



PRO CARTON
PACKAGING FOR
A BETTER WORLD

The carbon footprint of carton packaging 2025

Executive summary

Cradle-to-gate fossil carbon footprint

Pro Carton, the European Association of Cartonboard and Carton Manufacturers is pleased to present the carbon footprint for carton packaging.

8%

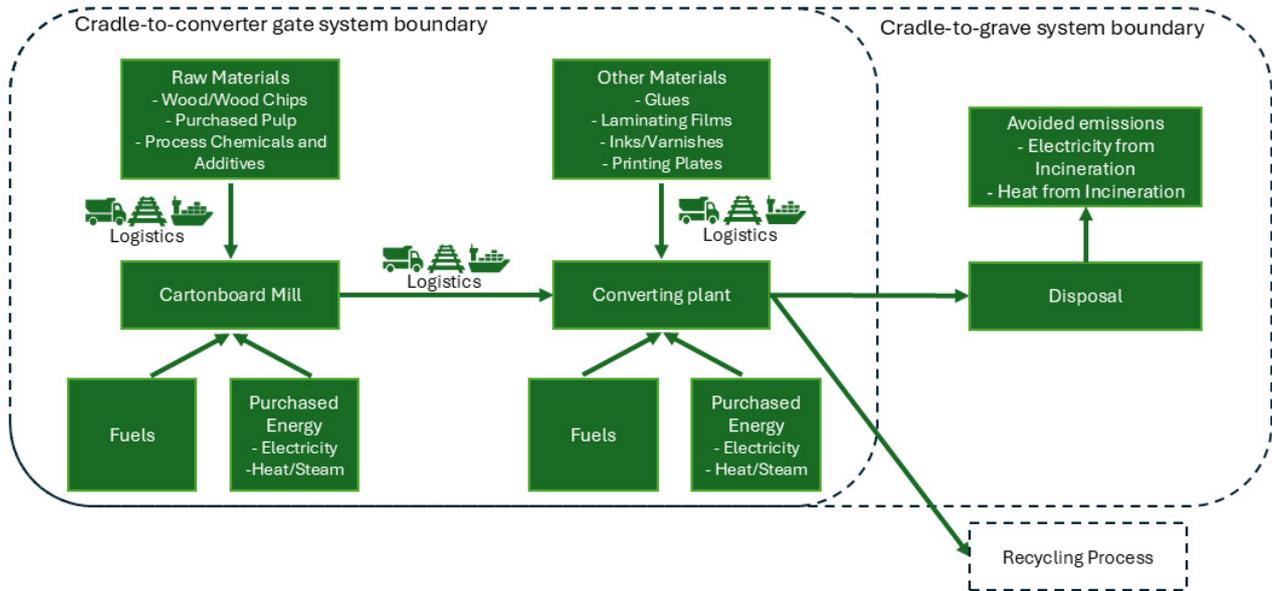
**reduction of cradle-to-gate
fossil carbon footprint
2021-2024**

From 929kgCO₂e per tonne of cartons in 2021 to 854kgCO₂e per tonne of cartons in 2024. This figure has been calculated using the latest data, and emission factors considering average European cartonboard production and carton converting processes for the market and technology situation in the calendar year 2024. The method applied is in accordance with the frameworks set out in CEPI's "Framework for Carbon Footprints for Paper and Board Products, April 2017" and the subsequent CITPA "Guidelines for calculating carbon footprints for paper-based packaging, March 2018". The calculations apply the IPCC Sixth Assessment Report (AR6) updated global warming potential values for the various greenhouse gases. The life cycle inventory data underpinning the calculations is derived from a detailed survey of the industry. Reporting sites covered 60% of cartonboard production and 16% of folding carton production (increased from 8% in the previous survey). The market share of virgin cartonboard and recycled cartonboard is assumed at 51% and 49% respectively. Converting losses are included in the calculations - 1,196t of cartonboard was assumed to be used to produce 1,000t of converted cartons.

The industry survey and the carbon footprint calculations were completed by RISE (Research Institutes of Sweden) and the raw data and calculations were independently verified by ifeu (Institut für Energie- und Umweltforschung) based in Heidelberg, Germany. ifeu has considerable experience of life cycle assessment as applied to the fibre-based packaging industry. Pro Carton makes the industry average life cycle inventory data available to commercial database providers such as Ecoinvent, Sphera, and the European Commission's Product Environmental Footprint (PEF) database, so stakeholders can use this data further in their own LCA studies.

The cradle-to-gate fossil carbon footprint demonstrates the impact of producing cartons ready for filling. However, different approaches and boundaries can be considered:

- Life cycle thinking requires that the impacts from end-of-life are also quantified. In some methods, a credit for avoided burdens from the recovery of energy for the proportion of cartons sent to incineration are considered.
- Biogenic carbon removals, biogenic carbon emissions and emissions due to land-use change can also be investigated.



The results considering these different boundaries are summarised in the table below:

	Boundaries considered ¹	Fossil GHG emissions	Biogenic GHG emissions	GHG removals	Direct land-use
2024	Cradle-to-converter's gate footprint	854kgCO ₂ e	852kgCO ₂ e	-1,874kgCO ₂ e	7kgCO ₂ e
	Cradle-to-grave footprint, including credit for energy recovery at end-of-life	824kgCO ₂ e	1,041kgCO ₂ e	-1,871kgCO ₂ e	7kgCO ₂ e
2021	Cradle-to-converter's gate footprint	929kgCO ₂ e	828kgCO ₂ e	-1,619kgCO ₂ e	9kgCO ₂ e
	Cradle-to-grave footprint, including credit for energy recovery at end-of-life	852kgCO ₂ e	1,014kgCO ₂ e	-1,619kgCO ₂ e	9kgCO ₂ e

Note: changes to results 2021 to 2024 are influenced by both trends in the industry and changes to the survey sample

About the fossil carbon footprint

A detailed analysis of the cradle-to-gate fossil carbon footprint reveals that:

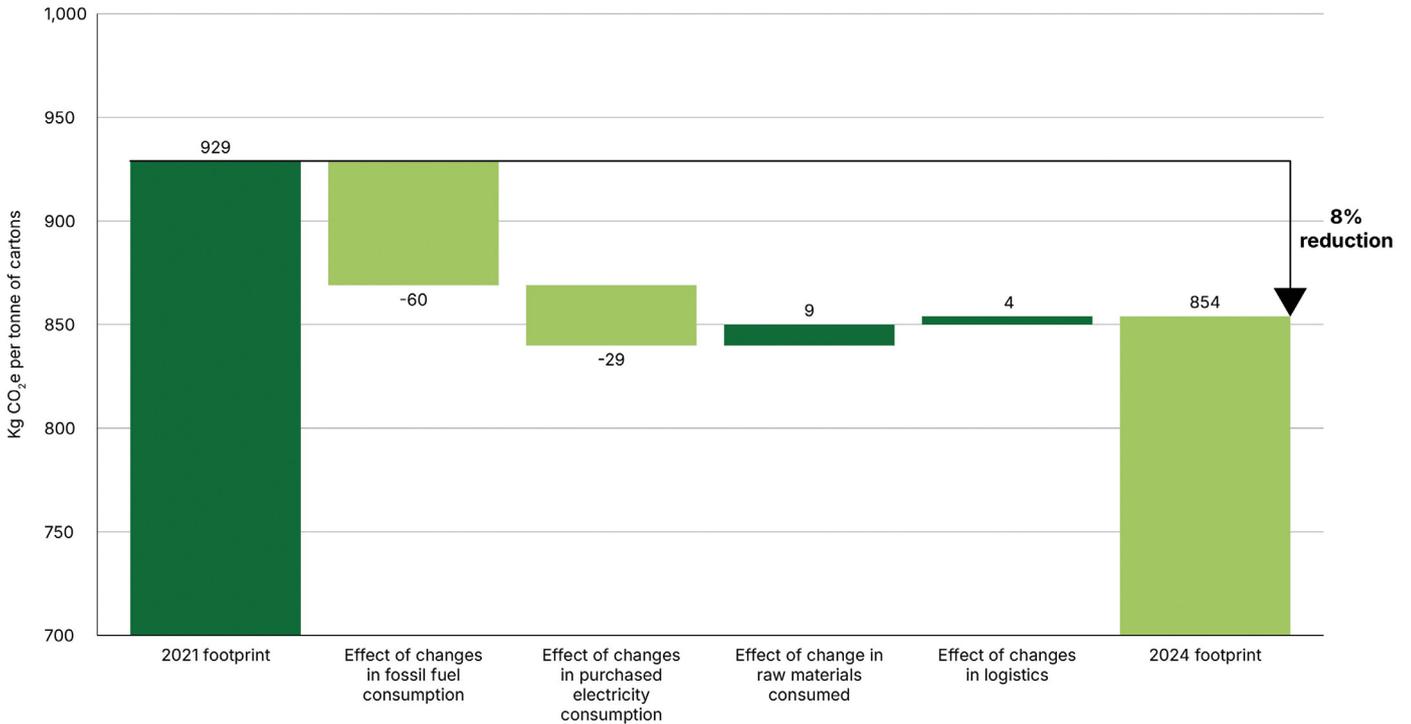
- The **production of cartonboard accounts for 73% of the fossil carbon footprint**. Emissions arising from the combustion of fossil fuels at the pulp and paper mills make the largest contribution. Emissions from purchased grid electricity consumed at the mills, production of non-fibre inputs, production of purchased fuels and production of purchased pulp are also important. Emissions associated with the transport of raw materials (wood, purchased pulp, paper for recycling, and non-fibre inputs) to the mill also contribute but to a lesser extent.
- Emissions from **the delivery of cartonboard from the mills to the carton converting facilities account for 6% of the fossil carbon footprint**
- **Converting of cartonboard into folding cartons accounts for 21% of the fossil carbon footprint**. The most important items are emissions associated with purchased electricity and the emissions associated with the production of additional materials (e.g., inks, varnishes, glues, etc). Scope 1 emissions arising from fuels consumed onsite for print drying processes and for space heating are low and account only for 2% of the cradle-to-gate fossil carbon footprint.

The substantial investments of our industry are reflected in an 8% reduction in cradle-to-gate fossil emissions compared to the last calculation taken in 2021.

¹ For more details on the system boundaries, please see the full carbon footprint statement, available on request



The reduction in fossil GHG emissions is significant.



The main drivers for the reduction are:

- Emissions from fuels consumed at the cartonboard mills and converting sites; these have been reduced by 60kgCO₂e per tonne of cartons. The reductions are mainly due to investments in renewable energy sources at the cartonboard mills. There has been a shift away from fossil fuels to biofuels for generating heat and electricity. In 2021, fossil fuels represented 46% of the fuels consumed at the mills, by 2024 the share of fossil fuels has fallen to 39%.
- Emissions from the consumption of purchased electricity at the cartonboard mills and converting sites; these have been reduced by 29kgCO₂e per tonne of cartons. The reductions are mainly due to increased purchasing of low carbon electricity. The share of low carbon purchased electricity at the mills increased from 23% in 2021 to 66% in 2024.
- In contrast, changes in raw materials consumed other than cartonboard and changes in logistics have resulted in slightly increased emissions.
- Emissions from purchased raw materials other than cartonboard at carton converting facilities have increased by 9kgCO₂e per tonne of cartons, which can be attributed to changes to the survey sample and evolution of product portfolios resulting in variations in the materials used. The emission factors applied for these inputs have also changed considerably between 2021 and 2024, with some increasing and some decreasing significantly.
- Emissions from logistics (transport of raw materials to the cartonboard mills and transport of cartonboard to the convertors) increased by 4kgCO₂e per tonne of cartons. The majority of this increase was due to a higher impact for delivery of the cartonboard from the mills to the converting sites.



About the extended analysis

The total cradle-to-grave carbon footprint of cartons has improved substantially for 2024 compared to 2021. When the extended analysis is considered:

- As a high proportion of cartons are recycled², additional impacts from waste management are negligible.
- Biogenic carbon removals are mostly associated with the growing forests which provide the fibre for the cartonboard and the biofuels consumed at the mills. The biogenic emissions are mostly associated with the combustion of biofuels at the mills. The biogenic carbon content of the product when first placed on the market is 1,577kgCO₂e per tonne of cartons.
- Land-use change emissions are very low, and are associated with the production of chemicals used in production where the extraction of specific minerals may lead to localised land-use changes. Inputs of fibres from the forest do not contribute to land-use change emissions, reflecting the fact that the fibres used in cartonboard production are sourced from sustainably managed forests in Europe. Deforestation (and emissions of greenhouse gases associated with deforestation) is not an issue that is relevant to the carton supply chain in Europe as European forests are growing in the last decades.
- Fossil GHG emissions can be calculated with a high degree of confidence, but estimating biogenic carbon removals and emissions is less precise. Quantifying biogenic removals and emissions is useful as it demonstrates that cartons are a solution which is part of the bio-based economy. However, the values should be considered as indicative of the magnitude of these emissions and removals rather than be considered as absolute values.

Definitions

Fossil emissions are greenhouse gas emissions arising from the oxidation or release of carbon originally stored in fossil sources (coal, oil, natural gas)

Biogenic emissions are greenhouse gas emissions resulting from the release of carbon that originates from biomass (recently living biological material)

GHG removals are the uptake of greenhouse gases from the atmosphere into biological systems, products, soils, or geological reservoirs (wood, roots)

Direct land-use emissions are greenhouse gas emissions resulting from changes in carbon stocks caused directly by converting land from one use to another

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² Standing at 87% according to Eurostat statistics for 2023
(<https://ec.europa.eu/eurostat/databrowser/view/ten00063/default/table?lang=en>)

