LCA Methodological Report

Life Cycle Assessment of Packaging

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Version monitoring

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Executive Summary

As part of their sustainability journey, **Loro Piana has developed a new packaging solution (named 'Minimal Packaging') that aims at being more environmentally friendly than the traditional solution (named 'Signature Packaging').** To analyze the environmental impact savings associated to the use of the Minimal Packaging option, **Loro Piana mandated a Life Cycle Assessment (LCA)** of said packaging solutions to EcoAct. Therefore, the present document is a methodological report describing the LCA of the two different packaging options:

- **The Signature Packaging (SP):** which includes an external Habana box, made from 30% recycled materials, and a branded box. In its interior, it includes a dust bag, a cedar ball, a brand sticker, a tissue paper, a document folder, and, if asked by the end customer, a gift note in paper. The entire package is then presented with an external cotton ribbon.
- **The Minimal Packaging (MP):** being aimed as more environmentally friendly, it includes **fewer elements** and **more recycled materials**. Therefore, it includes an external Habana made from 100% recycled materials and a cover box that contains a dust bag and, if asked by the end customer, an optional gift note.

Loro Piana's objective for this LCA project is to know the environmental impact savings associated to the use of the MP instead of the SP so **the end customer can make a conscious environmental decision** when selecting their preferred packaging solution for their purchases to be delivered on.

The scope of this study covers the **cradle-to-grave LCA** of the six different box sizes available for shipping orders as well as the different regions from which these are shipped.

The results have revealed **a clear reduction of environmental impact upon the selection of MP over SP**. Among the selected environmental impact categories, the following reductions are achieved (from highest to lowest reduction):

1. **Non-renewable energy resources** (use of energy sources like oil, gas, and coal that cannot be replenished, leading to resource depletion and pollution): **28% reduction.**
2. **Particulate matter formation** (release of tiny airborne particles that harm human health by causing respiratory diseases): **28% reduction.**
3. **Climate change** (emissions of greenhouse gases (GHG), mainly CO_2, that trap heat and cause global warming and climate disruptions): **26% reduction.**
4. **Acidification** (increase in soil and water acidity from pollutants, damaging ecosystems, and biodiversity): **25% reduction.**
5. **Marine eutrophication** (excess nutrients in water causing algae blooms that reduce oxygen and harm aquatic life): **18% reduction.**
6. **Water use** (amount of water consumed, which can affect water availability and aquatic ecosystems): **13% reduction.**

Depending on the region, the environmental savings **can be greater**. For example, in the United Kingdom, GHG emissions can decrease by 30% and particulate matter formation by 31%.

The results obtained in the study and disclosed in this report **are only valid for the specific situation defined by the assumptions and data declared**. The reliability of data used by third parties or for purposes other than those mentioned in this report cannot be ensured by Loro Piana.

Loro Piana commissioned a third party to critically review the LCA in order to validate the results and be in a position to communicate them.

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Vocabulary

The symbols and abbreviations used are:

EU: European Union.

EF: Emission Factor

LCA: Life Cycle Assessment.

LCI: Life Cycle Inventory.

GHG: Greenhouse Gas.

MP: Minimal Packaging.

PEF: Product Environmental Footprint.

PEFCR: Product Environmental Footprint Category Rule.

SP: Signature Packaging.

Context and Objectives

General Context

Loro Piana is a luxury clothing and accessory retailer, selling both face to face in physical shops and online through worldwide shipping. As part of their sustainability journey Loro Piana has developed a new packaging solution (referred to as 'Minimal Packaging' or MP) that aims at being more environmentally friendly than the traditional option (referred to as 'Signature Packaging' or SP).

Objectives of the Study

The objective of the study is to compare the environmental impact of the two different packaging options offered by Loro Piana from 'cradle to grave' with a focus on their impact on climate change and water resources because of their importance for Loro Piana. The MP includes fewer elements than the SP and some components with recycled content (detailed in part Collection and quality of data). In the assessment the different available packaging sizes and shipping geographies are to be included.

The steps considered in the analysis are:

1. Production of raw materials used to manufacture the packaging.
2. Upstream transportation of raw materials.
3. Manufacture of the packaging.
4. Production of secondary and tertiary packaging used to distribute the packaging.
5. Distribution of the packaging.
6. End of life of all materials used, including the packaging.

Therefore, the present document intends to present the methodological framework built to conduct the study of the environmental impacts of Loro Piana's SP and MP. It includes details on the functional unit, the system studied (boundaries and model), established assumptions, and parameters that were considered.

It must be stated that to tackle the emissions related to the different lifecycle steps of the packaging options, Loro Piana needs to consider the impact of each of the analyzed steps separately.

Thanks to the analysis and the comparison of the different packaging options, the company will be able to present the results to their clients. Hereby, clients will be able to make a conscious environmental decision when selecting their preferred packaging option for their purchases to be delivered on. This approach will be in line with Loro Piana's desire to minimize its environmental footprint, hoping that clients will select the less environmentally impactful packaging option.

References

The Life Cycle Assessment has been conducted in accordance with the principles and requirements needed to conduct Life Cycle Assessments specified in the NF EN ISO 14040: 2006 and EN ISO 14 044: 2006[1].

The Life Cycle Assessment has been conducted using an internal Excel tool based on the parameters available in ecoinvent v3.10 and the best LCA practice available during the time of the study.

Background on Life Cycle Assessment

Introduction to Life Cycle Assessment

The proposed approach is based on the application of the Life Cycle Assessment (LCA) method. LCA is a standardized international method (ISO 14040 and 14044) for assessing the quantifiable effects on the environment of a service or product from the extraction of materials up to its end-of-life. It is, therefore, a multi-step and multi-criteria approach. Figure 1 below depicts each of the steps that are considered when conducting a Life Cycle Assessment.

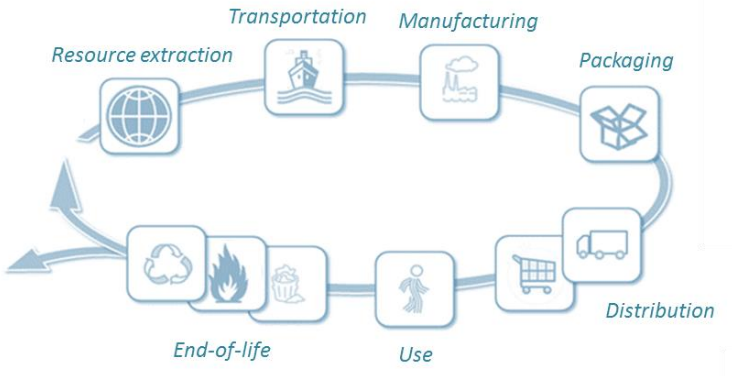

Figure 1: Steps considered in a Life Cycle Assessment.

This method aims to carry out an exhaustive assessment of natural resources consumed within the studied processes, including the energy consumption needed and the rejected emissions into the environment (air emissions, water, soil, and waste).

Part of the LCA consists in developing an exhaustive inventory of the inputs (energy and raw materials) and outputs (waste and emissions) of the product or service at each step of its life cycle, as shown in Figure 2. During the LCA these inputs and outputs are weighted and aggregated to quantify the potential environmental impact for each indicator. The balance of these inflows and outflows are named Life Cycle Inventories (LCI).

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[1] ISO 14040:2006 - Environmental management — Life cycle assessment — Principles and framework and ISO 14044:2006 - Environmental management — Life cycle assessment — Requirements and guidelines

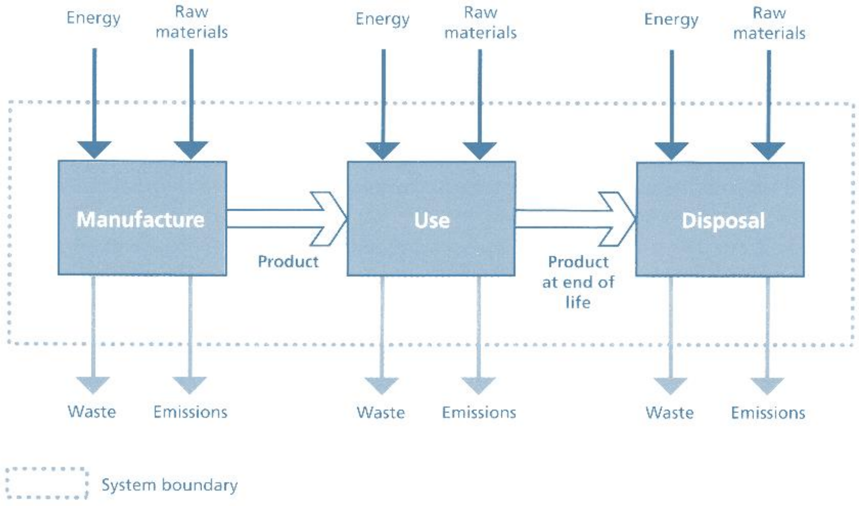

Figure 2: Exhaustive assessment of materials and energy inputs/outputs.

There are various environmental impacts considered in the Life Cycle Assessment, including global warming, resource use, photochemical ozone formation, among others. For instance, the climate change indicator is the sum of greenhouse gases (GHG) emissions weighted by different global warming potentials, which is expressed in kgCO_2 equivalent. The environmental impact categories considered in this LCA have been summarized in the section Environmental Indicators and Characterization Models of this report.

Life Cycle Assessment steps

LCA principles are defined by international standards in the ISO 14040 series. These describe the main characteristics of a LCA and provides guidelines for carrying out the study by establishing the methodological framework, transparency requirements, communication to third parties, and other requirements. According to the standards the assessment can be divided into 4 steps, as shown in Figure 3.

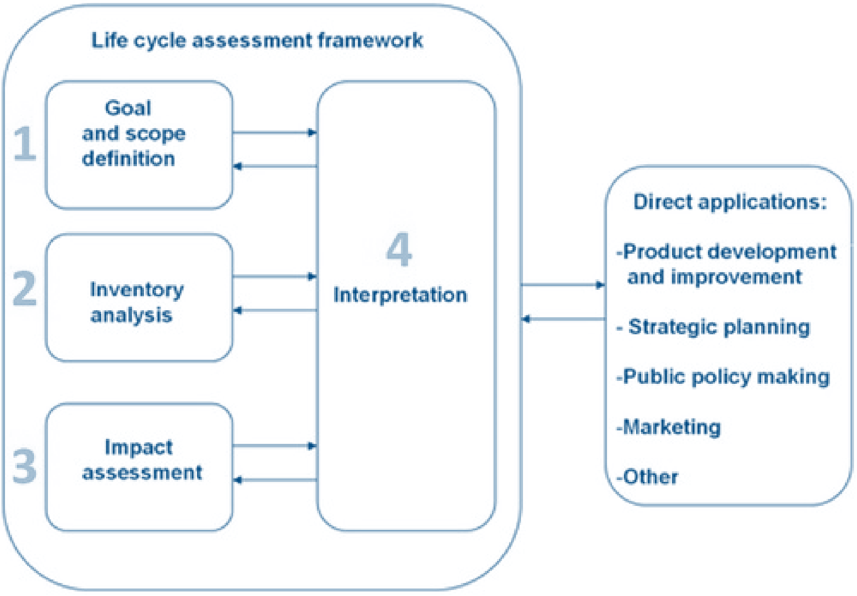

Figure 3: The different phases of a LCA according to ISO 14040.

The advantages of the general LCA approach are:

- The identification and quantification of the environmental footprint of a product or service, facilitating the reduction of its environmental impacts.
- The comparison of a system's different conditions.

Validity of the results and Critical Review

Validity of the Results

The results obtained in the study and disclosed in this report are only valid for the specific situation defined by the assumptions and data declared. It is to be noted that conclusions that can be drawn from this analysis are subject to change if such conditions are different. Therefore, the reliability of data used by third parties or for purposes other than those mentioned in this report cannot be ensured by Loro Piana.

Critical Review

The critical review has been carried out according to the International Standards ISO 14040/44 and ISO 14071. The LCA has been reviewed according to the five following aspects outlined in ISO 14040, assessing whether:

- 'The methods used to carry out the LCA are consistent with this International Standard,
- The methods used to carry out the LCA are scientifically and technically valid,
- The data used are appropriate and reasonable in relation to the goal of the study,
- The interpretations reflect the limitations identified and the goal of the study, and
- The study report is transparent and consistent.'

To limit possible misunderstandings or negative effects on external stakeholders, a stakeholder committee must conduct critical reviews of LCA when results are to be used to support a comparative assertion intended to be disclosed to the public.

However, only the products of Loro Piana are in the scope of the LCA, and not the competitor's product. As such, this study was the subject of a critical review by an independent external expert, to check the relevancy and the reliability of the methodology. The plan is to make the study available to Loro Piana's clients.

The critical review has been conducted by Thomas Bargain from ESSP Solutions. The report of the critical review is provided in detail in the *Annex VI – Life cycle assessment critical review* of this report.

Scope of the study

Product at stake

The products at stake in this study are the different packaging options offered by Loro Piana, aimed at storing the products sold when being shipped to the end customer. The available packaging options, shown in Figure 4, are:

- **The Signature Packaging:** which includes an external Habana box and a branded box. In its interior this packaging option includes a dust bag, a cedar ball, a brand sticker, tissue paper, a document folder, and, if asked by the end customer, a gift note in paper. The entire package is then presented with an external cotton ribbon.
- **The Minimal Packaging:** being aimed as more environmentally friendly, it includes fewer elements and recycled materials. Therefore, it includes an external Habana and cover box that contains a dust bag and, if asked by the end customer, an optional gift note.

Figure 4: Comparison of the two available packaging options: the Minimal Packaging (left) and Signature Packaging (right).

In total six different packaging option sizes have been analyzed, differentiated based on the size and the weight of the external Habana box of both the *Signature* and *Minimal Packaging*, as shown in Table 1 below.

Name	Measures (mm)	SP box weight (g)	MP box weight (g)	Weight difference between SP and MP (g)
Box 1	475x440x125	586	781	195
Box 2	405x340x210	638	830	192
Box 3	375x210x170	342	426	84
Box 4	325x190x150	270	336	66
Box 5	390x285x75	323	356	33
Box 6	375x390x170	576	707	131

Table 1. Details of the six analyzed packaging size options, both for the SP and MP.

MP boxes are heavier than SP boxes to better protect the product inside. Moreover, MP boxes are made of 100% recycled materials while SP boxes are only made of 30% recycled materials.

Here are the share of use of each box and the share of gross orders sold per region has been considered to guarantee the highest representativeness. As showcased in Table 2 Box 3, Box 4, and Box 7 are the most used boxes.

Name	Measures (mm)	Share of use (%)
Box 1	475x440x125	5%
Box 2	405x340x210	5%
Box 3	375x210x170	27%
Box 4	325x190x150	35%
Box 5	390x285x75	2%
Box 6	375x390x170	27%

Table 2. Share of use per box type (FU).

In line with this, as seen in Table 3, Europe, Middle East, and the United States are the regions where most share of gross order take place.

Region	Share of gross orders sold
Europe	30%
Middle East	22%
United States	22%
China	12%
United Kingdom	10%
Korea	2%
Canada	1%
Japan	1%
South Asia	1%

Table 3. Share of gross orders sold by region.

Functional Unit

The ISO 14040 standard defines the Functional Unit (FU) as 'the quantified performance of a product system', intended at being used as a reference unit during the life cycle assessment.

In other words, the Functional Unit is used to facilitate the comparison of different possible systems through the introduction of a common reference to express the material and energy balance of the life cycle of each system. It allows the results of an LCA study to be quantified in relation to the service provided.

The following aspects are considered as part of their definition:

1. The function / service rendered: 'what?'
2. The amount: 'how much?'
3. The level of quality of service: 'how?'
4. The lifespan of the service / product: 'for how long?'

For the purposes of the study, 7 functional units (FU) have been defined, one for each box size presented in Table 1 (UFs 1 to 6), to allow the comparison of SP and

MP for each box size, and a broader last one (UF 7) to calculate global weighted averages of the results:

FU 1. Store products in a 475 mm long, 440 mm wide, and 125 mm high box for 1 year. Also referred to as *Box 1* or *Box 475x440x125*.

FU 2. Store products in a 405 mm long, 340 mm wide, and 210 mm high box for 1 year. Also referred to as *Box 2* or *Box 405x340x210*.

FU 3. Store products in a 375 mm long, 210 mm wide, and 170 mm high box for 1 year. Also referred to as *Box 3* or *Box 375x210x170*.

FU 4. Store products in a 325 mm long, 190 mm wide, and 150 mm high box for 1 year. Also referred to as *Box 4* or *Box 325x190x150*.

FU 5. Store products in a 390 mm long, 285 mm wide, and 75 mm high box for 1 year. Also referred to as *Box 5* or *Box 390x285x75*.

FU 6. Store products in a 375 mm long, 390 mm wide, and 170 mm high box for 1 year. Also referred to as *Box 6* or *Box 375x390x170*.

FU 7. Store products in a 1 dm^3 box for 1 year.

Definition of the Reference Flow

The reference flow is the quantity of product needed to fulfil the defined function and is to be measured using specific units.

The reference flow includes:

- The reference product for performing the function describing the service,
- The complementary elements necessary for use (packaging),
- Associated losses.

For the purpose of the study, the reference flow was defined as follows:

- For UFs 1 to 6: 1 box,
- For UF 7, the reference flow is different for each box, as each box have a different volume:
  - Box 1: 0,04 box,
  - Box 2: 0,03 box,
  - Box 3: 0,07 box,
  - Box 4: 0,11 box,
  - Box 5: 0,12 box,
  - Box 6: 0,04 box.

The reference flows of UF 7 have been calculated based on the volume of each box, presented in Table 4.

Box	Measures (mm)	Length (mm)	Width (mm)	Height (mm)	Volume (dm3)
Box 1	BOX 475x440x125	475	440	125	26
Box 2	BOX 405x340x210	405	340	210	29
Box 3	BOX 375x210x170	375	210	170	13
Box 4	BOX 325x190x150	325	190	150	9
Box 5	BOX 390x285x75	390	285	75	8

Box 6	BOX 375x390x170	375	390	170	25

Table 4. Measures and volume of each box.

Perimeter of the study

Delimitation of system boundaries: stages and flows included

LCAs quantify the environmental impacts of the entire life cycle of a product. As part of the assessment the characteristics of the life cycle phases considered are to be defined. As the scope of the study will be a 'cradle to grave', the steps to be considered will be the following, as summarized in Figure 5:

Manufacturing, which includes the following processes:

- The extraction of raw materials.
- The transportation of raw materials.
- The processing of raw materials.

Transportation, which includes the following:

- Upstream transportation of raw materials from the sites where raw materials are bought to the manufacturing sites of Loro Piana.

Assembly, which includes the following:

- The energy consumption needed for assembly processes.

Distribution, which includes the following:

- Downstream distribution of the final product from the manufacturing sites of Loro Piana to the end customer.

Use, which includes the following:

- No impact is included in the use phase.

End of life, which includes the following:

- Waste treatment.

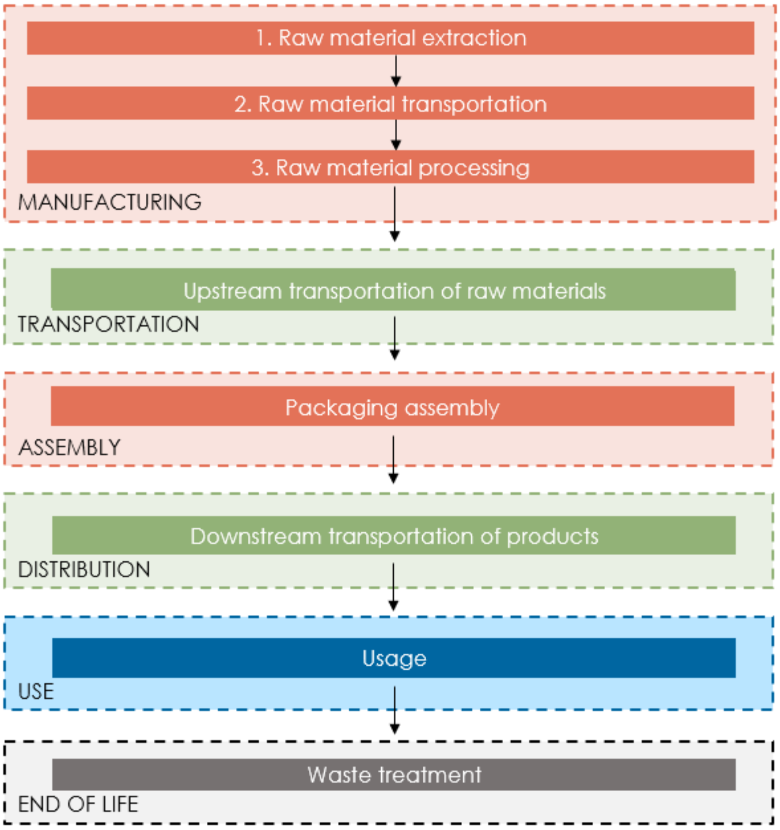

Figure 5: Life stages of the products to be assessed.

Steps of the life cycle excluded from the perimeter

The following flows have been excluded from the system boundaries:

- Flows related to human activities, such as employee commuting.
- Flows related to services associated with the product, such as advertising, sales strategy, and marketing, due to non-representative impacts, and difficulties to quantify these impacts.
- Flows related to the production and transportation of the packaging used to pack the raw materials (e.g., paper boxes, pallets, plastic films) as they are considered negligible regarding the whole life cycle of the packaging being studied.
- Flows related to the packaging assembly, production, and manufacturing; considered to require no or negligible energy since it is assembled by hand. Raw materials are indeed final products that do not need further processing and just need to be assembled (e.g., the internal compensator and the dust bag are put into the external Habana box), which is done by hand.
- Plant construction, production of machines, and transport systems are excluded as their impacts are assumed negligible compared to those of the product when compared to the lifetime of these systems.

- The product use by the customers, as there is no direct energy consumption during this life cycle stage.
- We have not taken into account delivery to the final customer due to the multiple scenarios and lack of available information (commonly referred to as the "last km").

Cut-off criteria and rules

All inputs for which data was available have been included in the LCI of the product. It has been estimated that approximately 100% of the inputs have been considered.

Collection and quality of data

Data collection responsible parties

All data related to the study was collected by Loro Piana through data collection forms provided by EcoAct. It is therefore considered that the data collection has been conducted under the responsibility of Loro Piana.

The attained data has later been reduced to the functional unit by EcoAct. The additional information and assumptions that had to be made during the study have been included in the *Assumptions and data for LCI* section of this report.

The following departments from Loro Piana have been involved in the data collection process:

- The procurement department for information regarding raw materials, manufacturing, and packaging.
- The logistics department for information regarding transportation (freight).

Used data

The data used in the LCA, as shown in Table 5, can be categorized in two data categories based on the source, which can be summarized as:

- Primary data, attained by Loro Piana, referring to specific data needed to create the system being analyzed and attained by Loro Piana. It usually refers to the data that describes the composition of a product and its packaging.
- Secondary data, which refers to data for the LCI of generic materials, energy, transport, etc., attained from databases such as ecoinvent.

Category	Primary data	Secondary data
Raw materials	Quantity and weight of raw materials	N/A
Upstream packaging	N/A (excluded)	N/A
Upstream transport	Distance traveled, quantity and weight of each raw material and means of transport	Inputs mode of each transport

Assembly	N/A (excluded)	N/A
Downstream packaging	Quantity and weight of packaging	Inputs mode of each transport
Distribution	Number of packaging sold by country or region and means of transport	N/A
End of life	Weight of raw materials and packaging	Waste treatment

Table 5: Comparison of data types by primary and secondary data.

Collected primary data

Primary data on raw materials has been attained by Loro Piana from suppliers, gathering information on the materials' composition (mainly regarding the recycled content), origin, and weight (e.g., 1 100%-recycled external Habana box from Italy). To later consider the transportation of these raw materials to Loro Piana's sites, information on the location of Loro Piana's suppliers, the distances traveled, and transport modes has as well been collected (e.g., 192 km traveled in truck wholly in Italy to transport external Habana boxes).

Primary data on secondary packaging (that surrounds the packaging) and tertiary packaging (that surrounds the secondary packaging) has as well been retrieved by Loro Piana internally, including information on the type, quantity, origin, and recycled content of the packaging used (e.g., 1 50%-recycled wooden pallet from South Korea).

No data for end-of-life treatment was made available by Loro Piana as products are shipped to different countries and their disposal relies on final costumer action and is therefore unknown.

Collected secondary data

All secondary data, or inventory data, used in the Life Cycle Assessment has been obtained from the ecoinvent v3.10 database. The quality of the data collected is believed to be supported by the robustness of ecoinvent v3.10. Additional CFF calculations have been made to estimate the impacts of partly recycled materials (e.g., 30%-recycled corrugated board).

The LCIs of raw materials are representative of technologies currently used in Europe (used for corrugated board, printed paper, solid compact board, wood, and wooden pallets) and globally (used for cotton, plastic film, and plastic pallets) The LCIs of freight are representative of Europe for truck and globally for plane. The LCIs of waste are representative of Europe for waste in Europe (apart from the United Kingdom, UK), the UK for waste in the UK and rest of the world for waste in other regions, apart from the LCI of waste cotton that is only representative of rest of the world.

Geographical and temporal representativeness

The data attained is considered to be representative of the international context as materials and processes are located globally, including Europe (including the United Kingdom), Middle East, South Korea, China, Hong Kong, Japan, and the United States of America. It must be noted that manufacturing factories are located in the region where the packaging is distributed (e.g., Italy for Europe, Dubaï for Middle East, the UK for the UK) and that the aforementioned locations are warehouses. All the assumptions for the distribution process have been detailed in the Perimeter of the study section.

The data collection was conducted between November 2024 and January 2025 and is, therefore, considered to be up to date for primary data.

Data Quality

The scale is as follows for geographical zones:

- 1: Data from the geographical area studied
- 2: Average data from a larger geographical area than the one under study
- 3: Data from an area with similar production conditions
- 4: Data from an area with almost similar production conditions
- 5: Data corresponding to a geographical area not determined or different from the study area.

The scale for temporal secondary data is as follows:

- 1: The data is less than 3 years different from the period studied.
- 2: Data differ by less than 6 years from the period studied
- 3: Data differ by less than 10 years from the period studied
- 4: Data differ by less than 15 years from the period studied
- 5: Data not dated or more than 15 years different from the period studied

Modeling data are taken from ecoinvent 3.10. They are considered technological representative. The scale is as follows:

- 1: Data from companies, processes and materials studied
- 2: Data from processes and materials studied, but from different companies
- 3: Data from the processes and materials studied, but from different technologies
- 4: Data from processes/materials assimilated to the processes/materials studied
- 5: Data from processes/materials similar to the processes/materials studied, but on a research scale or with different technologies.

The data supplied by Loro Piana is collected within the framework of activity monitoring, from internal databases. The scale for precision is as follows:

- 1: Data verified, based on measurements
- 2: Data verified, partially based on assumptions or unverified and based on measurements
- 3: Unverified data partially based on qualified estimates
- 4: Data estimated by experts
- 5: Estimated data, unqualified

Overall data quality was assessed on a scale of 1 (very good) to 5 (very uncertain), based on these 4 representativeness criteria. The final score is the average of the 4 scores defined above: geographical representativeness, temporal representativeness, technical representativeness, and reliability.

Table 5 shows the data quality scores for each life cycle step.

Life cycle step	Type of data	Geographical (1-5)	Temporal (1-5)	Technical (1-5)	Precision (1-5)	DQR (1-5)
Manufacturing	Primary data	1	1	1	1	1
	Secondary data	2	3	1	1	1,75
Upstream transportation	Primary data	1	1	1	2	1,25
	Secondary data	2	1	1	2	1,5
Downstream transportation	Primary data	1	1	1	2	1,25
	Secondary data	2	1	1	2	1,5
Distribution	Primary data	1	1	1	2	1,25
	Secondary data	2	1	1	2	1,5
End of life	Primary data	2	2	2	2	2
	Secondary data	4	4	4	4	4

Table 6: Comparison of data types by primary and secondary data.

Allocations

Raw material production and end of life:

For the application of the Circular Footprint Formula (CFF), we have chosen to use it only for the recycled parts of the input materials. As end-of-life scenarios are very complex, with many cases outside Europe, the formula has been simplified with R2 = 0 and R3 = 0. We have taken a conservative scenario to harmonize the method whether the end of life is in or outside Europe. The aim is to homogenize all end-of-life calculations.

There are no other allocation rules apart from those available in the Ecoinvent cut-off library.

Assembly:

There are no co-products.

Transportation (upstream and downstream):

The allocation is a “100% product” one in all our modules in SimaPro v9.6.0.1. We have a mass allocation in t.km for transport operations.

Environmental Indicators and Characterization Models

LCA Methodology & Impact Categories

The Product Environmental Footprint (PEF) was proposed by the European Commission as a common method for measuring environmental performance (Commission Recommendations 2013/179/EU). PEF is therefore the Life Cycle Assessment methodology recommended by the EU to quantify the environmental impacts of products (goods or services). The environmental indicators detailed in the EF 3.1 methodology and summarized in Table 7 have been considered in the LCA of the proposed scenarios and included in this study.

Impacts categories	Impact category indicator	Units	Characterization model	Robustness
Acidification	Accumulated Exceedance (AE)	mol H^+ eq	Accumulated Exceedance (Seppälä et al. 2006, Posch et al, 2008)	II
Climate change	Radiative forcing as global warming potential (GWP100)	kg CO_2 eq	Baseline model of 100 years of the IPCC (based on IPCC 2013)	I
Ecotoxicity, freshwater	Comparative Toxic Unit for ecosystems (CTUe)	CTUe	USEtox model 2.1 (Fankte et al, 2017)	III
Energy resources: non-renewable	Net calorific value of the energy consumed in megajoules (MJ)	MJ, net calorific value	CML 2002 (Guinée et al., 2002) and van Oers et al. 2002	III
Eutrophication, terrestrial	Accumulated Exceedance (AE)	mol N eq	Accumulated Exceedance (Seppälä et al. 2006, Posch et al, 2008)	II
Eutrophication, freshwater	Fraction of nutrients reaching freshwater end compartment (P)	kg P eq	EUTREND model (Struijs et al, 2009) as implemented in ReCiPe	II
Eutrophication, marine	Fraction of nutrients reaching marine end compartment (N)	kg N eq	EUTREND model (Struijs et al, 2009) as implemented in ReCiPe	II
Human toxicity: carcinogenic	Comparative Toxic Unit for humans (CTUh)	CTUh	USEtox model 2.1 (Fankte et al, 2017)	III
Human toxicity, non-carcinogenic	Comparative Toxic Unit for humans (CTUh)	CTUh	USEtox model 2.1 (Fankte et al, 2017)	III
Ionising radiation, human health	Human exposure efficiency relative to U235	kBq U235 eq	Human health effect model as developed by Dreicer et al. 1995 (Frischknecht et al, 2000)	II
Land use	Soil quality index24' Biotic production	Dimensionless (pt)	Soil quality index based on LANCA (Beck et al. 2010 and Bos et al. 2016)	III
	Erosion resistance	kg biotic production		
	Mechanical filtration	kg soil		
	Groundwater replenishment	m^3 water / m^3 groundwater		
Resource use, minerals and metals	Abiotic resource depletion (ADP ultimate reserves)	kg Sb eq	CML 2002 (Guinée et al., 2002) and van Oers et al. 2002.	III
Ozone depletion	Ozone Depletion Potential (ODP)	kg CFC-11 eq	Steady-state ODPs as in (WMO 2014 + integrations)	I
Photochemical oxidant formation, human health	Tropospheric ozone concentration increase	kg NMVOC eq	LOTOSEUROS model (Van Zelm et al, 2008) as implemented in ReCiPe 2008	II

Particulate matter	Impact on human health	disease incidence	PM method recommended by UNMP (UNMP 2016)	I
Water use	User deprivation potential (deprivation weighted water consumption)	m^3 world eq	Available Water Remaining (AWARE) as recommended by UNMP, 2016	III

Table 7. Considered impacts categories.

Impact Assessment

According to the PEF[2], characterization refers to the 'calculation of the magnitude of the contribution of each classified input and output to their respective impact categories, and aggregation of the contributions within each category. This is carried out by multiplying the values in the LCI by the relevant characterization factor for each EF impact category. The characterization factors are substance- or resource-specific. They represent the impact intensity of a substance relative to a common reference substance for an EF impact category (impact category indicator). For example, in the case of calculating climate change impacts, all greenhouse gas emissions inventoried in the LCI are weighted in terms of their impact intensity relative to carbon dioxide, which is the reference substance for this category. This allows for the aggregation of impact potentials and expression in terms of a single equivalent substance (in this case, CO_2 equivalents) for each EF impact category.'

Critical Analysis of Selected Indicators

Even though 16 impact categories have been selected to be analyzed in the study only 6 have been studied in detail and describe in this report under the

[2]: Zampori, L. and Pant, R., Suggestions for updating the Product Environmental Footprint (PEF) method, EUR 29682 EN, Publications Office of the European Union, Luxembourg, 2019

Presentation of Results and Interpretations section.

In order to identify the key impact categories contributors, we have calculated the single score (calculated based on EF 3.1 normalization and weighting factors, presented in the Annex V – Normalization and weighting factors) and consider almost 80% of the impact for each product. Focusing on indicators that represent almost 80% of the single score helps identify the most significant impact categories. This allows decision-makers to prioritize efforts on areas with the highest environmental impact, which is critical for effective environmental management and improvement.

This is how we came up with the following list of 6 indicators to take into account:

1. Climate change (kg CO_2-Eq)
2. Water use (m^3 world Eq deprived)
3. Energy resources: non-renewable (MJ, net calorific value)
4. Particulate matter formation (disease incidence)
5. Eutrophication: marine (kg N-eq)
6. Acidification (mol H^+-Eq)

Here are graphics showing how preponderant these indicators are out of the 16 indicators as a whole for Minimal Packaging and Signature Packaging:

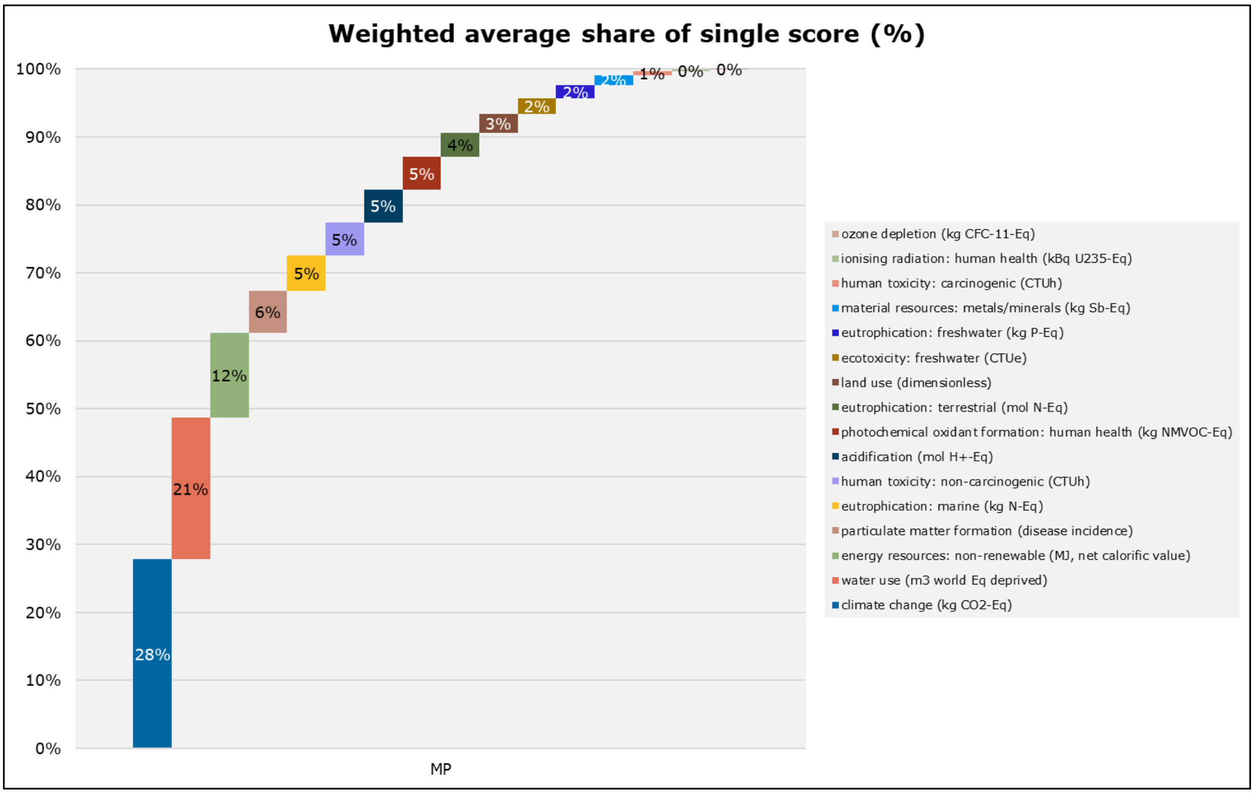

Figure 6: weighted average share of single score in % for Minimal Packaging.

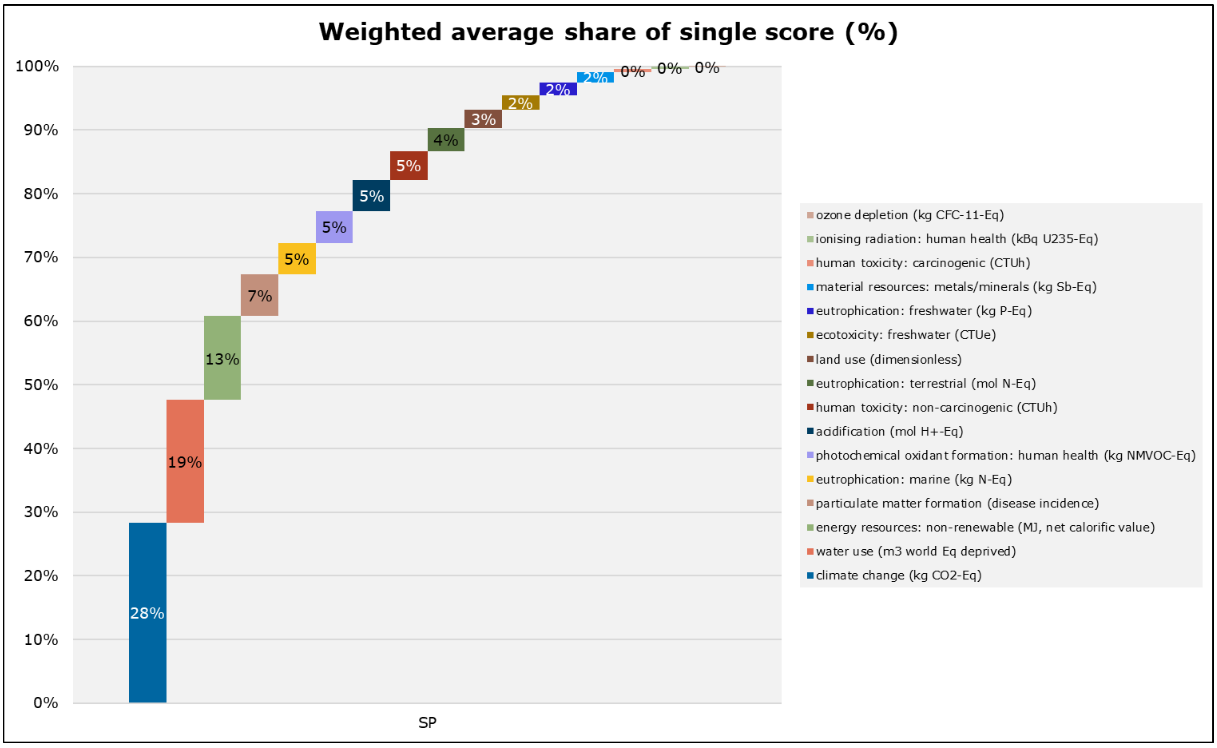

Figure 7: weighted average share of single score in % for Signature Packaging.

Climate change (kg CO_2-Eq)

The global warming potential is assessed in terms of all the substances emitted into the atmosphere that contribute to it. The main greenhouse gases are carbon dioxide, methane, nitrous oxide, and hydrofluorocarbons. The greenhouse effect is the increase in the average temperature of the atmosphere caused by an increase in the concentration of anthropogenic greenhouse gases in the atmosphere. Human activities, whether industrial, agricultural, or domestic; contribute to this phenomenon of climate change because of the fossil fuels used.

Water use (m^3 world Eq deprived)

The water resource impact category used here, according to the EF 3.1 method, is that of the AWARE method, also recommended by the UNMP-SETAC Life Cycle Initiative. It is not an indicator of the flow of water consumed during the life of the system under consideration, but a water scarcity impact representing the amount of water remaining available per area in a river basin once the demands of humans and aquatic ecosystems have been met. It assesses the potential for water deprivation, either to humans or to ecosystems, on the assumption that the less water available per area, the more likely it is that another user will be deprived. It therefore considers water scarcity.

Energy resources: non-renewable (MJ, net calorific value)

This impact category refers to the use of non-renewable energy resources (e.g natural gas, coal, oil) to produce the system under consideration. This refers to resources for fossil and nuclear energy.

Particulate matter formation (disease incidence)

This impact category is measured by studying the health effects (diseases, deaths) which are the consequences of particles pollution exposure. Indeed, breathing problems are characterized by the presence in the air of particulate matter with a small diameter, smaller than 10 microns, and represent a major issue for human health, as their inhalation can cause respiratory and cardiovascular problems. These particles come mainly from the combustion of different resources for energy purposes (wood, coal, oil), road transport and industry. This indicator presents the potential for the incidence of diseases that have occurred due to particulate matter in the air.

Eutrophication: marine (kg N-eq)

Accumulation of nitrogen nutrients in an environment causing the proliferation of algae, and thus the asphyxiation of the aquatic environment.

Acidification (mol H+-Eq)

This impact category takes into account human emissions of sulfur (SOx) and nitrogen (NOx) oxides and ammonia (NH3) in the atmosphere, linked to combustion processes and combustion processes and agricultural activities leading to an increase in increase in the acidity of the natural environment where they are deposited subsequently. One of the best known effects is acid rain.

Assumptions and data for LCI modeling

Certain assumptions have been made during both the LCI modeling and LCA, as explained in this section. It must be noted that secondary data has been sourced from the ecoinvent database and that each impact factor, attained by its own LCA, is associated to certain assumptions that have not been considered in this study. All secondary data (impact factors) used in the LCA may be found in *Annex I – Impact factors used* of this report.

Assumptions and data for raw materials

For each listed material its weight, recycled content, and material has been collected. If deemed relevant, its dimensions have been as well used. Information has been shared in average for the six different sizes except for their weight and size for which it was made available individually. All data provided may be found in the Annex II – Raw material data.

'Global' datasets have been chosen when no information on material origins was available. Global datasets also include 'market' average transport. By default, the materials were considered as 'virgin raw material' without recycled material introduction. However, market datasets sometimes contain recycled materials according to the average market production (e. g. corrugated cardboard).

Minimal Packaging option

External Habana box

Made from 100% recycled corrugated board (carboard), it has an average weight by country and by box of 0.51 kg. To include the use of recycled carboard, the impact factors used have been estimated based on the market for corrugated board box available in ecoinvent and the Circular Footprint Formula.

Here is the weight for all type of boxes:

Habana Ecommerce Box Outside	Measures	External Habana box (g)
1	BOX 475x440x125	781
2	BOX 405x340x210	830
3	BOX 375x210x170	426
4	BOX 325x190x150	336
5	BOX 390x285x75	356
6	BOX 375x390x170	707

Table 8. Habana box (Minimal Packaging) weight.

Internal compensator

Made from corrugated board, 100% recycled carboard, it has an average weight by country and by box of 0.16 kg. To include the use of recycled carboard the impact factors used have been estimated based on the market for corrugated board box available in ecoinvent and the Circular Footprint Formula (CFF).

Here is the weight for all type of boxes:

Habana Ecommerce Box Outside	Measures	Compensator (g)
1	BOX 475x440x125	254
2	BOX 405x340x210	263
3	BOX 375x210x170	139
4	BOX 325x190x150	104
5	BOX 390x285x75	136
6	BOX 375x390x170	215

Table 9. Internal compensator (Minimal Packaging) weight.

Dust bag

Made from 100% cotton sourced from the Better Cotton Initiative (BCI), aimed at guaranteeing social and environmental safeguard of the cotton produced. An average of 0,03 kg is used per order.

Gift note (optional)

It is made of printed paper and has a weight of 0.01 kg. General impact factors for printed paper have been used.

Signature Packaging option

External Habana box

Made from 30% recycled corrugated board (carboard), it has an average weight by country and by box of 0.45 kg. To include the use of recycled carboard impact factors used have been estimated based on the market for corrugated board box available in ecoinvent and the CFF tool.

Here is the weight for all type of boxes:

Habana Ecommerce Box Outside	Measures	Habana box (g)
1	BOX 475x440x125	586
2	BOX 405x340x210	638
3	BOX 375x210x170	342
4	BOX 325x190x150	270
5	BOX 390x285x75	323
6	BOX 375x390x170	576

Table 10. Habana box (Signature Packaging) weight.

Dust bag

Made from 100% cotton sourced from the Better Cotton Initiative (BCI), aimed at guaranteeing social and environmental safeguard of the cotton produced. An average of 0,03 kg is used per order. Dust bags are only present in 70% of orders as its use is reserved to specific products such as shoes and leather goods. Since specific impact factors for the cotton sourced through the Initiative were not available, general ones for cotton (globally sourced) has been used.

Branded box

Made from paper and cardboard, 80% made from recycled materials, it has an average weight of 0.32 kg. In this case, we only have an average per order, due to the lack of specific information per box type. To include the use of recycled carboard impact factors used have been estimated based on the market for corrugated board box available in ecoinvent and the CFF tool.

Ribbon

Made from cotton, a weight of 0.013 kg per order is used for each box. In this case, we only have an average per order, due to the lack of specific information per box type. General impact factors for the market of fiber cotton has been used in the LCA.

Cedar ball

Made from cedar (90%) and cotton (10%) it has a weight of 0,02 kg for each box. Impact factors for wood and cotton have been used based on its composition (90% cedar and 10% cotton).

Document folder

Made from PAP 22 paper, it is made 40% out of recycled paper. It weighs 0.024 kg for each box.

Sticker

Made from non-recycled printed paper, it weighs 0,0005 kg. Impact factors for paper have been used.

Packaging filling

Similar to tissue paper, it is thin paper used as a filler. An average of 3 to 5 sheets are used per order.

Gift note (optional)

It is made of printed paper and has a weight of 0.01 kg. General impact factors for printed paper have been used.

Assumptions and data for recycled content from CFF

As detailed in the Allocations section, we have only used the CFF for incoming recycled materials. We have used the following assumptions for the calculations:

Material	A	$E_{recycled}$	Qsin/Qp
LDPE	0,5	market for polyethylene, high density, granulate, recycled	0,9
HDPE	0,5	market for polyethylene, high density, granulate, recycled	0,9
Cardboard	0,2	Containerboard, linerboard {RER}| containerboard production, linerboard, testliner	0,85
Paper	0,5	graphic paper production, 100% recycled	0,85

Table 10. Circular footprint formula's (CFF) assumptions.

For LDPE, we had to use a proxy for the $E_{recycled}$ value, as no recycling dataset exists for LDPE. We therefore selected the HDPE dataset.

Assumptions and data for manufacturing

As defined under the section *Perimeter of the study* of this report, the packaging manufacturing has not been considered in the study as it has been deemed to be negligible.

Assumptions and data for transportation

During the data collection process certain assumptions were made regarding transportation. Data on transportation was made available by Loro Piana.

For upstream and downstream transportation

As information on the specific type of road freight was not available it has been estimated based on the secondary data associated to EURO5 trucks transporting loads heavier than 32 metric tons. The Europe-specific factor has been used.

As information on the specific type of air freight was not available it has been estimated based on the generic and global aircraft transportation secondary data.

For upstream transportation only

Loro Piana has provided the specific supplier address and Loro Piana's warehouses addresses in each country, as well as the transport type and distance in km traveled for each material listed. The intermediate warehouses are:

- DHL Loro Piana ECOM for shipments in South Korea.
- SNATT Logistica for shipments in Europe
- Schenker LLC for shipments in the Middle East.
- Textile Logistics Limited for shipments in Great Britain.
- OM LOG Ltd for shipments in Hong Kong.
- Tokyo Nohin Daiko Co., Ltd for shipments in Japan.
- East Rutherford - OMLOG, Inc. for shipments in the USA.
- Lifestyle Logistics Shanghai Co. Ltd for shipments in China.

Provided data can be found in Annex III – Upstream transportation data.

For downstream transportation only

Loro Piana has provided, as shown in Annex IV – Downstream transportation data:

- The average distance traveled by truck and by plane[3] to transport sold products from Loro Piana's sites to Loro Piana's first customers for each country of delivery (km); and
- The share of gross orders sold by country (%).

To calculate the volume of transport (t.km) of product sold for each packaging solution, each box size, each transport mode and each country, the total weight of components transported (i.e., the sum of the weight of the external Habana box, the branded box, the ribbon, etc.) has been calculated for each packaging solution, each box size and each country (t) and multiplied by the average distance traveled by country and by transport mode (km) and by the share of gross orders sold by country (%), in order to weight each country in regard to its representativeness.

[3] Only truck and plane are used by Loro Piana to transport sold products.

Finally, when certain areas grouped multiple countries, the volumes of transport (t.km) of each country (e.g., Germany, Netherlands) has been summed to get the volume of transport (t.km) of the area (e.g., Europe).

Korea is the only region using plastic pallets. As information regarding their weight was not available, the technical data for plastic pallets, publicly made available by National Plastics Co.[4], a Korean plastic manufacturer; has been used to estimate it. It has therefore been assumed that the estimated average weight would be representative of the actual pallets used during transport associated to orders in Korea.

Similarly, information on the quantity of boxes transported by one pellet (either made from wood or plastic) was provided on average for all box sizes. Therefore, it has been assumed that the same quantity of boxes was transported by one pellet regardless of the boxes' size. For countries in which no information was provided for this phase of the transportation process it was assumed that boxes were directly uploaded in the transportation vehicle.

We opted for a conservative choice by not taking into account the pallet reuse rate, as we didn't have any data and these values could vary according to geographical zones. Nevertheless, on each pallet, we can store 80 boxes.

Assumptions and data for end of life

There is no end-of-life data available regarding the analyzed options, as the packaging options are handled by the end customer. Therefore, for each material listed an average background LCI data has been considered. A country specific impact factor has been included if available in ecoinvent (which was the case only for Europe and the United Kingdom, for all components apart from cotton) and, if not, a general rest of the world impact factor has been used. For this life cycle stage, the data available for raw materials has been used, as found in Annex II – Raw material data.

Inputs and outputs balance

Input and output analysis is used to assess environmental impacts throughout a product's life cycle, from raw material extraction to disposal. Inputs refer to all materials and energy entering a system, whereas output refer to all emissions and waste produced. A summary of all inputs and outputs considered has been included in an Excel sheet provided with the report.

Losses have not been quantified as it has been assumed that during the life cycle stages of the analyzed products there are no losses.

[4] National Plastics Co. (2024). Pallet, Table of Specifications. Available at: http://www.npc.co.kr/m/english/2_product/pa_chart04.asp

Presentation of Results and Interpretations

For all the considered impact categories, the MP has demonstrated a lower impact in the environment, especially for Box 3 and Box 4, followed by Box 5. Environmental impact savings have ranged from 2% to 36% for the analyzed impact categories.

Although all impact categories presented in the section *Environmental Indicators and Characterization Models* of this report have been analyzed, only 6 have been included in this report as deemed most relevant, as reasoned in the section *Critical Analysis of Selected Indicators* of this report.

Comparison of environmental impacts of SP and MP

This first part of the results compare SP and MP average results by life cycle step for all boxes.

These results are overall weighted averages of UF 7 results. The UF 7 results are weighted by sales per country (%) and by box size utilization rate (%). UF 7 has been used to calculate average results of all boxes, since the results had to be calculated through the same UF in order to be summed.

The aim of this section is to get the best possible overall picture of the results, before detailing the gains between SP and MP for each box type.

Climate change (kg CO_2e)

Environmental impacts associated to the different life cycle stages remain similar for both packaging options regarding climate change.

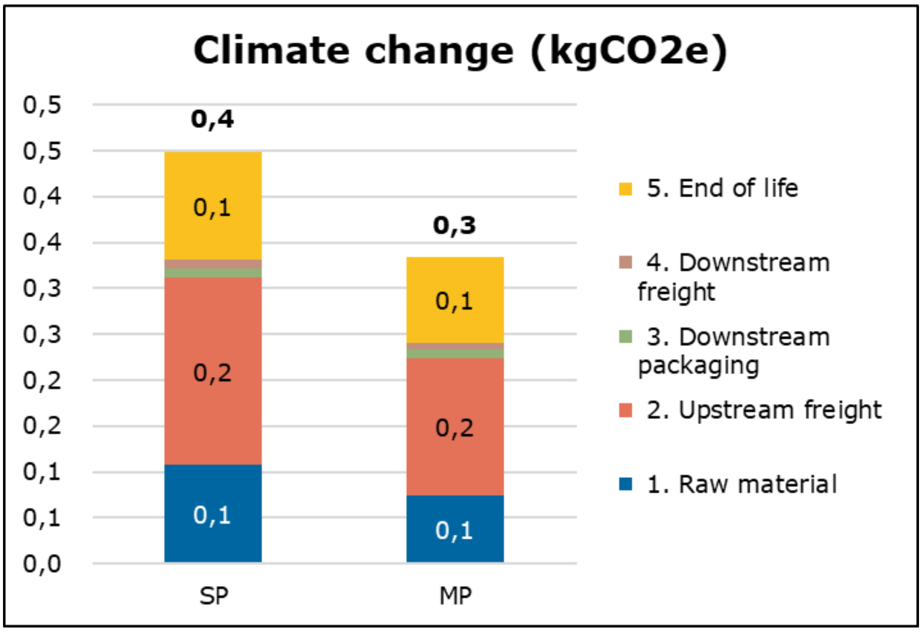

Figure 8. Comparison between SP and MP impact on climate change per life cycle stage.

We have 3 main stages: Upstream freight, End of Life and Raw materials.

Upstream freight is linked to the supply of raw materials, which is carried out by air, having a very strong impact on climate change. The airplane emits CO_2 mainly due to the combustion of kerosene, a fossil fuel derived from petroleum.

End-of-life has a major impact on climate change because of the cardboard and its highly emissive processing. We have taken an average impact factor that does not take regional specificities into account, in a conservative logic due to the various end-of-life regions.

Raw materials impact is come from the different components of the boxes in particular the Cardboard (around 40%) and cotton (around 30%).

When analyzing the underlying causes of environmental impacts for the cardboard, it is widely believed that they stem primarily from the energy-intensive processes involved in cardboard production. These processes include several stages, such as wood harvesting, transportation of raw materials, and the conversion of wood into pulp and other cardboard materials. Each of these stages requires substantial amounts of energy, which often results in significant carbon dioxide equivalent (CO_2e) emissions. This way, the elimination of the branded box in the MP entails the use of fewer carboard and reduces the box’s weight, which directly impacts the emissions associated to their transportation.

Cotton and its transformation processes have a significant impact on climate change due to both agricultural and industrial factors. Agriculture are driven by intensive use of fertilizers, pesticides, machinery, and massive water consumption. The transformation processes also contribute heavily to emissions. Weaving consumes substantial energy to operate machinery, mercerizing involves chemicals like caustic soda or ammonia that require resource-intensive effluent treatment, bleaching uses polluting chemicals that affect soil and water quality, and sanforizing is an energy-intensive process aimed at stabilizing fabrics. Together, these factors result in a high carbon footprint for cotton production and processing.

Water use (m^3 world eq deprived)

For the Water use indicator, we have similar impact distribution profiles for the two boxes. The vast majority of impact comes from the dust bag and ribbon, which are made from cotton. The production of cotton fiber requires large quantities of water, as does the weaving process. These two elements therefore outweigh all other materials and stages in the water use category as we can see in Figure 9.

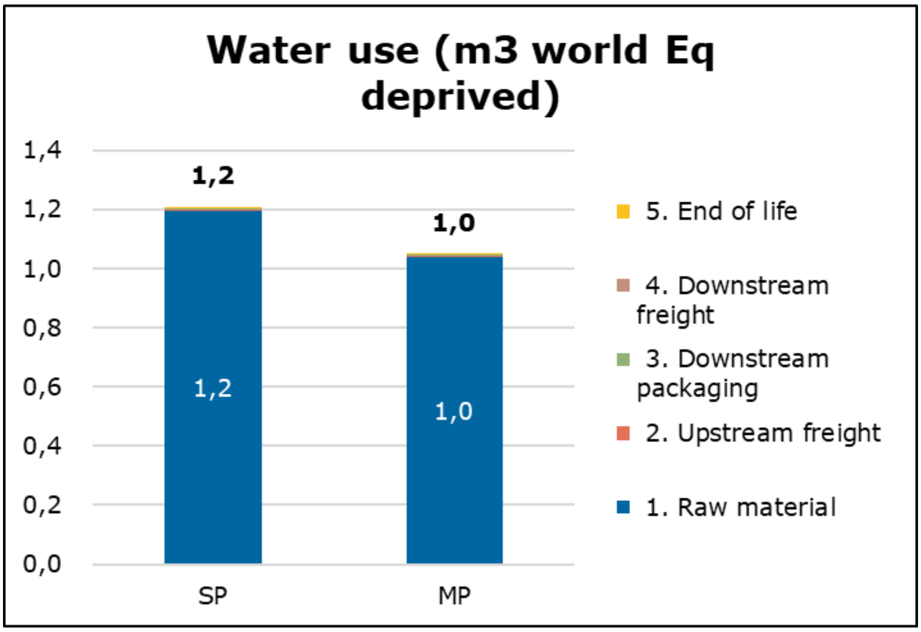

Figure 9. Comparison between SP and MP impact on water use per life cycle stage.

Ecopackaging uses less water, even if its dust bag is slightly heavier because it has no ribbon, which reduces the overall impact.

Energy resources: non-renewable (MJ, net calorific value)

When it comes to consumption of fossil fuel resources, in both cases upstream freight has the biggest impact (around 60%). This is due to the use of aircraft to supply raw materials, which consumes kerosene, a fossil fuel. MP is generally lighter on average, which is why we see less impact on upstream freight than on SP.

The second most important impact category on this indicator is raw materials.

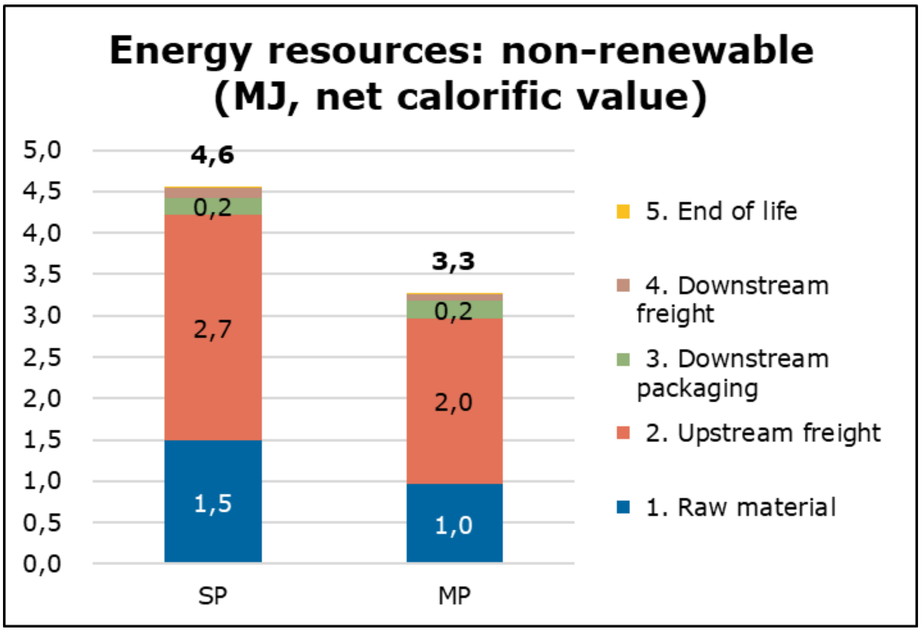

Figure 10. Comparison between SP and MP impact on resource use per life cycle stage.

Particulate matter formation (disease incidence)

Figure 11 shows the two main stages in the life cycle. These are end-of-life and raw materials.

With regard to raw materials, the impacts are linked to cotton (dust bag and ribbon), as its cultivation has a significant impact on particulate matter, mainly due to the use of pesticides and chemical fertilizers. These chemicals, often derived from the oil industry, release atmospheric pollutants such as nitrogen oxides, ammonia and sulfur dioxide, which contribute to the formation of particulate matter in the air.

Processes such as weaving also have an impact on particulate matter, mainly due to the use of energy and chemicals. Weaving machines consume a lot of electricity, often from non-renewable sources, which generates indirect emissions of particulate matter. Furthermore, the treatments applied to yarns to make them more resistant involve chemicals that contribute to the formation of particulate matter.

The second material contributing to particulate matter emissions is cardboard (habana box and branding box). The production of cardboard contributes to the formation of particulate matter mainly due to the industrial processes involved. During the transformation of raw materials into cardboard, polluting by-products such as particulate matter are generated and released into the air.

For the end-of-life phase, cardboard is the main contributor, in fact, we have taken a conservative scenario in which the incineration or unsanitary landfill phases are highly polluting and release many particulate matter.

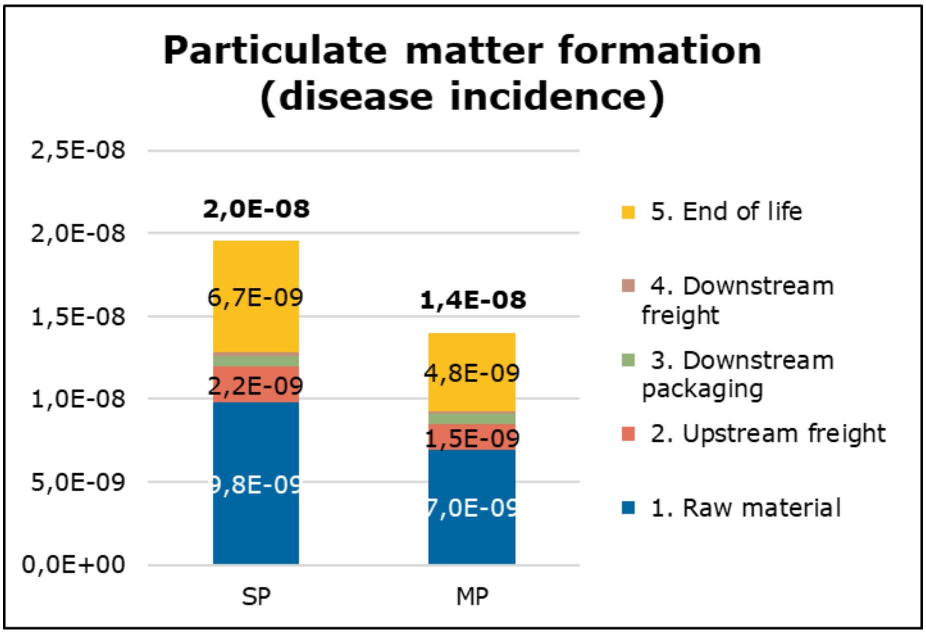

Figure 11. Comparison between SP and MP impact on particulate matter per life cycle stage.

Eutrophication: marine (kg N-eq)

For marine eutrophication, we have the same profile for both boxes. Around 70% is linked to raw materials and over 20% to the upstream freight as we can see in figure 12.

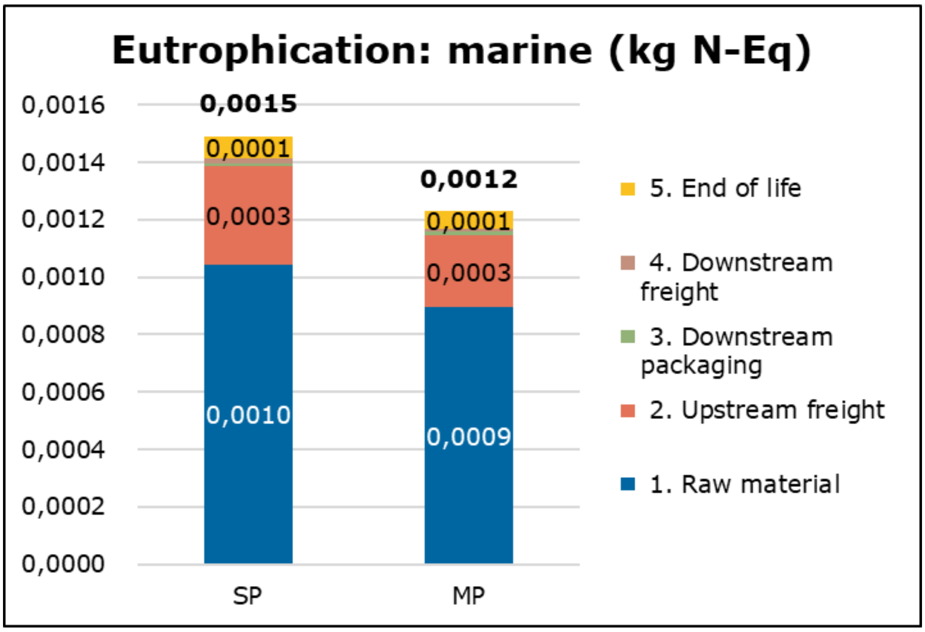

Figure 12. Comparison between SP and MP impact on water use per life cycle stage.

As far as raw materials are concerned, cotton components (dust bag and ribbon) account for 90% of the impact, particularly the fiber and weaving.

Cotton growing has a major impact on marine eutrophication, mainly due to the use of fertilizers and pesticides. These substances, carried by rainwater runoff, end up in rivers and oceans, causing an excess of nutrients. This enrichment stimulates the proliferation of algae, reducing the oxygen present in the oceans.

The weaving process also contributes to eutrophication through the discharge of wastewater containing chemicals used in fiber treatment. These substances, often left untreated, pollute waterways and exacerbate eutrophication.

For the upstream freight stage, it's aircraft use that's responsible. Aircraft contribute to marine eutrophication, mainly through emissions of nitrogen oxides (NOx) produced by the combustion of kerosene. Once released into the atmosphere, these NOx can be transported over long distances before being deposited in the oceans via precipitation. Once in the water, these compounds enrich marine ecosystems with nitrogen, a key nutrient that stimulates excessive algal blooms.

Acidification (mol H+-Eq)

For acidification, we have the same profile for both boxes. Almost 50% for raw materials and the upstream freight as we can see in figure 13.

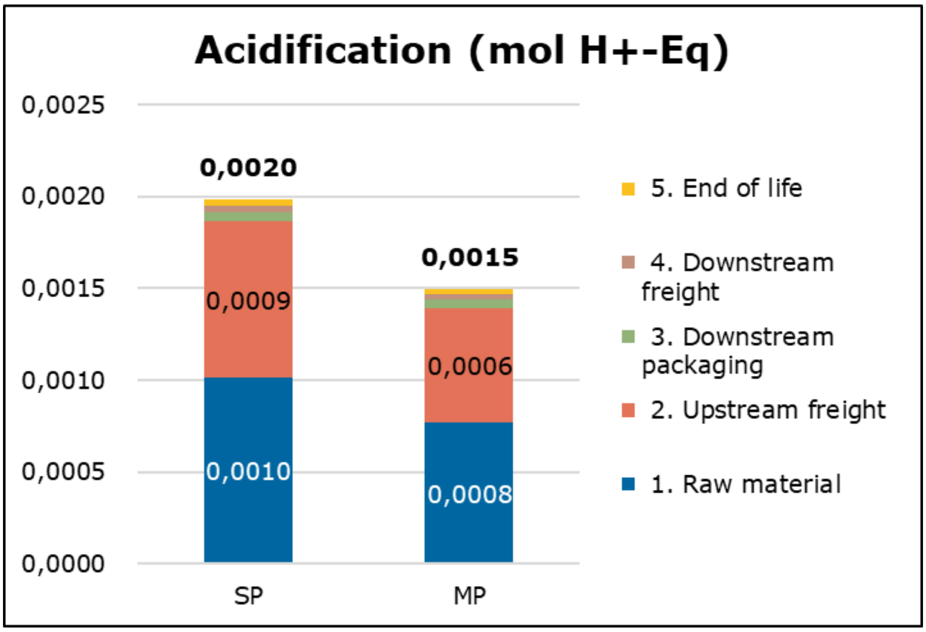

Figure 13. Comparison between SP and MP impact on acidification per life cycle stage.

The impact on acidification of the upstream freight step is linked to the aircraft itself. This is due to emissions of nitrogen oxides and sulfur oxides caused by the combustion of kerosene. Once in the atmosphere, these oxides react with water and other chemical compounds to form acids. These acids can then fall back onto the soil or oceans during rainfall, modifying the pH of these ecosystems.

In addition, for the raw materials section, around 70% of impacts are caused by cotton materials (Dust bag and ribbon). Cotton fiber production has a strong impact on acidification due to the use of fertilizers and pesticides. These chemicals, often rich in compounds such as nitrates and sulfates, are released into the environment in agricultural run-off, leading to chemical reactions that increase soil and water acidity. In addition, the weaving process requires chemical treatments and machinery which produce these same oxides and once in the atmosphere, contribute to the acidification of soil and water.

Environmental impacts of SP and MP

This second section of the results deep dives into the environmental impact reduction of MP, as compared to SP, for each of the 6 environmental impacts assessed and for each of the 6 box sizes considered.

Here, the UFs 1 to 6 has been used as results per box are neither compared nor summed, since the aim of this section is to analyze the absolute figures results of SP and MP for each box size.

Synthesis of the results

The environmental impact savings follow nearly always the same pattern: low for Boxes 1 and 2, high for Boxes 3, 4 and 5 and medium for Box 6. These results correlate to the total weight reduction of each box size (the total weight being the sum of the weight of all components of a box).

	Total weight (kg)			
Box	**Signature Packaging**	**Minimal Packaging**	**Weight saving (kg)**	**Weight saving (%)**
Box 1	1,16	1,14	- 0,01	-1%
Box 2	1,21	1,20	- 0,01	-1%
Box 3	0,91	0,67	- 0,24	-26%
Box 4	0,84	0,55	- 0,29	-35%
Box 5	0,89	0,60	- 0,29	-33%
Box 6	1,15	1,03	- 0,12	-10%
Weighted average	0,98	0,77	- 0,20	-21%

Figure 14. Total weight savings of all box sizes.

The majority of the savings are linked to the remove of some components in the MP, notably the ribbon, the tissue paper and the cedar ball. The decrease in weight of the branded box/internal compensator is also important, while the increase in weight of the external Habana box and the increase in use of the dust bag in the SP have generally a negative impact. Finally, for some indicators, the reduction of plane upstream freight due to the decrease of box weight is significant and, for others, the reduction of end-of-life treatment to the same decrease is also significant.

Climate change (kg CO_2e)

The use of MP is associated to an average reduction of 21% in kg CO_2e emissions in comparison to SP. In other words, the use of MP entails a reduction of approximately 20% in GHG emissions. As shown in Figure 15 below, when analyzing the reduction per type of box, the highest emission reduction comes from choosing MP over SP for Box 3 (-26%), Box 4 (-34%), and Box 5 (-32%). On the other hand, there is no significant reduction (-2%) for Boxes 1 and 2, and medium for Box 6 (-11%).

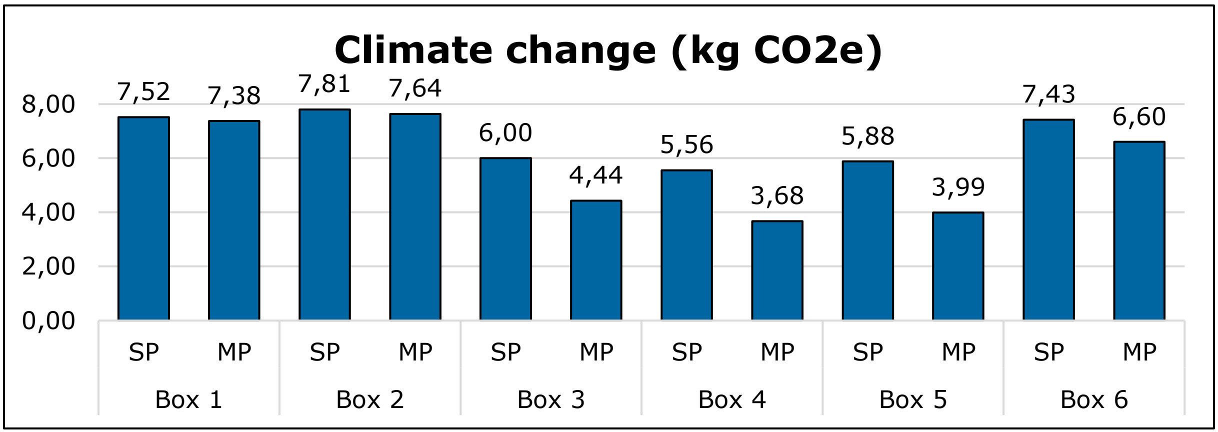

Figure 15. Comparison of kg CO_2e emitted by SP and MP for each available box.

The insignificant reductions for boxes 1 and 2 is mainly linked to the insignificant reduction in the total weight of all components of the boxes (-1%). The important reductions for boxes 3, 4 and 5, and slightly less for box 6, are due to important reduction in total weight, respectively -26%, -35%, -33% and -10%.

GHG savings are more specifically due to the remove of the tissue paper, the ribbon and, less importantly, the other components removed (documents folder, etc.). The reduction in weight of the branded box/internal compensator have also a notable impact. All these reductions have an impact on each life cycle step (raw material production, upstream freight, downstream packaging, downstream freight, and end of life), which offset the increase of the GHG emissions linked to the increase in weight of the external Habana box and to the increase in use of the dust bag.

Water use (m^3 world Eq deprived)

The use of the MP is associated an average decrease of 13% in water deprivation in comparison to the SP. Water use savings are nearly the same for all boxes (between -12% and -13%).

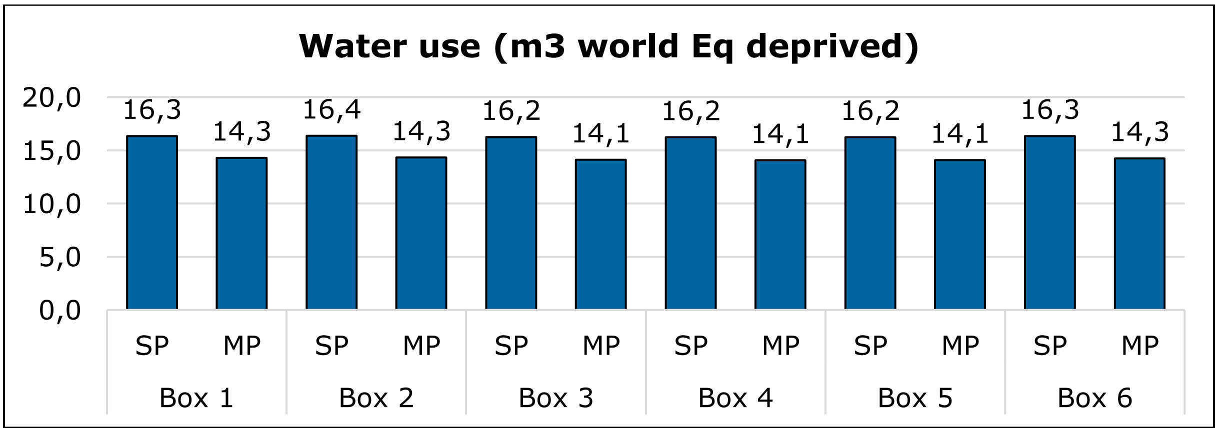

Figure 16. Comparison of weighted water deprivation caused by SP and MP for each available box.

The vast majority of water use impacts are linked to cotton production and transformation for the dust bag and the ribbon. The other components and life cycle steps have a negligible water use impact, as compared to the dust bag and the ribbon. Therefore, the vast majority of the water use impact evolution between SP and MP is linked to the evolution of the dust bag and the ribbon.

The dust bag being more often used in the MP than in the SP, the water use impact of the dust bag increases between SP and MP. But this increase is more than offset by the remove of the ribbon, leading to a global reduction in the water use impact.

There is no difference between the water use savings of each Box because the evolution of the dust bag use and the remove of the ribbon is the same for all boxes.

Energy resources: non-renewable (MJ, net calorific value)

The use of the MP is associated an average decrease of 24% in non-renewable energy resources in comparison to the SP. The savings are similar to GHG savings: low for Boxes 1 and 2 (-6%), high for Boxes 3, 4 and 5 (-28%, -36% and -34%) and medium for Box 6 (-14%).

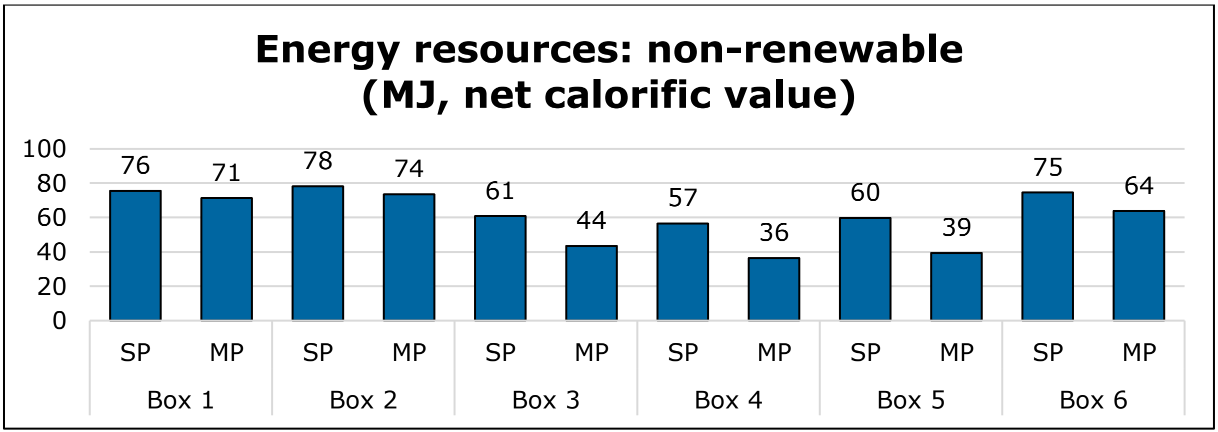

Figure 17. Comparison of weighted energy resources caused by SP and MP for each available box.

The explanation of the non-renewable energy use savings are the same as the ones for the GHG savings.

Particulate matter formation (disease incidence)

The use of MP rather than the SP entails an approximate average reduction of 25% of particulate matter formation. In other words, the selection of MP reduces by 25% the likelihood of contracting diseases associated to particulate matter in the air. The savings are similar to GHG savings: low for Boxes 1 and 2 (-10%), high for Boxes 3, 4 and 5 (-29%, -34% and -33%) and medium for Box 6 (-17%).

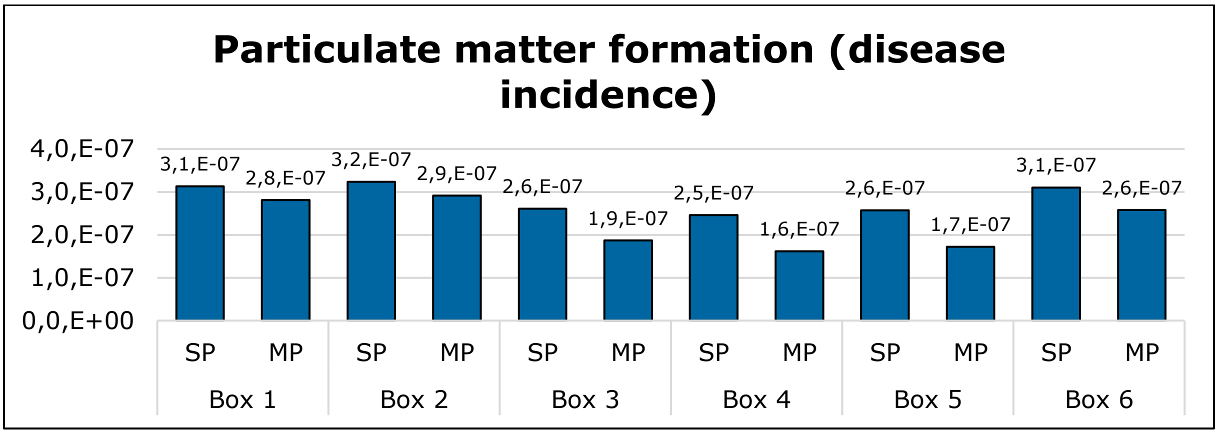

Figure 18. Comparison of particulate matter formation caused by SP and MP for each available box.

The reduction of particulate matter formation is notably linked to the decreased weight of the branded box/internal compensator, the remove of the tissue paper, the ribbon and the other raw materials, and the increase in recycled content of the external Habana box. These entails significant reductions in particulate matter formation in both the raw material production and the end-of-life steps.

Eutrophication: marine (kg N-Eq)

The use of MP is associated to a reduction of 25% of marine eutrophication. In other words, MP is associated to a reduction of 25% in the presence of Nitrogen equivalent in freshwater (in kg). The marine eutrophication reductions are low for Boxes 1 and 2 (-7%), high for Boxes 3, 4 and 5 (-18%, -20% and -20%) and medium for Box 6 (-17%).

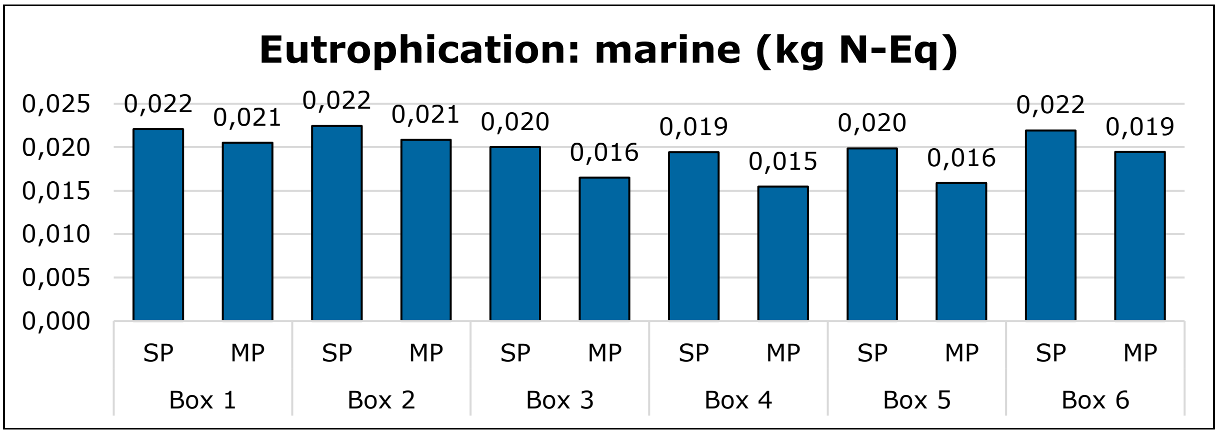

Figure 19. Comparison of marine eutrophication caused by SP and MP for each available box.

The reduction of marine eutrophication is mainly linked to the remove of the ribbon, the weight decrease of the branded box/internal compensator and, less importantly, to the remove of the other components (e.g., tissue paper and cedar ball). All of these reductions offset the important increase of marine eutrophication due to the increase of dust bag use, leading to a global decrease of marine eutrophication for all Boxes.

Acidification (mol H+-Eq)

The use of MP is associated to an average reduction of 22% in acidification. The acidification reductions are low for Boxes 1 and 2 (-8%), high for Boxes 3, 4 and 5 (-25%, -30% and -29%) and medium for Box 6 (-15%).

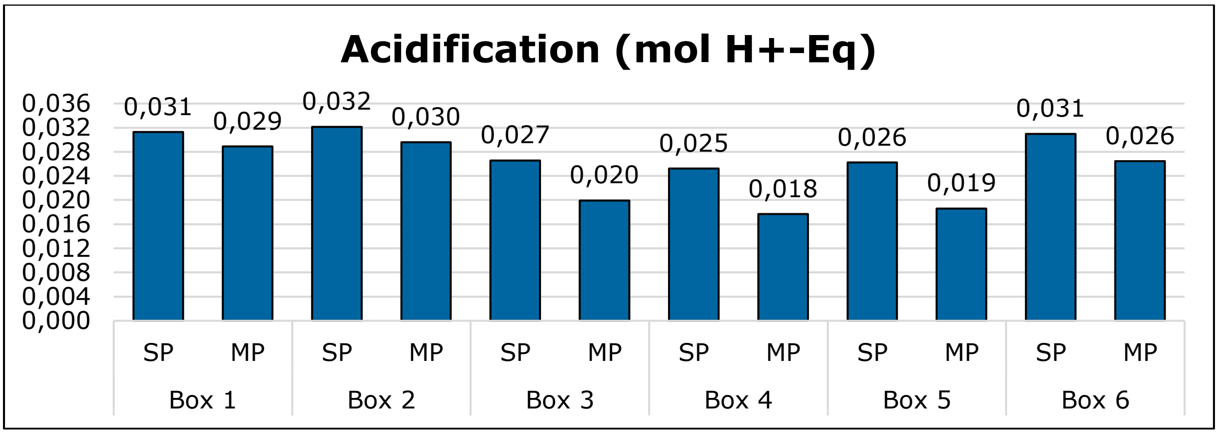

Figure 20. Comparison of acidification caused by SP and MP for each available box.

The vast majority of acidification comes from raw material production and upstream freight, and more specifically from plane. Therefore, the global decrease in total weight of all components explains an important part of acidification reduction.

Concerning the raw materials' production, the remove of the ribbon and the tissue paper and the weight decrease of branded box/internal compensator offset the increase of use of the dust bag, leading to a global decrease of acidification.

Limits of the study

Although the study was carefully conducted, there are some limitations worth sharing.

Certain limitations are inherent in the databases used, in particular the Ecoinvent 3.10 database and the age of the data for certain inventories, which are reflected in the chapter on data quality. The methods used to characterize environmental indicators, although the subject of scientific consensus, also present uncertainties.

For instance, the water use indicator in LCA, with a robustness level of 3, has limitations due to the lack of scientific consensus, spatial and temporal variability, and often incomplete data. It does not account for water quality or certain complex hydrological impacts. These uncertainties reduce the reliability and comparability of results. This is why we recommend not publishing results if the variance is less than 30% for this impact category. This is also the case for the impact category Energy resources: non-renewable.

For primary data, due to lack of available information, we had to make assumptions which are detailed in the various sections of the report linked to assumptions such as not taking into account the pallet reuse rate.

For the datasets, we have taken certain global datasets, not those associated with a specific country, because of the different possible scenarios, such as the end-of-life of cardboard.

In addition, we had to exclude certain elements from the scope of the study, such as delivery to the final customer due to the multiple scenarios and lack of available information, and these are all listed in the "Steps of the life cycle excluded from the perimeter" section.

The above limitations reflect the main sources of potential improvement, particularly with regard to primary data, but do not call into question the main conclusions of the study.

Conclusion

This study was aimed at studying the environmental impacts of the two different packaging options (SP vs. MP) offered by Loro Piana for each of the available box sizes.

The Life Cycle Assessment has provided Loro Piana an in-depth comparison of 6 impact categories: climate change, water use, non-renewable energy resources, particulate matter formation, marine eutrophication, and acidification. In average, the use of the MP instead of the SP delivers the following environmental impact reductions:

1. Non-renewable energy resources (MJ, net calorific value): 28% reduction.
2. Particulate matter formation (disease incidence): 28% reduction.
3. Climate change (CO_2e): 26% reduction.
4. Acidification (mol H^+ equivalent): 25% reduction.
5. Marine eutrophication (kg N equivalent): 18% reduction.
6. Water use (m^3 world equivalent deprived): 13% reduction.

The environmental profiles by life cycle step are relatively similar between the two packaging options (SP and MP) in terms of the various indicators.

We note strong impacts linked to raw materials for all the impact categories due to cotton and cardboard. In the case of cotton, it's the cultivation process, which involves the use of fertilizers and pesticides, as well as the weaving process, which is energy-intensive and requires the use of chemicals, that stand out. For cardboard, it’s his weight but also the production process, with its many stages, which is responsible for its presence in certain categories.

Moreover, the use of airplanes for upstream freight also highlights this stage significantly on 4 indicators, mainly due to kerosene combustion emissions.

Finally, the end-of-life stage is relevant in terms of climate change and particulate matter emissions, as cardboard is a high emitter in the incineration scenario.

When we compare the SP box with the MP box, we can see that the environmental impact savings follow nearly always the same pattern: low for Boxes 1 and 2, high for Boxes 3, 4 and 5 and medium for Box 6. The majority of the savings are linked to the remove of some components in the MP, notably the ribbon, the tissue paper and the cedar ball.

Bibliography

ISO 14040:2006 - Environmental management — Life cycle assessment — Principles and framework

ISO 14044:2006 - Environmental management — Life cycle assessment — Requirements and guidelines

2013/179/EU: Commission Recommendation of 9 April 2013 on the use of common methods to measure and communicate the life cycle environmental performance of products and organizations

Zampori, L. and Pant, R., Suggestions for updating the Product Environmental Footprint (PEF) method, EUR 29682 EN, Publications Office of the European Union, Luxembourg, 2019

Product Environmental Footprint Category Rule, Intermediate Paper Product, Version 6.3. Available at: https://eplca.jrc.ec.europa.eu/permalink/PEFCR_guidance_v6.3-2.pdf.

Annex I – Impact factors used

Adapted "Impact factors" worksheet from the LCA results calculation Excel.

Data	Dataset	Source	Unit
Corrugated board	market for corrugated board box (RER)	ecoinvent 3.10	kg
Corrugated board (100% recycled)	CFF calculation from: market for corrugated board box (RER)	Sheet "CFF calculation"	kg
Corrugated board (30% recycled)	CFF calculation from: market for corrugated board box (RER)	Sheet "CFF calculation"	kg
Cotton	market for fibre, cotton (GLO)	ecoinvent 3.10	kg
Cotton "BCI"	market for fibre, cotton (GLO)	ecoinvent 3.10	kg
Cotton (sanforizing)	market for sanforizing, textile (GLO)	ecoinvent 3.10	kg
Cotton (other processes)	sum of cotton processes datasets (without sanforizing)	EcoAct	kg
Cotton (finishing, woven cotton)	market for finishing, textile, woven cotton (GLO)	ecoinvent 3.10	kg
Cotton (mercerizing)	market for mercerizing, textile (GLO)	ecoinvent 3.10	kg
Cotton (bleaching and dyeing, yarn)	market for bleaching and dyeing, yarn (GLO)	ecoinvent 3.10	kg
Cotton (weaving)	textile production, cotton, weaving (RoW)	ecoinvent 3.10	kg
Plane unknown	transport, freight, aircraft, all distances to generic market for transport, freight,	ecoinvent 3.10	t.km
Plastic film	market for packaging film, low density polyethylene (GLO)	ecoinvent 3.10	kg
Plastic film (100% recycled)	CFF calculation from: market for packaging film, low density polyethylene (GLO)	Sheet "CFF calculation"	kg
Plastic pallet	market for polyethylene, high density, granulate (GLO)	ecoinvent 3.10	kg
Plastic pallet (50% recycled)	CFF calculation from: market for polyethylene, high density, granulate (GLO)	Sheet "CFF calculation"	kg
Plastic pallet (injection moulding)	market for injection moulding (GLO)	ecoinvent 3.10	kg
Printed paper	market for printed paper (GLO)	ecoinvent 3.10	kg
Printed paper (40% recycled)	CFF calculation from: market for printed paper (GLO)	Sheet "CFF calculation"	kg
Solid compact board	market for solid bleached and unbleached board carton (RER)	ecoinvent 3.10	kg
Solid compact board (80% recycled)	CFF calculation from: market for solid bleached and unbleached board carton (RER)	Sheet "CFF calculation"	kg
Truck unknown	transport, freight, lorry >32 metric ton, EURO5 (RER)	ecoinvent 3.10	t.km
Wood	market for wood pellet, measured as dry mass (RER)	ecoinvent 3.10	kg
Wooden pallet	market for EUR-flat pallet (RER)	ecoinvent 3.10	unit
Waste cotton (Europe)	market for waste yarn and waste textile (RoW)	ecoinvent 3.10	kg
Waste cotton (United States)	market for waste yarn and waste textile (RoW)	ecoinvent 3.10	kg
Waste cotton (Japan)	market for waste yarn and waste textile (RoW)	ecoinvent 3.10	kg
Waste cotton (Korea)	market for waste yarn and waste textile (RoW)	ecoinvent 3.10	kg
Waste cotton (South Asia)	market for waste yarn and waste textile (RoW)	ecoinvent 3.10	kg
Waste cotton (China)	market for waste yarn and waste textile (RoW)	ecoinvent 3.10	kg
Waste cotton (Canada)	market for waste yarn and waste textile (RoW)	ecoinvent 3.10	kg
Waste cotton (Middle East)	market for waste yarn and waste textile (RoW)	ecoinvent 3.10	kg
Waste cotton (United Kingdom)	market for waste yarn and waste textile (RoW)	ecoinvent 3.10	kg
Waste corrugated board (Europe)	market group for waste paperboard (Europe without Switzerland)	ecoinvent 3.10	kg
Waste corrugated board (United States)	market for waste paperboard (RoW)	ecoinvent 3.10	kg
Waste corrugated board (Japan)	market for waste paperboard (RoW)	ecoinvent 3.10	kg
Waste corrugated board (Korea)	market for waste paperboard (RoW)	ecoinvent 3.10	kg
Waste corrugated board (South Asia)	market for waste paperboard (RoW)	ecoinvent 3.10	kg
Waste corrugated board (China)	market for waste paperboard (RoW)	ecoinvent 3.10	kg
Waste corrugated board (Canada)	market for waste paperboard (RoW)	ecoinvent 3.10	kg
Waste corrugated board (Middle East)	market for waste paperboard (RoW)	ecoinvent 3.10	kg
Waste corrugated board (United Kingdom)	market for waste paperboard (GB)	ecoinvent 3.10	kg
Waste plastic film (Europe)	market group for waste polyethylene (Europe without Switzerland)	ecoinvent 3.10	kg
Waste plastic film (United States)	market for waste polyethylene (RoW)	ecoinvent 3.10	kg
Waste plastic film (Japan)	market for waste polyethylene (RoW)	ecoinvent 3.10	kg
Waste plastic film (Korea)	market for waste polyethylene (RoW)	ecoinvent 3.10	kg
Waste plastic film (South Asia)	market for waste polyethylene (RoW)	ecoinvent 3.10	kg
Waste plastic film (China)	market for waste polyethylene (RoW)	ecoinvent 3.10	kg
Waste plastic film (Canada)	market for waste polyethylene (RoW)	ecoinvent 3.10	kg
Waste plastic film (Middle East)	market for waste polyethylene (RoW)	ecoinvent 3.10	kg
Waste plastic film (United Kingdom)	market for waste polyethylene (GB)	ecoinvent 3.10	kg
Waste plastic pallet (Europe)	market group for waste polyethylene (Europe without Switzerland)	ecoinvent 3.10	kg
Waste plastic pallet (United States)	market for waste polyethylene (RoW)	ecoinvent 3.10	kg
Waste plastic pallet (Japan)	market for waste polyethylene (RoW)	ecoinvent 3.10	kg
Waste plastic pallet (Korea)	market for waste polyethylene (RoW)	ecoinvent 3.10	kg
Waste plastic pallet (South Asia)	market for waste polyethylene (RoW)	ecoinvent 3.10	kg
Waste plastic pallet (China)	market for waste polyethylene (RoW)	ecoinvent 3.10	kg
Waste plastic pallet (Canada)	market for waste polyethylene (RoW)	ecoinvent 3.10	kg
Waste plastic pallet (Middle East)	market for waste polyethylene (RoW)	ecoinvent 3.10	kg
Waste plastic pallet (United Kingdom)	market for waste polyethylene (GB)	ecoinvent 3.10	kg
Waste printed paper (Europe)	market group for waste graphical paper (Europe without Switzerland)	ecoinvent 3.10	kg
Waste printed paper (United States)	market for waste graphical paper (RoW)	ecoinvent 3.10	kg
Waste printed paper (Japan)	market for waste graphical paper (RoW)	ecoinvent 3.10	kg
Waste printed paper (Korea)	market for waste graphical paper (RoW)	ecoinvent 3.10	kg
Waste printed paper (South Asia)	market for waste graphical paper (RoW)	ecoinvent 3.10	kg
Waste printed paper (China)	market for waste graphical paper (RoW)	ecoinvent 3.10	kg
Waste printed paper (Canada)	market for waste graphical paper (RoW)	ecoinvent 3.10	kg
Waste printed paper (Middle East)	market for waste graphical paper (RoW)	ecoinvent 3.10	kg
Waste printed paper (United Kingdom)	market for waste graphical paper (GB)	ecoinvent 3.10	kg
Waste solid compact board (Europe)	market group for waste paperboard (Europe without Switzerland)	ecoinvent 3.10	kg
Waste solid compact board (United States)	market for waste paperboard (RoW)	ecoinvent 3.10	kg
Waste solid compact board (Japan)	market for waste paperboard (RoW)	ecoinvent 3.10	kg
Waste solid compact board (Korea)	market for waste paperboard (RoW)	ecoinvent 3.10	kg
Waste solid compact board (South Asia)	market for waste paperboard (RoW)	ecoinvent 3.10	kg
Waste solid compact board (China)	market for waste paperboard (RoW)	ecoinvent 3.10	kg
Waste solid compact board (Canada)	market for waste paperboard (RoW)	ecoinvent 3.10	kg
Waste solid compact board (Middle East)	market for waste paperboard (RoW)	ecoinvent 3.10	kg
Waste solid compact board (United Kingdom)	market for waste paperboard (GB)	ecoinvent 3.10	kg
Waste wood (Europe)	market group for waste wood, untreated (Europe without Switzerland)	ecoinvent 3.10	kg
Waste wood (United States)	market for waste wood, untreated (RoW)	ecoinvent 3.10	kg
Waste wood (Japan)	market for waste wood, untreated (RoW)	ecoinvent 3.10	kg
Waste wood (Korea)	market for waste wood, untreated (RoW)	ecoinvent 3.10	kg
Waste wood (South Asia)	market for waste wood, untreated (RoW)	ecoinvent 3.10	kg
Waste wood (China)	market for waste wood, untreated (RoW)	ecoinvent 3.10	kg
Waste wood (Canada)	market for waste wood, untreated (RoW)	ecoinvent 3.10	kg
Waste wood (Middle East)	market for waste wood, untreated (RoW)	ecoinvent 3.10	kg
Waste wood (United Kingdom)	market for waste wood, untreated (GB)	ecoinvent 3.10	kg
Waste wooden pallet (Europe)	market group for waste wood, untreated (Europe without Switzerland)	ecoinvent 3.10	kg
Waste wooden pallet (United States)	market for waste wood, untreated (RoW)	ecoinvent 3.10	kg
Waste wooden pallet (Japan)	market for waste wood, untreated (RoW)	ecoinvent 3.10	kg
Waste wooden pallet (Korea)	market for waste wood, untreated (RoW)	ecoinvent 3.10	kg
Waste wooden pallet (South Asia)	market for waste wood, untreated (RoW)	ecoinvent 3.10	kg
Waste wooden pallet (China)	market for waste wood, untreated (RoW)	ecoinvent 3.10	kg
Waste wooden pallet (Canada)	market for waste wood, untreated (RoW)	ecoinvent 3.10	kg
Waste wooden pallet (Middle East)	market for waste wood, untreated (RoW)	ecoinvent 3.10	kg
Waste wooden pallet (United Kingdom)	market for waste wood, untreated (GB)	ecoinvent 3.10	kg

Annex II – Raw material data

Table 11. Minimal Packaging raw material raw data (provided by Loro Piana).

Component	Type of product	Weight (kg)	Recycled content (%)	Material	Note
External habana box	Corrugated board	0,42	100%	cardboard made with 100% of recycled materials 350mg2	Costo: _8,95€ è la media del costo di 7 misure di scatole, scatola esterna + inserto. Attenzione: il prezzo è più alto perché i quantitativi di produzione sono inferiori e contiene il costo della cover _3,25€ è la media del costo delle 7 misure diverse di inserto Peso medio 7 scatole: 0,422 kg scatola
Internal compensator	Corrugated board	0,16	100%	cardboard made with 100% of recycled materials 350mg2	0,181 kg avg weight
Dust Bag	Other (please specify)	0,03	0%	100% cotone "BCI"	Costo 3,28€ (è la media del costo di 50 misure diverse) 0,032125 kg peso medio

Table 12. Signature Packaging raw materials raw data (provided by Loro Piana).

Component	Type of product	Weight (kg)	Recycled content (%)	Material	Note
External habana box	Corrugated board	0,67	30%	- composizione Cartoncino teso kraft 205 g/m² - nome scientifico: Cartoncino kraft non sbiancato da fibra vergine, non patinato - Origine: Foreste certificate FSC - composizione (lato esterno: KM/46/E (Kraft Medium/46/Microonda) - nome scientifico: Cartone ondulato con onda tipo microonda - Origine: K:Pasta chimica di conifera / M:Macero/riciclo Italia	Costo: _4,96€ è la media del costo di tutte le 13 misure di scatole esistenti. _3,51€ è la media del costo delle stesse 7 misure di scatole prese in considerazione per l'Minimal Packaging. Peso medio: _13 scatole: 0,672 kg _7 scatole misure uguale a Eco: 0,430 kg
Dust Bag	Other (please specify)	0,02	0%	100% cotone "BCI"	Costo: 3,28€ (è la media del costo di 50 misure diverse) 70% degli ordini contengono dust bag (shoes, leather goods, SLG...)

					Peso: 0,032125 kg peso medio
Branded box	Solid compact board	0,32	80%	100% Paper and Cardboard, made with 86% of recycled materials, FSC certified Prodotto completamente riciclabile (>95%)	Costo: 8,50€ (è la media di 24 misure di scatole diverse) Peso: medio 0,320 kg
Ribbon	Other (please specify)	0,01	0%	100% cotone	Costo: 0,69€ al metro / si usa una media di 2 metri a scatola Peso: 100mt = 0,626 kg, quindi considerando 2m sono 0,01252 kg per ordine
Cedar ball	Other (please specify)	0,02	0%	Pallina in legno - essenza cedro rosso Americano (89,8% di legno sul peso tot.articolo) Cordino Coda di Topo,VerdeVal in cotone (10,2% di cotone sul peso tot. articolo) Prodotto completamente riciclabile (>95%)	Costo: 1,19€ a pezzo / si usa 1 per ordine Peso: 0,015 kg, quindi 15g l'una pallina + cordino
Documents folder	Printed paper	0,02	40%	PAP 22 PAPER	Costo: 0,77€ a unità / si usa 1 per ordine Peso: 0,024 kg a unità
Sticker	Printed paper	0,00	0%	Paper	Costo: 0,01€ a unità / si usa 1 per ordine Peso: 0,0005 kg a unità
Tissue paper / packaging fillment	Printed paper	0,09	0%	Prodotto non riciclabile	Costo: carta velina verde che usiamo come riempitivo, costo di 0,08€ al pezzo. Si usano una media di 3 a 5 fogli per ordine Peso: grammatura 18 g/m2 formato mm 500 x 750
Gift Note (optional)	Printed paper	0,01	0%	Paper	Costo: 1,05€ a unità / si usa 1 per ordine Peso: 0,012 kg a unità

Annex III – Upstream transportation data

Table 13. Upstream transportation raw data (provided by Loro Piana).

	Main supplier location	Via Arno, 4, 21043 Castiglione Olona VA	Via Arno, 4, 21043 Castiglione Olona VA	Fagnano Olona VA	Via dell'Industria, 25, 62010 Pollenza MC	Via Monte Rosa, 21, 20863 Concorezzo MB	via Catlinetti 17, 13011 Isolella Sesia - Borgosesia	Via Ernesto Breda 98, 20121, Milano	Via Marche, 7, 20072 Pieve Emanuele MI	Via Ernesto Breda 98, 20121, Milano	Via Ernesto Breda 98, 20121, Milano
EUROPE (SNATT)	Distance 1 (km)	192	192	192	362	165	243	147	147	147	147
	Transport mode 1	Truck unkwown	Truck unkwown	Truck unkwown	Truck unkwown	Truck unkwown	Truck unkwown	Truck unkwown	Truck unkwown	Truck unkwown	Truck unkwown
	Distance 2 (km)										
	Transport mode 2	Please select	Please select	Please select	Please select	Please select	Please select	Please select	Please select	Please select	Please select
UK (ARCESE)	Distance 1 (km)	1171	1171	1171	1688	1197	1216	1243	1243	1243	1243
	Transport mode 1	Truck unkwown	Truck unkwown	Truck unkwown	Truck unkwown	Truck unkwown	Truck unkwown	Truck unkwown	Truck unkwown	Truck unkwown	Truck unkwown
	Distance 2 (km)										
	Transport mode 2	Please select	Please select	Please select	Please select	Please select	Please select	Please select	Please select	Please select	Please select
MIDDLE EAST	Distance 1 (km)	83	83	83	609	124	121	120	120	120	59
	Transport mode 1	Truck unkwown	Truck unkwown	Truck unkwown	Truck unkwown	Truck unkwown	Truck unkwown	Truck unkwown	Truck unkwown	Truck unkwown	Truck unkwown
	Distance 2 (km)	4.702	4.702	4.702	4.702	4.702	4.702	4.702	4.702	4.702	4.702

	Transport mode 2	Plane	Plane	Plane	Plane	Plane	Plane	Plane	Plane	Plane	Plane
UNITED STATES	**Distance 1 (km)**	65	65	65	591	106	103	102	102	102	102
	Transport mode 1	Truck unknown	Truck unkwown	Truck unkwown	Truck unkwown	Truck unkwown	Truck unkwown	Truck unkwown	Truck unkwown	Truck unkwown	Truck unkwown
	Distance 2 (km)	6.430	6.430	6.430	6.430	6.430	6.430	6.430	6.430	6.430	6.430
	Transport mode 2	Plane	Plane	Plane	Plane	Plane	Plane	Plane	Plane	Plane	Plane
CANADA (only remove from IT)	**Distance 1 (km)**	40	40	40	566	81	78	77	77	77	77
	Transport mode 1	Truck unkwown	Truck unkwown	Truck unkwown	Truck unkwown	Truck unkwown	Truck unkwown	Truck unkwown	Truck unkwown	Truck unkwown	Truck unkwown
	Distance 2 (km)	6.661	6.661	6.661	6.661	6.661	6.661	6.661	6.661	6.661	6.661
	Transport mode 2	Plane	Plane	Plane	Plane	Plane	Plane	Plane	Plane	Plane	Plane
KOREA	**Distance 1 (km)**	81	81	81	607	122	119	118	118	118	118
	Transport mode 1	Truck unkwown	Truck unkwown	Truck unkwown	Truck unkwown	Truck unkwown	Truck unkwown	Truck unkwown	Truck unkwown	Truck unkwown	Truck unkwown
	Distance 2 (km)	8.910	8.910	8.910	8.910	8.910	8.910	8.910	8.910	8.910	8.910
	Transport mode 2	Plane	Plane	Plane	Plane	Plane	Plane	Plane	Plane	Plane	Plane

JAPAN	Distance 1 (km)	64	64	64	590	105	102	101	101	101	101
	Transport mode 1	Truck unkwown	Truck unkwown	Truck unkwown	Truck unkwown	Truck unkwown	Truck unkwown	Truck unkwown	Truck unkwown	Truck unkwown	Truck unkwown
	Distance 2 (km)	9.749	9.749	9.749	9.749	9.749	9.749	9.749	9.749	9.749	9.749
	Transport mode 2	Plane	Plane	Plane	Plane	Plane	Plane	Plane	Plane	Plane	Plane
SOUTH ASIA (HONG KONG)	Distance 1 (km)	37	37	37	563	78	75	74	74	74	74
	Transport mode 1	Truck unkwown	Truck unkwown	Truck unkwown	Truck unkwown	Truck unkwown	Truck unkwown	Truck unkwown	Truck unkwown	Truck unkwown	Truck unkwown
	Distance 2 (km)	9.352	9.352	9.352	9.352	9.352	9.352	9.352	9.352	9.352	9.352
	Transport mode 2	Plane	Plane	Plane	Plane	Plane	Plane	Plane	Plane	Plane	Plane
CHINA	Distance 1 (km)	43	43	43	569	84	81	80	80	80	80
	Transport mode 1	Truck unkwown	Truck unkwown	Truck unkwown	Truck unkwown	Truck unkwown	Truck unkwown	Truck unkwown	Truck unkwown	Truck unkwown	Truck unkwown
	Distance 2 (km)	9111	9111	9111	9111	9111	9111	9111	9111	9111	9111
	Transport mode 2	Plane	Plane	Plane	Plane	Plane	Plane	Plane	Plane	Plane	Plane

Annex IV – Downstream transportation data

Table 14. Downstream transportation raw data (provided by Loro Piana).

Areas	Country	Gross Orders	Share of Gross Orders sold (%)	Distance 1 (km)	Transport mode 1	Distance 2 (km)	Transport mode 2
EUROPE		26352	39,74%	700			
Arcese	United Kingdom	6316	9,52%	40	Truck unknown		
SNATT Logistica	Rest Of EU:				Truck unknown	1.202	Plane
	Germany	3450	5,20%	985	Truck unknown	302	Plane
	Netherlands	3339	5,03%	1.172	Truck unknown	209	Plane
	France	2707	4,08%	1.158	Truck unknown	6	Plane
	Italy	2166	3,27%	453	Truck unknown	-	Plane
	Spain	972	1,47%	1.268	Truck unknown	590	Plane
	Switzerland	841	1,27%	391	Truck unknown	974	Plane
	Greece	735	1,11%	2.081	Truck unknown	72	Plane
	Poland	721	1,09%	1.868	Truck unknown	42	Plane
	Belgium	661	1,00%	1.271	Truck unknown	-	Plane
	Austria	585	0,88%	1.169	Truck unknown	132	Plane
	Romania	582	0,88%	1.953	Truck unknown	155	Plane
	Portugal	411	0,62%	2.512	Truck unknown	34	Plane
	Bulgaria	396	0,60%	2.445	Truck unknown	10	Plane
	Sweden	331	0,50%	763	Truck unknown	1.508	Plane
	Cyprus	256	0,39%	94	Truck unknown	3.534	Plane
	Czech Republic	229	0,35%	1.358	Truck unknown	169	Plane
	Denmark	194	0,29%	1.874	Truck unknown	-	Plane
	Latvia	185	0,28%	132	Truck unknown	2.618	Plane
	Hungary	167	0,25%	425	Truck unknown	933	Plane
	Croatia	160	0,24%	552	Truck unknown	4	Plane
	Estonia	153	0,23%	130	Truck unknown	2.332	Plane
	Monaco	147	0,22%	400	Truck unknown	-	Plane
	Lithuania	139	0,21%	762	Truck unknown	1.347	Plane

	Slovakia	121	0,18%	398	Truck unknown	1.162	Plane
	Ireland	98	0,15%	2.300	Truck unknown	47	Plane
	Finland	83	0,13%	266	Truck unknown	2.119	Plane
	Luxembourg	76	0,11%	1.494	Truck unknown	-	Plane
	Slovenia	70	0,11%	373	Truck unknown	1.018	Plane
	Malta	32	0,05%	90	Truck unknown	2.694	Plane
	Ukraine	29	0,04%	1.202	Truck unknown	1.450	Plane
MIDDLE EAST		14725	22,20%				
	Utd.Arab Emir.	8777	13,23%	108	Truck unknown	-	Plane
	Saudi Arabia	2614	3,94%	349	Truck unknown	677	Plane
	Qatar	1622	2,45%	133	Truck unknown	532	Plane
	Kuwait	1522	2,30%	141	Truck unknown	1.030	Plane
	Bahrain	190	0,29%	113	Truck unknown	697	Plane
UNITED STATES		14401	21,72%	490	Truck unknown	1.842	Plane
		14.401	21,72%				
CHINA		7997	12,06%	384	Truck unknown	226	Plane
		7.997	12,06%				
KOREA		1237	1,87%	62	Truck unknown		
		1.237	1,87%				
CANADA	Only Remote- From IT SNATT	820	1,24%	229	Truck unknown	6.661	Plane
		820	1,24%				
JAPAN (〒104-00613 Chome-5-8 Ginza)	From Ginza Store Direct To Customers	396	0,60%	259	Truck unknown		
		396	0,60%				
SOUTH ASIA		389	0,59%	31	Truck unknown		
	Hong Kong	389	0,59%				
Total		66317	100%				

Annex V – Normalization and weighting factors

Table 15. Normalization and weighting factors for the calculation of single scores.

Indicator	Normalization factor	Weighting factor
climate change (kg CO2-Eq)	7 553	21%
ozone depletion (kg CFC-11-Eq)	0	6%
ionising radiation: human health (kBq U235-Eq)	4 220	5%
photochemical oxidant formation: human health (kg NMVOC-Eq)	41	5%
particulate matter formation (disease incidence)	0	9%
human toxicity: non-carcinogenic (CTUh)	0	2%
human toxicity: carcinogenic (CTUh)	0	2%
acidification (mol H+-Eq)	56	6%
eutrophication: freshwater (kg P-Eq)	2	3%
eutrophication: marine (kg N-Eq)	20	3%
eutrophication: terrestrial (mol N-Eq)	177	4%
ecotoxicity: freshwater (CTUe)	56 717	2%
land use (dimensionless)	819 498	8%
water use (m3 world Eq deprived)	11 469	9%
energy resources: non-renewable (MJ, net calorific value)	65 004	8%
material resources: metals/minerals (kg Sb-Eq)	0	8%

Annex VI – Life cycle assessment critical review

Life cycle assessment critical review – Report

Methodology of the critical review

The critical review of this study was carried out in accordance with ISO 14071:2024. The purpose of this critical review is to ensure that the study and its report comply with the following standards:

- ISO 14040:2006 - Environmental management - Life cycle assessment - Principles and framework
- ISO 14044:2006 - Environmental management - Life cycle assessment - Requirements and guidelines

The LCA study was commissioned by Loro Piana and carried out by Guillaume Mignot and Arnaud Ripoll (EcoAct). The critical review was carried out by Thomas Bargain (ESSP Solutions).

Critical review process

The critical review was carried out between 18/04/2025 and 16/04/2025. 2 critical review iterations were carried out over this period. During each of these critical reviews, several elements were provided by EcoAct:

- The Excel file used to calculate the LCIA
- The LCA study report

These documents made it possible to assess all the work carried out by EcoAct during the LCA study, and in particular:

- Compliance with ISO 14040-44 standards
- Technical and scientific validity of the LCA study
- Consistency between the data used, the assumptions made and the objectives of the study
- Consideration of the study's limitations in all phases of interpretation
- Transparency and completeness of the LCA report

Discussions between EcoAct and ESSP Solutions during the critical review process took place in several ways:

- By means of the critical review table
- By Teams, including by videoconference when necessary

Conclusions of the critical review

The comparison of the potential environmental impacts of MP and SP packaging shows no sign of bias and clearly demonstrates the environmental benefits of MP packaging compared with SP packaging.

However, interpretation of the results must take into account a number of limitations, in particular:

- The exclusion of certain stages in the packaging life cycle (last-km delivery);
- Very conservative end-of-life scenarios, which do not include energy or material recovery from packaging;

These limitations are mentioned in the study report and have no impact on the environmental comparison of MP and SP packaging, since they are applied uniformly to all packaging.

However, the use of the results of the LCA carried out by EcoAct, and in particular the communication of potential comparative impacts, must be carried out with caution for several reasons:

- LCA results are valid only within the scope of the study as defined in the study report
- Potential environmental impacts are expressed in relation to different functional units to suit the different products studied and the objectives of the study. Communication of the potential environmental impact of packaging and comparative statements should be based on the appropriate functional unit.

Verdict of the critical review

The LCA report complies with the requirements of ISO 14040-44 standards for comparative statements.

Thomas Bargain
Ecodesign Project Manager
ESSP Solutions
be@essp-solutions.com

Life cycle assessment critical review – Review table

LCIA file review

1st iteration

Reviewer's initials	Index	Tab	Box	Reviewer's comment	Reviewer's recommendation	Response from the author of the LCA study	Reviewer's response
TB	1	Impact factors	C7, C8	No process for spinning, cutting, dyeing, etc. Cotton		We have now considered the following processes for cotton: - market for finishing, textile, knit cotton (GLO) - market for finishing, textile, woven cotton (GLO) - market for mercerizing, textile (GLO) - market for sanforizing, textile (GLO) - market for bleaching and dyeing, yarn (GLO) - textile production, cotton, weaving (RoW)	Ok, except "knit cotton"
TB	2	Impact factors	C12, C13	No plastic pellet shaping process		We have now considered the following processes for plastic: market for injection moulding (GLO)	OK
TB	3	Impact factors	C14, C15	The choice of a "woodfree" paper is not very representative of this type of paper. In addition, printing is not counted in the process.	Choose a "market for printed paper" process, more representative of the product being modelled.	Ok, we have changed to "market for printed paper"	OK
TB	4	Results	H48	Where does the 1/80 parameter come from? To a pallet reuse rate or to the number of boxes per pallet.		This is the number of boxes. Having no information on the reuse rate of pallets, we made a conservative assumption of a single use.	Ok, very conservative approach on the number of uses

TB	5	CFF calculation	C26	The second part of the SBB formula corresponds to the end of life of the material. It is considered here in the impact of the raw material (even if the parameter R2=0 makes the impacts related to the FDV disappear).	Move the part of the formula corresponding to the impacts of the recycling process and the substitution of the raw material to the end of life.	We have removed the mention PEF compliant from the report and added an explanation on the use of the CFF in the Allocation section. The objective is to keep a harmonized and conservative methodology for the end of life.	Ok, very conservative approach to the benefits of recycling and energy recovery at the end of life
TB	6	Impact factors	D5, D6, D17	No access to CFF's assumptions for cardboard products.	To be added.	We have added a section in "General assumption" with all the assumptions about the following materials: cardboard, LDPE, HDPE and Paper	OK
TB	7	CFF calculation	G14	All values of R2 are set to 0. However, Appendix C of the PEFCR Guidance v6.3 gives other values for R2 for post-consumer waste.	Use the recommended values for waste generated within the EU.	We have removed the mention PEF compliant from the report and added an explanation on the use of the CFF in the Allocation section. The objective is to keep a harmonized and conservative methodology for the end of life.	Ok, very conservative approach to the benefits of recycling and energy recovery at the end of life
TB	8	CFF calculation		Waste recovery aspects not taken into account (SBB energy part)	Add aspects related to energy recovery at the end of the life of incinerated products.	We have removed the mention PEF compliant from the report and added an explanation on the use of the CFF in the Allocation section. The objective is to keep a harmonized and conservative methodology for the end of life.	Ok, very conservative approach to the benefits of recycling and energy recovery at the end of life
TB	9	Impact factors		For all end-of-life processes, the use of end-of-life scenarios provided by ecoinvent processes leads to inconsistencies with the parameters indicated in the SBB calculation tab (in particular with regard to energy recovery rates).	Describe the end-of-life scenarios selected for each material and region and apply them consistently.	We have removed the mention PEF compliant from the report and added an explanation on the use of the CFF in the Allocation section. The objective is to keep a harmonized and conservative methodology for the end of life.	Ok, very conservative approach to the benefits of recycling and energy recovery at the end of life

TB	11	Impact factors		The use of "market for waste..." excludes recycling from end-of-life scenarios of materials. This hypothesis is particularly strong for certain materials (plastics, cardboard, etc.) whose effective recycling rate at the end of their life is far from negligible, particularly in Europe.	Add a recycling process (based on CFF) according to the selected end-of-life scenarios.	We have removed the mention PEF compliant from the report and added an explanation on the use of the CFF in the Allocation section. The objective is to keep a harmonized and conservative methodology for the end of life.	Ok, very conservative approach to the benefits of recycling and energy recovery at the end of life
TB	10	CFF calculation	B23	The LDPE recycling process is the same as HDPE	Specify in the report the use of a proxy for LDPE recycling	We have added a section in "General assumption" with all the assumptions specifying that we had to use a proxy for the LDPE	OK

2nd iteration

Reviewer's initials	Index	Tab	Box	Reviewer's comment	Reviewer's recommendation	Response from the author of the LCA study	Reviewer's response
TB	1	Impact factors	C9	This "knit cotton" process does not seem to correspond to the finish of cotton which is simply woven.		Elimination of the knitting process (knit cotton)	OK
TB	2	Résults	G10, G3220	Double counting on cotton processes, the "textile production, cotton, weaving" process includes cotton yarn and therefore cotton fiber	Eliminate the cotton fiber process since it is counted in other textile shaping processes	The weaving process does not include cotton yarn so no changes have been made.	Ok, HS comment
TB	3	Impact factors	C12	(Detail): "This activity is modelled as a service and therefore does not include the fabric. It should be used with 1.005kg of fabric per kg sanforized fabric" Losses in other textile processes, even if minor, not taken into account		Addition of losses for the quantity of cotton used for the sanforizing process: Cedar ball: 1.53 > 1.54 g Ribbon: 12.5 > 12.6 g Dust bag: SP: 225 > 226 g MP: 311 > 323 g	OK

TB	4	Résults	H889, H3436	Detail: "1 kg of this process equals 0.994 kg of injection moulded plastics." Loss not taken into account in plastic shaping	Correcting the mass of plastics by taking into account the efficiency of the process	Addition of losses for the quantity of plastics used for the injection moulding process Plastic pallet: 1,243 > 1,250 kg	OK
TB	5	Results	H48	No consideration of pallet reuse rate		No data were available. A conservative hypothesis was therefore considered (no reuse of pallets).	Ok, very conservative approach on the number of uses
TB	6	Impact factors	D5, D6, D17	No access to CFF's assumptions for cardboard products.		The CFF's assumptions have been added to the report.	OK

LCA file report

1st iteration

Reviewer's initials	Index	Line Number	Article / paragraph	Paragraph / figure / table	Comment Type ge - General ed - Editorial te - Technical	Reviewer's comment	Reviewer's recommendation	Response from the author of the LCA study	Reviewer's response
TB	2	10	Objectives of the study		ed	Unclear wording: "Production of packaging used to distribute the packaging"	Specify whether it is secondary or tertiary packaging.	Clarification made with the following wording: "4. Production of secondary and tertiary packaging used to distribute the packaging."	OK
TB	1	12	Objectives of the study		ed	Avoiding the imprecise use of "higher recycled materials"		We have modified the mention by specifying the part of the report that presents the details: "and some components with recycled content (detailed in part Collection and quality of data)."	OK
TB	3	51	Introduction to Life Cycle Assessment		ed		Change the wording "A multi-step AND multi-criteria approach"	The wording has been changed.	

TB	4	95	Critical review		ge	Absence of ISO 14071 in the list of standards governing LCA critical review	Add 14071 to the list of standards cited	Addition of the mention: "ISO 14071"	OK
TB	5	128	Product at stake		ed	Avoiding the imprecise use of "more recycled materials"		We have removed the mention "more"	OK
TB	47	131	Product at stake	Figure 4	ge	The image appears to show a different storage volume between the two packaging formats. Can we say that they perform an equivalent service when the MP box seems to be able to store larger lenses?		This is an optical effect but the two boxes have an identical capacity.	OK
TB	6	136	Product at stake	Tableau 1	ed	Measurements are in mm, not cm	Fix "Measures (mm)"	fixed with mm	OK

TB	7	150	Functional unit		te	Why choose 6 separate Functional Units rather than a common Functional Unit bringing together the functions of the different products? Since the function of the product is storage, a single functional unit relating to the volume stored would have been relevant.	Justify the choice of functional units	We will only compare boxes of the same size with each other. All allusions to other comparisons have been removed.	OK
TB	8	190	Delimitation of system boundaries: stages and flows included		ge	A significant portion of the lifecycle stages is missing from the description. The list appears to be truncated and does not mention all of the steps mentioned in Figure 5.		We have completed the list with all the steps in Figure 5	OK
TB	9	284	Allocation		te	No details on the allocation of flows relating to the transport of boxes (especially at the delivery stage) to a box unit.		We have added the mention "We have a mass allocation in Tkm."	OK

	50	284	Allocation		ge	No mention of the rule for the allocation of environmental benefits and charges related to the recovery of end-of-life materials.	Present the CFF and the parameters used for each material	We have presented the choices relating to the use of the CFF in the allocation paragraph. In addition, in general assumptions, the assumptions for values and proxy are detailed.	OK
TB	10	296	LCA Methodology & Impact Categories		ed	Error in "PEF 3.1"?	"EF 3.1"?	fixed with EF3.1	OK
TB	11	302	Impact Assessment		ed	"iMacImpact"	"Impact"	Fixed with impact	OK
TB	12	304	Impact Assessment		ed	No definition of the acronym "EF"	To be added to the list of abbreviations at the beginning of the report	Added to the list page 8	OK

TB	14	313	Critical Analysis of Selected Indicators		ge	Problem of consistency in the choice of impact indicators studied in detail. The "water use" indicator is not mentioned in the first list of indicators studied but is presented subsequently. Similarly, the first mention of eutrophication refers to marine eutrophication, but the indicator presented next is an indicator of freshwater eutrophication. The indicator "Energy resources: non-renewable" is listed but not presented in detail, creating doubt about its inclusion in the rest of the study.	Better specify and homogenize the detailed indicators. Only these indicators should be presented in detail.	We chose to use the average single score to determine the relevant indicators to be analyzed during the study in order to cover almost 80% of the impacts on all scenarios, namely: 1. Climate change. 2. Water use 3. Energy resources: non-renewable. 4. Particulate matter 5. Marine eutrophication 6. Acidification	OK

TB	13	328	Critical Analysis of Selected Indicators		ed	The sentence "- Since wastewater discharges from pulp mills are known to contribute to the eutrophication of aquatic ecosystems marine as well been included in the scope of the study" is unclear.	To reformulate and specify the indicator concerned (marine eutrophication?)	This sentence is no longer present in the report.	OK
TB	16	331	Water use [m3 eq]		ed	"[m3 eq]" is not the exact unit of this indicator.	"[M3 World EQ]"	Corrected	OK
TB	15	332	Water use [m3 eq]		ed	"EF 2.0"	"EF 3.1"	Corrected	OK
TB	17	406	Minimal Packaging option		ge	Lack of clarity on why an "average" weight is presented. Is it an average point between the different companies?	Present a table with the weights of each element in each box format.	We have added a table with the weight of each of the elements. However, there are 2 other cases, the case where the item is the same for all boxes (e.g. gift note) and the case where we have taken an average weight per order due to lack of more precise information (e.g. dust bag). All these cases have been specified in each paragraph.	OK

TB	18	420	Minimal Packaging option		te	The Better Cotton Initiative label does not guarantee the same growing conditions as organic cotton (especially with regard to the use of substances such as pesticides). This hypothesis therefore seems very optimistic.	To carry out a sensitivity study with a modelling of cotton in conventional cultivation.	We changed the emission factor and we did not use organic cotton but standard cotton.	OK
TB	40	461	Assumptions and Data for Transportation		te	Comment on all transport assumptions: Lack of clarity on the assumptions for assigning the impacts of transport to the product system studied.	Specify the rules for assigning the impacts of transport, which is an important stage in the life cycle of a packaging. In particular, specify the rates of use of transport modes and specify whether transport is limited by the volume or mass capacity of the transport mode (see PEFCR guidance v6.3, 7.14 Modelling transport).	We based ourselves on Ecoinvent's assumptions. A reference was made in the paragraph on allowances.	OK
TB	19	464	Assumptions and Data for Transportation		ed	"plastic pellets"	"plastic pallets"	Corrected	OK

TB	39	477	Assumptions and Data for Transportation		te	Has >32t truck transport been taken into account for all road logistics? Including the final delivery to the customer? This hypothesis seems very strong since last-mile logistics are much more often carried out with trucks with a much lower capacity and a low utilization rate.	Specify the assumptions for final delivery. Distinguish between transport to the logistics site and to the end customer.	The last mile was not taken into account due to the multiple possible scenarios as well as the lack of information. A sentence to this effect has been added in the paragraph "Steps of the life cycle excluded from the perimeter"	OK
TB	20	478	Impact factors		ed	Avoid the term "Emission factors", which is too restrictive regarding the various impacts that can be understood in LCA.	Prefer "secondary data", "background LCI data" or something like that	Fixed with Secondary data	OK
TB	21	483	Impact factors		ed	Avoid the term "Emission factors", which is too restrictive regarding the various impacts that can be understood in LCA.	Prefer "background LCI data" or something like that	Fixed with Secondary data	OK
TB	24	484	Impact factors		ed	This paragraph is repeated with the content of the "Assumptions and data for end of life" section, line 504 and does not concern the transport phases	To be deleted	Suppressed	OK

TB	22	485	Impact factors		ed	Avoid the term "Emission factors", which is too restrictive regarding the various impacts that can be understood in LCA.	Prefer "background LCI data" or something like that	Deleted because included in the previous paragraph	OK
TB	37	499	Assumptions and Data for Transportation		ed	"Annex II"	"Annex III"	Fixed with "Annex III"	OK
TB	38	502	Assumptions and Data for Transportation		ed	"Annex III"	"Annex IV"	Fixed with "Annex IV"	OK
TB	23	507	Assumptions and data for end of life		ed	Avoid the term "Emission factors", which is too restrictive regarding the various impacts that can be understood in LCA.	Prefer "background LCI data" or something like that	Corrected with "background LCI data"	OK
TB	50	521	Presentation of Results and Interpretations		ge	A lot of use of conditional tenses in ACVI analyses (e.g. "is believed to be caused by...").	These statements must be supported by graphs, figures, etc. in order to clarify these claims.	We've removed the use of the conditional in the analyses. In addition, we have removed some specific analyses that are not necessary so as not to overlook the report. All the data and calculations are nevertheless available in the Excel file that will be	OK

								given to the client with the report so that they can extract targeted results.	
TB	51	521	Presentation of Results and Interpretations		ge	The articulation between the environmental profiles of the different boxes and the comparison of the MP and SP boxes is unclear.	First of all, present the environmental profile of the boxes (e.g. distribution of impacts by stages of the life cycle) to then support the comparison between the two families of packaging on each format.	Contribution analysis and benchmarking available for 6 indicators	OK
TB	52	521	Presentation of Results and Interpretations		ge	The impacts presented are averaged over all delivery scenarios.	Present the environmental impacts for each box delivery area in a sensitivity study.	There are no different delivery scenarios. Distribution is calculated based on actual sales per country as Loro Piana already sells products packaged in Signature Packaging packaging. Also, Loro Piana is not interested in a sensitivity study of the distribution by country because they do not plan to change their distribution countries.	OK. The sensitivity study does not bring value to the eco-design carried out on the packaging. On the other hand, the sensitivity study would have provided value in terms of communicating the results to customers in order to provide the most accurate information for each geographical area.

TB	25	529	Presentation of Results and Interpretations	Table 4 et table 5	ed	This content seems to concern global data on the product systems studied without being directly related to the LCA results.	Move this content to the "Product at stake" paragraph of product system description.	This content has been reinstated in the "product at stake" section	OK
TB	26	545	Environmental impacts of SP and MP		ed	"highwater"	"high water"	Corrected	OK
TB	27	550	Climate change (kg CO2e)		te	No mention of the fact that the MP box results in a slight increase in impacts for two formats (box 1 and box 2).	Add this mention and explain the increase in the contribution to climate change on these formats.	In view of the changes that have occurred with the update of the calculations, the MP boxes 1 and 2 are no longer increasing but barely decreasing. A mention of the fact that the non-significant decrease was indicated.	OK
TB	28	575	Water use (m3 world eq deprived)		ed	"depravity"	"Deprivation"	Corrected	OK
TB	29	578	Water use (m3 world eq deprived)		ed	"depravity"	"Deprivation"	Corrected	OK
TB	30	579	Water use (m3 world eq deprived)		ed	"depravity"	"Deprivation"	Corrected	OK

TB	31	580	Water use (m3 world eq deprived)		ed	"depravity"	"Deprivation"	Corrected	OK
TB	32	589	Water use (m3 world eq deprived)		ed	"depravity"	"Deprivation"	Corrected	OK
TB	33	595	Particulate matter formation (disease incidence)		te	"In other words, the selection of MP reduces by 31% the likelihood of contracting diseases associated to fine particles in the air." The IACV results are relative expressions and do not predict impacts on category parameters, threshold exceedance, safety margins or risks.	Delete or rephrase this statement to avoid predictions about the ultimate effects of potential environmental impact categories.	This indicator is no longer taken into account in the analysis because it does not appear in the single score.	OK
TB	34	607	Particulate matter formation (disease incidence)		ed	The figure and its legend are incorrectly positioned in the report.		All figures and legends in the report have been updated and positioned as needed.	OK

TB	35	610	Eutrophication : feshwater (kg P-eq)		ed	The 25% discount is an average across all boxes.	Specify that this is an average value and not valid for each box individually.	Average of all specified boxes	OK
TB	36	644	Energy resources: non-renewable (MJ)		ed	The title mentions the consumption of non-renewable resources, but the following paragraphs concern the acidification indicator.	Change the title.	We took the non-renewable resources indicator and not acidification with regard to the single score	OK
TB	42	660	Comparison of environmental impacts of SP and MP		ge	LCA involves 6 distinct product systems. No mention is made here of the type of box used for the comparison of the environmental profiles between the MP and SP box.	Specify whether the comparison is based on an average box between the different formats or on another assumption.	We have clarified that the results are overall weighted averages, with the results weighted by country sales (%) and box usage rate (%)	OK
TB	43	660	Comparison of environmental impacts of SP and MP		ge	Why present environmental profiles on only 2 indicators?	Complete on the other selected indicators.	We have presented 6 indicators for the results	OK
TB	41	664	Comparison of environmental impacts of SP and MP		te	Unclear link between GHG emissions and human health.	Specify.	We have reviewed the comments based on the updated results.	OK

TB	44	704	Conclusion		te	The fact that the LCA is based on a different UF for each format does not allow for a comparison of the environmental performance of each format. Only boxes modelled on the basis of the same UF (and therefore the same format) can be compared.	Choose a single UF or remove any mention of comparison between different formats.	We only compare SP and MP options (format by format), so we have removed the comparison mentions between the different sizes.	OK
TB	45	707	Conclusion		ge	Once again, the choice of impact indicators is not clear.	Needs to be clarified.	The choice of indicators has been clarified	OK
TB	46	709	Conclusion		ge	Climate change instead of "non-renewable energy use"?		Corrected in the conclusion	OK
TB	48	740	Annex I - Impact factors used (ecoinvent)		ge	No content	To be completed	We integrated the LCI which was in the Excel file.	OK
TB	49	755	Annex V - Inputs and outputs		ge	No content	To be completed	We have removed this appendix	OK

TB	53	461	Assumptions and Data for Transportation		te	No quantified assumptions regarding the reuse rate of pallets, as well as the number of boxes stored per pallet.	To be specified.	A comment has been added at the end of the paragraph to clarify these two points.	OK

2nd iteration

Reviewer's initials	Index	Line Number	Article / paragraph	Paragraph / figure / table	Comment Type ge - General ed - Editorial te - Technical	Reviewer's comment	Reviewer's recommendation	Response from the author of the LCA study	Reviewer's response
TB	1		Executive summary		ge	Indicators are not ranked from highest to lowest		The indicators have been reordered. Including in the conclusion.	OK

TB	2	147	Introduction to Life Cycle Assessment		ge	Lack of clarity: "These include raw materials and energy flows needed during the different steps of the life cycle which produce waste and emissions, as shown in Figure 2" The wording suggests that we only look at the stages during which emissions/waste are produced.		This sentence has been deleted and the previous sentence has been enriched with these elements: "Part of the LCA consists in developing an exhaustive inventory of the inputs (energy and raw materials) and outputs (waste and emissions) of the product or service at each step of its life cycle, as shown in Figure 2."	OK
TB	3	149	Introduction to Life Cycle Assessment		ge	LCA measures potential environmental impacts	"to quantify the potential environmental..."	"Potential" has been added.	OK
TB	4	202	Critical Review		ge	Critical review by Thomas Bargain and not Lucas Lassegnore		Corrected.	OK
TB	5	284	Delimitation of system boundaries: stages and flows included		ge	Two stages are called "manufacturing"	Gather them or rename the second step "assembly"	The second stage was renamed "Assembly". There were also two "Distribution" stages; the first was renamed "Transportation". Figure 5 has been updated accordingly.	OK

TB	6	301	Steps of the life cycle excluded from the perimeter		ge	Secondary and tertiary packaging are nevertheless taken into account in the modelling		They are used for the packaging of the finished product (the cardboard), downstream for distribution. Primary, secondary and tertiary packaging of the components of the finished product (box, ball, ribbon, etc.) have not been integrated.	OK
TB	7	367	Collected secondary data		te	The Cut-Off (Recycled Content) approach was not really mobilized since the CFF was applied.	Remove the mention "modelled with"	The mention has been withdrawn.	OK
TB	8	419	Data quality		ed	"Loropiana" -> "Loro Piana"		Corrected.	OK
TB	9	437	Data quality	Table 5	ge	It seems to me that the evaluation of secondary data does not concern secondary data from Ecoinvent (no secondary data on manufacturing for example). These data are of crucial importance in the validity of the results.		We have added secondary data (raw materials and dirstribution) for data quality. However, since we are not PEFCR compliant, we do not think that further details are necessary in this part.	OK
TB	10	443	Allocation		te	Lack of clarity regarding the allocation rules applied.	More precise: - Raw material production and end-of-life: application of the CFF (as described in the following paragraph), no other allocation rules except those used in the Ecoinvent cut-off library - Assembly: no allocation - Logistics: mass allocation of transport operations (application of data in t*km)	We have brought clarity to this paragraph by adding subsections.	OK

TB	11	482	Critical analysis of selected indicators		te	Specify the method of calculating the single score (normalization and weighting parameters from the EF 3.1 method).		Clarification added: "we have calculated the single score (calculated based on EF 3.1 normalization and weighting factors, presented in the Annex V – Normalization and weighting factors)". A new appendix has been added to present the normalization and weighting factors.	OK
TB	12	552	Assumptions and data for LCI modelling		ed	"Emission factors" ->"Impact factors"		Corrected. All other references to "emission factor" in the report have also been changed to "impact factor".	OK
TB	13	559	Assumptions and data for raw materials		ed	"Annex I" -> "Annex II"		Corrected.	OK
TB	14	602	Signature Packaging box		ge	Cotton is no longer modeled from organic cotton		"Organic" mention deleted.	OK
TB	15	704	Assumptions and data for end of life		ed	"Emission factor" ->"Impact factor"		Corrected.	OK
TB	16	708	Assumptions and data for end of life		ed	"Annex I" -> "Annex II"		Corrected.	OK

TB	17	715	Inputs and outputs balance		ge	Annex V is not attached to the report.		We mentioned in the report that what was supposed to be available is in this appendix is finally in the Excel file.	OK
TB	18	728	Comparison of environmental impacts of SP and MP		ge	The results in this section are averages based on potential impacts on different functional units. The average on different UFs seems invalid to me.	Several possible solutions, including: - Use a common UF for all boxes - Normalize the results on the different boxes to present relative results (e.g. (20% reduction of the X indicator between SP and MP)	We use an additional UF which is reduced to dm3 for analyses where we make averages. FU 7. Store products in a 1 dm3 box for 1 year.	OK

1 LCA report content – ISO 14044

		Presence in the LCA report
General aspects		
Sponsor and implementer of the LCA (internal or external)		OK
Report Date		OK
Indication that the study has been carried out in accordance with the requirements of this Internal Standard (ISO 14044)		OK
Objectives of the study		
Reasons for conducting the study		OK
Envisaged applications		OK
Target audience		OK
Whether the study will support comparative claims intended for public disclosure		OK
Scope of the study		
Function, including	Indication of performance characteristics	OK
	Any omission of additional features in comparisons	N/A
Functional Unit, including	Consistency with the objectives and scope of the study	OK
	Definition	OK
	Performance measurement result	N/A
System boundary, including	Omissions of lifecycle steps, processes, or data needs	OK
	Quantification of energy and material inputs and outputs	OK
	Assumptions about electricity production	N/A
Cut-off criteria for the initial introduction of inputs and outputs, including	Description of cut-off criteria and assumption	OK
	Effect of selection on results	N/A
	Inclusion of mass, energy and environmental cut-off criteria	N/A
Life Cycle Inventory		
Data collection methods		OK
Qualitative and quantitative description of elementary processes		OK
Source of published literature		OK
Calculation procedures		OK
Data validation, including	Data quality assessment	OK
	Handling of missing data	OK
Sensitivity analysis for system boundary refinement		N/A
Allocation principles and rules, including	Documentation and justification of the allocation rules	OK
	Uniform application of the allocation rules	OK
Life Cycle Impact Assessment, if applicable		

<table>
<tr><td colspan="2">ACVI Evaluation Procedures, Calculations and Results</td><td>OK</td></tr>
<tr><td colspan="2">Limitations of LCA results in relation to LCA objectives and scope</td><td>OK</td></tr>
<tr><td colspan="2">Relationship between the results of the ACVI and the defined objectives and scope of the study</td><td>OK</td></tr>
<tr><td colspan="2">Relationship between ACVI and LCI outcomes</td><td>OK</td></tr>
<tr><td colspan="2">Impact categories and the categories of indicators considered, including a rationale for their selection and a reference to their source</td><td>OK</td></tr>
<tr><td colspan="2">Descriptions or reference of all characterization models, characterization factors, and methods used, including all assumptions and limitations</td><td>OK</td></tr>
<tr><td colspan="2">Descriptions or references of all value choices used in relation to impact categories, characterization models, characterization factors, standardization, grouping, weighting, and, elsewhere in the IAAC, a rationale for their use and influence on results, conclusions, and recommendations</td><td>N/A</td></tr>
<tr><td colspan="2">An indication that the LCIA results are relative expressions and do not predict effects on final impacts by category, exceedance of thresholds, margins of safety, or risk</td><td>OK</td></tr>
<tr><td rowspan="5">and when included as part of the life cycle assessment</td><td>A description and rationale for the definition and description of any new impact categories, category indicators, or characterization models used for LCIA</td><td>N/A</td></tr>
<tr><td>An indication and rationale for any grouping of impact categories</td><td>N/A</td></tr>
<tr><td>All other methods transforming indicator results and a justification of selected benchmarks, weighting factors, etc.</td><td>OK</td></tr>
<tr><td>Any analysis of indicator results, e.g., sensitivity and uncertainty analyses or the use of environmental data, including implication for outcomes,</td><td>N/A</td></tr>
<tr><td>The data and results of indicators obtained before any standardisation, grouping or weighting operation must be available as well as the standardised, aggregated or weighted results</td><td>N/A</td></tr>
<tr><td colspan="2">Life Cycle Interpretation</td><td></td></tr>
<tr><td colspan="2">Results</td><td>OK</td></tr>
<tr><td colspan="2">Assumptions and limitations associated with the interpretation of the results, in relation to the methodology and data</td><td>OK</td></tr>
<tr><td colspan="2">Data quality assessment</td><td>OK</td></tr>
<tr><td colspan="2">Full transparency in terms of stock choices, justifications and expert assessments</td><td>N/A</td></tr>
<tr><td colspan="2">Critical review, if applicable</td><td></td></tr>
<tr><td colspan="2">Name and affiliation of the actors of the critical review</td><td>OK</td></tr>
<tr><td colspan="2">Critical Review Reports</td><td>OK</td></tr>
<tr><td colspan="2">Responses to recommendations</td><td>OK</td></tr>
</table>

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