Spinlife
SPIN-OFF DELL'UNIVERSITÀ DI PADOVA

UNIVERSITÀ DEGLI STUDI DI PADOVA

Comparative LCA of Tetra Pak® caps for the wine sector packaging

Comparative LCA of HeliCap 27 Plant-based and HeliCap 26 Pro Plant-based caps produced by Tetra Pak Italiana SpA

Version n. 3

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Introduction

The objective of this study, performed by Spinlife Srl, is to analyse the differences between the "cradle to gate" Carbon Footprint of two caps produced by Tetra Pak Italiana SpA: HeliCap 27 Plant-Based (P.B.) and HeliCap 26 Pro P.B.

This analysis will be used to:

1) verify the contribution of the new HeliCap 26 Pro P.B. to the total life cycle Carbon Footprint (CF) of the Tetra Pak wine packaging:
    a. Tetra Brik Aseptic (TBA) 1000 Square P.B. HeliCap 27 plant-based;
    b. Tetra Prisma Aseptic (TPA) 1000 Square P.B. HeliCap 27 plant-based,

reported in the IFEU report *Comparative Life Cycle Assessment of Tetra Pak® carton packages and alternative packaging systems for beverages and liquid food on the Italian market* (IFEU, 2020);

2) verify if the difference between the CFs of the above-mentioned packaging with the new cap and the CF of a glass bottle (weight 0,385g) is the same of that reported in the IFEU report;
3) validate the claim reported on the selected packaging:

"CO2 reduction of over 80% compared to a 385 g glass bottle"

The LCA comparison between the two caps will be subjected to a critical review process by an external expert, in order to ensure its consistency with the International Standards ISO 14040 and 14044.

1 The company

Tetra Pak is a Swedish–Swiss multinational food packaging and processing company with head offices in Lund, Sweden, and Pully, Switzerland. The company offers packaging, filling machines and processing for dairy, beverages, cheese, ice cream and prepared food, including distribution tools like accumulators, cap applicators, conveyors, crate packers, film wrappers, line controllers and straw applicators (Wikipedia, 2023).

1.1 Production plant

The production of the analyzed caps takes place in the Italian branch located in Tetra Pak Closures Italy Srl, Via Roncarino 3, Sezzadio (AL).

2 Analysed products

The products analyzed are HeliCap 27 P.B and HeliCap 26 Pro P.B (Figure 1 and Figure 2). The technical characteristics are reported in Table 2.

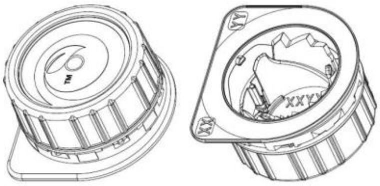

Figure 1 – HeliCap 27 P.B.

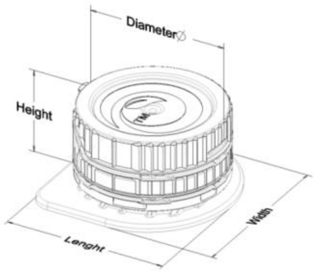

Figure 2 – HeliCap 26 Pro P.B.

Table 1 – Materials subdivision for HeliCap 26 Pro P.B. and HeliCap 27 P.B.

HeliCap 26 Pro P.B.	Weight (g)
Biobased High-Density Polyethylene	2,695
Polypropylene	0,49
Additives	0,155
Total weight	3,34
HeliCap 27 P.B.	**Weight (g)**
Biobased High-Density Polyethylene	1,74
Polypropylene	2,04
Additives	0,11
Total weight	3,89

3 Goal and scope definition

3.1 Goal of the study

The goal of this study is analyze and compare the "cradle to gate" GWP of two caps for the wine packaging sector: HeliCap 27 P.B. and HeliCap 26 Pro P.B.

The analysis was commissioned by Tetra Pak Italiana S.p.A. to Spinlife S.r.l. and was conducted in agreement with the standard ISO:

- ISO 14040:2006/Amd 1:2020, Environmental management — Life cycle assessment — Principles and framework — Amendment 1;
- ISO 14044:2006/Amd 2:2020, Environmental management — Life cycle assessment — Requirements and guidelines — Amendment 2;

and will be reviewed by an external LCA expert.

The results will be used by the commissioner (Tetra Pak) in comparative assertions disclosed to the public.

The communication will be Business to Customer (B2C).

3.2 Scope of the study

The scope of an LCA study includes the definition of the following items:

- Functional and declared unit;
- System boundary;
- Allocation procedure;
- Life Cycle Impact Assessment method;
- Data requirements;
- Cut off criteria;
- Data quality requirements;
- Assumptions.

3.2.1 Functional and declared unit

The functional unit specifies the performance characteristics of the systems being studied and provides the reference to which input and output are normalized.

In this LCA the function considered is the closure of a wine carton package. The declared unit to which the Climate Change impact is referred is one cap.

3.2.2 System boundary

This analysis considers the Upstream and Core stages, according to a "from cradle to gate" LCA. The construction, maintenance and decommissioning of infrastructure, i.e. buildings and machinery, as well as the occupation of industrial land was not considered, as their contribution to the environmental impact of the declared unit is considered negligible. The life cycle impacts of the carton packages and the caps packaging are not included.

The following life cycle phases and processes are included in this study:

1. **Upstream phase:**
   - Extraction and production of raw materials;
   - Raw materials transport;
   - Components production and transportation to the Company plant;
   - Impacts due to the production of electricity and fuels used in the upstream module;
2. **Core phase**:
   - Cap production;
   - Management of waste generated during the production process;
   - Impacts associated with the production of electricity and fuels used within the Core Module;

The systems boundary scheme is shown in Figure 3.

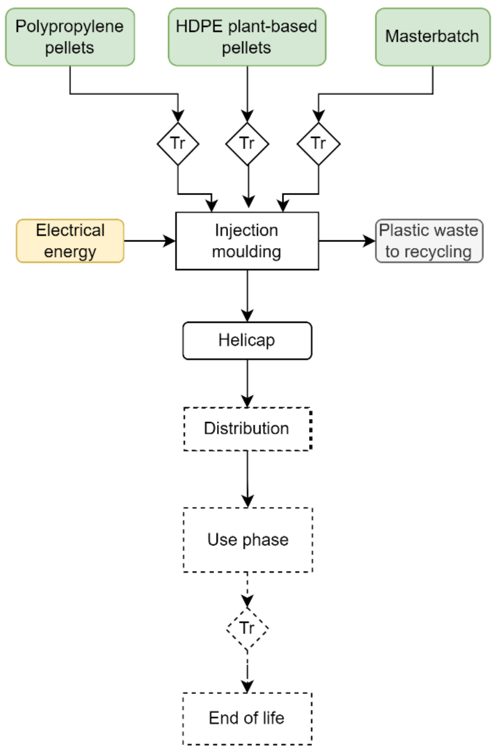

Figure 3 – System diagram of HeliCap 26 Pro P.B. and HeliCap 27 P.B. production.

3.2.3 Allocation procedure

The allocation of input flows can arise in two cases:

- In the case of processes shared between different products,
- In the case of reuse and recycling situations.

In the case under study the specific energy consumption for the components production and the products assembly are considered, therefore no allocation between products is required.

Regarding the end-of-life allocation, the "polluters pay principle" was adopted. According to this principle, processes related to waste treatment or disposal must be assigned to the product system that generated them, until they reach the "end-of-waste" status.

3.2.4 Life Cycle Impact Assessment method

According to the goal of this study, the same Impact Assessment method of the IFEU study was adopted to calculate the potential impacts on Climate Change: the *Global Warming Potential* for a 100-year time period based on IPCC 2013. The characterization factors used are those included in the method included in SimaPro v9.3 software.

In the IFEU study, the biogenic carbon approach adopted consider the CO_2 uptake by the plant and the re-emissions of CO_2 at the packaging end of life. For the purpose of comparing only the caps production, the CO_2 emission at the end of life was not considered in the quantification of the GWP.

3.2.5 Data requirements

Data used in this study can be classified in primary and secondary data.

Primary data, collected directly from the company through interviews and questionnaires, refer to:

- Caps composition;
- Raw materials suppliers;
- Plant-based polyethylene GWP;
- Caps production process.

Secondary data, derived from the database ecoinvent v3.8, the IFEU report or literature, refer to:

- Polipropylene production;
- Additives production;
- Production of energy carriers;
- Waste treatment processes;
- Transport processes.

3.2.6 Cut off criteria

The criterion chosen for the initial inclusion of inputs and outputs is based on the definition of a 1% cut-off level, both in terms of mass, energy and environmental significance. This means that a process is considered negligible if it represents less than 1% of the total mass or primary energy. However, all processes for which data are available were considered, even if they contribute less than 1%. Consequently, this threshold value is used to avoid collecting unknown data, but not to disregard data that are already available.

3.2.7 Data quality requirements

Data used in this study are collected in accordance with the following requirements:

- **Temporal coverage**: primary data are collected in May 2023. Where secondary data are used, the most recent available versions are used (i.e. representative of the situation in 2023 and not older than 10 years);
- **Geographical coverage**: the geographical area of caps production is Italy. For country specific raw material production, specific location was used; in other cases, average market data from database are used.
- **Technological coverage**: the data collected refer to the state of the art of the technologies used to produce materials;
- **Accuracy**: the primary data refer to actual consumption relating to the considered period; therefore, they are specific consumption, obtained from documents such as invoices, technical data sheets or questionnaires supplied to the companies concerned;
- **Completeness**: all information and data necessary to achieve the purpose of the analysis were collected and used in the analysis. In the case of missing data, the assumptions reported in the inventory analysis phase are made;
- **Representativeness**: data are collected directly on the sites of interest, in the reference period and considering the most recent technologies;
- **Consistency**: the methodology of the study is applied in a uniform way to the different components of the analysis;
- **Reproducibility**: the description of the methodology used to obtain the results has been reported in detail in this report in order to allow the reproducibility of the analysis by an independent practitioner;
- **Data sources**: Tetra Pak Italiana for primary data; ecoinvent v3.8 for secondary data; IFEU report for comparison data.
- **Uncertainty of the information**: data uncertainty was calculated for the primary data using the pedigree matrix, while the overall uncertainty associated with the results of the analysis was calculated using the Monte Carlo analysis and reported in the report.

3.2.8 Assumptions

Transport of plastic waste to the recycling factory is assumed to be 100 km.

The caps packaging is not included in the analysis as it is the same for both the cap and is not considered in the IFEU report.

3.3 Life cycle inventory analysis

This chapter describes the references and the procedures for collecting data and calculating the relevant input and output flows of the product systems.

3.3.1 Raw materials

Data on raw material production are taken from the ecoinvent database and supplier reports (Braskem, 2023). In Table 2 information on caps weight and data sources for material production are reported for both the caps.

Table 2 – Technical data for HeliCap 26 Pro P.B. and HeliCap 27 P.B.

HeliCap 26 Pro P.B.	Weight (g)	Additives	Material
Lid	1,37	2%	Biobased High-Density Polyethylene with colouring agents
Frame	1,47	8%	Biobased High-Density Polyethylene with colouring agents
Cutter	0,5	2%	Polypropylene with colouring agents
Total weight	3,34		
HeliCap 27 P.B.	**Weight (g)**		**Material**
Lid	1,81	4%	Bio-based Polyethylene with colouring agents
Frame	1,46	2%	Polypropylene with colouring agents
Cutter	0,62	2%	Polypropylene with colouring agents
Total weight	3,89		

Plant-based polyethylene

The HDPE plant-based is produced by the Brazilian company Braskem and is produced from sugar cane ethanol. Information about the GWP of this material are reported in the LCIA report "I'm green™ bio-based PE" (Braskem, 2023) and below in Table 3.

Table 3 Contribution analysis for Climate Change impact category for HDPE plant based produced by Braskem.

Production phase		GWP (kgCO2e/kg)	GWP (kgCO2e/kg)
Sugarcane growing	Agricultural operation	0,91	0,91
	Land use change credits	-1.10	
	CO2 Uptake	-3,14	-3,14
Ethanol production	Ethanol production	0,03	0,03
	Bagasse burning	0,16	0,16
	Electricity cogeneration credits	-1,17	

HDPE plant based produciton	Ethanol transport	0,46	0,46
	HDPE manufacturing	0,76	0,76
Total		-3,09	**-0,82**

As in the IFEU report, in this study the "Land use change" credits are not accounted for. Also, the electricity cogeneration credits are not considered as not relevant to the study goal and scope. It must be highlighted that the CO2 uptake will be re-emitted at the caps end of life, that is not part of the scope of this study.

Polypropylene

Data on polypropylene production derives from ecoinvent v.3.8.

3.3.2 Manufacturing process

Data for caps injection moulding are provided by the manufacturing plant and are reported in Table 4 and Table 5.

Table 4 Caps production data for HeliCap 27 P.B.

Flow	Amount	Unit
Input		
HDPE plant based	1,74	kg/1000 caps
PP	2,04	kg/1000 caps
Masterbatch	0,11	kg/1000 caps
Electrical energy	4,49	kWh/1000 caps
Output		
HeliCap 27 P.B.	3,89	kg/1000 caps
Scraps to recycling	0,12 (3%)	kg/1000 caps

Table 5 Caps production data for HeliCap 26 Pro P.B.

Flow	Amount	Unit
Input		
HDPE plant based	2,69	kg/1000 caps
PP	0,49	kg/1000 caps
Masterbatch	0,15	kg/1000 caps

Electrical energy	4,81	kWh/1000 caps
Output		
HeliCap 27 P.B.	3,34	kg/1000 caps
Scraps to recycling	0,1 (3%)	kg/1000 caps

Waste production

For the purpose of comparison, only the plastic waste generated from the plastic injection molding was considered, that is sent to a recycling plant. Distance to the waste treatment plant is assumed to be 100 km.

3.3.3 Packaging

The caps are packaged with the same type of packaging. Materials and weights are reported in Table 6. Being the packaging the same for both the caps, for the purpose of comparison it is not included in the model.

Table 6 Caps packaging

Type	Material	Materiale / Polimero
Primary	Plastic bag	HDPE
Secondary	Cartonboard box	Corrugated board
Tertiary	Plastic strech film	LDPE
Tertiary	Wooden pallet	Wood

3.3.4 Transport

3.3.4.1 Components and raw materials transport

The distances between the raw materials production plant and the Tetra Pak manufacturing plant are taken from the IFEU report inventory data and reported in Table 7.

Table 7 Raw material transport distances to manufacturing plant.

Raw material	Distance material producer to manufacturing plant
Polypropylene	500 km by road
Plant-based polyethylene	10800 by sea 700 by road
Masterbatch	800 km by road

For land transport, the use of Euro 4 class trucks is assumed, with size higher than 32 tons for distances greater than 200 km and between 16 and 32 tones for distances of less than 200 km.

3.4 Processes and materials modelling

In this chapter the datasets used for the secondary processes in the LCA model are reported, together with any changes necessary to adapt them to the analyzed systems.

3.4.1 HeliCap 26 Pro P.B. and HeliCap 27 P.B.

Material	Raw material dataset	Manufacturing process dataset	Changes	Proxy process	Source
PP (RER)	Polypropylene, granulate {RoW}| production | Cut-off, U		none	no	Ecoinvent 3.8
HDPE (RER)	INPUT: Carbon dioxide, in air = CO2 uptake OUTPUT in air: Carbon dioxide		Dataset built using the GWP calculated by the producer	no	(Braskem, 2023)
Masterbatch	Titanium dioxide {RER}| market for | Cut-off, U		none	Selected generic process	Ecoinvent 3.8
Waste from injection moulding	Waste polyethylene, for recycling, sorted {Europe without Switzerland}| treatment of waste polyethylene, for recycling, unsorted, sorting | Cut-off, U		none	no	Ecoinvent 3.8

3.4.2 Injection moulding consumptions

The energy consumption of the caps production is modelled as "Electricity, medium voltage {IT}| market for | Cut-off, U".

3.4.3 Transport

Distance	Dataset transport	Source
0-200 km	Transport, freight, lorry 16-32 metric ton, EURO4 {RER}| transport, freight, lorry 16-32 metric ton, EURO4 | Cut-off, U	Ecoinvent 3.8
>= 200 km	Transport, freight, lorry >32 metric ton, EURO4 {RER}| transport, freight, lorry >32 metric ton, EURO4 | Cut-off, U	Ecoinvent 3.8
Lorry + sea transport	Transport, freight, lorry 16-32 metric ton, EURO4 {RoW}| transport, freight, lorry 16-32 metric ton, EURO4 | Cut-off, U Transport, freight, sea, container ship {GLO}| transport, freight, sea, container ship | Cut-off, U	Ecoinvent 3.8

3.5 Life Cycle Impact Assessment

The impact assessment phase defines the potential impacts that the investigated system may have by using the results obtained in the previous inventory analysis phase. The mandatory elements, i.e. classification and characterization, required by the ISO 14040 and ISO 14044 Standards are reported in this section, for the Climate Change impact category.

It is necessary to highlight that the reported results are relative expressions that do not provide forecasts on the impacts on the category endpoints, exceeding of thresholds, safety margins or risks.

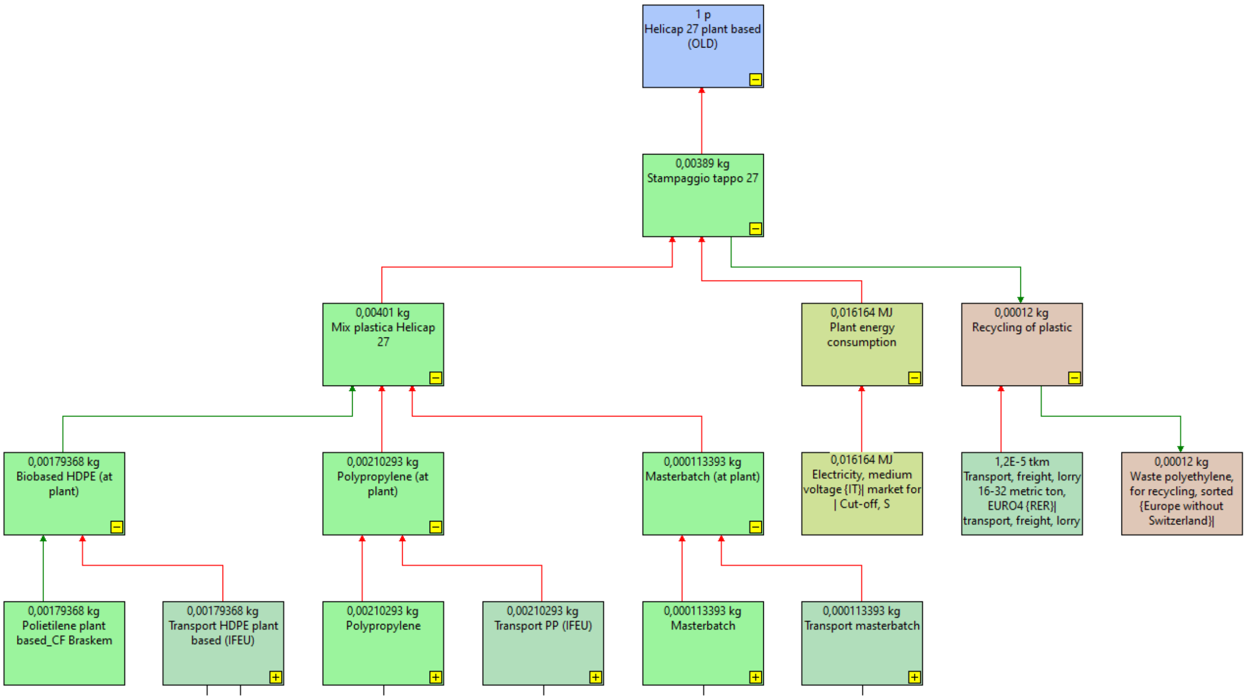

Figure 4 – Flow diagram of HeliCap 27 P.B. production LCA model

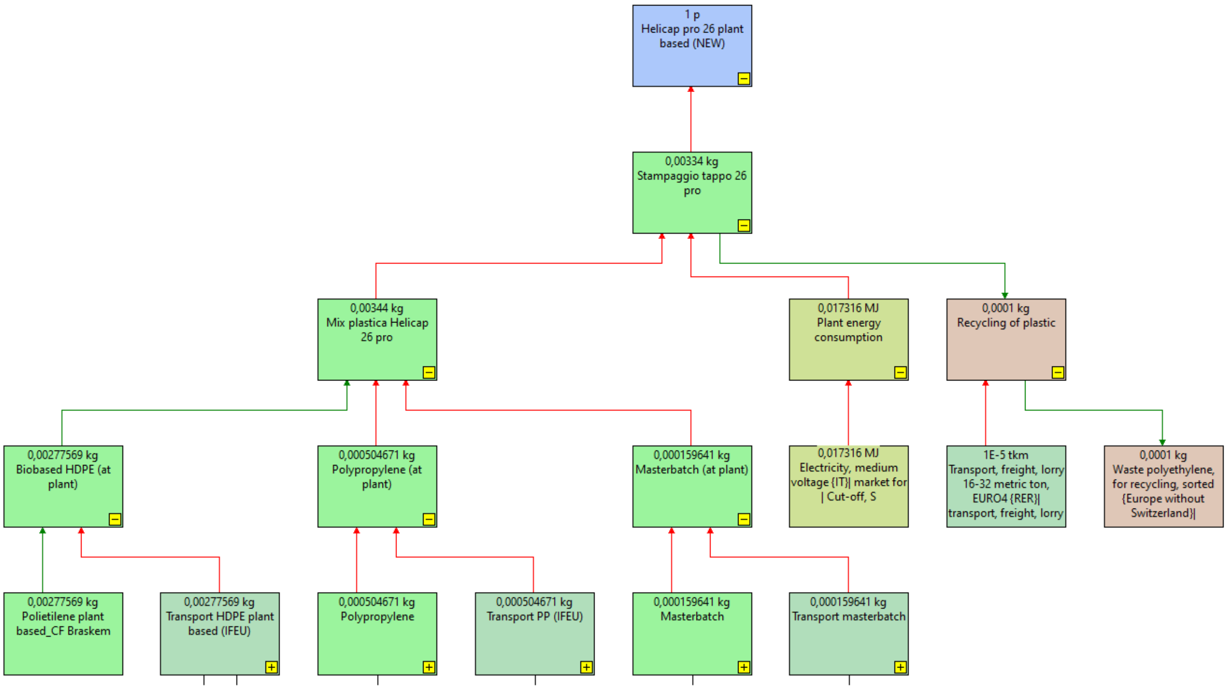

Figure 5 – Flow diagram of HeliCap 26 Pro P.B. production LCA model

3.5.1 LCA comparison between HeliCap 26 Pro P.B. and HeliCap 27 P.B.

In this section the GWPs of HeliCap 26 Pro P.B. and HeliCap 27 P.B. are reported and compared, showing the percentage difference between the new cap (HeliCap 26 Pro P.B.) respect to the substituted cap HeliCap 27 P.B.

Table 8 – Climate Change characterization results for HeliCap 26 Pro P.B. and HeliCap 27 P.B.

Impact category	Indicator	Unit	HeliCap 27 P.B	HeliCap 26 Pro P.B.	% difference Respect to H27 p.b.
Climate Change - fossil	GWP-fossil	$kgCO_2e$	0,012	0,011	-8,5%
Climate Change - biogenic	GWP-biogenic	$kgCO_2e$	0,00036	0,00037	+0,6%
Climate Change – CO2 uptake	GWP-uptake	$kgCO_2e$	-0,006	-0,009	+65,3
Climate Change - luluc	GWP-luluc	$kgCO_2e$	2,48E-6	1,46E-6	-41,5
Total Climate change	**GWP total**	**$kgCO_2e$**	**0,0062**	**0,0022**	**-65,2%**

The Climate Change characterization results reported in Table 8 show that the new cap HeliCap 26 Pro P.B. has a smaller GWP respect to the substituted HeliCap 27 P.B.

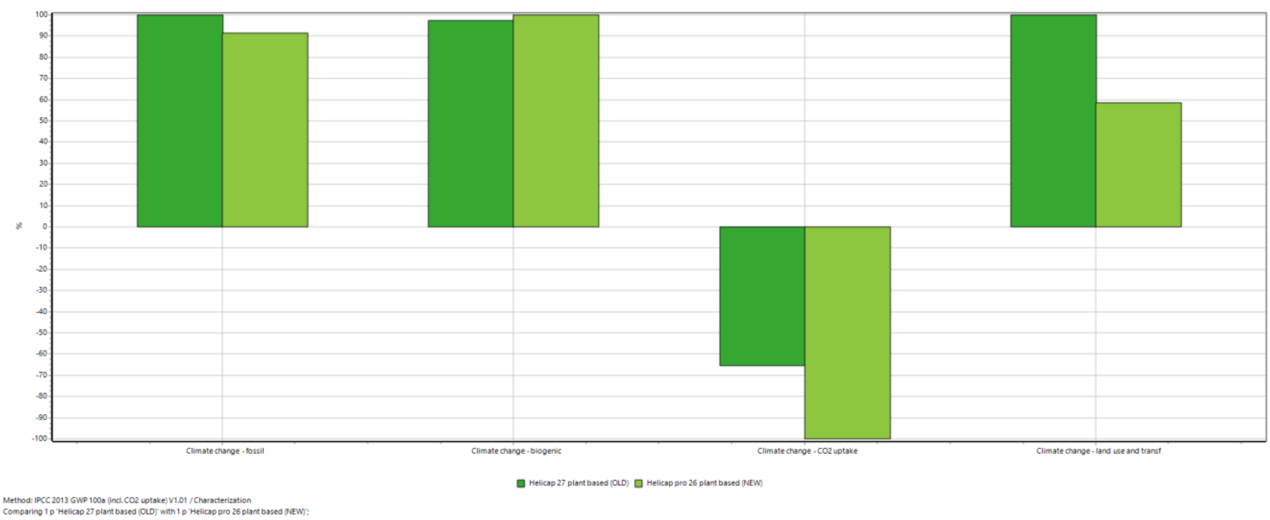

Figure 6 – Comparison between the GWP values of HeliCap 26 Pro P.B: and HeliCap 27 P.B.

In the next chapter the origin of these potential impacts is investigated for both the products life cycles.

4 Interpretation

The life cycle interpretation phase of an LCA comprehends the following elements:

- identification of the process contributions based on the results of the LCIA phases;
- evaluation: completeness, sensitivity and consistency checks;
- conclusions, limitations, and recommendations.

4.1 Process contributions

4.1.1 HeliCap 27 P.B. LCIA

Below is reported the HeliCap 27 P.B. process contribution for Climate Change.

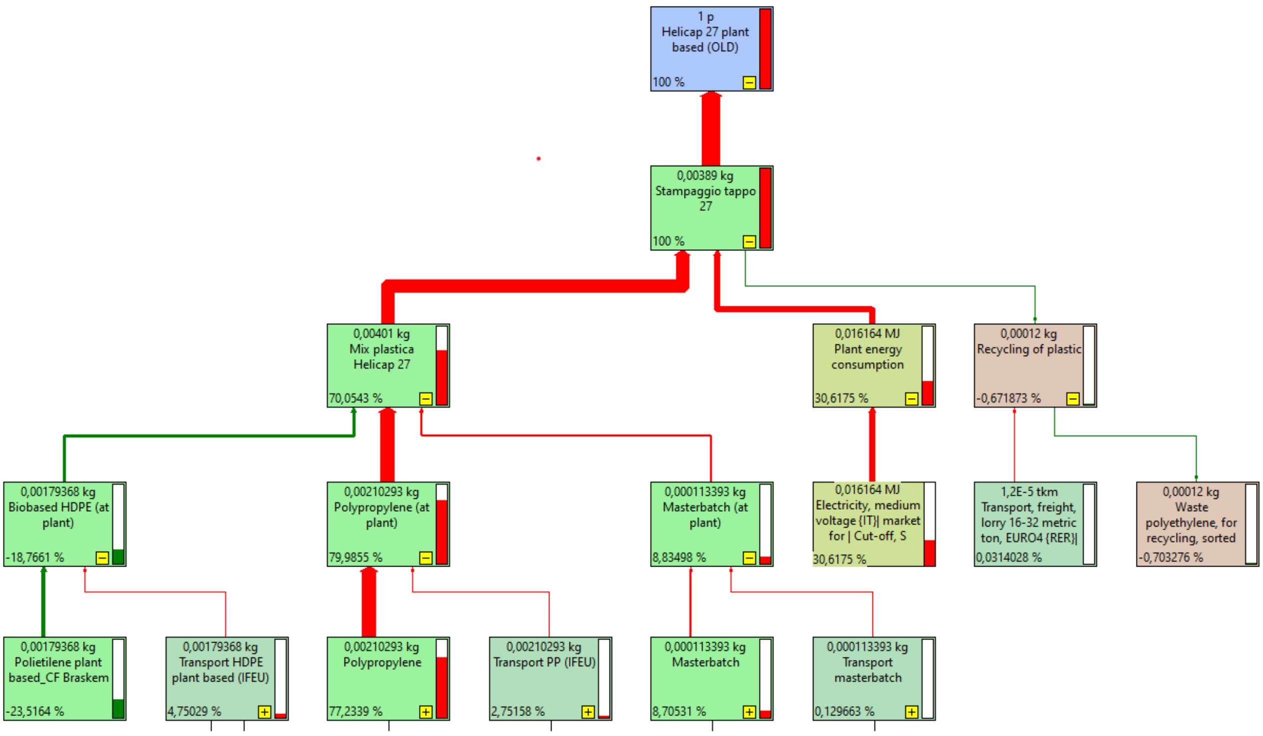

Figure 7 Flow diagram for the HeliCap 27 PLANT BASED GWP (characterization))

4.1.2 HeliCap 26 Pro P.B.

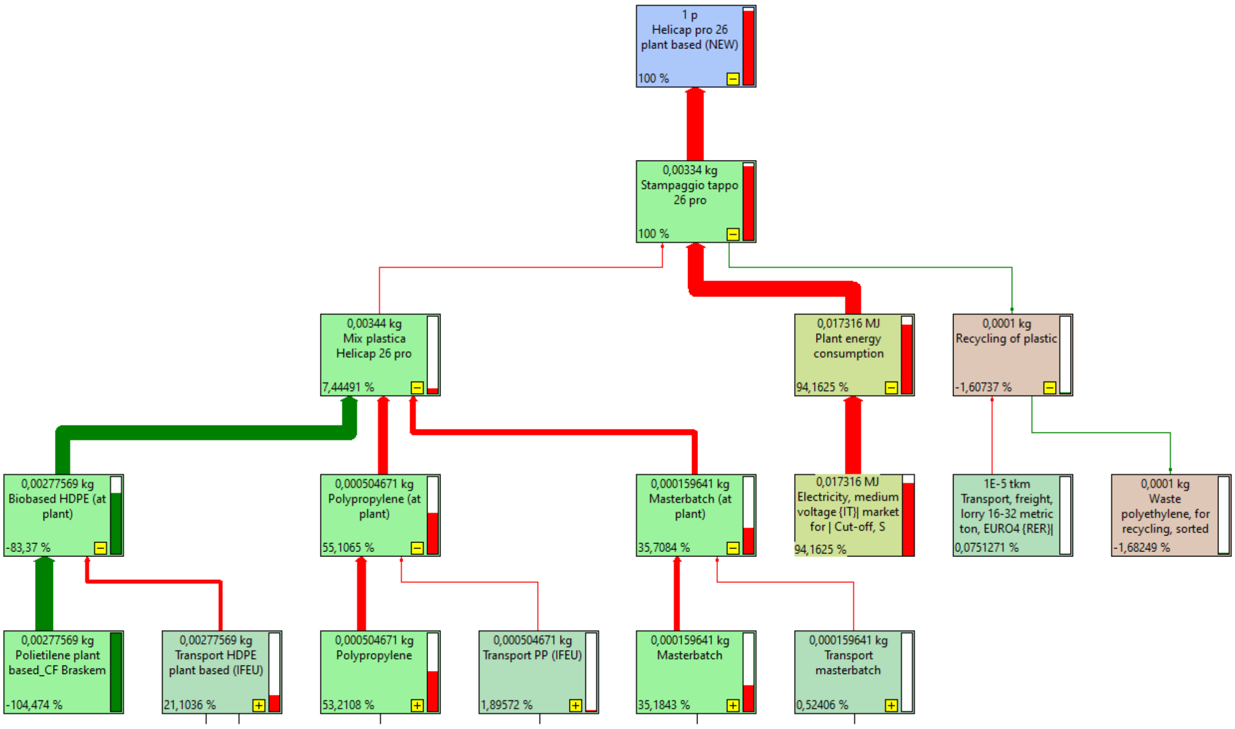

Figure 8 Flow diagram for the HeliCap 26 Pro PLANT BASED GWP (characterization)

4.2 Evaluation

The evaluation is be performed in accordance with the goal and scope of the study, considering the following three techniques:

— completeness check;

— sensitivity check;

— consistency check.

4.2.1 Completeness check

All information and data required to satisfy the goal and scope of the LCA. When data were not available, the assumptions reported in the Inventory analysis Chapter were made.

Table 9– Inventory completeness check

Unit process	HeliCap 27 P.B	Complete?	Action required	HeliCap 26 Pro P.B	Complete?	Action required
Upstream phase						
Raw materials production	x	yes	none	x	yes	none
Raw materials transport	x	yes	none	x	yes	none
Core phase						
Caps production	x	yes	none	x	yes	none

4.2.2 Sensitivity check

The objective of the sensitivity check is to assess the reliability of the results and conclusions by determining how they are affected by uncertainties in the data, allocation methods or calculation of category indicator results, etc.

The comparison was evaluated also by using the injection molding dataset provided by ecoinvent 3.8 (Injection moulding {RER}| processing | Cut-off, U instead of the specific energy consumption provided by Tetra Pak.

Table 10 – Climate Change characterization results for HeliCap 26 Pro P.B. and HeliCap 27 P.B with substitution of energy consumption with injection molding process.

Impact category	Indicator	Unit	HeliCap 27 P.B	HeliCap 26 Pro P.B.	% difference Respect to H27 p.b.
Total Climate change (basic case)	GWP total	$kgCO_2e$	0,0062	0,0022	-65,2%
Total Climate change(sensitivity)	GWP total	$kgCO_2e$	0,0078	0,0031	-60,1%

The recalculated environmental impacts of both caps are comparable with the previous reported GWPs.

4.2.2.1 Uncertainty analysis

Below the uncertainty analyses LCIA are reported, calculated in SimaPro by using the Monte Carlo method.

Figure 9 shows the graphical distribution of the difference between the values of the GWPs for HeliCap 27 P.B (A) and for HeliCap 26 Pro P.B (B) derived from the Monte Carlo simulation. The orange bars indicate the percentage of Monte Carlo runs in which the impacts of HeliCap 27 P.B are greater than the impacts of HeliCap 26 Pro P.B. The difference is considered significant when this percentage falls between 90 and 95% (Pré, 2016).

In the analysed LCA it is confirmed that the GWP of HeliCap 26 Pro P.B is always lower than that of HeliCap 27 P.B.

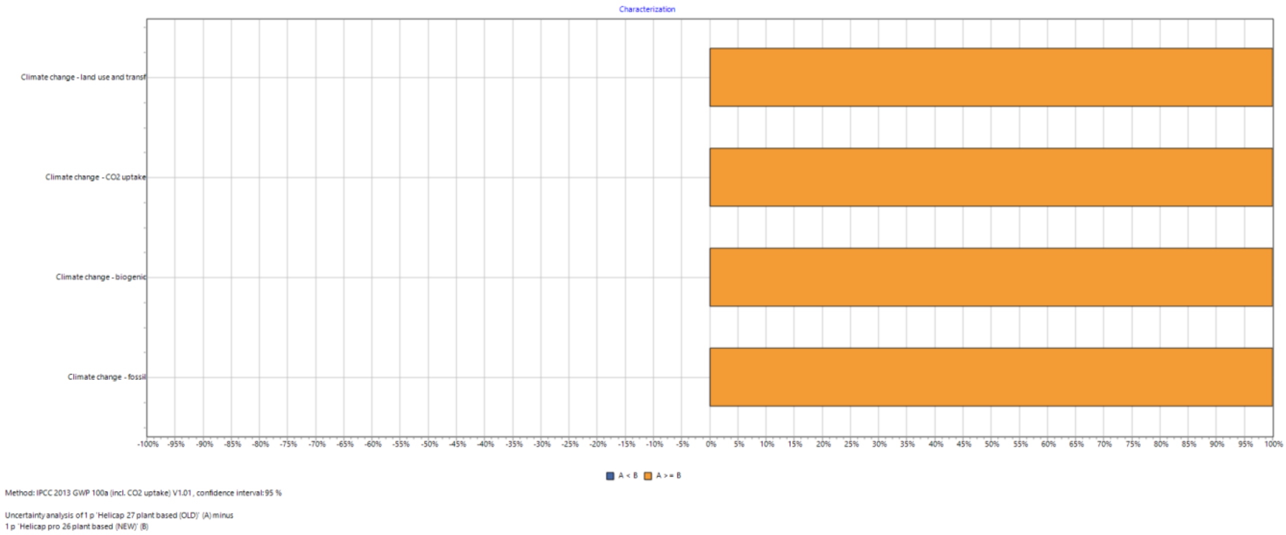

Figure 9 - Monte Carlo uncertainty analysis of HeliCap 27 P.B (A) and HeliCap 26 Pro P.B (B)

4.2.3 Consistency check

The objective of the consistency check is determining if the assumptions, methods and data are consistent with the goal and scope of the LCA. The following elements are considered:

1) Data quality: the comparison is made by using primary data for the production and use of both the products, referred to the same year, location and linked to recent technologies.
2) The environmental impact method is the same for both the products LCIA.
3) The allocation rules and the system boundary are consistently applied to both the product systems.

4.2.3.1 Data quality assessment

The data quality assessment was performed on the processes that account for more the 80% of the total impact of each of the EF categories considered.

The evaluation was made by using the Pedigree Matrix (Weidema, 1998) reported in Table 11. Higher values indicate lower data quality.

Table 11 - Pedigree MATRIX used to evaluate the data source quality (Weidema, 1998)

Indicator score	**1**	**2**	**3**	**4**	**5** (default)
Reliability	Verified[5] data based on measurements[6]	Verified data partly based on assumptions ***or*** non-verified data based on measurements	Non-verified data partly based on qualified estimates	Qualified estimate (e.g. by industrial expert)	Non-qualified estimate
Completeness	Representative data from all sites relevant for the market considered, over an adequate period to even out normal fluctuations	Representative data from >50% of the sites relevant for the market considered, over an adequate period to even out normal fluctuations	Representative data from only some sites (<<50%) relevant for the market considered ***or*** >50% of sites but from shorter periods	Representative data from only one site relevant for the market considered ***or*** some sites but from shorter periods	Representativeness unknown or data from a small number of sites ***and*** from shorter periods
Temporal correlation	Less than 3 years of difference to the time period of the dataset	Less than 6 years of difference to the time period of the dataset	Less than 10 years of difference to the time period of the dataset	Less than 15 years of difference to the time period of the dataset	Age of data unknown or more than 15 years of difference to the time period of the dataset
Geographical correlation	Data from area under study	Average data from larger area in which the area under study is included	Data from area with similar production conditions	Data from area with slightly similar production conditions	Data from unknown ***or*** distinctly different area (North America instead of Middle East, OECD-Europe instead of Russia)
Further technological correlation	Data from enterprises, processes and materials under study	Data from processes and materials under study (i.e. identical technology) but from different enterprises	Data from processes and materials under study but from different technology	Data on related processes or materials	Data on related processes on laboratory scale ***or*** from different technology

Table 12 Data quality assessment for HeliCap 27 P.B. and HeliCap 26 Pro P.B. production processes with impact higher than 10% on Climate Change impact category.

Process	Pedigree matrix scores
HDPE plant-based	2,n.a.,1,1,1
PP	2,n.a.,2,1,2
Masterbatch	2,n.a.,2,1,2
Plant energy consumption	2,n.a.,1,1,1

The analysis shows that the process data used have a very good (1) or good (2) quality in the applicable categories analyzed.

5 Conclusions and discussion

In this report a comparative life cycle assessment of two packaging closure produced by Tetra Pak is reported: the HeliCap 27 P.B. and the new HeliCap 26 Pro P.B.

The analysis shows that the production of the new HeliCap 26 Pro P.B. has a lower impact on total Climate Change category (-65,2%) respect to HeliCap 27 P.B, due to higher percentage of HDPE plant based in the new HeliCap 26 Pro P.B. The results are confirmed by the uncertainty analysis performed with Monte Carlo Analysis.

In the IFEU LCA report (IFEU, 2020) the comparison of the two wine packaging Tetra Brik Aseptic (TBA) 1000 Square P.B. Helicap27 P.B. and Tetra Prisma Aseptic (TPA) 1000 Square P.B. Helicap27 p.b. against a glass bottle (750 ml, 385 g) is reported. The total Climate Change for both products calculated in this report is reported in Table 13.

Table 13 Climate Change results for wine packaging with allocation factors 100% (IFEU, 2020) and comparison with a glass bottle.

	Total GWP [a] (kgCO2e)	Comparison with glass bottle[a]	Contribution of closure[a]	GWP without caps[b] (kgCO2e)	GWP of closure (kgCO2e) [b]
Tetra Brik Aseptic (TBA) 1000 Square P.B. Helicap27 p.b.	0,073	-84%	10%	0,0657	0,0073
Tetra Prisma Aseptic (TPA) 1000 Square P.B. Helicap27 p.b.	0,069	-85%	10%	0,0617	0,0073
Glass bottle (750ml)	0,468	100			

(a) Data from IFEU (2020)
(b) Calculated from IFEU data

The higher share of total burdens caused by the production of the wine carton closures reported in the cited report (IFEU, 2020, page 85) is 10% and it is used to calculate the higher contribution of the HeliCap 27 p.b. to the total wine packaging GWP (considering the TBA version).

$GWP_{closure} = GWP_{packaging} * 10\%$

The GWP of closures calculated from the IFEU results are quite different from the GWP calculated in this report (0,0062 kgCO2e) due to different datasets used in the IFEU analysis. Therefore, only the absolute difference between the calculated GWP of the two closures (-62,5%) is used and applied to the IFEU results to verify the comparison with the glass bottle.

Table 14 Recalculated comparison between the wine packaging and the glass bottle considering a reduction of 65,2% of the closures impact.

	Total GWP[b] (kgCO2e)	Comparison with glass bottle[b]	Contribution of closure[b]	GWP without caps[a] (kgCO2e)	GWP of closure[b] (kgCO2e)
Tetra Brik Aseptic (TBA) Square P.B. Helicap26 pro p.b. 1000 ml	0,068	-85%	3,7%	0,0657	0,0025
Tetra Prisma Aseptic (TPA) Square P.B. Helicap26 pro p.b. 1000 ml	0,064	-86%	4,0%	0,0617	0,0025
Glass bottle (750ml)	0,468	100	-		

(a) Data from IFEU (2020)
(b) Calculated considering the GWP reduction calculated in this report

The substitution of Helicap 27 P.B. with Helicap 26 pro P.B. leads to a reduction of 65,2% of the closures GWPs. The recalculated differences between the two wine carton packaging and the glass bottle are reported in Table 14 and confirm the results reported in the IFEU report.

Therefore, it is confirmed that the Tetra Pak wine packaging *Tetra Brik Aseptic (TBA) Square plant-based Helicap 26 pro plant-based 1000 ml* and *Tetra Prisma Aseptic (TPA) Square plant-based Helicap 26 pro plant-based 1000 ml* led to a CO2e reduction of over 80% compared to a 385 g glass bottle.

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