INSTITUT FÜR ENERGIE- UND UMWELTFORSCHUNG HEIDELBERG

Extension: Life Cycle Assessment of cb8/cf8 SIG beverage cartons and alternative packaging systems on the German market

Comparative life cycle assessment of *cb8/cf8 SIG beverage cartons* for liquid dairy and NCSD on the German market

Final report

CB-100741

commissioned by SIG Combibloc

Heidelberg, April 2025

1 Introduction

The focus of this extension is to investigate cb8/cf8 SIG beverage cartons on the German market. In this extension, the beverage cartons listed in **Table 1-1**, which were already examined in the main report (Analysis of *cb8/cf8 SIG beverage cartons* on the European market), are evaluated again, but with country-specific parameters for Germany (same material composition, same weight). The comparisons of the cb8/cf8 SIG beverage cartons are structured according to the same scheme. In addition, the Climate Change result of a PET bottle – 1000 mL for juice is included and compared to those of the cb8/cf8 SIG beverage cartons.

Table 1-1: List of cb8/cf8 SIG beverage cartons examined for the German market

Beverage carton with closure	Short name of beverage carton
SIG MidiBloc (cb8) Standard RS - 1000 ml with SIG SwiftCap Linked	cb8/cf8 standard RS - 1000 ml SwiftCap Linked
SIG MidiFit (cf8) Standard RS - 1000 ml with SIG SwiftCap Linked	
SIG Terra MidiBloc (cb8) Alu-free Full barrier - 1000 ml with SIG SwiftCap Linked LightProof	cb8/cf8 SIG Terra AFFB - 1000 ml SwiftCap Linked LP
SIG Terra MidiFit (cf8) Alu-free Full barrier - 1000 ml with SIG SwiftCap Linked LightProof	
SIG Terra MidiBloc (cb8) Alu-free Full barrier Forest-based polymers - 1000 ml with SIG SwiftCap Linked LightProof	cb8/cf8 SIG Terra AFFB + fbp - 1000 ml SwiftCap Linked LP
SIG Terra MidiFit (cf8) Alu-free Full barrier Forest-based polymers - 1000 ml with SIG SwiftCap Linked LightProof	

This extension focusses only on the environmental impact category, ‘Climate Change’. Impacts on ‘Climate Change’ depend strongly on local settings like end-of-life processes or the local electricity mix. For other environmental impact categories, please refer to the results regarding the European market that are presented in the main report.

2 Complemented packaging system and adjusted parameters

Complemented packaging system:

- Selection of packaging system
- Packaging specifications
- Life cycle inventory
- System boundaries

Adjusted parameters for the geographic scope of the extension are:

- Transport distances
- Distribution
- End-of-life
- Electricity mix for filling processes, recycling processes and credits
- Electrical and thermal efficiencies of the municipal waste incineration
- Landfill gas recovery rates

The following parameters correspond to the parameters of the main report on the European market:

- Functional unit
- System boundaries
- Data gathering and data quality
- Methodological aspects (mass-balanced renewable material approach, allocation, biogenic carbon)
- Manufacture of raw materials
- Process data for converting and filling
- Electricity mix for converting processes

2.1 Complemented packaging system

2.1.1 Selection of packaging system

The comparative packaging system for this extension has been chosen by the SIG Combibloc. The selected *PET bottle* – 1000 mL for juice is a well-known brand with a high market share on the German market but does not represent the entire market. This means, that this extension does not support claims for the best option to pack a certain product in the German market but aims to present comparative Climate Change results for SIG's beverage cartons and one of their main competitors.

2.1.2 Packaging specifications

With this extension, the Climate Change impacts of the *cb8/cf8 SIG beverage cartons* shall be assessed and compared with that of a specific brand *PET bottle* – 1000 mL on the German market. Based on the samples collected, the weights and material composition of the primary and secondary packaging were analysed and determined by SIG. The selected PET bottle has a PA barrier. However, it's important to note, that alternative barrier materials, such as silicon oxide (SiOx), are also used in PET bottles. The choice of barrier material can impact the ecological result of the packaging. As a specific brand was chosen as the comparative system for this study, no PET bottles with other barrier materials were analysed.

The pallet configuration of the selected PET bottle for the German market has been provided by SIG as well. The specifications of the tertiary packaging were estimated by ifeu based on information exchanged with bottling companies and retailers.

The exact share of recycled content of this PET bottles is not known. The EU Directive 2019/904, also known as the Single-Use Plastics Directive, requires that single-use beverage bottles made primarily of PET must contain at least 25% recycled content by 2025, based on the average of all bottles put on the market in an EU member state. This study assumes a recycled content of 30 %, as the specified minimum percentage of 25 % relates to the entire primary packaging (including caps and labels).

The applied packaging specifications of the competing PET bottle are listed in **Table 2-1**. Further relevant settings and parameters for the scenario of the competing PET bottle are listed in the following sections.

Table 2-1: Packaging specifications of PET bottle - 1000 mL for juice in Germany

Specification	Unit	Packaging system
		PET bottle
segment	-	juice
volume	mL	1000
geographic scope	-	DE
opaque/ clear	-	clear
primary packaging (sum)[1]	**g**	**34.22**
primary packaging (per FU)	**g/FU**	**34220**
bottle	g	29.16
- PET	g	27.71
- PA	g	1.53
- recycled content	%	30
label	g	1.08
- paper	g	1.08
closure	g	3.98
- HDPE	g	3.98
secondary packaging (sum)[2]	**g**	13
- stretch film per tray	g	13
tertiary packaging (sum)[3] **Fehler!**	g	**24250**
- pallet	g	22000
- type of pallet	-	EURO
number of use cycles	-	25
- cardboard layer (per pallet)	g	1750
- number of cardboard layers	-	5
- stretch film (per pallet) (LDPE)	g	500
pallet configuration		
prim. packaging per sec. packaging	pc	6
sec. packaging per layer	pc	19
layers per pallet	pc	5
prim. packaging per pallet	pc	570

[1] per primary packaging unit; [2] per secondary packaging unit; [3] per tertiary packaging unit (pallet)

2.1.3 Life cycle inventory

In this section, life cycle inventory data of the complemented PET bottle are listed. For information on the life cycle inventory data of cb8/cf8 SIG beverage cartons, please refer to the European main report. **Table 2-2** gives an overview of important datasets applied for the PET bottle in the current extension.

Table 2-2: Overview on inventory/process datasets used in the current extension for the PET bottle.

Material / process	Reference	Reference year/ period	Geographic scope
Intermediate goods			
Fossil PET	(Ecoinvent 3.10)	2015-2023	Europe
Fossil HDPE	(Ecoinvent 3.10)	2011-2023	Europe
Fossil PA	PlasticsEurope 2005	1999	Europe
Corrugated cardboard	(FEFCO and Cepi Container Board 2022)	2020	Europe
Fossil LDPE	(Ecoinvent 3.10)	2011-2023	Europe
Production			
PET preform production	ifeu data, obtained from various preform producers	2019	Germany
Filling			
Filling plastic bottles	ifeu database, filling data includes bottle stretch blow molding (SBM)	2019	Germany
Recovery			
PET bottle	ifeu database, data collected from different recyclers in Germany and Europe	2009	Germany
Background data			
Electricity production	ifeu database, based on statistics and power plant models	2021	Europe/Germany
Municipal waste incineration	ifeu database, based on statistics and incineration plant models	2016-2022	Germany
Landfill	ifeu database, based on statistics and landfill models	2019	Germany
Lorry transport	ifeu database, based on statistics and transport models, emission factors based on HBEFA 4.1 (INFRAS 2017).	2017	Europe
Rail transport	(EcoTransIT World 2016)	2016	Europe
Sea ship transport	(EcoTransIT World 2016)	2016	Europe

2.1.4 System boundaries

Additional to the described system boundaries in the main report the following simplified flow charts (**Figure 2-2** and **Figure 2-1**) shall illustrate the system boundaries considered for the beverage cartons and the PET bottles on the German market.

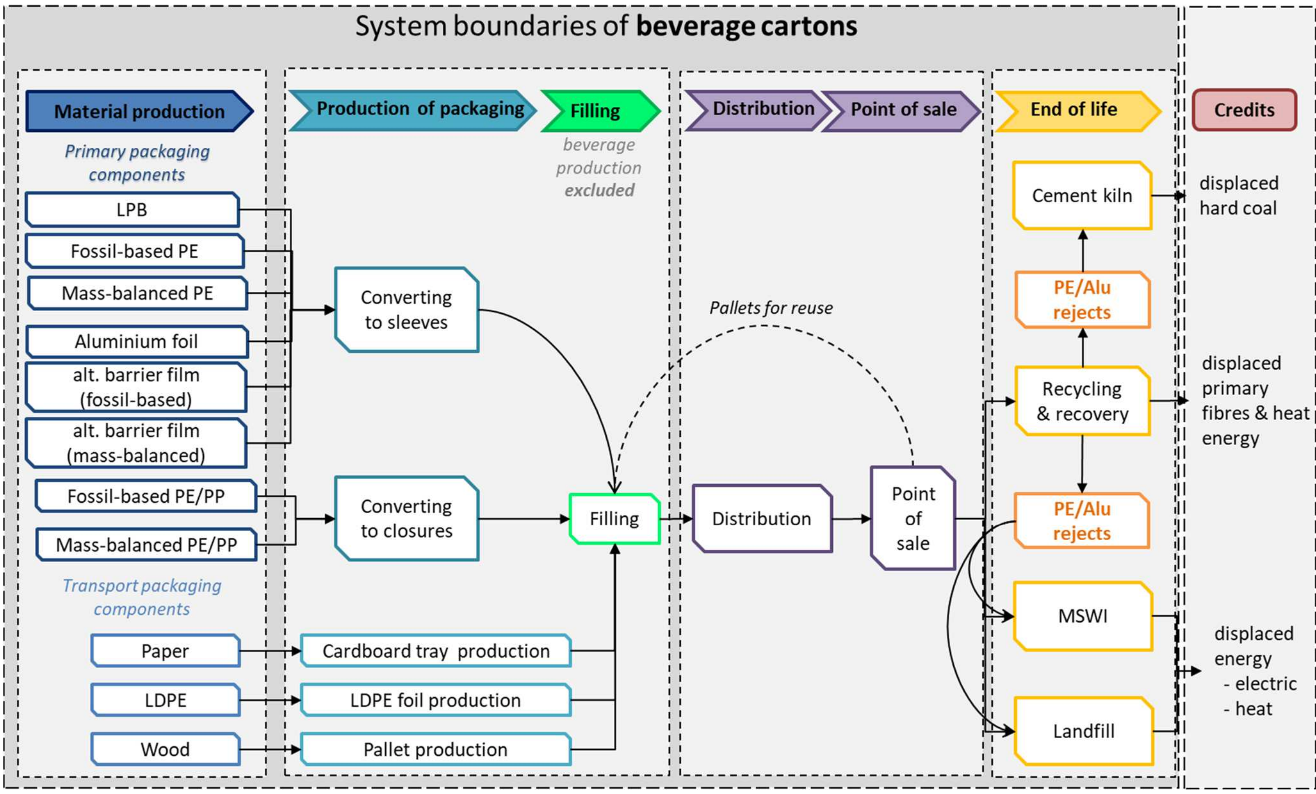

Figure 2-1: System boundaries of the beverage cartons examined for the German market

In Germany, the PolyAl fraction undergoes a thermal treatment in cement kilns substituting hard coal.

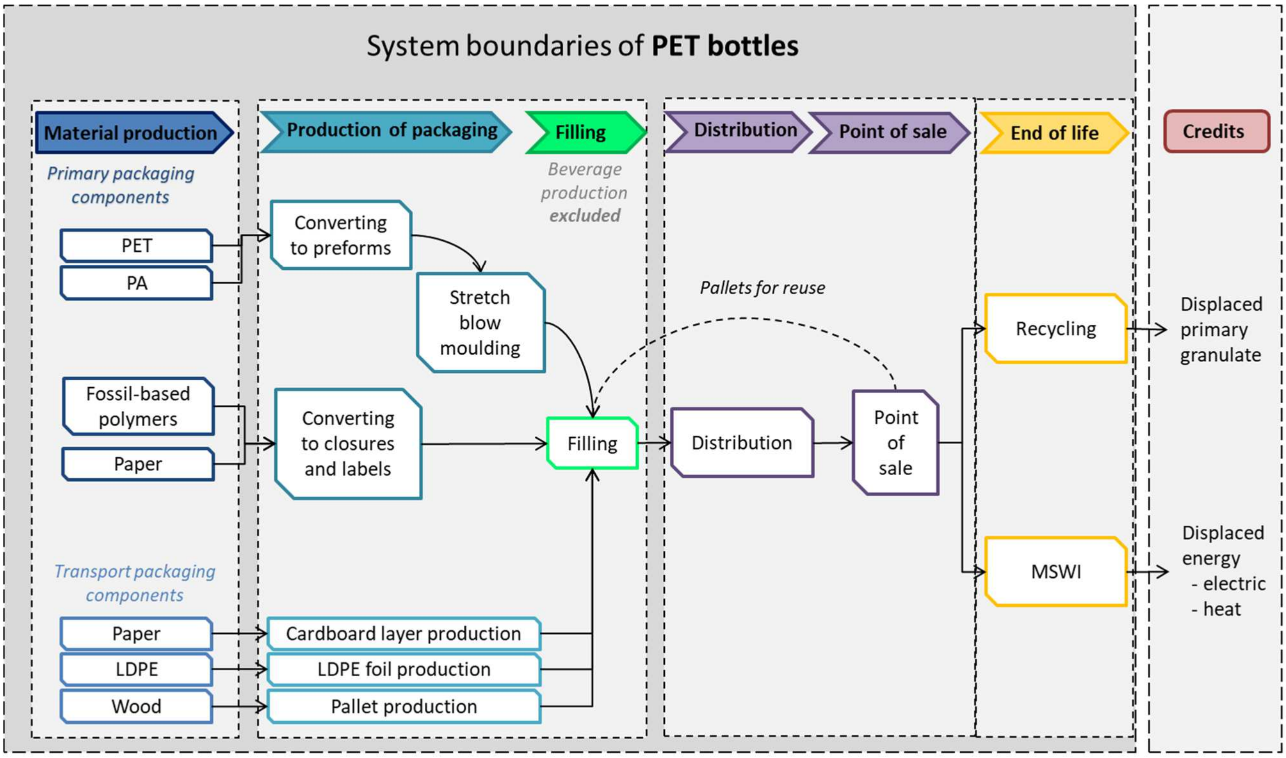

Figure 2-2: System boundaries of the PET bottles examined for the German market

2.2 Adjusted parameters

2.2.1 Transport distances

The following **Table 2-3** shows the transport distances applied for the German market. The data were obtained from SIG Combibloc.

Table 2-3: Transport distances and means for the German market: Transport defined by distance and mode (km/mode)

Germany	Transport distance
Packaging element	**Distance of converter to filler (km)**
Converted cartons	700 / road[1]
PET preforms	350 / road[1]

[1] SIG assumption

2.2.2 Distribution

Table 2-4 shows the applied distribution distances for the German market. The distribution distances from filling to the point-of-sale (POS) for the German market were determined by SIG Combibloc using the actual filling locations of their customers. Similarly, the distances for the competing packaging system was determined by using the actual filling locations of the selected brand.

Table 2-4: Distribution distances in Germany for the examined packaging systems

	Distribution distance			
	Distribution Step 1		Distribution step 2	
Germany	Filler → distribution centre (delivery)	Distribution centre → filler (return trip)	Distribution centre → POS (delivery)	POS → distribution centre (return trip)
Beverage cartons	300 km	90 km	30 km	30 km
PET bottles	350 km	105 km	30 km	30 km

2.2.3 End-of-life

To model the end-of-life of the examined packaging systems one needs to know their fate after their use by the consumers. It is aimed to apply the recycling rate and disposal split for the examined packaging systems of the German market. These data have been collected from different waste management reports and statistics. For beverage cartons, specific recycling rate is publicly available for the market examined. The applied recycling rate and the disposal split for Germany are listed in **Table 2-5**. The recyclability of the *SIG Terra Alu-free Full barrier (AFFB) beverage carton* has been tested by SIG in several trials. No negative impact on the recyclability of these beverage cartons was observed. Thus, the same recycling rate is applied for all beverage carton systems studied.

Table 2-5: End-of-life split of packaging systems examined

Germany		Source
Recycling rate		
Beverage cartons	62,8%	(Cayé et al. 2024), data for 2022
PET bottles	79.6 %	(Cayé 2024), GVM data for 2023
Disposal split		
Landfill	0.0 %	(Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection, BGBl. I, 2009)[2]
Incineration	100.0 %	

The remaining part of the post-consumer packaging waste is modelled and calculated according to the average rates for landfilling and incineration (MSWI) on the German market. The disposal split (100 %) is divided into landfilling 0 % and incineration 100 %. This disposal split is also applied for the final disposal of recycled materials undergoing another life cycle in a subsequent system.

2.2.4 Electricity mix

Modelling of electricity generation is particularly relevant for the production of base materials as well as for filling processes, recycling processes and credits. Electric power supply is modelled using country specific grid electricity mixes, since the environmental burdens of power production varies strongly depending on the electricity generation technology. A more detailed description is given in **section 3.9.2** of the main report.

The emission factor (Climate Change) for Germany is 483 g/kWh for the electricity mix used (reference year 2021) (Fehrenbach et al. 2016; IEA 2021), while the average EU electricity mix is 349 g/kWh. This means that the German electricity mix is responsible for around 27 % higher greenhouse gas emissions than the European one.

[2] Since the landfill regulation of 25 July 2005 (Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection), household waste has no longer been disposed of in landfills. These conditions have been revised and replaced by the regulation BGBl. I, 27 April 2009.

2.2.5 Municipal waste incineration

The electrical and thermal efficiencies of the municipal solid waste incineration plants (MSWI) are shown in **Table 2-6**.

Table 2-6: Electrical and thermal efficiencies of the incineration plants for Germany

Geographic Scope	Electrical efficiency	Thermal efficiency	Reference period	Source
Germany	10.9%	34.0%	2022	(Equanimator Ltd 2023; ITAD 2021)

The efficiencies are used as parameters for the incineration model, which assumes a technical standard (especially regarding flue gas cleaning) that complies with the requirements given by the EU incineration directive (EU 2018). It is assumed, that the electric energy generated in MSWI plants substitutes market specific grid electricity. Furthermore, it is assumed that the thermal energy recovered in MSWI plants is used as process heat.

3 Results and discussion

3.1 Germany cb8/cf8 SIG beverage cartons and PET bottle

3.1.1 Base scenarios with 50 % allocation: numerical values and graphs

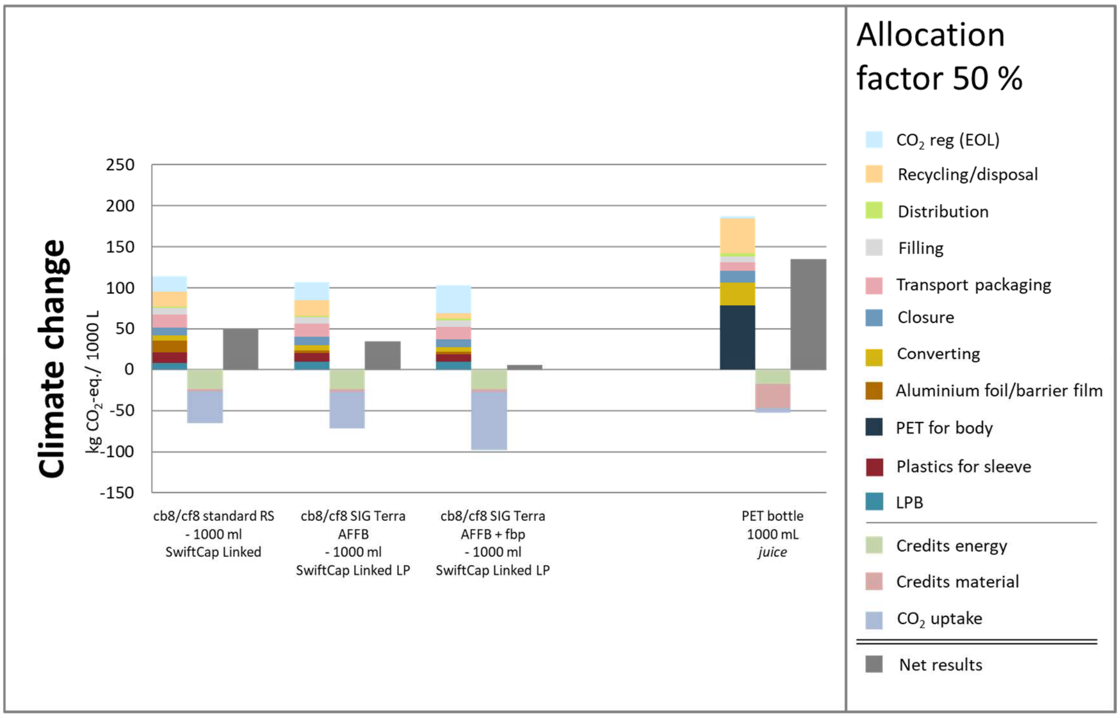

Figure 3-1: Climate Change results of examined packaging systems with allocation factor 50 %

Table 3-1: Climate Change results of allocation factor 50 %: burdens, credits and net results per functional unit of 1000 L beverage

Base scenarios: allocation factor 50 %		cb8/cf8 standard RS - 1000 ml SwiftCap Linked	cb8/cf8 SIG Terra AFFB - 1000 ml SwiftCap Linked LP	cb8/cf8 SIG Terra AFFB + fbp - 1000 ml SwiftCap Linked LP	PET bottle - 1000 ml juice
Climate Change [kg CO_2-equivalents]	Burdens	95,05	84,48	67,79	184,46
	CO2 (reg)	19,56	22,29	35,49	2,62
	Credits	-26,53	-27,19	-27,19	-47,08
	CO_2 uptake	-39,12	-44,58	-70,97	-5,23
	Net results (∑)	48,95	35,00	5,12	134,76

3.1.2 Base scenarios with 100 % allocation: numerical values and graphs

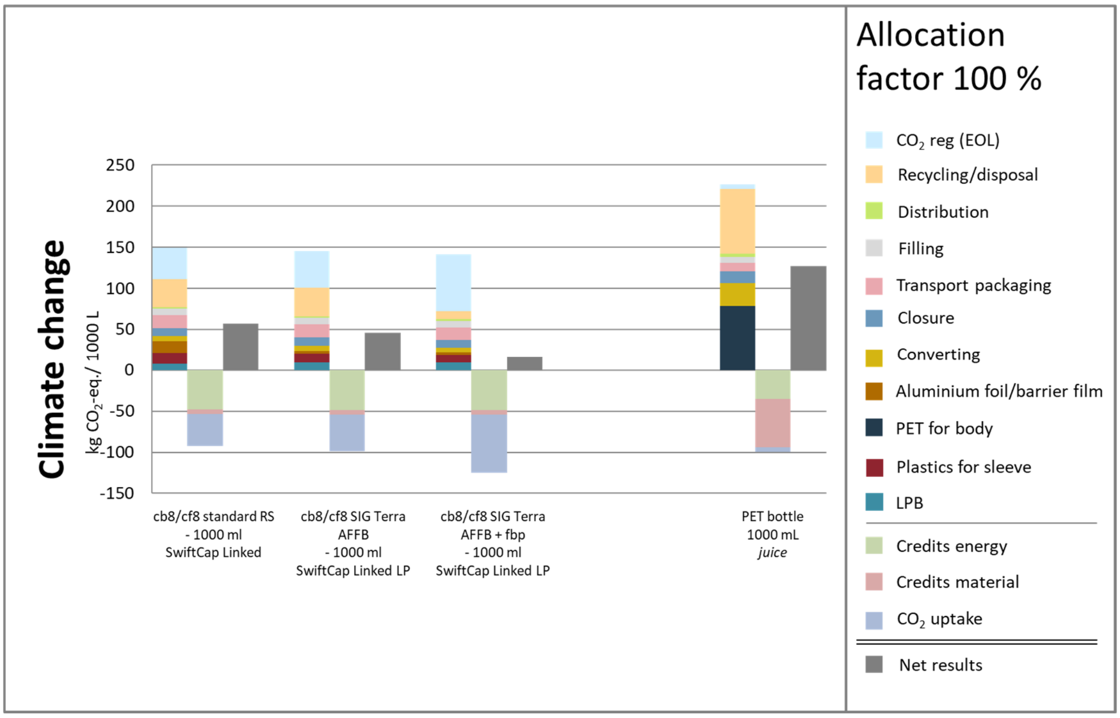

Figure 3-2: Climate Change results of examined packaging systems with allocation factor 100%

Table 3-2: Climate Change results of allocation factor 100 %: burdens, credits and net results per functional unit of 1000 L beverage

Base scenarios: allocation factor 100 %		cb8/cf8 standard RS - 1000 ml SwiftCap Linked	cb8/cf8 SIG Terra AFFB - 1000 ml SwiftCap Linked LP	cb8/cf8 SIG Terra AFFB + fbp - 1000 ml SwiftCap Linked LP	PET bottle - 1000 ml juice
Climate Change [kg CO_2-equivalents]	Burdens	110,36	100,56	70,68	221,14
	CO2 (reg)	39,12	44,58	70,97	5,23
	Credits	-53,09	-54,39	-54,39	-94,25
	CO_2 uptake	-39,12	-44,58	-70,97	-5,23
	Net results (∑)	57,28	46,17	16,29	126,89

3.1.3 Description of results

The life cycle stages that determine the Climate Change results of the PET bottle for juice are:

- The production of the plastic (PET), determined by the weight of the packaging in terms of the mass of the primary packaging per functional unit.
- Converting process, determined by the use of country-specific electricity and thermal energy to process PET pellets into PET preforms and then into bottles via stretch blow moulding.
- Recycling and disposal of packaging material, determined by the mass of packaging per functional unit and the split between energy recovery and material recycling.
- Material credit from recycling for the provision of secondary material to a subsequent system, determined by the split between energy recovery and material recycling.

The description of the cb8/cf8 SIG beverage cartons life cycle is shown in the main report in chapter ***4.3 Description and interpretation of base scenario results***.

3.1.4 Comparison between systems

The percentages in **Table 3-3** to **Table 3-8** show the net result comparison for the base scenarios with allocation factor 50 % and with allocation factor 100 %.

The colors green and blue illustrate the distinction between more (green) and less (blue[3]) favorable net results from the viewpoint of the packaging which is indicated in the respective table at the top and compared to the other packaging systems listed below. Percentages lower than 10 % are considered as insignificant differences and therefore marked by a grey shading of the respective fields.

The percentage is based on the net results of each packaging system. The base scenarios with allocation factor 50 % as well as with allocation factor 100 % are equally used for the comparison between the packaging systems.

[3] Note that this does not apply to any of the categories shown in Table 3-3 to Table 3-8, as the corresponding comparison does not show less favourable results.

Table 3-3: Comparison 1 of Climate Change net results of cb8/cf8 SIG beverage cartons (Germany)

	The net results of the base scenario of **cb8/cf8 SIG Terra AFFB - 1000 ml SwiftCap Linked LP** are lower (green)/higher (blue) than those of the base scenario for cb8/cf8 standard RS - 1000 ml SwiftCap Linked	
	AF 50	**AF 100**
Climate Change	-29%	-19%

In both base scenarios, the *cb8/cf8 SIG Terra AFFB - 1000 ml SwiftCap Linked LP* shows lower net results than the *cb8/cf8 standard RS - 1000 ml SwiftCap Linked* in the impact category 'Climate Change'.

Table 3-4: Comparison 2 of Climate Change net results of cb8/cf8 SIG beverage cartons (Germany)

	The net results of the base scenario of **cb8/cf8 SIG Terra AFFB + fbp - 1000 ml SwiftCap Linked LP** are lower (green)/higher (blue) than those of the base scenario for cb8/cf8 standard RS - 1000 ml SwiftCap Linked	
	AF 50	**AF 100**
Climate Change	-90%	-72%

In both base scenarios, the *cb8/cf8 SIG Terra AFFB + fbp - 1000 ml SwiftCap Linked LP* shows lower net results than the *cb8/cf8 standard RS - 1000 ml SwiftCap Linked* in the impact category 'Climate Change'.

Table 3-5: Comparison 3 of Climate Change net results of cb8/cf8 SIG beverage cartons (Germany)

	The net results of the base scenario of	
	cb8/cf8 SIG Terra AFFB + fbp - 1000 ml SwiftCap Linked LP	
	are lower (green)/higher (blue) than those of the base scenario for	
	cb8/cf8 SIG Terra AFFB - 1000 ml SwiftCap Linked LP	
	AF 50	**AF 100**
Climate Change	-85%	-65%

In both base scenarios, the *cb8/cf8 SIG Terra AFFB + fbp - 1000 ml SwiftCap Linked LP* shows lower net results than the *cb8/cf8 SIG Terra AFFB - 1000 ml SwiftCap Linked LP* in the impact category 'Climate change'.

Table 3-6: Comparison of Climate Change net results of cb8/cf8 standard RS - 1000 ml SwiftCap Linked and PET bottle (Germany)

	The net results of the base scenario of	
	cb8/cf8 standard RS - 1000 ml SwiftCap Linked	
	are lower (green)/higher (blue) than those of the base scenario for	
	PET bottle 1000 mL *juice*	
	AF 50	**AF 100**
Climate Change	-64%	-55%

In both base scenarios, the *cb8/cf8 standard RS - 1000 ml SwiftCap Linked* shows lower net results than the PET bottle 1000 mL *juice* in the impact category 'Climate change'.

Table 3-7: Comparison of Climate Change net results of cb8/cf8 SIG Terra AFFB - 1000 ml SwiftCap Linked LP and PET bottle (Germany)

	The net results of the base scenario of	
	cb8/cf8 SIG Terra AFFB - 1000 ml SwiftCap Linked LP	
	are lower (green)/higher (blue) than those of the base scenario for	
	PET bottle 1000 mL *juice*	
	AF 50	**AF 100**
Climate Change	-74%	-64%

In both base scenarios, the *cb8/cf8 SIG Terra AFFB - 1000 ml SwiftCap Linked LP* shows lower net results than the PET bottle 1000 mL *juice* in the impact category 'Climate change'.

Table 3-8: Comparison of Climate Change net results of cb8/cf8 SIG Terra AFFB + fbp - 1000 ml SwiftCap Linked LP and PET bottle (Germany)

	The net results of the base scenario of	
	cb8/cf8 SIG Terra AFFB + fbp - 1000 ml SwiftCap Linked LP	
	are lower (green)/higher (blue) than those of the base scenario for	
	PET bottle 1000 mL *juice*	
	AF 50	**AF 100**
Climate Change	-96%	-87%

In both base scenarios, the *cb8/cf8 SIG Terra AFFB + fbp - 1000 ml SwiftCap Linked LP* shows lower net results than the PET bottle 1000 mL *juice* in the impact category 'Climate change'.

4 Conclusions and Recommendations

4.1 Conclusions

4.1.1 Comparison of cb8/cf8 SIG beverage cartons

- The *cb8/cf8 SIG Terra AFFB - 1000 ml SwiftCap Linked LP* shows lower net results in the 'Climate Change' category than the compared *cb8/cf8 standard RS - 1000 ml SwiftCap Linked* in both base scenarios (AF 50, AF 100). For this category and the comparison of cb8*/cf8* packaging systems, the results for Germany show a similar picture as those of the European market.
- The *cb8/cf8 SIG Terra AFFB + fbp - 1000 ml SwiftCap Linked LP* shows lower net results in the 'Climate Change' category than the compared *cb8/cf8 standard RS - 1000 ml SwiftCap Linked* in both base scenarios (AF 50, AF 100). For this category and the comparison of cb8*/cf8* packaging systems, the results for Germany show a similar picture as those of the European market.
- The *cb8/cf8 SIG Terra AFFB + fbp - 1000 ml SwiftCap Linked LP* shows lower net results in the 'Climate Change' category than the compared *cb8/cf8 SIG Terra AFFB - 1000 ml SwiftCap Linked LP* in base both scenarios (AF 50, AF 100). For this category and the comparison of cb8*/cf8* packaging systems, the results for Germany show a similar picture as those of the European market.

4.1.2 Comparisons of cb8/cf8 SIG beverage cartons with PET bottle

- The *cb8/cf8 standard RS - 1000 ml SwiftCap Linked* shows lower net results in the 'Climate Change' category than the compared PET bottle 1000 mL *juice* in both base scenarios (AF 50, AF 100).
- The *cb8/cf8 SIG Terra AFFB - 1000 ml SwiftCap Linked LP* shows lower net results in the 'Climate Change' category than the compared PET bottle 1000 mL *juice* in both base scenarios (AF 50, AF 100).
- The *cb8/cf8 SIG Terra AFFB - 1000 ml SwiftCap Linked LP* shows lower net results in the 'Climate Change' category than the compared PET bottle 1000 mL *juice* in both base scenarios (AF 50, AF 100).

4.2 Recommendations

- Since the Climate Change result of the *cb8/cf8 SIG beverage carton* format is significantly influenced by the production of its main components, the sleeve and closure, measures to use less material are recommended as long as the same functionality is ensured.
- It is further shown, that the alternative barrier film used for the *cb8/cf8 SIG Terra AFFB + fbp - 1000 ml SwiftCap Linked LP* and the *cb8/cf8 SIG Terra AFFB - 1000 ml SwiftCap Linked LP* has lower impacts in 'Climate Change' than the aluminium foil used in the *cb8/cf8 standard RS -1000 ml SwiftCap Linked beverage cartons.* In view of this and the fact that the use of the alternative barrier film has no negative influence on the recyclability of the beverage cartons after use, it is therefore recommended, that aluminium foils are substituted by alternative barrier films.
- The beverage cartons *cb8/cf8 SIG Terra AFFB + fbp - 1000 ml SwiftCap Linked LP* (1000 mL) show the lowest environmental impacts in 'Climate Change'. Therefore, with a focus on climate change mitigation, it is recommended to prefer the *cb8/cf8 SIG Terra AFFB + fbp - 1000 ml SwiftCap Linked LP* (1000 mL) over the other beverage carton formats examined in this study on the German market.
- The *cb8/cf8 SIG Terra AFFB + fbp - 1000 ml SwiftCap Linked LP* having lower impacts than *cb8/cf8 SIG Terra AFFB - 1000 ml SwiftCap Linked LP* (which has the same specifications apart from the choice of polymers) shows that advantages in terms of Climate Change results can be reached by the use of mass-balanced renewable material. Consequently, the use of mass-balanced renewable material is recommended for Climate Change mitigation. In the authors' view, showing the benefits of using renewable materials by the application of the mass-balanced approach in the production of polymers, is an important driver to facilitate an increasing substitution of fossil resources by biogenic resources for the production of polymers.
- It is also recommended to actually achieve a more significant physical share of tall oil-based input materials for the production of polymers, as the by-product of the pulp industry is currently mainly dedicated to direct thermal use. The utilisation and demand of mass-balanced polymers by SIG Combibloc might be a driver to do so.
- As this extension only includes results for the impact category Climate Change, it is recommended to consult the European main study (Analysis of *cb8/cf8 SIG beverage cartons* on the European market) in order to get an indication on how results of other impact categories may look like for similar packaging systems. The knowledge and understanding of the European study regarding the other impact categories is necessary to understand the broad environmental relevance of the examined packaging systems. It is important though, to keep in mind that the different geographic parameters also have a major impact on the results.
- In regards to Climate Change, it is recommended to prefer *cb8/cf8 SIG beverage cartons* over the chosen PET bottle – 1000 mL for juice examined in this study on the German market. It has however to be pointed out, that a specific PET bottle (brand) has been selected as comparative packaging system for this extension. Other PET bottles, which may be more optimized (higher recycled content, lightweight options, different material composition), were not included in the study as the selected PET bottle – 1000 mL for juice has been identified by SIG as its main competitor on the German market. Therefore, the statements made apply exclusively to the comparison with this specific PET bottle.

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Critical review statement

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Date
2025-04-14

Reference
SIG-ifeu

Analysis of cb8/cf8 SIG beverage cartons on the European, French, Germany, Italian and Spanish markets

This document forms the critical review statement for the study "Analysis of cb8/cf8 SIG beverage cartons on the European market; Comparative life cycle assessment of cb8/cf8 SIG beverage cartons for liquid dairy and NCSD on the European market" as reported by ifeu in their report for Study Number CB- 100740, dated January 2025, and the subsequent market extension reports covering the more specific markets of France, Germany, Italy and Spain.

The study was prepared by ifeu, Institut fur Energie und Umweltforschung Heidelberg, and was commissioned and funded by SIG, a leading provider of packaging solutions including cartons, pouches and bag-in-box.

The critical review has been performed by an independent panel consisting of:

- Michael Sturges (panel chair) - RISE Research Institutes of Sweden – a life cycle (LCA) assessment practitioner with specific experience of environmental studies relating to packaging and forest industry value chains
- Nicolas Caye – GVM – a project manager with specific expertise in packaging markets
- Dr Alex Hetherington – Head of Climate Nature and Resources at sustainability consultancy 3Keel Group Ltd– an experienced sustainability professional with a multi-sector background in the process and FMCG industries, and over 15 years experience of LCA, including those involving packaging systems.

All reviewers were contracted directly by SIG and were independent of the LCA study.

Critical review process

The review was performed based on the requirements of ISO14044:2006 Section 6.3, i.e., critical review by panel of relevant experts.

The critical review began with consideration of the goal and scope and draft final report. These were presented to the critical review panel during a video conference and delivered as MS Word documents for detailed consideration. One of the critical review panel members (Dr Alex Hetherington) was also guided through the Umberto LCA models.

The critical review panel provided written feedback on the draft documents which was also discussed during a follow up video conference with the LCA practitioners and the project sponsors.

The LCA practitioners responded to the comments, providing amendments or further explanations as appropriate. This was an iterative process until the critical review panel were satisfied that all points raised had been sufficiently addressed.

For each round, comments were provided using a MS Excel feedback template. The LCA team then responded to the comments and provided its feedback, also describing subsequent changes to the data, models and report, by using the appropriate section of the feedback template. This approach provided a clear audit trail of the critical review panel's comments and the LCA practitioners' subsequent actions and responses.

The reviewers have considered these responses and changes and are satisfied that appropriate clarifications and actions have been provided.

Result of the critical review

The critical review panel found that the study was performed in conformance with ISO 14040 and ISO 14044.

Opinion of the reviewers

The reviewers conclude that the study's level of quality, detail and transparency is appropriate considering the goal and scope.

As with all LCA studies, there are methodological choices and modelling limitations that need to be understood when interpreting the results. All methodological choices are transparently documented in Sections 1.7 & 1.8 of the main report; it is of course important that users of LCA reports take account of such aspects.

In this particular study, as with all LCA studies including systems for forest industry products, the treatment of biogenic carbon requires consideration. In the baseline systems the practitioners have chosen an impact assessment methodology which accounts for biogenic removals and emissions of carbon dioxide. However, for bio-based materials with potential for recycling at end-of-life, allocation between the first life cycle of virgin fibres and subsequent life cycles of secondary or recovered fibres is required. In the approach adopted and documented in this study, uptake of biogenic carbon dioxide is allocated to the primary product, whereas a significant proportion of the biogenic emissions are allocated to the subsequent life cycle, thereby apparently reducing the overall climate change impact of the virgin product. The methodological choice regarding treatment of biogenic carbon dioxide emissions and removals is entirely valid and transparently documented.

The detailed sensitivity analysis provides transparency of the uncertainties and confidence in the overall robustness of the results achieved and conclusions drawn.

Subsequently, the reviewers consider the results and conclusions to be a sound and fair reflection of the potential comparative environmental impacts of the studied systems representing the SIG packaging solutions and the compared solutions.

In conclusion, it is the opinion of the review panel that the report provides useful and realistic information for stakeholders interested in this topic.

Critical review sign-off

The reviewers certify that the statement provided is a fair reflection of their assessment and views of the study "Analysis of cb8/cf8 SIG beverage cartons on the European market;

Comparative life cycle assessment of cb8/cf8 SIG beverage cartons for liquid dairy and NCSD on the European market" (CB- 100740) and the subsequent extension reports:

a. "Extension: Life Cycle Assessment of cb8/cf8 SIG beverage cartons and alternative packaging systems on the French market; Comparative life cycle assessment of cb8/cf8 SIG beverage cartons for liquid dairy and NCSD on the French market" (CB-100742),

b. "Extension: Life Cycle Assessment of cb8/cf8 SIG beverage cartons and alternative packaging systems on the German market; Comparative life cycle assessment of cb8/cf8 SIG beverage cartons for liquid dairy and NCSD on the German market" (CB-100741);

c. "Extension: Life Cycle Assessment of cb8/cf8 SIG beverage cartons and alternative packaging systems on the Italian market; Comparative life cycle assessment of cb8/cf8 SIG beverage cartons for liquid dairy and NCSD on the Italian market" (CB-100744); and

d. "Extension: Life Cycle Assessment of cb8/cf8 SIG beverage cartons and alternative packaging systems on the Spanish market; Comparative life cycle assessment of cb8/cf8 SIG beverage cartons for liquid dairy and NCSD on the Spanish market" (CB-100743).

Signed………………………. **Dated:** 14th April 2025

Michael Sturges, RISE Research Institutes of Sweden (lead panelist)

Signed………………………. **Dated:** 14th April 2025

Nicolas Caye, GVM Gesellschaft für Verpackungsmarktforschung mbH

Signed………………………. **Dated:** 22nd April 2025

Dr Alex Hetherington, 3Keel Group Ltd