FEFCO
Corrugated Packaging

CIRCULAR BY NATURE

Case study analyses:

Assessing impacts in the supply chain of substituting corrugated cardboard packaging with reusable alternatives

An overview of the results.

Introduction

The goal of the new Packaging and Packaging Waste Regulation (PPWR) is to make packaging more circular and reduce emissions from the production, use, and end-of-life of packaging.

However, mandatory reuse targets may have unintended consequences.

Corrugated cardboard would be particularly impacted as it is almost exclusively single use.

FEFCO collaborated with Deloitte* to examine the potential impact of replacing corrugated cardboard with reusable packaging.

The result is a study
focusing on logistics aspects including transport and storage, as well as environmental impacts.

The analysis builds
on two case studies related to grouped packaging for biscuits and heavy furniture kits. The analytical model compiles insight from industry interviews and literature data to provide quantitative and qualitative insight.

To conduct the study,
Deloitte developed an analytical circular network design model. The model is based on a stylised version of the packaging supply chain that includes material producers, packaging producers, brand owners, retailers, and reuse or recycling activities to compare the current situation with the hypothetical one in which corrugated is replaced by reusable crates.

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REPLACING CORRUGATED CARDBOARD WITH REUSABLE ALTERNATIVES TO TRANSPORT:

BISCUIT CASE

BISCUIT
Case study 1

TRANSPORT

increase **+39%**

Distance per year **+0.5 billion km**

Costs per year **+0.6 billion €**

CO_2 EMISSIONS

increase **+10%**

STORAGE

increase **+41%**

SIZES

	CORRUGATED CARDBOARD BOX		REUSABLE PLASTIC CRATES
BOX LENGTH	0.58 m		0.58 m
BOX WIDTH	0.39 m		0.39 m
▶ BOX HEIGHT	0.23 m	+20%	0.27 m
BOX WEIGHT	0.65 kg		1.66 kg

FURNITURE CASE

FURNITURE
Case study 2

TRANSPORT

increase **+36%**

CO_2 EMISSIONS

increase **+31%**

STORAGE

increase **+30%**

SIZES

	CORRUGATED CARDBOARD BOX		REUSABLE PLASTIC CRATES
BOX LENGTH	1.15 m		1.15 m
BOX WIDTH	0.77 m		0.77 m
▶ BOX HEIGHT	0.60 m	+20%	0.72 m
BOX WEIGHT	3.10 kg		11.64 kg

GROUPED PACKAGING FOR BISCUITS

The first case study analyses the potential impacts of a shift from **corrugated cardboard to reusable crates** for grouped packaging of **biscuits**.

The set-up assumptions were:

Total demand for cardboard packaging:

28 million tonnes with **~5%** or **1.4 million tonnes** of cardboard used for biscuit packaging.

This equals **2.2 billion boxes.**

The study assumes:

An increase

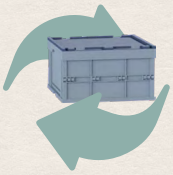
+20% efficiency loss

(bigger box) in crates due to standardisation.

+20% extra buffer

for crates (allocated using a time horizon of 4 years) to absorb supply chain abnormalities.

Reusable crate can be (re)used



25 times

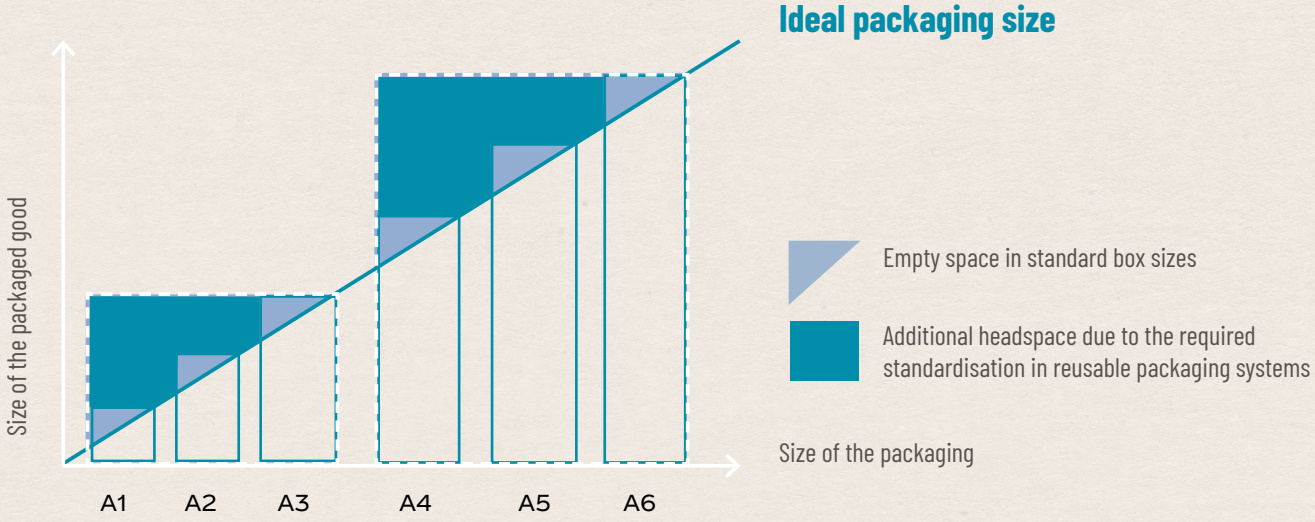


Figure: Illustration of efficiency loss when packaging has to be highly standardized

BISCUIT CASE

Impact on transport

The model compares **TRANSPORT COSTS** and the **NUMBER OF TRUCK JOURNEYS** required to ship **2.2 billion boxes of biscuits per year.**

In the case of **CORRUGATED CARDBOARD** the operation requires

1.2 billion km per year

for a total cost of

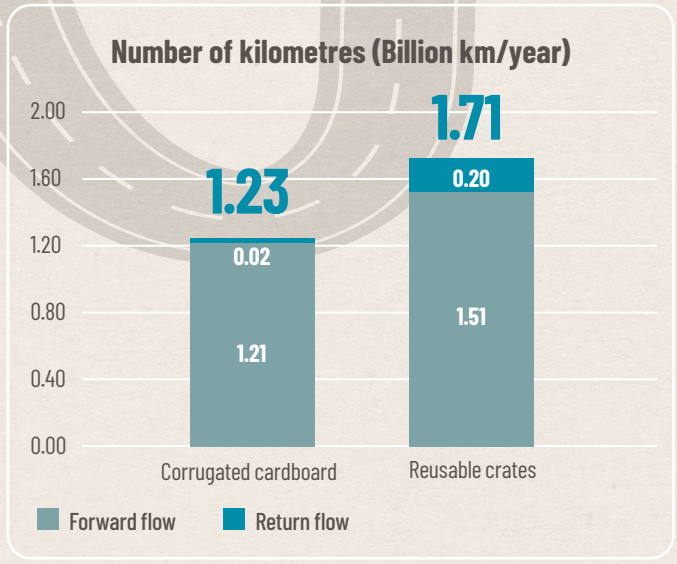
1.5 billion € per year

In the case of **REUSABLE PACKAGING** the same economic activity requires

1.7 billion km per year

for a total cost of

2.1 billion € per year



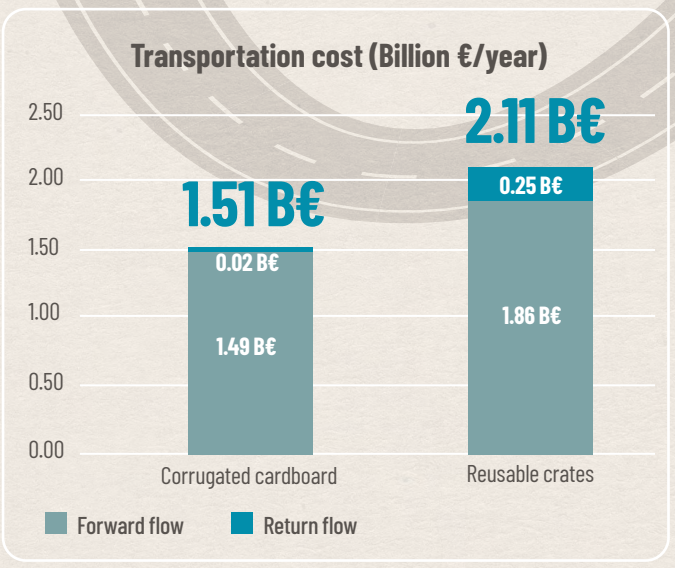


Figure: kilometres and costs of transport in the selected scenarios for grouped packaging of biscuits

Source: Deloitte internal resources

Key elements that drive the **0.5 BILLION KILOMETRE GAP** and the **39% COST INCREASE PER YEAR** include:

- ✓ Reusable crates are 20% bigger than corrugated cardboard boxes and require extra truck journeys.
- ✓ The production of corrugated cardboard is close to the biscuit manufacturer.
- ✓ Despite the need for lower quantities, reusable crates need to be produced at sufficient scale to be profitable; meaning an extra 120/200 km compared to the corrugated scenario.
- ✓ Folded reusable crates are 11x thicker than folded corrugated (and even more when you compare with compressed corrugated at end-of-life).

WHAT DOES THE SHIFT FROM CORRUGATED CARDBOARD TO REUSABLE PLASTIC CRATES LEAD TO?

Impact on emissions

The model shows an

↑ **increase** CO_2 **emissions by 10%**

which corresponds to a

↑ **40% increase** **in transport**

(driven by an increase in shipments and kilometers crossed)

and a

↓ **39% decrease** **in production**

(as the carbon footprint of plastic crates is more than **5x higher** than cardboard, reusability results in less units created, and crates are **40% heavier** than cardboard).

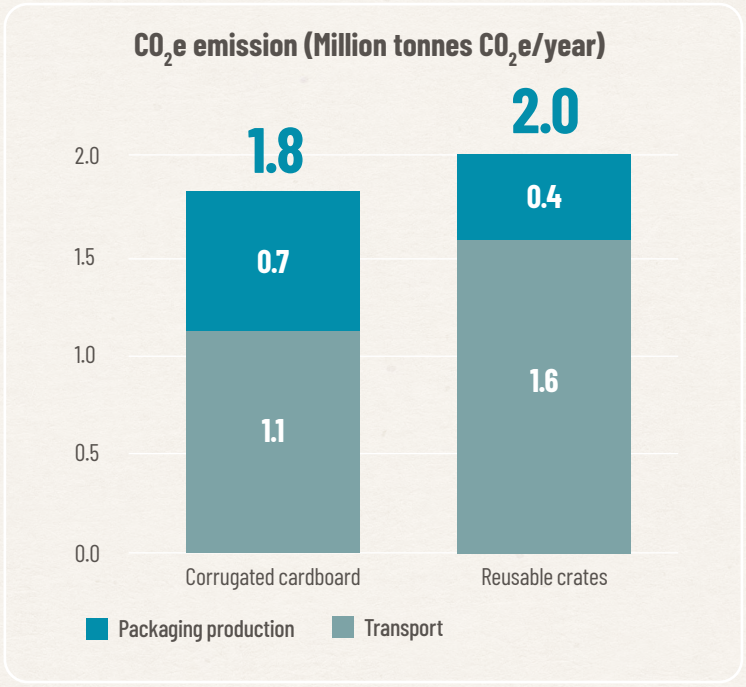


Figure: Summary graph on CO_2e emissions impact for grouped packaging for biscuits

Source: Deloitte internal resources

Impact on storage

The shift from **corrugated cardboard to reusable plastic crates** leads to:

↑ **41% increase** **in storage space needs** and a related **increase** **in storage costs.**

The need for additional storage for **reusable packaging** is driven by **packaging size and thickness**.

Plastic crates are on average shipped with

+20% more **empty space** than corrugated packaging.

PACKAGING FOR HEAVY FURNITURE KITS

The second case study analyses the potential impacts of a **shift from corrugated cardboard to reusable crates** for packaging for **heavy furniture kits.**

The set-up assumptions were:

Total demand for corrugated cardboard is estimated at:

28 million tonnes with around **0.9%** or **252 thousand tonnes** **per year** being used for furniture packaging.

This relates to **81 million furniture** kits that need to be shipped.

The study assumes:

An increase

+20% efficiency loss

(bigger box) in crates due to standardisation.

+20% extra buffer

for crates (allocated using a time horizon of 4 years) to absorb supply chain abnormalities.

Reusable crate can be (re)used

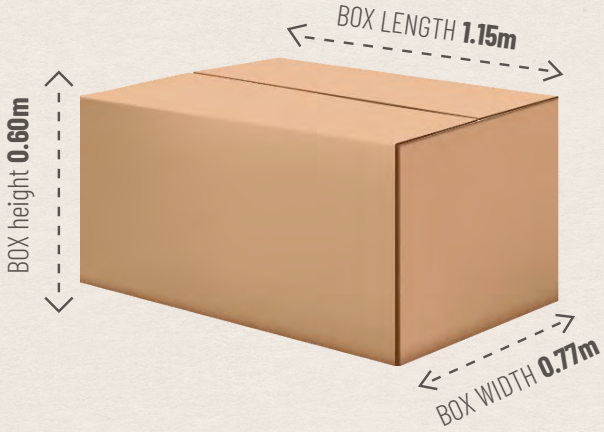
25 times

As with other products, using reusable crates leads to a **material loss in space efficiency.**

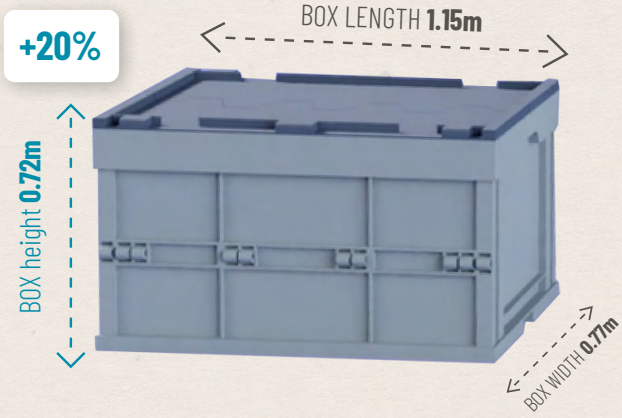
The additional **empty space** is estimated at **20%**

The most important difference with the **biscuits case study** is that the **furniture kit** goes beyond the retailer level and reaches households.

Corrugated cardboard box



Reusable plastic cretes



WHAT DOES THE SHIFT FROM CORRUGATED CARDBOARD TO REUSABLE PLASTIC CRATES LEAD TO?

Impact on transport

The model shows a

36% increase in **transport kilometres** and associated costs in case reusable packaging would be legally imposed.

33% increase in **costs** from brand owners to retailers and from retailer depots to points of sale.

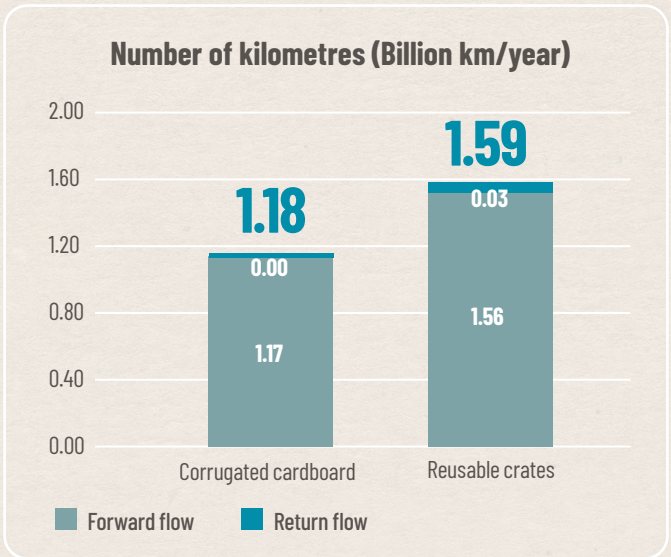
The additional **empty space** caused by the lack of customisation to the dimensions of a product and leads to an

extra 0.4 billion kilometers

because the volume available on pallets and in trucks is an important logistics constraint.

In addition, **reusable crate production** is assumed to be farther away from packers for production volume purposes (**~120 km farther**). Similarly, in the return flow, **reusing crates** leads to more nodes and slightly more kilometers (**20 km more** from end-consumer back to brand owner).

As a result, **reusable crates cross** more kilometers than **corrugated cardboard**, which benefits from its close proximity to packers.



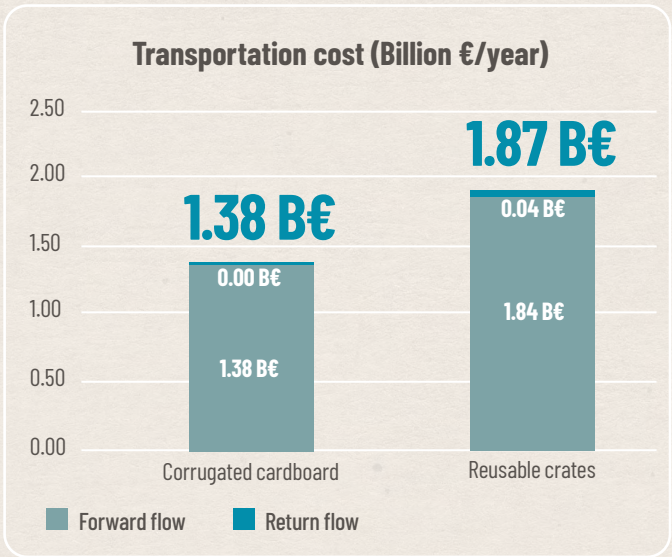


Figure: Summary graph on transport impact for packaging for heavy furniture kits

Source: Deloitte internal resources

These findings mean an **extra burden for end customers.** The analysis likely portrays an underestimation of the **direct** and **indirect costs** of a shift to **reusable packaging.**

WHAT DOES THE SHIFT FROM CORRUGATED CARDBOARD TO REUSABLE PLASTIC CRATES LEAD TO?

Impact on emissions

For **GHG emissions** the model shows an overall ↑ **31% increase**

For **transport emissions,** the model shows an ↑ **36% increase**

It is important to note that the higher **weight of the crates,** **4x higher**

the need for **additional buffer** (allocated over a 4-year time horizon) **20%**

and the **weight-based carbon footprint** **5x higher**

mean that the **production emissions** in a reuse system for **furniture kits** are only **slightly lower.**

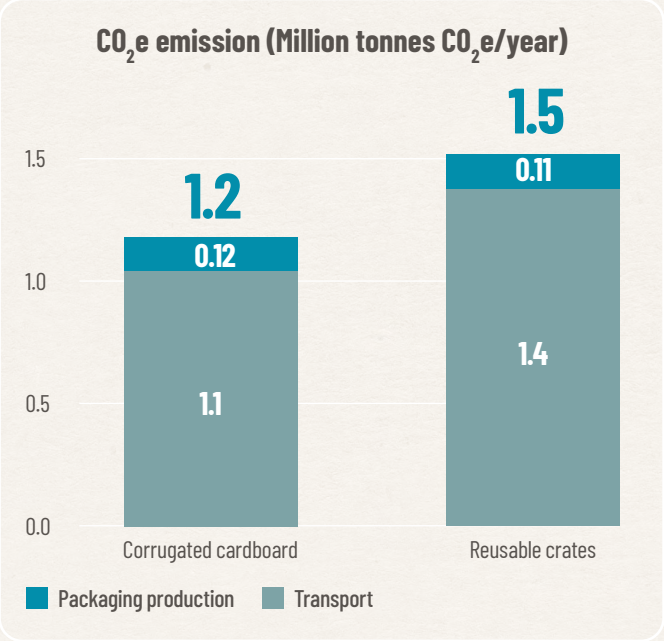
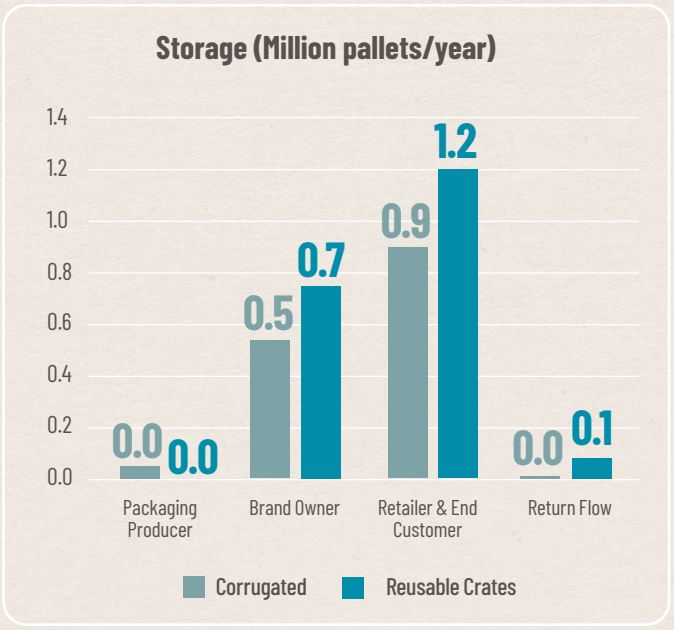


Figure 12: Summary graph on CO_2e emissions for packaging for heavy furniture kits

Source: Deloitte internal resources

Impact on storage

For **storage costs** the model shows ↑ **30% increase**



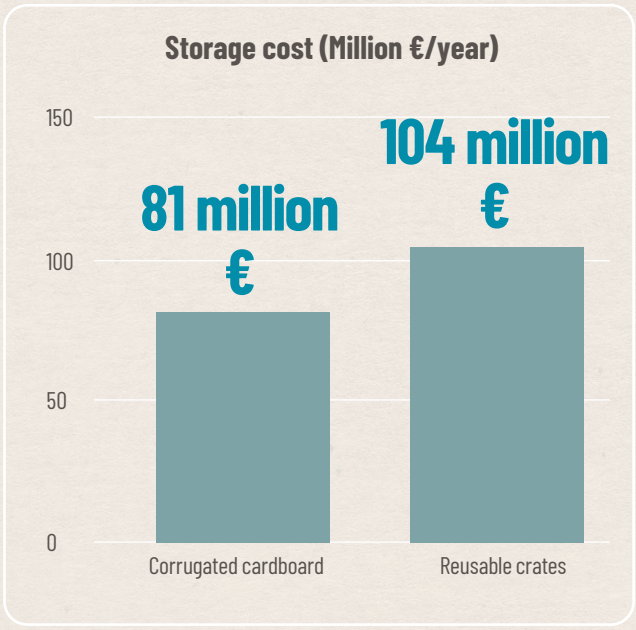


Figure 13: Summary graph on storage for packaging for packaging for heavy furniture kits

Source: Deloitte internal resources

Sensitivity analysis

A sensitivity analysis was performed to demonstrate the robustness of the study.

BISCUIT CASE

Case study 1:

THE TRANSPORT KILOMETERS and COSTS

increase by 16%

even when modifying the key assumptions.

THE STORAGE SPACE and COSTS

increase by 18%

even when modifying the key assumptions.

FURNITURE CASE

Case study 2:

THE TRANSPORT KILOMETERS and COSTS

increase by 20%

even when modifying the key assumptions.

THE STORAGE SPACE and COSTS

increase by 15%

even when modifying the key assumptions.

FOR GREENHOUSE GAS EMISSIONS,

the sensitivity analysis revealed that there is no significant difference between the two packaging solutions to favour one over the other.

Conclusions and key take-aways

The two case studies highlight the many important impacts that would take place should regulation force the market to shift from corrugated cardboard to reusable crates.

These consequences include:

Substantially
INCREASED TRANSPORT COSTS

More
EMPTY SPACE IN CRATES IN TRANSIT

Substantial
LOGISTICS CHALLENGES

DECREASED PRODUCTION EMISSIONS
because of a lower need for new crates but significantly
INCREASED TRANSPORT EMISSIONS

The need to recirculate used packaging, which
INCREASES ENERGY CONSUMPTION
for transportation, sorting and cleaning

An increased need for
TEMPORARY STORAGE FOR RETAILERS AND CONSUMERS

Practical issues, including the need to find new solutions for
SHOCK ABSORPTION AND SCRATCH PREVENTION

A decrease in
RECYCLING RATES AND RELATED CIRCULARITY ADVANTAGES

Implications for policy

Reuse is not always better than single use.

The effect of reusable packaging on forward flow is critical.

Without Europe-wide and cross-product standardisation, reuse will increase the environmental footprint of packaging instead of decreasing it.

Find out more on the Deloitte page about the case studies.

Read the full report **here**. Check our dedicated webpage **here**.

The Federation of Corrugated Board Manufacturers

General information and requests for publications: info@fefco.org

FEFCO Corrugated Packaging

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