflected in strong long-term viability and policy resilience scores [2]

Environmental scores (/5)

E-Commerce B2C	**4,5**
Transport B2B	**5,0**
Food & Beverage B2B	**4,8**

Packaging performance shows a balanced set of pros and cons across systems, consistent with the KPI's qualitative nature. For F&B specifically, this includes moisture management, cold-chain insulation, and retail-ready design. Areas where scores are comparatively lower include **material efficiency** (weight-to-load ratio), structurally capped under this KPI framework by load size and **number of uses**, despite continued material optimisation: average basis weight has fallen from 506 g/m² to 489 g/m² since 2020, with box weight

* Please note that for the E-commerce case, the environmental impact KPI scores are non-discriminating at 3 for both baseline and alternative, due to a lack of data and high uncertainty.

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Key finding **#2**: Plastic crates carry an **environmental** disadvantage

Corrugated cardboard (CC) strongly outperforms plastic crates in the B2B Transport and Food & Beverage (F&B) use cases, largely driven by their environmental performance.

RPC environmental scores (/5)

TRANSPORT (B2B)

1,3 vs **5,0** (CC baseline)

FOOD & BEVERAGE (B2B)

1,1 vs **4,8** (CC baseline)

The operational strengths and reuse rates of plastic crates do not compensate for the environmental and recycling infrastructure limitations and associated weaker policy resilience to date.

The significantly weaker environmental performance is primarily driven by:

- **Low recycled content** in plastic packaging (10% - 40% depending on the use case) [4, 10]
- Predominantly fossil-based **material origin**
- **End-of-life treatments** are still largely relying on incineration or landfill

These factors are further linked to **policy alignment** scores reflecting that PP and HDPE **recycling capacities** remain comparatively underdeveloped. As a result, to date, recycled plastic remains significantly more **expensive** than virgin plastics, thus not supporting the creation of a financially viable secondary material market as envisioned with the CEA.

Operational Performance Scores (/5)

	Transport	F&B
Baseline (CC)	**3,0**	**2,8**
Alternative (RPC)	**3,0**	**3,3**

RPCs illustrate mixed operational performance across the following factors:

- **Transport distances** structurally disadvantage plastic solutions today, which rely on petrochemical feedstocks sourced from the USA or the Middle East [4,5]
- **Packaging performance** (adaptability, etc.) is broadly on par with corrugated, and RPCs offer strong durability across repeated logistics trips. However, folded corrugated (6–10mm) is 7–11× thinner than a folded RPC (70mm) when empty, creating a structural space and cost disadvantage for reverse logistics that persists regardless of reuse-loop maturity.
- Plastic crates perform well in terms of the **number of uses**, which positively affects **material efficiency** (weight-to-load ratio divided by the times of use) [7]

* RPC = Reusable plastic crates (HDPE/PP) | CC = Corrugated Cardboard Single Use

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Key finding **#3**: Packaging recycling and reuse function credibly in **parallel**

Please see sources specific to the executive summary on page 15

The findings support the parallel development of reuse systems and high-performing recycling models, aligned with EU policy objectives on recycling capacity and secondary material markets.

Policy alignment scores (/5)

5,0 for the baseline across the three use cases;

for the alternatives:

3,3 - **E-COMMERCE (B2C)**

2,0 - **TRANSPORT (B2B)**

Differences across use cases and materials confirm that reuse and sustainable recycling are complementary rather than mutually exclusive, building on the strengths of existing corrugated systems while enabling targeted innovation where it delivers value.

In B2C e-commerce, results show notable performance differences depending on the material:

- Due to the diversity of low-adoption reuse solutions, the core analysis bundled reusable alternatives made of plastic, paper, and corrugated cardboard.
- When isolating fibre-based reuse solutions, these perform better than plastic alternatives under current conditions, maintaining environmental performance and policy alignment scores similar to the baseline.

Reusable plastic crates are also expected to deliver strong circular performance for specific applications, provided hygiene conditions are met and associated logistics and resource consumptions are well-managed.

Environmental scores (/5)

Baseline (CC)	**3,9**
Alternative (plastic & fibre)	**3,2**
Alternative (fibre only)	**4,3**

While not covered in detail in this study, examples include:

- Closed-loop or controlled logistics systems with high rotation rates and efficient recovery
- High-frequency reusable applications such as beverage crates in hospitality or similar standardised returnable flows.

Finally, the study notes that reuse loops are not yet optimised and that plastic recycling is expected to improve over the coming years in line with upcoming legislation (see next slide).

* Please note that for the E-commerce case, the environmental impact KPI scores are non-discriminating at 3 for both baseline and alternative, due to a lack of data and high uncertainty.

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Strategic recommendations to FEFCO and its members

Build from strength, communicate with evidence

Corrugated cardboard **already demonstrates strong circularity performance** today: high recycled content, high recyclability, and a short, localised value chain. The strategic principle that follows: any shift toward alternative packaging systems should be justified by **measured comparative performance**, not by the assumption that reuse is inherently more circular. A reusable solution that isn't actually reused at scale delivers less value than a recyclable material effectively recycled in a closed-loop system. Getting this **message** and mastering its **nuances** right matters too: a member **advocacy toolkit** is available to members to support clear, accurate messaging on corrugated's strengths.

Invest to stay ahead in the reuse economy

The regulatory tailwinds will lift whichever material moves first. Corrugated enters this race with **structural advantages**: lighter weight, adaptability, a proven high-performing end-of-life, and native alignment with recycled-content requirements - but advantages only convert into outcomes through **sustained R&D investment**.

Turning aggregate sector strength into targeted company-level action

FEFCO's role in shaping favourable regulation remains essential - and its impact multiplies when paired with measurable operational improvement. Sector-wide performance is strong in aggregate. Company-level performance varies, and company-specific assessments allow individual members to identify and capture further gains. These may relate tool:

- **Material sourcing**; **energy** sourcing and consumption; **design**-for-recycling compliance
- **Operational factors**: logistics and process optimisation, maintenance and repairs/ retrofit, reuse, reconditioning, reverse logistics, waste management
- **Strategy**, governance, **training** and awareness, **innovation**, and industry-wide collaboration

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Sources for the executive summary

This source section only highlights an extract of sources associated with figures mentioned in the executive summary. Please see the full list of sources used for this study in the appendix.

1. FEFCO x Cirpack - Recycling Performance Of Corrugated Cardboard In Europe (March 2026)
2. FEFCO - Annual Statistics (2024)
3. RISE Bioeconomy x FEFCO x CCB - LCA Report: European Database For Corrugated Board Life Cycle Studies (2023)
4. FEFCO x Ramboll - Comparative Life Cycle Assessment (LCA) Packaging Solutions For The Food (2022)
5. FEFCO x Ramboll - Hot-Spot Analysis Of E-Commerce Logistic Chain Single Use Vs Reusable Solutions (2022)
6. Ecoinvent 3.10
7. Deloitte x FEFCO - Case study analyses: Assessing impacts in the supply chain of substituting corrugated cardboard packaging with reusable alternatives (2023)
8. Cirpack - Corrugated Board Recycling Rate Verification (2023)
9. Packaging and Packaging Waste Regulation (2025)
10. Plastics Recyclers Europe x ICIS - HDPE & PP Rigids Market In Europe - State Of Play (2023)
11. European parliament - Briefing: Circular Economy Act (January 2026)
12. FEFCO x Recycle ME - Study for FEFCO: Sorting performance of corrugated packaging in Europe (July 2025)
13. DS Smith - Wasted Paper - A path to better recycling

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#Circular byNature

ABOUT FEFCO

FEFCO (European Federation of Corrugated Board Manufacturers) represents the interests of the European Corrugated Board Manufacturers. Headquartered in Brussels, FEFCO has 16 Association members, all European national corrugated packaging organisations. The role of the Federation is to investigate economic, financial, technical and policy issues of interest to the corrugated packaging Industry, to analyse all factors which may influence the industry, and to promote and develop its reputation.

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www.fefco.org