

Recycling vs Reuse for Packaging

Bringing the science to the
packaging debate

Recyclable corrugated packaging outperforms reusable packaging overall on environmental indicators, demonstrated by peer-reviewed study.

FEFCO OVERVIEW OF STUDY RESULTS – MAY 2022



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Overview of results from three studies commissioned by FEFCO – the European Federation of Corrugated Board Manufacturers – conducted by the independent consultancy Ramboll, and research institute VTT. The studies evaluate the impact of corrugated board packaging compared to reusable plastic packaging.





INTRODUCTION

FEFCO commissioned **three studies in 2021** aiming to better understand the environmental impact of packaging solutions and to provide scientific evidence to support the policy discussion on packaging and packaging waste in the context of the **EU Green Deal**.

The studies were conducted by the independent consultancy, Ramboll, and research institute, VTT, and evaluate the impact of corrugated board packaging compared to reusable packaging through:

- 1** A peer-reviewed **comparative life-cycle assessment** for packaging solutions for the food segment comparing the environmental impacts of corrugated boxes and plastic crates. (Ramboll)
- 2** A **hot spot analysis** of the e-commerce logistics chain evaluating recyclable corrugated packaging versus reusable options. (Ramboll)
- 3** A white paper providing a **critical view** on packaging recycling and reuse in the European Circular Economy. (VTT)

These studies provide scientific and technical evidence to support the application of the 2008 Waste Directive so that *“when applying the waste hierarchy, Member States shall take measures to encourage the options that deliver the best overall environmental outcome. This may require specific waste streams departing from the hierarchy where this is justified by life-cycle thinking on the overall impacts of the generation and management of such waste”* (Directive 2008/98/EC, article 4§2).

The efficient circulation of materials is a prerequisite for a well-performing **circular economy**, and corrugated packaging is **circular by nature**: it is made from a renewable source, recycled, and biodegradable. These three studies demonstrate that **recyclable corrugated packaging outperforms reusable packaging** overall on key environmental indicators. As such, policymakers need to consider the evidence in their current revision of the Packaging and Packaging Waste Directive.



ABOUT THE 1ST STUDY

The peer reviewed LCA study compared the environmental impacts of packaging solutions in the food segment representing recyclable and reusable packaging.

It compared business-to-business (B2B) transport of fresh food within the EU using two packaging solutions: corrugated boxes (CBs) and reusable plastic crates (RPCs).

The study was conducted according to ISO 14040 and ISO 14044 standards and peer reviewed by a dedicated panel of three independent peer-reviewers. It evaluated a basic scenario for fifteen Environmental Footprint

(EF) impact categories. Data was collected from both primary sources and secondary ones, including literature. The study includes extensive assessment of 14 different scenario (called sensitivity analysis), increasing its credibility.

The functional unit used for this study was 1 tonne of fresh produce (vegetables) over a transport distance of 840km from producer to retailer within the EU-27 (+UK), allowing the study to be representative of average food transport systems in the EU.

Average distance
840 km



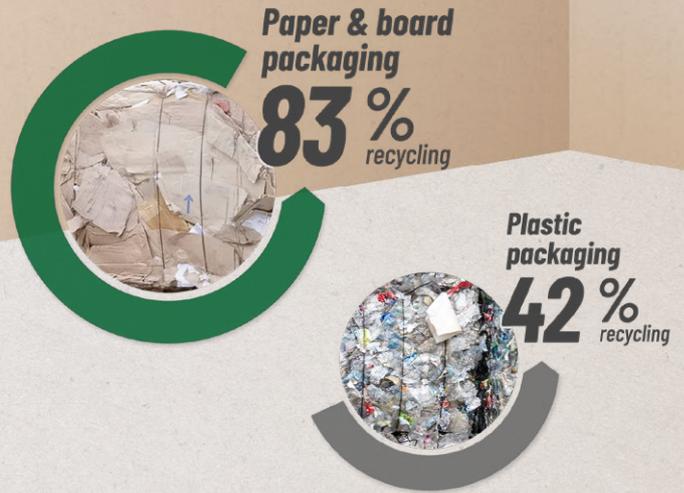
Calculations on
1 tonne
of transported
product



PAPER & BOARD PACKAGING IS A RECYCLING CHAMPION

A baseline scenario (a representative case study used as an average scenario to identify parameters, data and potential implications on B2B transportation in Europe) was used in the study. This baseline scenario used Eurostat data for end-of-life (paper & board: 83% recycling / 17% incineration with energy recovery; plastic: 42% recycling / 58% incineration with energy recovery).

The aggregated total impacts of the baseline systems were calculated for both packaging solutions.



*Eurostat EU 28 - 2018

WHAT THE STUDY SHOWED

KEY FINDINGS SUMMARISED BY FEFCO

1

Recyclable corrugated packaging outperforms plastic reuse systems on environmental impact in



Climate change



Resource use - fossils



Water use



Eutrophication fresh water

Recyclable corrugated board was more beneficial in 10 out of 15 impact categories, including climate change, resource use - fossils, water use, and other factors*.

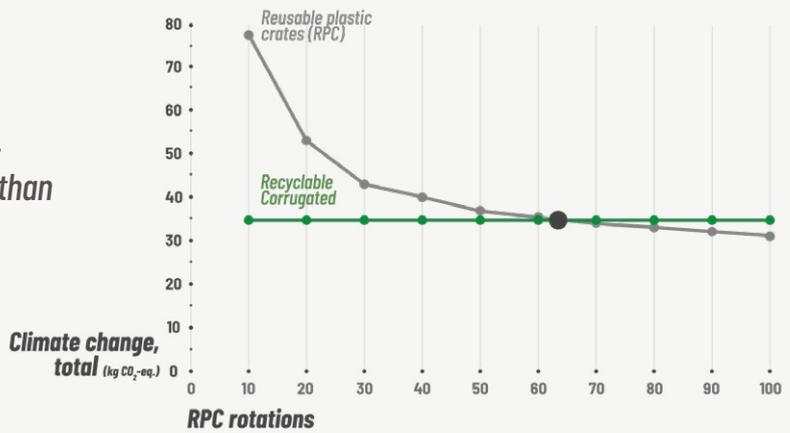
*For the full table see annex 1.

2

Plastic crates are unlikely to be reused enough to outperform corrugated trays in the climate change category.

Reusable plastic crates would need to be reused **63 Times** to be better for climate than corrugated.

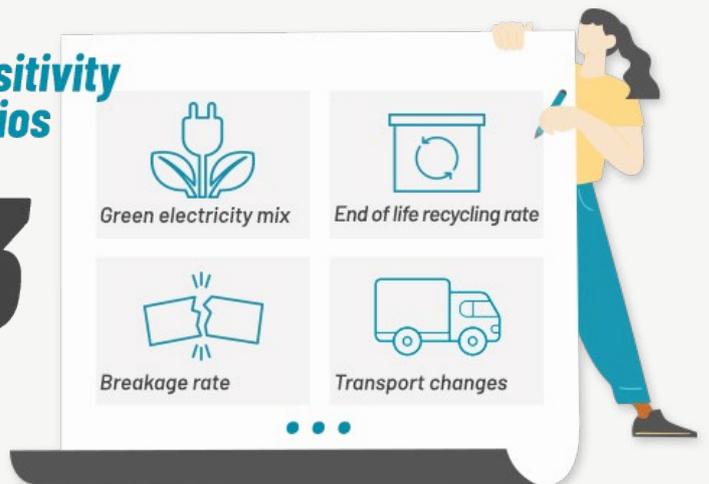
The baseline scenario considers a return rate of 24 times for reusable plastic crates based on available scientific data.



3

Corrugated packaging performs better on climate than reusable crates in different scenarios.

Out of **14** sensitivity analysis scenarios corrugated is better in **13**



Corrugated board shows better results for climate change in 13 out of 14 different scenarios, among them lower breakage rate, different recycling rate and others*.

*For the detailed results of the scenarios see annex 2.

HOT SPOT ANALYSIS

ABOUT THE 2ND STUDY

This study focused on the e-commerce supply chain in the context of business to customer (B2C) delivery of small and personal items within Europe using corrugated or plastic packaging. It identifies hot spots*, or life cycle stages, which account for a significant proportion of the environmental impact of the packaging within this supply chain.

The analysis evaluated 48 relevant scientific and commercial papers.



FOSSIL BASED
PACKAGING



CORRUGATED BOARD
PACKAGING

WHAT THE STUDY SHOWED

51 hot spots were identified and grouped into 9 thematic categories. The study also elaborates on possible actions for innovation and improvement of the top 15 highest ranking ones. The top 3 highest ranking hot spots are below with further elaboration by FEFCO:

1 Real number of uses for reusable options

This is the most important parameter, as it was cited in 35% of the analysed sources; there is no official EU data on real number of uses and no transparent industry figures.



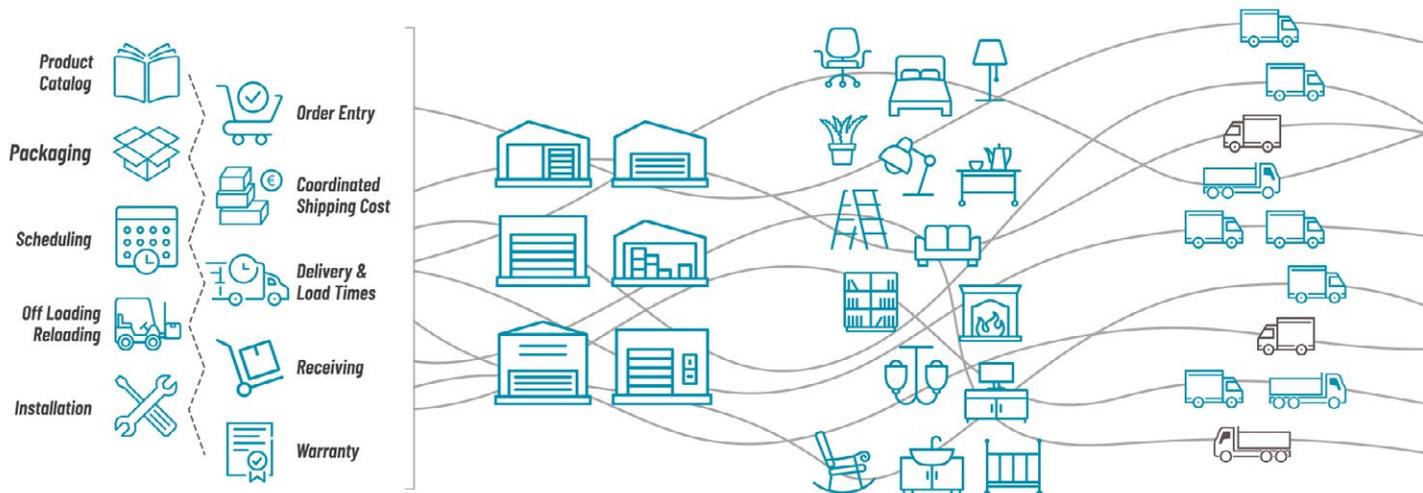
* Hot spot: A life cycle stage, process or elementary flow which accounts for a significant proportion of the impact of the functional unit.

2 Logistics parameters, including storage, transport distances, number of packages in each delivery and the need for sorting

This is the second most important hot spot cited by 31% of the analysed studies. Transport distances have a significant impact on emissions; the further a package is being transported, the higher the potential emissions related to backhauling.

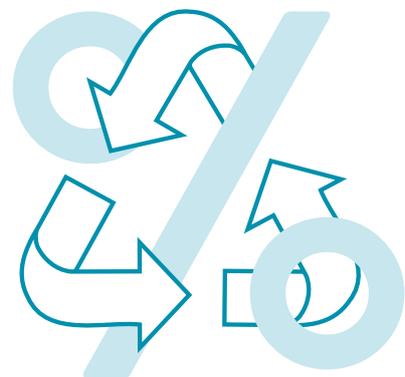
Complexity of E-commerce Logistics Supply Chain

Every decision in the logistics chain has an impact



3 Percentage of recycled material used in production

This is cited in 23% of the sources, making it the third most important hot spot. Data on recycled content of reusable packaging is unclear and generally unavailable, whereas **corrugated packaging contains on average 89% recycled content¹**.



1 [LCA Report 2018](#)

CRITICAL VIEW ON REUSE OF PACKAGING

ABOUT THE WHITE PAPER

The white paper provides a comprehensive review of existing arguments, literature, and policy on the issue of packaging recycling versus reuse.

The findings of the study stress the importance of creating legislation that incentivises functionality and sustainability of packaging.

If packaging functionality is disregarded, the product it protects runs a higher risk of being damaged. This creates a higher negative environmental impact as the environmental footprint of packaging is substantially lower than that of the packed product.



RECOMMENDATIONS

The key conclusions, summarised by FEFCO, are as follows:

The concept of 'fit for purpose' packaging should be central in EU legislation as it contributes to sustainability goals while reducing waste.

The waste hierarchy should be improved based on life cycle thinking as reusable packaging is not always the most sustainable solution.

The unintended consequence of scaling up reuse systems may be that **negative environmental impacts are simply shifted, but don't disappear.**

There is no obvious best choice when selecting between recyclable and reusable packaging solutions as results vary significantly on a case-by-case basis.

The reusable systems involve substantial economic investment and create new costs related to logistics, washing, etc. with no guarantee of success. The shift to reuse can compromise the economic value of the current well-functioning recycling system.

CONCLUSION

The three studies demonstrate that both recyclable and reusable packaging play a valuable role in the Circular Economy. They also provide evidence that there could be unintentional consequences should the EU prioritise scaling up reuse at the cost of recycling.

The peer-reviewed LCA shows that recyclable corrugated packaging outperforms the reusable options on most environmental indicators, including climate change and resource reuse.

To be truly sustainable, products need to be evaluated across their life cycle, starting with a sustainable source. Corrugated packaging comes from a renewable resource – sustainably managed forests; it is 100% recyclable and recycled in reality; and it is biodegradable – sustainability is embedded in the product already.

The efficiencies provided through the paper & board recycling value chain could be compromised if policy change disrupted this well-functioning system.

A sustainable and circular value chain for packaging in Europe that delivers on the EU Green Deal ambitions requires both recycling and reuse, working in parallel, with a “fit for purpose” approach. EU policies should incentivise sustainable packaging solutions that truly contribute to the green transition.



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ANNEX 1

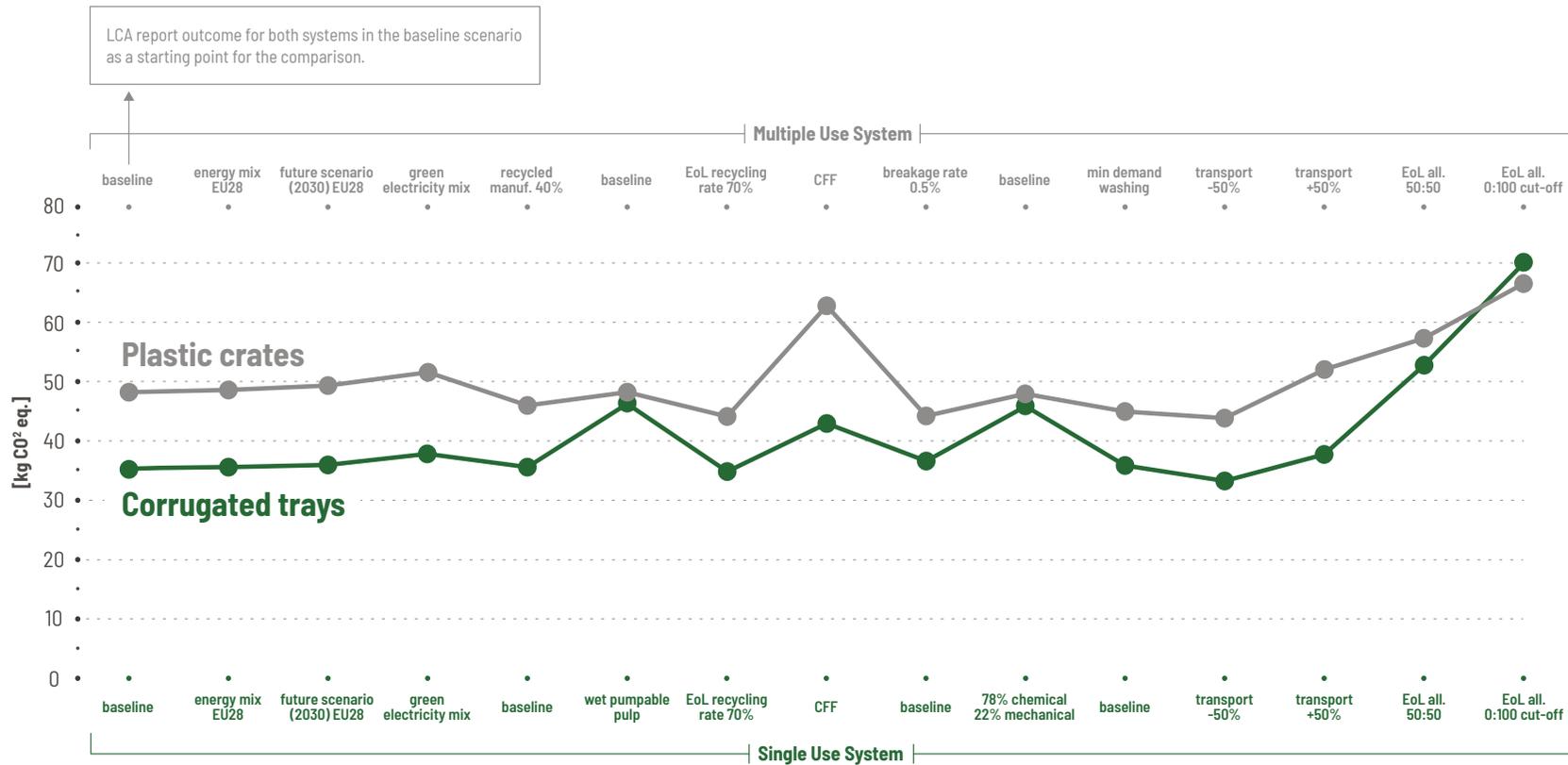
Comparison of Environmental Footprint Impact Categories - Full Table

Environmental Footprint Impact category	Single use Corrugated trays	Multiple use Plastic crates
 Acidification [Mole of H+ eq.]	0,14	0,10
 Climate change, biogenic [kg CO2 eq.]	34,70	47,94
 Ecotoxicity, freshwater [CTUe]	3,62	16,99
 Eutrophication, freshwater [kg P eq.]	-1,83E-02	1,35E-03
 Eutrophication, marine [kg N eq.]	0,11	0,05
 Eutrophication, terrestrial [Mole of N eq.]	0,97	0,39
 Human toxicity, cancer [CTUh]	-3,39E-07	3,13E-07
 Human toxicity, non-cancer [CTUh]	-5,83E-07	1,66E-06
 Ionising radiation, human health [kBq U225 eq.]	-7,03	0,68
 Ozone depletion [kg CFC-11 eq.]	-2,16E-06	1,72E-07
 Particulate matter [Disease incidences]	3,04E-06	8,00E-07
 Photochemical ozone formation, human health [kg NMVOC eq.]	0,32	0,09
 Resource use, fossils [MJ]	238,37	476,23
 Resource use, mineral and metals [kg Sb eq.]	-1,14E-04	4,15E-05
 Water use [m³ world eq.]	-13,20	10,83

ANNEX 2

Climate Change Total

Results from the 14 scenarios that compare the 2 systems

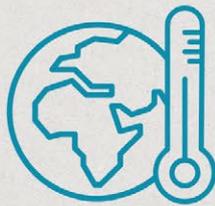


The referenced baseline scenario includes main parameters used in the 1st study like Eurostat recycling rate EU-27 UK (2018), plastic crates breakage rate of 2.5%, plastic crates reuse rate of 24 average uses and others.

Corrugated board trays outperform reusable plastic crates in

10 out of 15 environmental categories

The peer-reviewed LCA was conducted by an independent consultant according to ISO 14040 and ISO 14044 standards and peer reviewed by a dedicated panel of three independent peer-reviewers



Climate change

28%
less impact



Ozone depletion

1356%
less impact



Ionising radiation

1133%
less impact



Resource use, fossils

50%
less impact



Resource use minerals & metals

375%
less impact



Human toxicity cancer

200%
less impact



Water use

222%
less impact



Ecotoxicity

79%
less impact



Human toxicity non-cancer

28%
less impact



Eutrophication freshwater

1455%
less impact

See full study [here](#)



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