Comparative assertion on climate change impacts of packaging solutions for beautycare end use applications

Technical background report

Metsä Board Corporation
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Verified by IVL Swedish Environmental Research Institute

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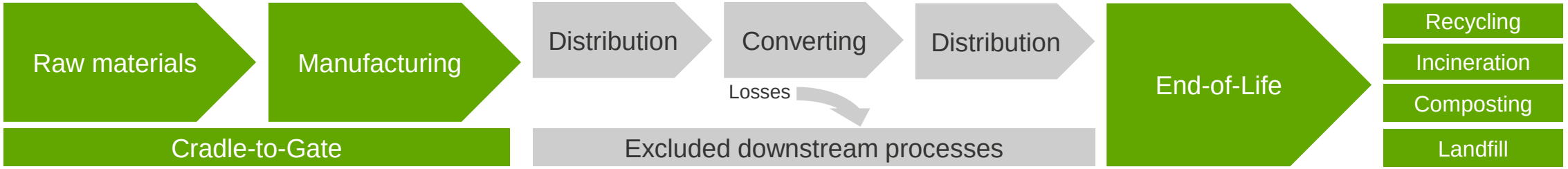
Goal and scope

Objective	Comparative assertion on climate change impacts of packaging solutions for beauty care and food end use applications.
Product system / functional unit	1 package with comparative cross direction stiffness properties
System boundary	Cradle-to-Gate + End-of-Life (based on equal EoL scenario for all packaging solutions)
Assumptions and limitations:	Comparative assertions excludes transportation of paperboard to converting and packaging line as well as related converting processess. Converting processes are assumed to be equal between packaging solutions. Packaging solutions made of Metsä Board's paperboards are compared to generic datasets which aim to represent corresponding product in European market. The climate impact of Metsä Board's paperboards is derived from LCA's following EPD International PCR 2010:14 Processed paper and paperboard (3.1). Comparisons are not made between individual suppliers of these paperboards and thus the results would differ depending on the supplier.
Impact Assessment	Impact assessment is based on EF3.1 methodology of Climate Change - Total

System boundary



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Standards, tools and methodologies used

Metsä Board assess the life cycle impacts of our paperboards following EPD International PCR 2010:14 Processed paper and paperboard (3.1) which are in conformity with ISO 14040(2006) and ISO 14044 (2006).

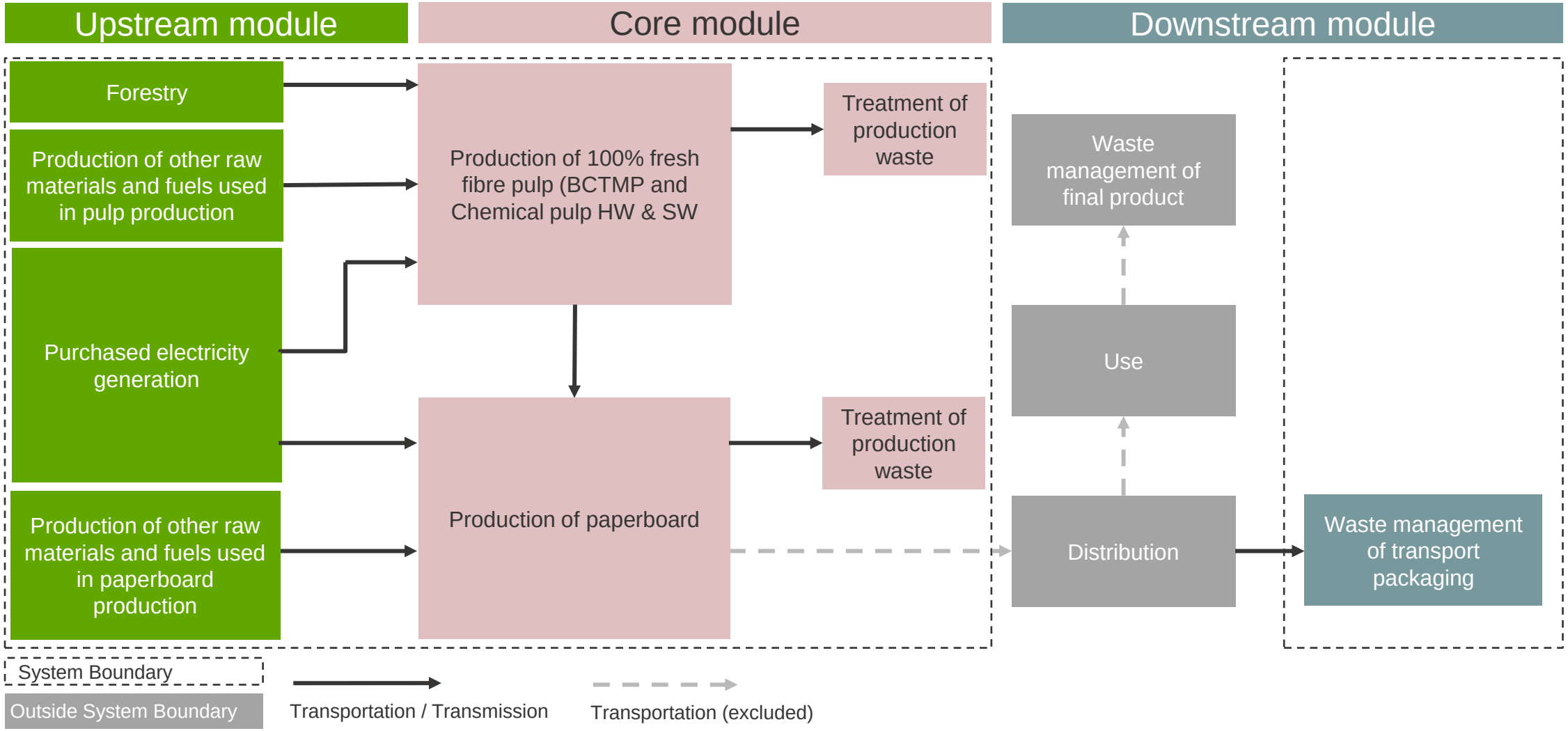
For comparative assertions we use a third party verified Sphera's LCA for Packaging software (https://sphera.com/sustainable-packaging-calculator/) which methodological requirements are equally in conformity with the ISO standards. The purpose of this calculator is to create life cycle assessments of packaging solutions and compare them with alternative designs and materials.

System boundaries used in comparison are cradle-to-gate + end-of-life. Cradle-to-gate assessment excludes distribution and converting phase of packaging and focuses solely on the impacts of different materials used in packaging solutions. The reason for this is that the converting phase is assumed to be equal for all studied cartons and emphasis is put into the paperboard material itself. Jurisdictional waste statistics (Europe) are used when assessing end-of-life impacts.

Description of Life Cycle Inventory (LCI)

	Metsä Board	Folding Box Board	Solid Bleached Board
LCI data	Following EPD International PCR 2010:14 Processed paper and paperboard (3.1) MetsäBoard Pro FBB Bright MetsäBoard Prime FBB Bright	Sphera LCA for Packaging RER: Folding Box Board (FBB), production mix	Sphera LCA for Packaging RER: Solid Bleached Board (SBB), production mix
System boundary	Cradle-to-gate	Cradle-to-gate	Cradle-to-gate
Data sources	Primary data: pulp and paperboard processes Secondary data: forestry and raw material production Third-party verified mother EPD: S-P-09340	100% generic secondary data Inventories are mainly based on literature (published between 1994 and 2018) with up-to-date background datasets. Overall data quality is evaluated as good and is thus considered representative of European market.	
Time representativeness	2023 (annual average)	2022 (annual average)	
Geographical representativeness	Finland (Europe)	Europe	Europe
Electricity mix	Market-based	Location-based (Europe). Conservative approach compared to market-based residual mix which would result in higher climate impact.	
Technological representativeness	Coated paperboard used for chocolate and confectionery, foods, healthcare, graphic applications, beautycare, consumer electronics	Coated cardboard is used as a packaging material with printed information on it for applications such as food, pharma, cosmetics, and others.	Coated cardboard is used as a packaging material with printed information on it for applications such as food, pharma, cosmetics, and others.
Cut-off	Coverage of at least 99 % of mass and energy of the input and output flows.	Coverage of at least 95 % of mass and energy of the input and output flows, and 98 % of their environmental relevance (according to expert judgement).	
End-of-Life	End-of-life impacts are the same for all studied paperboard grades. Packaging: 75% recycled, 10% incinerated, 8% composted, 7% landfilled.		

System boundaries applied for Metsä Board



Functional unit (paperboard quality parameters)

- Functional unit: packaging solution with similar CD (cross direction) stiffness
  - Paperboard stiffness correlate well runnability and conversion ability of carton making processes and also it's important property of final packaging rigidity. (Source: Levlin, J-E. and Söderbjelm, L. *Pulp and Paper Testing*, p. 218 and Järvi-Kääriäinen, T. and Ollila, M. *Toimiva pakkaus*, p. 131)
  - Commonly FBB (folding boxboard) has higher stiffness properties than WLC (white lined chipboard) or SBB (solid bleached board) with similar grammages (gsm)
  - According to publicly available technical specification sheets on paperboards on the market we see that similar stiffness properties can be achieved with our paperboards with 25-36% lighter grammage compared to WLC and with 15-25% lighter grammage compared to SBB
  - Other than technical aspects which impact material selection: Brand image, availability and price of the material, brand owners' sustainability targets

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EF3.1 Climate Change – Total

Global warming potential (GWP) over a 100-year time horizon based on IPCC 2021 (Forster et al., 2021) as implemented by PEF

- The global warming potential is calculated in carbon dioxide equivalents (CO2-Eq.). This means that the greenhouse potential of an emission is given in relation to CO2
- The indicator is calculated for a 100-year time horizon and represents the sum of the different contributions of the chemical's global warming potentials. This impact category only includes biogenic origin carbon when re-released in the form of other greenhouse gases such as methane, but uptake of CO2 during the plant’s growth and release of the same at the End of Life are not considered (0/0 approach to biogenic CO2)
- Packaging products are typically a fast-moving consumer goods and therefore any biogenic carbon sequestered during biomass growth in plant-based products such as paperboard, will be re-released at end-of-life. An exception to this is when paperboard is landfilled. Landfilling of paperboard can create biogenic carbon sink but is likely to cause methane emissions contributing to climate change. This is accounted for.

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Carbon footprint assessments

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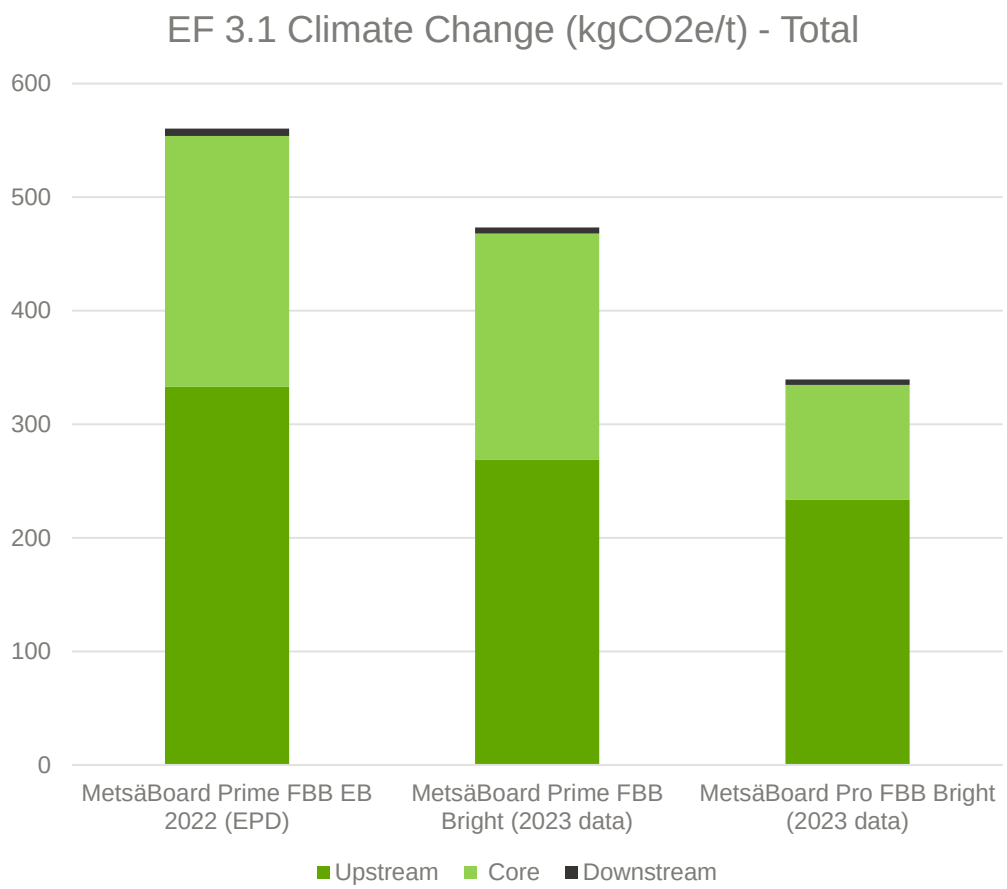
Climate change impact of Metsä Board’s paperboards following PCR 2010:14 Processed paper and paperboard (3.1)



Climate impact comparison includes Metsä Board grades MetsäBoard Pro FBB Bright and MetsäBoard Prime FBB Bright. The climate change impact of MetsäBoard Prime FBB EB is here for reference as it is derived from third-party verified mother EPD (S-P-09340).

Main difference between data collection years of 2022 and 2023 was change in market-based electricity grid mix. For 2023 grid mix consisted 100% of nuclear power (5.4 kgCO2e/MWh), whereas during 2022 there were still some fossil fuels included (81.2 kgCO2e/MWh).

Main difference between the grades MetsäBoard Prime FBB EB, MetsäBoard Prime FBB Bright and MetsäBoard Pro FBB Bright comes from the associated mills. MetsäBoard Pro FBB Bright is produced in Äänekoski with fossil free energy for both chemical pulp and board production, while the other two are produced at Kyro mill.

Additionally the use of latex is higher in MetsäBoard Prime FBB EB than other two grades. Associated climate impact is between 52-63% higher for MetsäBoard Prime FBB EB than the other two grades.

Upstream

Production of plants, energy wares, materials and substances, forestry, production of energy wares and chemicals and other raw materials used in the core processes.

Core

Transportation of all materials (including wood) to the core processes, production of pulp, production of paperboard, and treatment of waste management of production waste

Downstream

Waste management of transport packaging (based on scenarios)

EoL

End-of-life impacts are not part of standard LCA for paper and paperboard products. End-of-life impacts are added on top of the results represented based on the weight of each carton (pages 11,13, 14, 16).

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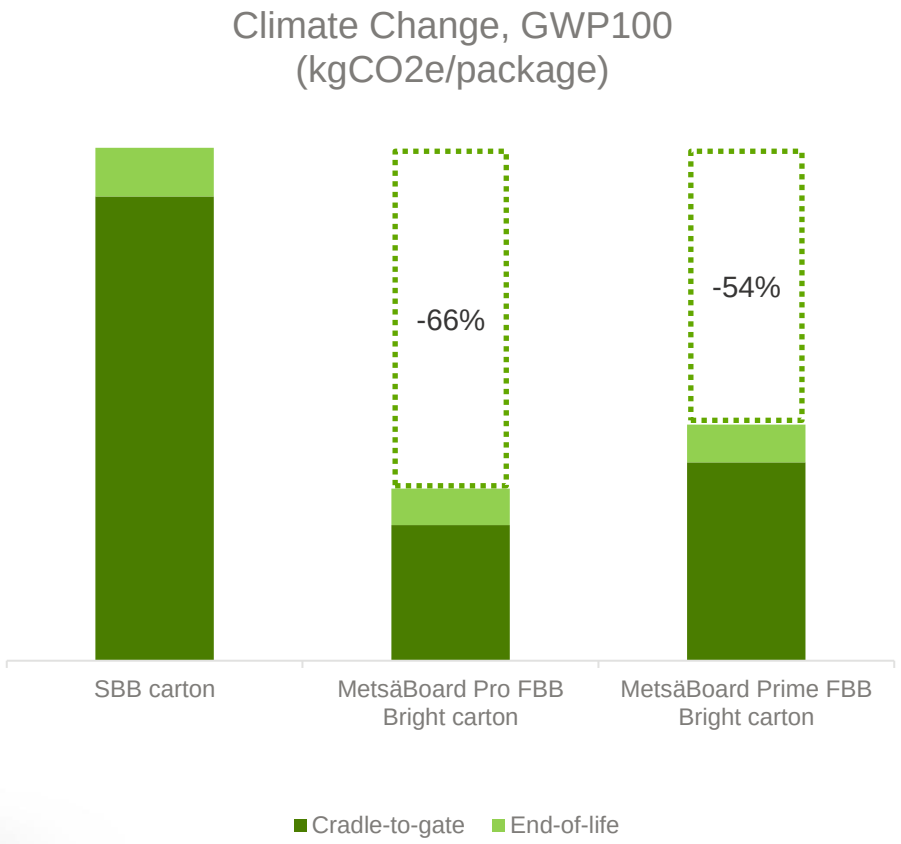
Switching from solid bleached board to Metsä Board's folding boxboard can reduce carbon footprint over 50%

- Cradle-to-gate + EoL impacts of a carton made of MetsäBoard Pro FBB Bright and MetsäBoard Prime FBB Bright are between 54 to 66% lower than a carton made of solid bleached board representative of European market due to
  - 22-25% lighter paperboard and packaging with comparable function (cross directional stiffness)
  - High share of fossil free energy in paperboard production
  - The production of SBS relies on chemical pulp where fuel mix used impacts heavily in climate change results
  - If the carbon footprints for Metsä Board's paperboards would have been modelled using location-based electricity (FI*) they would have still been between 38 to 46% lower than a carton made of solid bleached board representative of European market



*AIB, Total Supplier Mix 2023 (FI)

		Current solution		New solutions			
Materials and technical parameters	**Materials and basis weight**	solid bleached board carton	326 g/m2	MetsäBoard Pro FBB Bright carton	245 g/m2	MetsäBoard Prime FBB Bright carton	255 g/m2
	Caliper	374 µm		415 µm		400 µm	
	Stiffness Taber 15º CD	6.7 mNm		8.1 mNm		8.1 mNm	
	Stiffness Taber 15º MD	-		16.5 mNm		16.2 mNm	

Climate impact	**Weight of packaging solution**	8.6 g (measured packaging on the market)	6.4 g (25.6% lighter)	6.7 g (22.1% lighter)
	Process information / Applied dataset(s) to calculate climate impact	RER: Solid Bleached Board (SBB), production mix Sphera LCA for Packaging	Primary data from own processes (2023), secondary data from GaBi and ecoinvent databases.	Primary data from own processes (2023), secondary data from GaBi and ecoinvent databases.
	EF 3.1 Climate change (kgCO2eq) of a packaging solution			
	Cradle-to-gate	**0.0074**	**0.0022**	**0.0032**
	End-of-life scenario	Carton: 75% recycled, 10% incinerated, 8% composted, 7% landfilled. Recycling rate based on EU PEFCR Annex C and other disposal rates are based on Eurostat 2021.		
	End-of-life	**0.0008**	**0.0006**	**0.0006**
	Total climate impact	**0.0082**	**0.0028 (-66%)**	**0.0038 (-54%)**

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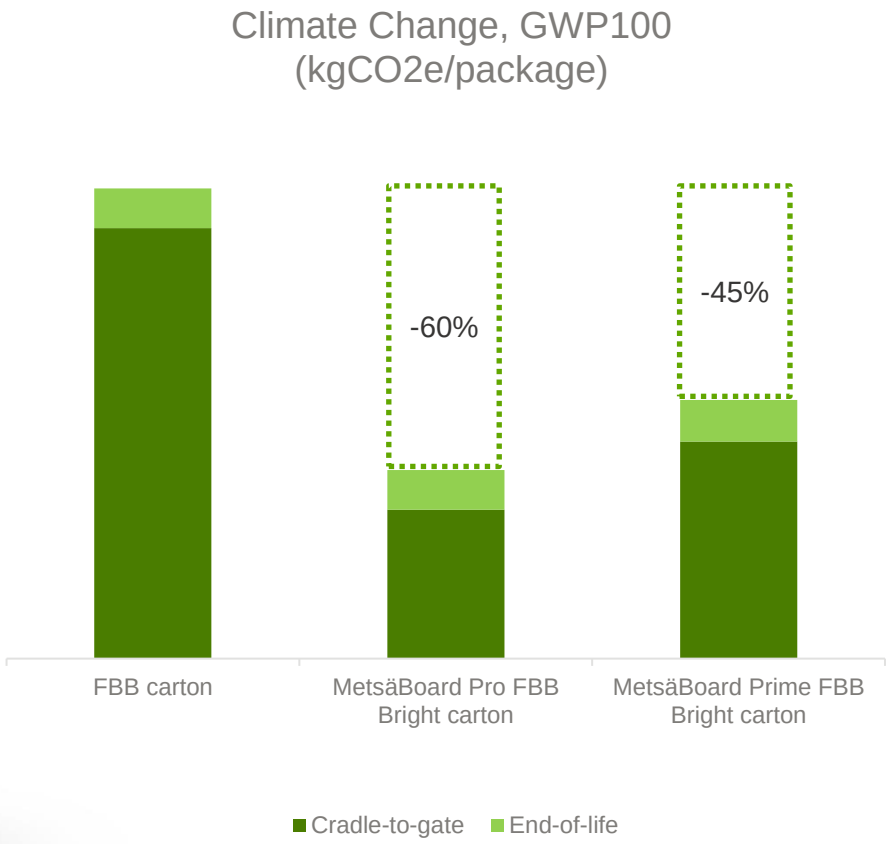
Switching from folding boxboard to Metsä Board's folding boxboard can reduce carbon footprint over 40%

- Cradle-to-gate + EoL impacts of a carton made of MetsäBoard Pro FBB Bright and MetsäBoard Prime FBB Bright are between 45 to 60% lower than a carton made of folding boxboard representative of European market due to
  - High share of fossil free energy in paperboard production
  - The production of CTMP used in the production of Folding Box Board is electricity intensive process, this is by Metsä mitigated by the procurement of fossil free electricity
  - If the carbon footprints for Metsä Board's paperboards would have been modelled using location-based electricity (FI*) they would have still been between 26 to 35% lower than a carton made of folding boxboard representative of European market



*AIB, Total Supplier Mix 2023 (FI)

		Current solution		New solutions			
Materials and technical parameters	**Materials and basis weight**	Folding boxboard	245 g/m2	MetsäBoard Pro FBB Bright carton	245 g/m2	MetsäBoard Prime FBB Bright carton	255 g/m2
	Caliper	415 µm		415 µm		400 µm	
	Stiffness Taber 15º CD	8.1 mNm		8.1 mNm		8.1 mNm	
	Stiffness Taber 15º MD	16.5 mNm		16.5 mNm		16.2 mNm	

Climate impact	**Weight of packaging solution**	6.4 g (measured packaging on the market)	6.4 g	6.7 g (5% higher)
	Process information / Applied dataset(s) to calculate climate impact	RER: Folding Box Board (FBB), production mix Sphera LCA for Packaging	Primary data from own processes (2023), secondary data from GaBi and ecoinvent databases.	Primary data from own processes (2023), secondary data from GaBi and ecoinvent databases.
	EF 3.1 Climate change (kgCO2eq) of a packaging solution			
	Cradle-to-gate	**0.0063**	**0.0022**	**0.0032**
	End-of-life scenario	Carton: 75% recycled, 10% incinerated, 8% composted, 7% landfilled. Recycling rate based on EU PEFCR Annex C and other disposal rates are based on Eurostat 2021.		
	End-of-life	**0.0006**	**0.0006**	**0.0006**
	Total climate impact	**0.0069**	**0.0028 (-60%)**	**0.0038 (-45%)**

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Glossary on the terminology used in the comparisons

EF3.1	Environmental Footprint and the method is maintained by the European Commission. The use of this impact method is required to align the results from Sphera's LCA for Packaging with Metsä Board's own LCA results and allow comparison
EPD	Environmental Product Declaration
PCR	Product Category Rules
Cradle-to-Gate	An assessment of a partial product life cycle from resource extraction (cradle) to the factory gate (i.e., before it is transported to the consumer)
RER	Europe
Primary data	Data gathered from the actual manufacturing plant where product-specific processes are carried out
Secondary data	Data from commonly available data sources (e.g. databases)
LCA for packaging	A tool to evaluate and understand the environmental impact of different packaging solutions (Sphera)
Managed LCA Content	LCA database with annually updated datasets managed by Sphera
Ecoinvent database	LCA database with information on the environmental impacts of products and services managed by ecoinvent
End-of-life/EoL –scenario	Assumed disposal route of packaging material under study
EU PEFCR Guidance (Annex C)	Default parameters (recycling rate) used in EU Product Environmental Footprint Category Rules (PEFCR) Circular Footprint Formula
Eurostat	Statistical office of the European Union

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References

EPD® SYSTEM

The International EPD System. Product Category Rules (PCR): PCR 2010:14 Processed paper and paperboard (3.1). The International EPD System.

EN ISO 14040+A1

EN ISO 14040:2006 + A1:2020 Environmental management - Life cycle assessment - Principles and framework (ISO 14040:2006 + Amd 1:2020)

Sphera LCA for Packaging

https://sphera.com/sustainable-packaging-calculator/

Metsä Board's third-party verified EPDs

MetsäBoard Prime FBB EB (https://www.environdec.com/library/epd9340)

MetsäBoard Pro FBB Bright (https://www.environdec.com/library/epd4273)

Total supplier mix

AIB (https://www.aib-net.org/sites/default/files/assets/facts/residual-mix/2023/AIB_2023_Residual_Mix_FINALResults09072024.pdf)

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Growth, with
a future