The Carbon Footprint of Carton Packaging 2019

PRO CARTON
PACKAGING FOR A BETTER WORLD

RISE Bioeconomy

PACKAGING FOR
A BETTER WORLD

PRO CARTON
PACKAGING FOR
A BETTER WORLD

Contents

Contents	3
Foreword	4
Introduction	5
Background and Methodology	6 - 10
Results and conclusions	11 - 12
Annex: Sources of Carbon Factors	13
About RISE	14

Foreword

This is the fourth version of Pro Carton's "Carbon Footprint of Carton Packaging" and forms part of a wider Environmental Data report. The report was compiled and written by RISE (Research Institutes of Sweden), the raw data was also verified by ifeu (Institut für Energie- und Umweltforschung) based in Heidelberg, Germany.

It provides a new calculation of the carbon footprint for cartons using the latest industry guidelines and in line with ISO standards, and as such it is not directly comparable with previous studies.
It is encouraging to note that the carbon footprint for cartons continues to come down and cartons are, without doubt, one of the most environmentally-friendly forms of packaging there is.

Tony Hitchin, General Manager, Pro Carton, August 2019.

1. Introduction

Pro Carton, the European Association of Cartonboard and Carton Manufacturers is pleased to present the carbon footprint for carton packaging. The carbon footprint has been calculated using latest methodologies and data. 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". As recommended by these documents, the total carbon footprint value calculated covers the cradle-to-grave carbon impact of carton packaging, taking account of fossil and biogenic greenhouse gas (GHG) emissions and removals and emissions from direct land use change (dLUC). Carbon contained within the product when it is first placed on the market is also quantified.

The calculations have been carried out using a tool developed by CITPA. The calculations make use of the gate-to-gate life cycle inventory data covering cartonboard production and carton converting compiled by Pro Carton. The subsequent Environmental Data Report covers the resources, energy, emissions and wastes per tonne of average cartons manufactured in Europe during the calendar year 2017. Carbon factors for emissions and removals (covering fossil, biogenic and dLUC GHGs), for e.g. inputs of raw materials and fuels, purchased electricity, emissions from various modes of transport, etc have been sourced from recognised life cycle inventory databases. The sources for the various carbon factors applied are summarised in the Annex.

Using the methods and data described in this report, the carbon footprint has been calculated as 326kgCO2e per tonne of cartons, as summarised in the table below. However, it is stressed that calculating the carbon footprint of fibre-based packaging materials is complex. Stake-holders should not take the carbon footprint result at face value but are encouraged to read this report to fully understand the factors and methodology decisions that contribute to this result.

Carbon footprint of cartons, kgCO2e per tonne of cartons

Fossil GHG emissions	Biogenic GHG emissions	GHG removals	Direct land-use	**Total**
1,025kgCO_2e	1,001kgCO_2e	-1,708kgCO_2e	9kgCO_2e	**326kgCO_2e**

The report itself has been prepared by RISE (Research Institutes of Sweden) on behalf of Pro Carton. The underlying Environmental Data Report has been subjected to external peer review by ifeu – Institute for Energy and Environmental Research Heidelberg GmbH, Germany. The CITPA methodology and tool, and the specific calculations made for cartons, have not been subject to external peer review.

2. Background and methodology

Climate change is a topic of high public interest. Stakeholders are increasingly looking at standards, labels and other instruments that broaden the focus beyond emissions related to production activities. In this context, buyers are asking for the "carbon footprint" associated with the supply chain for the manufacture, distribution and disposal of products and packaging provided to them. Customers want a simple statement that accurately reflects the real situation and is credible.

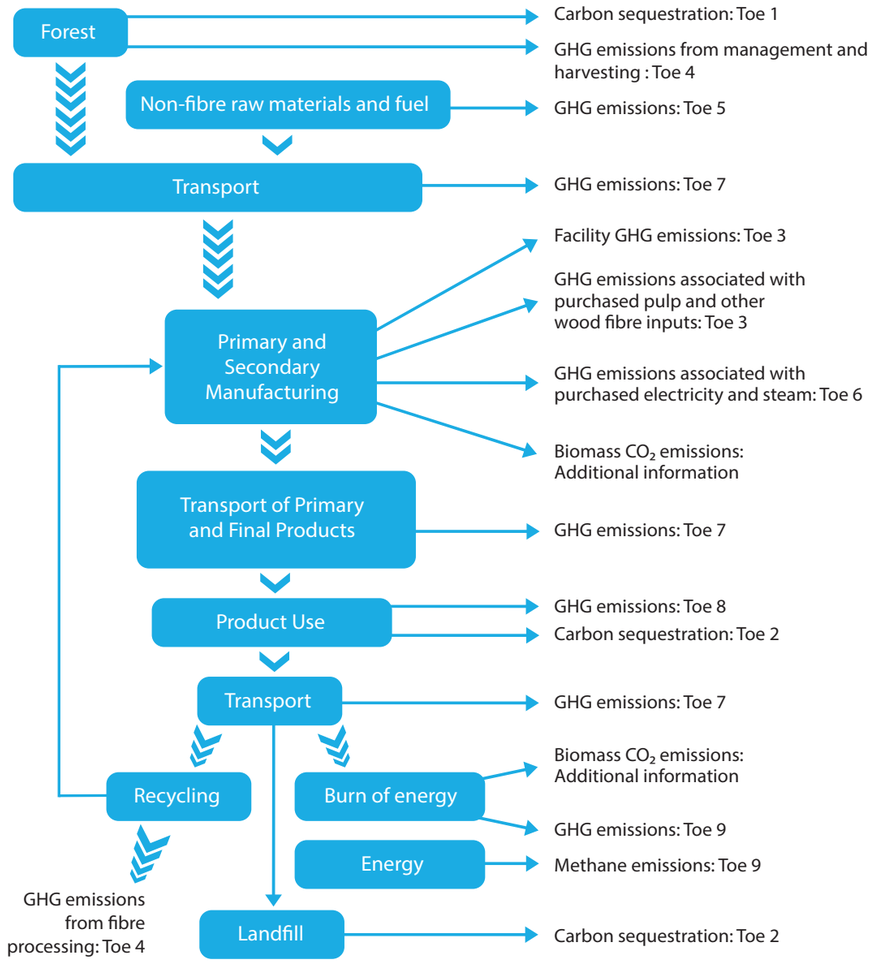
To contribute appropriate and accurate information for the needs of stakeholders, Pro Carton participated in a co-ordinated activity by the European paper and board industry to develop a common framework for carbon footprinting (CEPI's "Framework for Carbon Footprints for Paper and Board Products, April 2017"). Pro Carton then further collaborated with paper and board convertors to produce a common methodology for the converting sector (CITPA's "Guidelines for calculating carbon footprints for paper-based packaging, March 2018"). These latest two documents replace earlier versions and significantly extend and enhance the methodology applied for paper and board packaging. Whilst the earlier methodology focused on fossil greenhouse gas (GHG) emissions from cradle-to-gate only, the approach now covers the cradle-to-grave carbon impact, taking account of both fossil and biogenic GHG emissions and removals and emissions from direct land use change (dLUC).

This extended approach provides better harmonisation with existing internationally accepted protocols and frameworks, namely:

- The "Greenhouse gases - Carbon footprint of products - Requirements and guidelines for quantification and communication" technical specification from the International Organization for Standardization (ISO/TS 14067:2013);
- The Product Life Cycle Accounting and Reporting Standard (Product Standard) from the World Resource Institute (WRI) and World Business Council for Sustainable Development (WBCSD) GHG Protocol published in 2011; and
- The European Commission Product Environmental Footprint (PEF) Category Rules (PEFCR) for Intermediate Paper Product (Draft PEFCR for stakeholder consultation, May 2016).

The method applied ensures that all emissions and removals associated with forest-based products are taken into account, including aspects that are unique to the forest industry's value chain. The framework is summarised in Figure 1.

Figure 1 **CEPI carbon footprinting framework**



1 Biomass carbon removal and storage in forests
2 Biomass carbon in paper and board products
3 Greenhouse gas emissions from paper and board manufacturing facilities
4 Greenhouse gas emissions associated with producing wood fibre
5 Greenhouse gas emissions associated with producing other raw material/fuels
6 Greenhouse gas emissions associated with purchased electricity, steam, heat and hot and cold water
7 Greenhouse gas emissions associated with transportation
8 Greenhouse gas emissions associated with production use
9 Greenhouse gas emissions associated with product end of life
10 Avoided greenhouse gas emissions

Fossil GHG emissions are those emissions arising from non-renewable sources such as fossil fuels. Biogenic emissions are those emissions of GHGs arising from natural sources such as plants and trees.

2. Background and methodology (continued)

The methodology described overleaf builds upon and significantly extends the approach applied in previous iterations of the carbon footprint calculations for carton packaging. Figures 2 and 3 summarise the differences between the scope of the previous calculations (in terms of aspects, life cycle stages and types of emissions) considered compared to the latest calculations.

The new methodology is far more complete and extensive, and it fully recognises the carbon impacts of fibre-based packaging. This is shown clearly in Figures 2 and 3, where it can be seen that the overall coverage of the new methodology is complete, compared to the previous approach which missed many of the carbon interventions of paper packaging and many of the potential advantages.
The calculations now take a cradle-to-grave approach and include biogenic GHG emissions and removals of GHGs from the atmosphere.

In addition to these underlying methodological changes, the following changes should also be considered:

- Changes to the carbon emission factors for inputs to the papermaking process (e.g. carbon impact of producing and burning fuels; carbon impact of process chemicals and additives, carbon impact of electricity) – this reflects new and improved data available for these inputs.
- Inclusion of emissions associated with gas consumption at converting/printing plants – due to data gaps, this important source of GHG emissions was previously excluded.
- Development and application of improved data and methods for calculating the average transport distances for delivery of wood and fibre to the mills and delivery of cartonboard from the mills to the carton convertors – this had previously been highlighted by the independent peer review of the underlying inventory data as being an aspect of the study that required significant improvement.
- Extension of the study from cradle-to-gate to cradle-to-grave means that it is necessary to set the functional unit as 1 tonne of converted cartons, rather than 1 tonne of printed sheets.

For these reasons, it is stressed that it is not appropriate to directly compare the result presented in this document with the results presented in previous iterations of the carbon footprint calculations.

Figure 2

Aspects, life cycle stages and types of emissions included in the 2007 method/CITPA tool
(as applied in previous iterations of the carbon footprint calculation for carton packaging)

Element	Fossil GHG emissions	Biogenic GHG emissions	GHG removals from the atmosphere	Carbon in the product
1. Biomass removal and storage in the forests	Not applicable	Included via a qualitative statement only	Included via a qualitative statement only	Not applicable
2. Biomass carbon in forest products	Not applicable			Included
3. GHG emissions from paper and board manufacturing facilities	Included	Not included	Not included	Not applicable
4. GHG emissions from producing wood fibre	Included	Not included	Not included	Not applicable
5. GHG emissions from producing non-fibre raw materials and producing fuels	Included	Not included	Not included	Not applicable
6. GHG emissions from purchased electricity, heat etc	Included	Not included	Not included	Not applicable
7. GHG emissions from transportation	Included	Not included	Not included	Not applicable
8. GHG emissions from product use	Not applicable	Always assumed as zero for paper packaging	Not applicable	
9. GHG emissions from End-of-Life	Optional	Not included	Not included	Not applicable
10. Avoided emissions	Optional	Not included	Not included	Not applicable

Cradle-to-Gate

Fossil GHGs only

Figure 3

Aspects, life cycle stages and types of emissions included in the 2017 method/CITPA tool
(as applied in the current iteration of the carbon footprint calculation for carton packaging)

Element	Fossil GHG emissions	Biogenic GHG emissions	GHG removals from the atmosphere	Carbon in the product
1. Biomass removal and storage in the forests	Not applicable	Included	Included	Not applicable
2. Biomass carbon in forest products	Not applicable			Included
3. GHG emissions from paper and board manufacturing facilities	Included	Included	Included	Not applicable
4. GHG emissions from producing wood fibre	Included	Included	Included	Not applicable
5. GHG emissions from producing non-fibre raw materials and producing fuels	Included	Included	Included	Not applicable
6. GHG emissions from purchased electricity, heat etc	Included	Included	Included	Not applicable
7. GHG emissions from transportation	Included	Included	Included	Not applicable
8. GHG emissions from product use	Not applicable	Always assumed as zero for paper packaging	Not applicable	
9. GHG emissions from End-of-Life	Included	Included	Included	Not applicable
10. Avoided emissions	Included	Included	Included	Not applicable

Cradle-to-Grave

All relevant GHGs

3. Results and conclusions

The key results from the study were:

- The fossil GHG emissions across the entire life cycle are 1,025kgCO2e per tonne of cartons.
- The biogenic emissions across the life cycle are 1,001kgCO2e per tonne of cartons.
- The emissions due to land-use are just 9kgCO2e per tonne of cartons.
- However, the GHG removals across the life cycle are 1,708kgCO2e per tonne of cartons.
- These emissions and removals can be summed to give us **a total GHG footprint across the entire life cycle of 326kgCO2e per tonne of cartons.**
- In addition, the carbon content of the product when first placed on the market is 1,689kgCO2e per tonne of cartons. In line with the CITPA methodology, this value is provided as additional information only, and should not be subtracted from the total carbon footprint.
- However, in interpreting the values presented above, it should be remembered that a high proportion of the original carbon contained in the product when it is first placed on the market is carried through to the product life cycle of subsequent products. 91% of the cartons are assumed to be recycled. According to the CITPA methodology, it is recommended that a cut-off method is applied, and therefore the emissions associated with material recycling and the subsequent credits for replacing virgin fibre production are outside the boundaries of the footprint calculation. It should be remembered that the carbon contained in the recovered fibres will be passed on to other products and will remain "sequestered" in the products but only until recycling of the fibres is no longer viable, at which stage the fibres will be sent for either incineration with energy recovery or landfill, with associated emissions to consider. The "carbon content of recovered cartons" is therefore also reported separately as "additional information" to provide full transparency for stakeholders.

In line with the requirements of the applicable CEPI and CITPA guidelines, the reader's attention is also drawn to the following statements:

1) All paper and board products have two unique positive attributes:
   - They are based on a renewable raw material, using as a starting point the capacity of forests to bind CO2.
   - They store carbon and, furthermore, the recycling of paper and board products delays this CO2 from returning to the atmosphere.

3. Results and conclusions (continued)

2) When forests are managed sustainably, carbon stocks are growing or at least stable. According to the European GHG inventory, forests of the EU-28 are a net carbon sink, with net removals by forests having increased by over 19% between 1990 and 2014.

The cradle-to-grave carbon footprint calculations provide a complete picture which allows stakeholders to fully understand the life cycle carbon impacts of cartons and allow the industry to monitor impacts and improve carbon management on a fully informed basis.

As previously stressed, it is not appropriate to compare the result presented in this document with those previous iterations. However, if we were to calculate the 2019 carbon impact of cartons using the same methodology as applied in those previous iterations, then the result would show a 9% improvement for 2019 compared to 2015.

Annex: Sources of Carbon Factors

Flows	Units	Carbon Factor Source
Wood and purchased pulp		
Purchased Pulp	kgCO2e/t dry	Supplier Source
Soft wood logs	kgCO2e/t dry	Ecoinvent 3.5
Hard wood logs		
Saw mill residues (wood chips)		
FUELS		
Natural gas	kgCO2e/GJ	ELCD
Heavy Fuel Oil		
Light Fuel Oil		
Diesel oil		
Hard coal		
Brown coal (lignite)		
Peat		
Biofuels	kgCO2e/GJ	Ecoinvent 3.5
ADDITIVES AND CHEMICALS		
Alum	kgCO2e/kg	Ecoinvent 3.5
Glue		
H_2O_2, peroxide		
H3PO4		
H2SO4		
Ink, flexo (offset)		
$NaClO_3$		
Na2SO4		
Oxygen O_2		
Rosin size		
Starches		
NaOH	kgCO2e/kg	ELCD
Clay	kgCO2e/kg	ELCD/IMA
Purchased and sold grid electricity		
Electricity*	kgCO2e/GJ	ELCD
Transport operations		
Articulated lorry	kgCO2e/tonne.km	ELCD
Rail		
Container ship		
End-of-life		
Incineration (emissions and credit for sold energy)	kgCO2e/kg	ELCD
Landfill (emissions and credit for landfill gas)		

**A weighted average grid electricity mix is considered based on actual consumption at each mill and relative share of production for each mill*

About RISE

Through our international collaboration programmes with academia, industry, and the public sector, we ensure the competitiveness of the Swedish business community on an international level and contribute to a sustainable society. Our 2,200 employees support and promote all manner of innovative processes, and our roughly 100 test beds and demonstration facilities are instrumental in developing the future-proofing of products, technologies, and services. RISE Research Institutes of Sweden is fully owned by the Swedish state.

PACKAGING FOR
A BETTER WORLD

PRO CARTON
PACKAGING FOR
A BETTER WORLD

Published 2019 by:
Pro Carton
P.O. Box 1507
CH-8027 Zürich
mail@procarton.com
www.procarton.com

Pro Carton is the Association of European Cartonboard and Carton Manufacturers with the aim of promoting cartonboard and cartons as an economically and ecologically balanced packaging medium with an important role to play in our society.