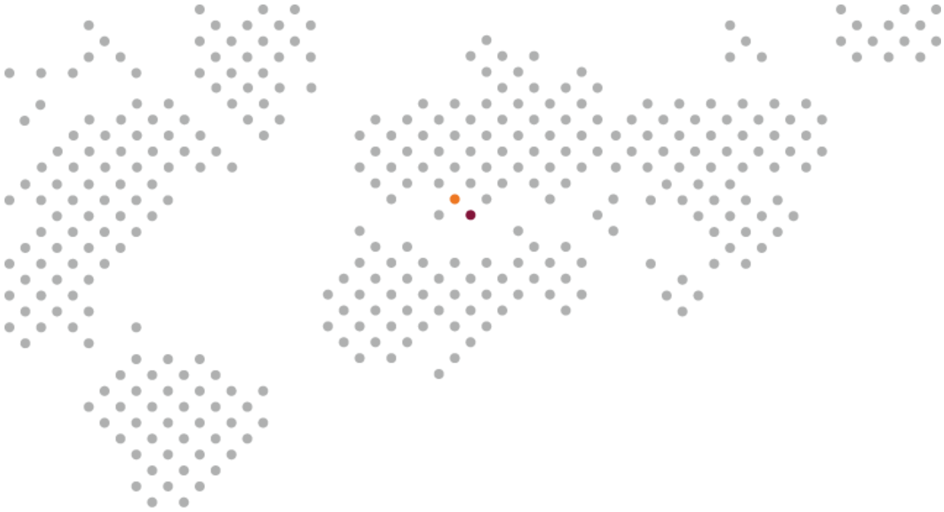

Metal Packaging Europe

STEEL FOR PACKAGING EUROPE

Independent assessment of comparative LCA studies by IFEU and comparative assertions by Tetra Pak between Tetra Pak carton and metal cans for food products

Document type	Report
Version	05
Issue date	04/09/2024
Author STUDIO FIESCHI & SOCI sostenibilità su misura	Studio Fieschi & soci Srl Società con Socio Unico Società soggetta a direzione e coordinamento di Tinexta S.p.A. C.so Vittorio Emanuele II, 18 10123 Torino (TO) – Italia Tel.: +39 011 6599677 Dorsoduro 3441 30123 Venezia (VE) – Italia Tel.: +39 041 8627563 www.studiofieschi.it
References	Marco Chiappero Ugo Pretato
Commissioner Metal Packaging Europe STEEL FOR PACKAGING EUROPE	**Metal Packaging Europe** Avenue des Arts 41, 1040 Brussels, Belgium Home | Metal Packaging Europe +32 (2) 897 04 90 info@metalpackagingeurope.org **Steel For Packaging Europe** Avenue Ariane 5, Building 'Integrale' E3 ground floor, 1200 Brussels, Belgium https://www.steelforpackagingeurope.eu/ +32 (2) 537 91 51 info-(at)-steelforpackagingeurope.eu

TABLE OF CONTENTS

0. Executive summary

There is a growing market focus on the sustainability and circularity of packaging materials. Consumers are bombarded with "green messages" about industries and products, sometimes claiming the environmental superiority of one material over another. These environmental claims are often based on comparative Life Cycle Assessment (LCA) studies, which shall follow strict rules to be transparent, objective and reliable. In January 2024, the European Parliament approved its provisional agreement with the Council on the Green Claims Directive, which introduces specific requirements for environmental claims and amends the Unfair Commercial Practices Directive (Directive 2005/29).

Recently the Tetra Pak company has launched a communication campaign claiming significant reductions of CO_2 emissions in the food and beverage sector compared to alternative packaging materials. Such claims are based on comparative LCA studies carried out by IFEU (www.IFEU.de) and critically reviewed by panels of experts according to ISO 14040-44 standards.

Aiming to obtain an additional third-party opinion on these studies, Metal Packaging Europe (MPE) and Steel For Packaging Europe (SfPE) have asked Studio Fieschi & soci (SF) an independent assessment of the comparative LCA studies and environmental claims by Tetra Pak. With these aims, the assessment involves two scopes:

- Assessment of the comparative LCA studies realized by IFEU;
- Assessment of Tetra Pak communication claims.

The structure of the report reflects the two scopes. First, in Chapter 2, the comparative LCA reports of IFEU in 2017 and 2020 are critically analysed on the basis of ISO 14040-44 standards. Then, in chapter 3, Tetra Pak's environmental communication is assessed and verified against the ISO 14026 for footprint communication and the proposed EU Green Claims Directive. Finally, chapter 4 presents the conclusions.

Regarding the first objective, the comparative LCA studies by IFEU (IFEU, 2017; IFEU, 2020) assess the environmental performance of beverage and food cartons compared to alternative packaging systems and are overall compliant with the requirements of the ISO 14040/44 standards, as confirmed by the two independent Review Panels.

In the IFEU 2017 study, the results show potential lower environmental impacts for food carton compared to the examined steel can in most impact categories, valid within the study framework. In the IFEU 2020 study, for the climate change category, beverage and liquid cartons have lower environmental impacts in almost all segments, whereas for the other impact categories, the comparisons with competing packaging systems are more varied so that no general conclusions can be drawn.

In our opinion there are some relevant limitations on data quality and methodology that could negatively affect the reliability and robustness of comparisons for the analyzed packaging systems. These limitations are mainly related to the time coverage, quality and uncertainty of steel can data, goal and scope, specifications of packaging materials, quality of recycling data for beverage and food cartons, biogenic carbon accounting and impact categories considered. These limitations are detailed as follows.

1. Functional unit and system boundaries. The exclusion of shelf life and food losses from the scope of the analysis appears questionable, considering that primary packages aren't equivalent regarding the mechanical protection of packaged food and that the shelf life of canned food may last up to five years. This limitation should have been mentioned in the study report as it affects the comparability of the analyzed packaging systems. **The properties of metal packaging in terms of content protection are therefore underrated.**

2. Packaging specifications. In the IFEU 2017 study, primary packaging specifications are related to specific products purchased at the point of sale and are obtained by Tetra Pak. In the IFEU 2020 study, the specifications of primary packaging elements are determined by IFEU as "virtual typical packaging systems for Europe". The information available in both reports does not allow for a discussion on the representativeness of competing packaging systems. **In fact, the 400 ml steel cans used in IFEU, 2017 and IFEU, 2020** (57.5 g and 57.0 g, respectively) **are more than 15% heavier than the average weight** (49.8 g in 2013 and 49.6 g in 2018) **of steel cans of comparable size from different EU production sites** (MPE, 2022). The weight of the primary packaging in relation to the weight of the food it contains is a key parameter at all life cycle stages, determining the quantity of raw materials extracted and processed, as well as the quantity of packaging produced, transported, distributed and disposed of/recycled at the EoL. **The associated environmental impacts of steel packaging could be therefore overestimated**.

3. LCI of steel can filling step. In IFEU, 2017 and 2020, the filling step for steel cans is modelled as a proxy using data provided by Tetra Pak specific to carton packaging and referring to 2005 machine consumption, despite significant differences between the two packaging systems in terms of filling speed. **The use of an outdated and unrepresentative proxy for the filling of the steel can is a limitation** of the study which affects the equivalence of the data quality for the analyzed packaging systems. **It may also contribute to an overestimation of the associated environmental impacts of steel packaging**.

4. LCI of steel can converting. In IFEU, 2017 and 2020, the production of steel cans from tinplate is modelled on the basis of old literature data referred to 1996 in both studies (BUWAL 1999). **The use of outdated data is a limitation of the study which may overestimate the impacts of metal packaging and affect the comparability of the analyzed packaging systems**.

5. LCI of End-of-life – EoL. In IFEU 2017 and 2020, the collection and recovery rates used to model the EoL of beverage and liquid cartons are overestimated compared to more recent data from the same references (i.e. ACE), due to the use of the new EU methodology in the more recent statistics (Commission Decision 2019/665/EC). This results in higher credits from recycling and lower burdens from recycling and disposal in different impact categories, hence in a potential **underestimation of the environmental impacts of the cartons**. Therefore, the availability of significantly different, updated recycling rate data limits the time validity of the LCI of End-of-Life (EoL) for beverage and food cartons.

6. Life Cycle Impact Assessment (LCIA) - the UBA methodology used in both studies is sufficiently robust and comprehensive, covering many impact categories in line with ISO 14040/44 standards, with two exceptions. In IFEU 2017 study, the 'use of nature' category is excluded from the comparison of competing packaging systems due to data gaps. This is a relevant impact category for food cartons sourced from forests, so **the overall environmental impact of Tetra Recart may be incomplete and underestimated in the comparisons**. In IFEU 2017 and 2020, the "Water use" indicator is quantified but not considered for comparisons between packaging systems, justified by the lack of data and required information. The exclusion of these indicators represents another limitation of the study, since they are both relevant in paper production systems and therefore **potentially affecting the comparison** with metal packaging materials.

7. Biogenic carbon modelling. biogenic carbon is considered at two points for bio-based materials, CO_2 uptake during plant growth and re-emission of CO_2 at the EoL, where CO_2 uptake is not included in the credits (secondary bio-based raw materials). **This assumption has a significant impact on the reduction of climate change impacts of carton packaging** and should have been taken into account when interpreting the results.

In summary, the results of the studies in both IFEU 2017 and IFEU 2020 **are only valid in the specific context** of the systems analysed and the packaging solutions compared, which in case of the **steel and aluminium cans are quite generic and do not necessarily correspond to**

specific products on the market. As such and according to ISO standards 14040/44, **the results cannot be extended to situations or packaging solutions other than those considered in the studies**. A variation in some key parameters, assumptions and background data of the studies would probably lead to different results and possibly changing the general outcomes of the comparisons.

Regarding the four comparative environmental claims by Tetra Pak showing a specified reduction in CO_2 emissions between a specific food carton by Tetra Pak (i.e. Tetra Recart) and generic competing steel cans for different food products, all the claims report the comparative assertions, together with some explanatory statements and a reference to the comparative LCA studies available on Tetra Pak website. However, there are some important items that make the communication not completely compliant with the ISO standard 14026 and the EU proposal for Geen Claims Directive, and to some extent incorrect and potentially misleading to consumers.

1. **Arbitrary extension of the specific LCA results to a general comparison valid in all circumstances**

The comparison between Tetra Recart and a generic steel can is partly outside the scope of the LCA reference studies (IFEU, 2017; IFEU, 2020. Supplement for Italy) and may therefore be misinterpreted by the reader. The results of the LCA studies refer to specific filling products and packaging systems with a defined filling volume and weight specifications. Therefore, the LCA results cannot be extrapolated to packaging with other specifications outside the geographical boundaries and the reference year.

2. **Inequivalent information and data quality for steel can and Tetra Recart**

The information and data used to assess the environmental impact of steel cans and Tetra Recart are not fully equivalent (see Article 4(1) letter a) and b), Green Claims Directive proposal). Tetra Recart, modelled with specific, mainly primary and mainly updated data, is compared to steel can, modelled with generic, secondary and often older data (e.g. old data in the LCI for tinplate converting and proxy data for steel can filling).

3. **Incomplete communication of the comparative explicit environmental claims**

There is no summary of the assessment that is clear and understandable to the consumers targeted by the claim, except for the introductory sections of IFEU, 2017 and IFEU, 2020, which are not clear to the general public.

4. **Incomplete presentation of environmental properties**

The statement “recyclable” in claim 2, which refers only to Tetra Pak, is misleading for a reader who is led to attribute this property only to the Tetra Recart packaging system. Furthermore, this additional claim is not supported by any study (see claim 2 in Figure 2).

5. **Incorrect association of background images**

Furthermore, " words, numbers or graphics used for other purposes shall not be used in a manner that is likely to be misunderstood as being part of that footprint communication" (cf. section 6.5, ISO 14026). In claim 2 (see Figure 2), a real steel can and a Tetra Recart package are included in the ad with their CO_{2e} emissions as captions. In addition, the generic background images of the "emitting industry" and the "cultivated field", which refer to the steel can and Tetra Recart respectively, could easily be misunderstood as part of the comparative environmental claim (i.e. footprint communication). Therefore, the generic images are misleading for the consumer.

1. Introduction

Metal Packaging Europe (MPE) represents manufacturers, suppliers, and national associations of Europe's rigid metal packaging industry. MPE serves as the industry's collective voice, advocating for the positive image of metal packaging trough marketing, environmental and technical initiatives, so that stakeholders understand the contribute of metal packaging on the Circular Economy.

Founded in 1986, Steel For Packaging Europe (SfPE) is the association of European producers of steel for packaging, aiming to contribute positively on EU policy related to steel for packaging, particularly concerning the End-of-Life (EoL), and to monitor technical developments to ensure industry compliance.

There is a growing market focus on the sustainability and circularity of packaging materials. Consumers are bombarded with "green messages" about industries and products, sometimes claiming the environmental superiority of one material over another. These environmental claims are often based on comparative Life Cycle Assessment (LCA) studies, which shall follow strict rules to be transparent, objective and reliable. In January 2024, the European Parliament approved its provisional agreement with the Council on the Green Claims Directive, which introduces specific requirements for environmental claims and amends the Unfair Commercial Practices Directive (Directive 2005/29).

Recently the Tetra Pak company has launched a communication campaign claiming significant reductions of CO_2 emissions in the food and beverage sector compared to alternative packaging materials. Such claims are based on comparative LCA studies carried out by IFEU (www.IFEU.de) and critically reviewed by panels of experts according to ISO 14040-44 standards. The study reports are publicly available at this link.

Aiming to obtain an additional third-party opinion on these studies, MPE and SfPE have asked Studio Fieschi & soci (SF) an independent assessment of the comparative LCA studies and environmental claims by Tetra Pak. With these aims, the assessment involves two scopes:

- Assessment of the comparative LCA studies realized by IFEU;
- Assessment of Tetra Pak communication claims.

The structure of the report reflects the two scopes. First, in Chapter 2, the comparative LCA reports of IFEU in 2017 and 2020 are critically analysed on the basis of ISO 14040-44 standards. Then, in chapter 3, Tetra Pak's environmental communication is assessed and verified against the ISO 14026 for footprint communication and the proposed EU Green Claims Directive. Finally, chapter 4 presents the conclusions.

2. Assessment of the original comparative LCA studies

2.1 Approach

The comparative LCA studies assessed in this report are the following ones, which are publicly available on Tetra Pak's website (link):

- IFEU, 2017. Comparative Life Cycle Assessment of shelf stable canned food packaging, Final Report. Heidelberg, December 2017.
- IFEU, 2020. Comparative Life Cycle Assessment of Tetra Pak® carton packages and alternative packaging systems for beverages and liquid food on the European market. Final report. Heidelberg, March 9, 2020 (extended version with further specific supplements for selected EU countries).

In the following, these reports will be referred to as "IFEU, 2017" and "IFEU, 2020". Where reference is made to a specific supplementary study, this is referred to as "IFEU, 2020. Supplement for Country name". Other LCA studies carried out for other sectors than food packaging are excluded from the assessment.

The assessment is based on a list of resources, including documents publicly available on the Tetra Pak and ACE (The Alliance for Beverage Cartons and the Environment) Association websites, materials produced by MPE and SfPE, and other documents from industry associations, companies and research institutes.

The reference standards for this assessment include:

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

The IFEU, 2017 and IFEU, 2020 studies are assessed below. The full report is considered, including the dedicated independent review panel assessment. In each case, an overview of the LCA study is presented first, summarising the main aspects of the objective and scope, life cycle inventory, life cycle impact assessment and results. Based on the overview, the results of the assessment are presented, divided into general comments and specific comments. **The assessment is limited to the information presented in the available IFEU reports**. A thorough review of life cycle inventory data and model was not possible since we did not have access to the IFEU software and internal database.

2.2 Comparative LCA of Tetra Recart and steel can packages for food (IFEU, 2017)

2.2.1 Overview of the LCA study

The 2017 IFEU study “Comparative life cycle assessment of shelf stable canned food packaging” compares the environmental performance of alternative packaging systems for sterilized canned tomatoes, being food carton Tetra Recart, glass jars and steel cans. The study covers Germany, Italy and EU28+2 markets in 2016.

Within the study framework, the Tetra Recart food carton shows a potentially lower life cycle impact compared to glass jars and steel cans in both the base and sensitivity scenarios, except for the categories Aquatic Eutrophication and Ozone Depletion. This is mainly due to the lightweight design of Tetra Recart, influencing the environmental profile of both the production phase of the primary packaging and the distribution phase of the packaged food.

The critical review panel is composed by three independent experts, being Manfred Russ (thinkstep AG, Germany), Gian Luca Baldo (LCE Srl, Italy), Leigh Holloway (eco^3 Design Ltd, UK). The critical review panel concluded that the LCA study is consistent with ISO14040/44 standards.

2.2.1.1 Goal and Scope

The LCA study commissioned by Recart AB aims to evaluate the environmental performance of Tetra Recart retortable cartons for sterilized food compared to steel cans and glass jars. The focus is on German and Italian markets, and the study aims to provide quantitative data intended for external communication by Tetra Pak.

The primary function is the packaging of retorted food for retail. Therefore, the functional unit is defined as the provision of 1000 L of packed food to the point of sale. The reference flow is the actual filled volume of packaging, encompassing all container elements and transport packaging elements required for the packaging, filling, and delivery of 1000 L of food.

The study adopts a cradle-to-grave LCA approach, with certain life cycle phases excluded. Excluded phases are the production, transport to fillers, and distribution of food. Additionally, losses of food at various points in the supply and consumption chain, the shelf life of filled packages, and the consumer use phase of packages are excluded from the analysis. The study assumes technical equivalence in the primary packaging systems for mechanical food protection, ensuring a sufficiently long shelf life to prevent losses from discarded filled packages.

The packaging systems consist of primary (food package), secondary (e.g. tray), and tertiary (e.g. pallet) packaging elements. The specifications of primary packages refer to specific products at the point of sale with a capacity of around 400 g of canned tomatoes.

The geographical coverage is focused on the production, distribution, and disposal of packaging systems in Germany, Italy, and the EU-28+2 region. A portion of the raw materials production occurs in specific European Countries. The reference year for comparing the packaging systems is 2016.

For each of the studied packaging systems, a base scenario was defined for the German and Italian markets, applying an allocation factor of 50% for open-loop recycling at End-of-Life (EoL). This factor defines how the environmental burdens and benefits of recycling steps are allocated between the product system under consideration, i.e. the steel can or Tetra Recart (primary product), and the subsequent product system, e.g. a product made from recycled material from the previous steel can/Tetra Recart packaging (secondary product). Therefore, in a 50% method, the burdens of the material production of the primary product and the benefits of its recovery at the EoL, are allocated equally to the primary and secondary products. The EoL allocation factors are defined on a mass basis.

For recycling, a substitution factor was defined to take into account the "down-cycling" effect, i.e. a recycling process in which a recycled material is converted into secondary materials of lower quality. For steel cans, the substitution factor is set at 1, while for paper fibres of Tetra Recart it is set at 0.9 (i.e. 90% of the recycled paper can be used to produce beverage/food cartons).

Additionally, a sensitivity analysis scenario was considered, employing a 100% EoL allocation method. In a 100% EoL allocation method, 100% of the burdens of the material production of the primary product and the benefits of its recovery at the EoL are allocated to the primary product,. Furthermore, a separate sensitivity analysis was conducted, varying the recycling rate in the EU-28+2 region while using the 50% allocation method.

2.2.1.2 Life Cycle Inventory

Overall, the majority of inventory data are collected from Tetra Pak, industry associations and literature, with background data primarily sourced from the IFEU internal database. Datasets refer to specific countries or the European Union. Most data cover the years between 2004 and 2016, except for steel can production referring to 1996 (BUWAL, 1998).

Specifications of primary, secondary and tertiary packaging elements were determined by Tetra Pak in 2016**. Primary packaging specifications for glass jars and steel cans were derived from specific products purchased at the point of sale.**

Distances and transportation modes regarding base materials and packaging were obtained from producers or through expert judgements. The distribution of filled packs trip to the point-of-sale was modeled as a two-stage delivery transport, including the return trip: first to a central warehouse and then to the supermarket.

Concerning EoL, distinct scenarios were designed for material and/or energy recovery, and disposal processes specific for each packaging system and market. Collection and recycling rates were primarily sourced from published statistics and from Tetra Pak. In each market, specific proportions for landfilling and incineration were established. For Tetra Recart, the carton fraction underwent open-loop material recycling with an allocation factor of 0.9. This means that the recycled carton is not used to make Tetra Recart again, but is used to make other carton products (open loop) where 90% is food/beverage carton and 10% is lower quality carton. Glass jars and steel cans followed a combination of closed-loop and open-loop recycling, with a substitution factor of 1.0 for both. Therefore, some of the recycled steel is used to make the steel cans (closed-loop) and some is used in other products (open-loop) where the 100% recycled material maintains the original quality.

Regarding background data, energy generation, transport, incineration and landfill were derived from IFEU's internal database. Country specific grid electricity mix were derived from IFEU database, referring to 2012 based on IEA electricity mix statistics. Landfills were modelled based on specific assumptions, such as 50 % of the methane generated being recovered through gas capture systems involving energy conversion and flare processes.

2.2.1.3 Life Cycle Impact Assessment

A set of midpoint impact categories was defined based on the German Federal Environment Agency (UBA) approach of 2016. The list includes: Climate Change, Stratospheric Ozone Depletion, Photo-Oxidant Formation, Acidification, Terrestrial and Aquatic Eutrophication, Particulate Matter, Use of Nature and Raw materials. **Due to data gaps, the results of the use of the Nature Impact category are shown in the base scenario, but are not used to compare packaging systems.**

Additionally, Water use and Primary energy consumption were added at the inventory level, however, the quantified values for Water Use were not considered for comparisons between packaging systems, due to the lack of data and required information (e.g. freshwater origin and wastewater quality).

For each impact category, the results are presented as «Environmental burdens» (i.e. potential impacts to the environment), «Credits» (i.e. potential benefits to the environment), and «Net results» (i.e. impacts minus credits).

Biogenic carbon was incorporated at two points in the model: during the plant growth phase for CO_2 uptake (potential benefit) and at the EoL for CO_2 re-emissions (potential impact) with a 50% allocation assumed.

A quantitative uncertainty analysis was not conducted, despite requested by ISO 14044 (cf. par 4.4.5 and par. 5.3.1, ISO 14044), because of the difficulty and limited validity of the statistical methods applied to the datasets and LCA results. An assumed significance threshold of 10 % between mean differences was applied. Sensitivity analyses were performed on the open-loop recycling allocation factor and recycling rates.

2.2.1.4 Interpretation and Conclusions

The main conclusions of the study are as follows:

- Tetra Recart demonstrates superior environmental performance compared to glass jars and steel cans in both base scenarios (50% allocation factor) and analyzed sensitivity scenarios, except for Aquatic Eutrophication and Ozone Depletion. The lightweight design of Tetra Recart and the low environmental impact of the base material, light paperboard (LPB), made from renewable materials and produced with renewable energy, contribute to significant differences with steel cans. The energy-intensive production of tinplate for the body and closure of steel cans significantly contributes to their environmental impact.

- For most environmental impact indicators, the results for Tetra Recart are primarily associated with the production of primary packaging base materials, where plastic and aluminum have notable impacts. EoL processes for food cartons contribute significantly to the Climate Change category, and the Use of Nature category is dominated by the production of light paperboard (LPB). Energy recovery from non-collected packaging at EoL plays a major role in generating credits for the food carton.

- The environmental impact results for steel cans are predominantly influenced by the production of tinplate for all indicators except Use of Nature. In addition to tinplate production, the can manufacturing step significantly contributes to Ozone Depletion and Aquatic Eutrophication. Distribution of steel cans has a relevant impact in some categories. Material recycling contributes the most credits for the steel can.

Concerning the limitations of the study:

- The results obtained from the analyzed packaging systems and the subsequent comparisons are applicable exclusively within the study's framework. Specifically, these findings are solely valid for canned tomatoes as the filling product. Additionally, the validity of the results is confined to the reference year 2016 and the specified geographic regions of Germany, Italy, and EU28+2. **Extrapolating the study results to packages with different filling volumes and weight specifications is not allowed** as specified by the authors.

2.2.2 Critical review

According to the Critical Review Panel Report, the comparative LCA study by IFEU in 2017 is compliant with the requirements of the ISO 14040/44 standards. The critical review confirms that data sources and life cycle models are enough robust, and that the assumptions, methods and results are exposed transparently and appropriately to inform customers and other stakeholders of the commissioner (cf. Review Statement, IFEU 2017). However, as underlying by the authors of the study, it is important to note that the results for each packaging system and the comparisons among packaging systems are exclusively valid within the framework defined in Section 1 and 2 of IFEU 2017 study, as clearly punctuated in a separate chapter (cf. Section 8, IFEU 2017). Overall, the LCA framework and the limitations of the study are described in sufficient detail and in a transparent manner in the report.

In our opinion, although the comparative LCA study is formally correct according to ISO 14040/44, there are some specific limitations and assumptions that could negatively affect the reliability and robustness of comparisons for the analyzed packaging systems. These limitations are mainly related to the time coverage, quality, and uncertainty of steel can data, goal and scope, quality of EoL recycling data of Tetra Recart, specifications of packaging materials, and biogenic carbon accounting. These limitations are detailed as follows.

Goal and Scope. Regarding the definition of the functional unit, some assumptions are as follows (par. 1.4 Functional Unit, IFEU 2017):

- *“The packaging used is suitable for the required shelf life of the product. The maximum shelf life of all regarded packaging systems is long enough that no losses are to be expected because of discarded filled packages. This means, that the products would be used up, before the lowest shelf life of any packaging is reached.”*

- *“The primary packages examined are assumed to be technically equivalent regarding the mechanical protection of the packaged food during transport, the storage at the point-of-sale and the use phase”.*

Based on these assumptions, some steps and aspects have been excluded from the system boundaries, in particular:

- Losses of food at different points in the supply and consumption chain, such as during filling process, handling and storage, etc. as they are considered to be approximately the same for all the examined packaging systems considered.
- Shelf life of the filled packaging system.
- Use phase of packaging at the consumer.

The exclusion of the shelf life of the filled packaging system and the losses of food along the supply chain is justified by IFEU due to the lack of data and the uncertainty. **However, it is a limitation of the LCA study that should have been mentioned, considering that primary packages aren’t equivalent regarding the mechanical protection of packaged food and the shelf life of canned food may last up to five years.** The exclusion of the shelf life may therefore contribute to an overestimation of the associated environmental impacts of steel packaging.

The shelf life of packed tomatoes may vary depending on the packaging type. Steel cans effectively isolate food from sunlight and oxygen, therefore have a longer shelf life ranging from 2 to 5 years for low-acid foods (e.g. vegetables) and up to 18 months for high-acid foods such as tomatoes (USDA, 2023). While alternative containers are reported to provide 12 months of shelf-life (Sivertsvik, 2021) and food carton packages up to 24 months at ambient temperature and depending on the food (Tetra Pak a).

Food carton and steel cans do not provide equivalent food mechanical protection during the supply chain. Steel cans are impact-resistant and puncture-resistant, reducing the risk of food losses during transportation and other life cycle phases. Further, steel cans are reported to resist high axial loads, up to 10 times higher than for beverage cartons (APEAL, 2018).

Packaging specifications (cf. Section 2.2, IFEU 2017). The authors of the LCA study clearly stated that “*It is not possible to transfer the results of this study to packages with other filling volumes or weight specifications.*” (cf. Section 8, IFEU 2017). This is particularly true given the significant variation in packaging sizes. While the size of Tetra Recart is between 100 and 500 ml (Tetra Pak c), the capacity of steel cans varies significantly, typically from 250 g to 5000 g. Interestingly, there is only a partial overlap between the two size ranges. Further, the specifications of primary packaging are related to specific products purchased at the point of sale. Finally, the methodology for determining the specifications for secondary and tertiary packaging is not specified in the LCA report.

A sensitivity analysis regarding primary packaging specifications is not provided, and a comparison with the specifications of other products of equivalent filling volume is not shown, despite it is mentioned in the study report. **The specifications of the steel can vary between different EU producers**, as shown Table 1, **where the 400 ml steel can (57.5 g) used in IFEU, 2017 is more than 15% heavier than the average weight (49.8 g in 2013 and 49.6 g in 2018) of steel cans of comparable size from different EU production sites** (MPE, 2022). As underlined by the authors “*To some extent, there may be a certain variation of design (i.e. specifications) within a specific packaging system. Packaging specifications different from the ones used in this study cannot be compared directly with the results of this study.*” (cf. Section 8, IFEU 2017).

It is important to note that the weight of the primary packaging in relation to the weight of the food it contains is a key parameter at all life cycle stages, determining the quantity of raw materials extracted and processed, as well as the quantity of packaging produced, transported, distributed and disposed of/recycled at the EoL, and thus influencing the associated environmental impacts. Therefore, the comparison between the steel can and the Tetra Recart is only valid in the context of the IFEU, 2017 study and cannot be extended, for examples, to a generic food steel can vs food Tetra Recart.

Table 1. Comparison of steel can primary packaging specifications from different references.

Parameter	Unit of measure	IFEU, 2017		MPE, 2022	MPE, 2022
Reference year	Year	2016	2016	2018	2013
Geographical location		Italy	Germany	EU	EU
Reference product		Specific product at the point of sale		Average of multiple EU production sites (MPE members)	Average of multiple EU production sites (MPE members)
Food content		Canned tomatoes	Canned tomatoes	n.a.	n.a.
Volume	ml	390 (of contained food)	403 (of contained food)	425 (nominal volume of food)	425 (nominal volume of food)
Mass of contained food	g	381	409	n.a.	n.a.
Tinplate body (botton end + body)	g	50.5	50.5	38.6	n.a.
Tinplate closure (top end)	g	7.0	7.0	11.0	n.a.
Steel can (sum of body and closure)	**g**	**57.5**	**57.5**	**49.6**	**49.8**
Lid (paper)	g	2.0	2.0	n.a.	n.a.
Primary packaging (sum of steel can and lid)	g	59.5	59.5	n.a.	n.a.
Reference		Table 6, IFEU, 2017	Table 5, IFEU, 2017	Table 15, MPE, 2022.	Table 4, MPE, 2022 (executive summary)

Filling step (cf. Section 3.8 Filling, IFEU 2017). For the filling step of food packaging, form, fill and seal data were provided by Tetra Pak for all packaging systems, based on machine consumption data specifications from 2005, assuming the Tetra Recart filling process as a proxy for glass jars and steel cans. However, manufacturers and industry associations report significantly different speeds for filling machines for steel cans and Tetra Recart: up to 500 steel cans per minute or 30,000 per hour (related to 500 g food cans) (APEAL, 2018) compared to up to 6,000 packages per hour for Tetra Recart (100-500 ml capacity) (Tetra Pak b). Specific machine specifications are often available in manufacturers' technical data sheets. The higher filling efficiency of steel cans would significantly reduce the energy consumption per functional unit compared to the proxy inventory, which may therefore overestimate the associated environmental impacts in the energy-related impact categories. Therefore, using the Tetra Recart filling as a proxy for the steel can is a limitation of the LCI of the steel can and may overestimate the associated environmental impacts of steel packaging.

Converting of tinplate can (cf. Section 3.7.3, IFEU 2017). While the Tetra Recart conversion LCI is based on primary data and refers to 2016, **the production of tinplate food cans is modelled using secondary literature data from 1996, 20 years before the reference year of the study**, with background datasets updated using data from the IFEU internal database and referring to 2008 (cf. Table 9, IFEU 2017). In the base scenario, for steel cans, the "converting" step has a significant impact on the overall environmental burden in the “ozone depletion potential” category in Italy (cf. Table 20, IFEU 2017), and in Germany for “ozone depletion potential” and “aquatic eutrophication” (cf. Table 14, IFEU 2017). The report states that “*According to APEAL [APEAL 2008], the BUWAL converting process dataset is the only available food can converting dataset for the time being*”. However, a LCA of steel food can has been developed by The European Metal Packaging Association (EMPAC) and has been publicly available since 2013 (Packaging Today, 2013).

According to ISO 14044 standard (cf. 4.2.3.7 Comparisons between systems), in a comparative study “*Systems shall be compared using the same functional unit and equivalent methodological considerations, such as performance, system boundary, data quality, allocation procedures, decision rules on evaluating inputs, and outputs and impact assessment. Any differences between systems regarding these parameters shall be identified and reported.”* In the IFEU 2017 study (see 4.1.5 Data quality assessment), the use of data between 8 and 12 years old is considered valid for the time frame of the study for data on processing steps, e.g. converting and filling, as the technologies used for the production steps would not have changed during this period, however this was not demonstrated.

The equivalence of the data quality (time coverage) used to model the converting/production step of the two packaging systems must be questioned, as an improvement in the efficiency and speed of steel can production (e.g. introduction of highly automated and robotic machinery for cutting, forming, palletizing and rinsing steps) and a reduction in the associated environmental impacts are expected in 20 years' time. For instance, according to a cradle-to-grave LCA commissioned by MPE (MPE, 2022), between 2000 and 2018, the overall impact of a steel food can (425 ml) on the climate change impact category has been reduced by more than 30% (MPE, 2022), with most of the impact due to the raw material, followed by can manufacturing.

Overall, there is a lack of discussion on the equivalence of data quality for the steel can and the Tetra Recart, in particular for the filling step (unrepresentative proxy data for the steel can vs. primary data for the Tetra Recart) and the conversion step (different time coverage, 1996 for the steel can vs. 2016 for the Tetra Recart).

End-of-life – EoL (cf. Section 2.3, IFEU 2017). The collection and recovery rates used to model the EoL of Tetra Recart and steel cans packaging are derived from statistics provided by industry associations (e.g. APEAL for steel cans and ACE for Tetra Recart in the EU, RiCrea for steel cans in Italy), national authorities (UBA for steel cans and Tetra Recart in Germany), Tetra Pak (Tetra Recart in Italy) and are partly based on assumptions (e.g. the amount of sorted residues used to determine recycling rates from collection rates if not available in the statistics).

For instance, considering the Tetra Recart EoL in Germany (cf. Fig. 8, IFEU 2017), starting from the 100 % of food carton put on the market, the authors assumed an approx. 10 % of sorting residues to derive the recovery rate (76.8%) from the known collection rate (85.3 %). Out of the recovery rate of 76.8%, 53 % are recycled as paper fibres ready as secondary raw materials (assuming no paper losses in paper recycling) and 23.8 % is PE/Al fraction. This recycling rate of paper fibres (53.0%), related to the year 2014, seems reasonable but is slightly higher than an independent estimate by Eunomia and Zero Waste Europe (Eunomia, 2020). The Eunomia study estimated a recycling rate of 47.8% as paper fibres (entering the recycling facility), but only the 38.7% recycled paper material as secondary raw material (leaving the recycling facility), based on a collection rate of 87.4% for beverage and food cartons in Germany in 2019, using the new EU methodology of Commission Decision 2005/270/EC, as amended by Commission Decision 2019/665/EC. This estimate assumes a sorting rejection rate of 11.2 %, a paper recycling loss rate of 20 % (data from Deutsche Umwelthilfe - DUH), contamination of collected cartons with foreign materials (12.5 %) and dirt (17 %), and a paper content of 70 % in carton packs. Despite the different reference year (2014 vs 2019) the collection rates are comparable (85.3% vs 87.4%), however the resulting recycling rates of paper fibres are quite different (53.0% vs 38.7%) due to the different loss rate assumption for the recycling facility and level of contamination, which are underestimated in the IFEU study (see the related comment referring to IFEU, 2020 in section 2.3.2).

Despite the significant uncertainty regarding the amount of recycled paper from Tetra Recart at the EoL, and given the relevance of the recycling rate parameter, in IFEU, 2017, a sensitivity analysis was performed only on the recycling rates for steel cans and glass jars, but not for Tetra Recart. This is even more outstanding considering that in the base scenario the recycling and disposal step has a relevant impact only for Tetra Recart in the “Climate Change” category, an impact that is more significant in Italy (28% of the environmental impacts, cf. Table 20 IFEU 2017) than in Germany (17%, cf. Table 14 IFEU 2017), probably due to the lower recycling rate in Italy. Therefore, a sensitivity analysis of the recycling rate of food cartons should have also been included, as for other competing packaging, as this step is significant for Tetra Recart packaging system in a key category such as "climate change".

LCIA - Use of nature (Section 1.8.1, IFEU 2017). The Use of Nature category within the UBA methodology is related to land use and biodiversity. However, this category is quantified but not used for comparisons between competing packaging systems due to data gaps at the time of the LCA study. This is one of the main limitations of the LCA study given the relevance of the land use impact category for a bio-based material such as food cartons, so the overall environmental impact of Tetra Recart may be incomplete and underestimated in the comparisons. In fact, in the baseline scenarios, Tetra Recart shows high environmental impacts in the category "Use of nature", dominated by the step "LPB production" in both Germany (cf. section 4.1.1, IFEU 2017) and Italy (cf. section 5.1.1, IFEU 2017).

LCIA - Biogenic carbon (Section 1.8.1 and Appendix A, IFEU 2017). Biogenic carbon refers to carbon stored in biomass and bio-based materials, such as food cartons from sustainably managed forests. This carbon is removed from the atmosphere by photosynthesis during biomass growth and stored in chemicals until it is released back into the atmosphere as CO_2 and CH_4 during its transformation or degradation (e.g. combustion, anaerobic digestion, landfilling, etc.). There are two approaches to include biogenic carbon flows in an LCA: the 0/0 approach, i.e. to ignore biogenic carbon dioxide flows, or the -1/+1 approach, i.e. to include biogenic carbon dioxide flows respectively for both uptake and release, where ISO14040/44 standards do not recommend a specific methodology.

In IFEU, 2017, biogenic carbon is accounted for in two points in the model: its uptake through plant growth and its release at EoL of biogenic materials during landfilling and incineration. Therefore, in the results section of the category "Climate change", the item "CO_2 uptake" is reported on the credit side, while the item "CO_2 reg. (EoL)" is reported on the environmental impact side and includes the CO_2 emissions from the combustion of biobased and renewable materials.

Together with the allocation factor for the EoL, 50% or 100% allocation, this leads to different net results in the Climate Change category, with **additional benefits in the Climate Change category for the producer of the primary biogenic material** (see Table 2). **Although this choice is compliant with ISO 14040/44 standards, it does have a significant impact on the**

net results of Tetra Recart in the Climate Change category, determined by both biogenic and fossil carbon flows, and should be clearly stated when presenting the net results to avoid any misinterpretation.

In fact, in the base scenario with 50% allocation to the EoL, the amount of CO_2 sequestered by the trees harvested for paper production is re-emitted during the incineration and landfilling of paper at the EoL (term CO_2 reg.), but only the 50% of the emissions from incineration and landfilling are allocated to the product system under study. **The "net results", determined by both fossil and biogenic emissions, receive a significant benefit** from the balance of biogenic CO_2 (CO_2 uptake + CO_2 reg), which represents the 37% and the 31% of the net results in Germany and Italy, respectively. Conversely, in the sensitivity scenario with 100% allocation at the EoL, 100% of the emissions from incineration and landfilling are attributed to the system, with a smaller benefit for the system compared to the 50% EoL scenario. In this case, the terms 'CO_2 uptake' and 'CO_2 reg.' are balanced in the case of Germany (0 $kgCO_{2e}$/1000 L), where 100% of waste for disposal is incinerated, but not in the case of Italy (- 20 $kgCO_{2e}$/1000 L), probably due to the different proportions of waste to landfill (58% in Italy and 0% in Germany) and incineration (42% in Italy and 100% in Germany).

Table 2. LCA results regarding "Climate Change" category (kg CO_{2-e}/1000 L) per each Tetra Recart in Germany and Italy, for 50% and 100% allocation methods, as reported in IFEU 2017 LCA study; where "CO_2 reg. (EoL)" are CO_2 emissions from incineration of plant-based and renewable materials at the EoL and "CO_2 uptake" is the uptake of CO_2 during the plant growth phase. In addition, for both allocation methods, the balance of positive and negative emissions is provided as fossil net results (Burdens + Credits), biogenic net results (CO_2 reg. + CO_2 uptake), and total net results (sum of fossil and biogenic net results, i.e. the net results shown in IFEU, 2017).

Segment	Member State	Climate change [kg CO_{2-e}/1000 L]													
		50 % allocation							100 % allocation						
		Positive and negative emissions				Balance			Positive and negative emissions				Balance		
		Burdens	CO_2 reg. (EoL)	Credits	CO_2 uptake	Total - Net results	Fossil - Net results	Biogenic – Net results	Burdens	CO_2 reg. (EoL)	Credits	CO_2 uptake	Total - Net results	Fossil - Net results	Biogenic – Net results
Tetra Recart	Germany	139.09	25.86	-43.24	-51.72	70	95.85	-25.86	163.51	51.72	-95.97	-51.72	50.24	67.54	0
	Italy	158.99	15.95	-8.15	-51.72	115.07	150.84	-35.77	180.23	31.32	-15.94	-51.72	143.89	164.29	-20.4

2.3 Comparative Life Cycle Assessment of Tetra Pak® carton packages and alternative packaging systems for beverages and liquid food on the European market (IFEU, 2020)

2.3.1 Overview of the LCA study

The 2020 IFEU study "Comparative Life Cycle Assessment of Tetra Pak® carton packages and alternative packaging systems for beverages and liquid food on the European market" compares the environmental performance of alternative packaging systems for beverages, liquid products and food. This study is an update and extension compared to the previous study (IFEU, 2017), including more beverage and food segments and more competing packaging. The IFEU 2020 study is designed as a baseline study for the EU market, with additional country-specific supplemental studies focusing only on the climate change category (e.g. IFEU 2020. Supplement for Italy).

The study covers carton packages and competing packages in different beverage segments in the European market in 2019. The study was conducted in accordance with ISO 14040/44 standards and subjected to a critical review process.

Alternative packaging systems showed higher environmental burdens due to the production of their base materials like plastics, glass, aluminum, or steel. Beverage and liquid food cartons showed lower environmental impacts than their compared packaging systems in almost all segments regarding 'Climate Change'. For beverage and liquid food cartons, liquid packaging board (LPB) does not contribute significantly to the environmental impacts, due to renewable energy use in its production. The use of plant-based polyethylene instead of fossil-based polyethylene led to lower 'Climate Change' results, but increased environmental impacts in all other considered categories.

The critical review panel is composed by three independent experts, being Prof. Dr. Birgit Grahl (INTEGRAHL, Germany), Dr. Alessandra Zamagni (Ecoinnovazione srl, Italy), Dr. Leigh Holloway (eco³ Design Ltd, UK). The critical review panel concluded that the LCA study is consistent with ISO14040/44 standards.

2.3.1.1 Goal and Scope

The LCA study by IFEU commissioned by Tetra Pak aims to evaluate the environmental performance of key Tetra Pak's carton packages and competing packages in different liquid and beverage segments covering the European market. The study aims to provide quantitative data intended for external communication by Tetra Pak.

Competing packaging systems include PET bottles, HDPE bottles, stand up pouches (SUP), single use glass bottles, aluminium cans, steel cans, single use glass jars. All packaging systems are divided into "Family packs" (FP) with volumes 1000-2000 ml and "portion packs" (PP) with volumes 200-500 ml.

The study considers different beverage and food segments chilled or at ambient temperature, being: dairy products or coffee drinks (chilled and ambient FP of 1000 ml, chilled PP of 200 ml); juice, nectars and still drinks JNSD (ambient FP of 1000 ml, ambient PP 200-250 ml); still, unflavored water (ambient PP of 500 ml); tomato sauce (ambient PP of 390 ml).

The primary function is "the packaging of beverages or liquid food for retail". Therefore, the functional unit is defined as "the provision of 1000 L packaging volume for chilled or ambient beverage or liquid food at the point of sale". The reference flow is the actual filled volume of packaging, encompassing all container elements and transport packaging elements required for the packaging, filling, and delivery of 1000 L of beverage or liquid food.

The study is a cradle-to-grave LCA without the use phase. Excluded phases are the life cycle of infrastructures, as well as the production, transport to fillers, and distribution of beverage and liquid food. Further, losses of food at various points in the supply and consumption chain, the shelf life of filled packages, and the consumer use phase of packages are not considered. The study assumes technical equivalence in the primary packaging systems for mechanical protection of beverage and liquid food. All packaging systems guarantee the required shelf life of beverage and liquid food.

The packaging systems consist of primary (food package), secondary (e.g. tray), and tertiary (e.g. pallet) packaging elements. Specifications of carton packaging systems are average of different batches and production sites. Specifications of competing packaging systems represent “virtual packaging systems for Europe”, determined by IFEU based on specifications of packaging from different EU countries.

The geographical coverage focuses on the production, distribution, and disposal of packaging systems in Europe. In most cases, European average data are used. Country-specific data are used when a raw material is produced in a specific European country. The reference year for the comparison of packaging systems is 2019.

For each of the studied packaging systems, a scenario for the European market is defined, with two sub-scenarios regarding open-loop allocation at EoL with allocation factors of 50% and 100% (on a mass basis). These scenarios are clustered into groups of the same segment and volume. In addition, scenario variants regarding plant-based plastics in HDPE bottles, recycled content in PET bottles, and plastic bottle weight, are constructed and analyzed.

2.3.1.2 Life Cycle Inventory

Overall, inventory data are collected from Tetra Pak, industry associations, and literature, with background data primarily sourced from the IFEU internal database. The geographical coverage is Europe, except where country-specific data are used if a material/process step is located in a specific country. The reference period for the datasets comprises years between 1999 and 2019, with the majority of datasets referring to years from 2010.

Based on market relevance, Tetra Pak selected cartons of different volumes for the packaging of various beverages and liquid foods, as well as competing packaging systems for each segment. Specifications of carton packaging systems are determined by Tetra Pak as a weighted average of different batches and production sites. Specifications of competing packaging systems are defined by IFEU as “virtual packaging systems for Europe”, and checked by Tetra Pak.

The dataset for primary aluminium from European Aluminium Association (EEA) refers to the production of aluminium bars from bauxite extraction via aluminium oxide manufacture in 2015, including the manufacture of the anodes and the electrolysis. The dataset for aluminium sheet from EEA includes homogenization, hot rolling, cold rolling, and annealing and refers to 2015. The dataset for aluminium foil from EEA and European Aluminium Foil Association (EAFA) is modeled on strip casting technology and the classical production route, covering the year 2010.

Data for the production of tinplate from Worldsteel refer to 2014. Data for the production of liquid packaging board (LPB) for carton packaging are specific to producers in Sweden and Finland and refer to 2009.

Concerning the converting of base materials to primary packaging, average European data for the production of composite cartons from Tetra Pak refer to 2017. Data for the converting from aluminium sheets to aluminium cans and closures are from the IFEU internal database and are referred to 2009. Data regarding the production of steel cans from tinplate are derived from literature, referring to 1996 (BUWAL, 1998).

Data regarding the filling processes are diversified based on the packaging systems. Data for beverage and liquid food cartons from Tetra Pak refer to 2019. Data regarding the filling of aluminium cans derive from the IFEU internal database. Filling data for steel cans from Tetra Pak refer to 2005 and are based on machine consumption data specifications.

Distances and transportation modes regarding the transport of base materials and packaging are obtained from producers or through expert judgements. The distribution of filled packs trip to the point-of-sale is modeled as a two-stage delivery transport, including the return trip: first to a central warehouse and then to the supermarket.

Concerning the EoL, a base scenario is defined for each packaging system, assuming European average collection and recycling rates for post-consumer packaging from published statistics. Regarding disposal, the share between landfilling and incineration is defined using Eurostat data. A substitution factor is used in the calculation of recycled material flows to account for down-cycling (e.g., 0.9 for paper fibres, 1.0 for steel, 1.0 for aluminium).

Regarding background data, energy generation, transport, incineration and landfill are derived from IFEU's internal database. EU 28 and country specific grid electricity mixes are derived from IFEU database, referring to 2015 based on IEA electricity mix statistics.

2.3.1.1 Life Cycle Impact Assessment

A set of midpoint impact categories is defined based on the German Federal Environment Agency (UBA) approach of 2016. The list includes: Climate Change, Stratospheric Ozone Depletion, Photo-Oxidant Formation, Acidification, Terrestrial and Aquatic Eutrophication, Particulate Matter, Use of Nature and Raw materials. Additionally, Water use and Primary energy consumption are added at the inventory level. However, the quantified values for Water use are not considered for comparisons between packaging systems due to the lack of necessary information in the inventories (e.g. origin of water flows and quality of discharged water). For each impact category, the results are presented as «Environmental burdens» (impacts), «Credits», and «Net results».

Biogenic carbon is accounted at two points in the model, its uptake during the plant growth phase and the re-emissions at the EoL (subjected to 50 % and 100 % allocation), where the CO_2 uptake is not considered in credits (assumption). This assumption implies that only for the considered system, i.e., the producer of biogenic material, the CO_2 uptake is applied and reflected in the results. In the case of an allocation factor of 50%, this leads to a benefit in "Climate Change" for the considered system.

An uncertainty analysis on a quantitative basis is not conducted, despite requested by ISO 14044 (cf. par 4.4.5 and par. 5.3.1, ISO 14044)**,** because of the difficulty and limited validity of the statistical methods applied to the datasets and LCA results. An assumed significance threshold of 10 % between mean differences is applied (i.e. results with a difference of less than 10% are assumed to be equal).

Segment: water portion pack ambient, 500 ml

Packaging systems (500 ml): beverage carton systems – TPA Square StreamCap and TT Mi di C38 plant based; Aluminium can.

Beverage carton systems. In most impact categories a large fraction of environmental burdens is caused by the production of base materials for the beverage carton, including plant-based plastics. Concerning biogenic carbon, the CO_2 uptake by trees (used for paperboard) and sugarcane (used for bio-plastic) plays a crucial role in the category "Climate change" as credits. For convention, these credits are only applied to the producer of the primary biogenic material.

Aluminium can. The major fraction for most impact categories is due to the production and the converting of the aluminium can body. The substitution of virgin material with recycled aluminium reduces the overall burdens.

Segment: liquid food portion ambient, 500 ml

Packaging systems: liquid food carton systems – Tetra Recart; steel can.

Tetra Recart. The production of the base materials of the liquid food carton accounts for a large proportion in most impact categories, with LPB and plastics for sleeves being the most significant materials. The EoL is the most relevant life cycle stage in the climate change category. The CO_2 uptake by trees (used for paperboard) and sugar cane (used for bioplastics) play an important role as credits in the climate change category.

The production of steel for the can body accounts for the majority of the environmental impacts in most categories, while the "conversion" process has a significantly lower share in most categories. The "distribution" of the filled steel can plays a major role in many impact categories. Substitution of recycled steel for virgin steel reduces the overall impact.

2.3.1.2 Interpretation and Conclusions

Overall, beverage and liquid food carton systems have different environmental performances depending on the segment and packaging specification. Alternative packaging systems have higher impacts from the production of the raw materials (e.g. aluminium and steel). Conversely, for carton packaging, the production of LPB does not contribute as much to the environmental profile.

For the climate change category, beverage and liquid cartons have lower environmental impacts in almost all segments. For the other impact categories, the comparisons with competing packaging systems are more varied so that no general conclusions can be drawn. For "Use of nature", cartons have higher impacts than competing packaging systems.

Some specific conclusions per each segment are as follows:

Water portion pack ambient

In the "water portion pack ambient" segment, the aluminium can performs better than beverage cartons in most impact categories, with the exception of climate change and ozone depletion potential for the "TPA Square StreamCap 500 ml" carton and climate change and acidification for the "TT Midi C38 plant-based 500 ml" carton.

Liquid food portion ambient

For "Climate change" and other categories, Tetra Recart and TPA Edge StreamCap have lower impacts than the steel can, regardless of the allocation factor. This is not the case for "Use of Nature", and "Aquatic Eutrophication".

With regard to the limitations of the study, **the results obtained from the packaging systems analyzed and the subsequent comparisons are only valid within the framework of the study**. In particular, these findings are only valid for the selected market segments and selected packaging systems, which do not represent the entire European market.

Extrapolating the results of the study to packaging with different volume and weight specifications is not allowed as specified by the authors. In addition, the validity of the results is limited to the reference year 2019.

2.3.2 Critical review

In general, the LCA study 2020 for the European market is in line with the requirements of the ISO 14040/44 standards, as confirmed by the Review Panel. The study purposes to assess the environmental performance of beverage and liquid food cartons compared to competing packaging systems is clearly stated and broken down into specific objectives. The functional unit and system boundaries are adequately described in the report and are consistent with the objective of the study.

The Life Cycle Impact Assessment methodology is derived from the UBA and is consistent with ISO 14040/44 standards, including a sufficient number of impact categories. Two improvements to the LCIA methodology have been introduced compared to the previous study (IFEU 2017): the inclusion of the 'use of nature' category for comparisons between packaging systems, and a clearer discussion of biogenic carbon modelling in a separate section. It is important to note that the modelling choices provide a benefit to the producer of the virgin biogenic material (food carton) in the Climate Change impact category, as explained in the specific comment below. The climate change results must be interpreted in the context of the study, the modelling of biogenic carbon and the specific EoL allocation methodology (see the specific comments below).

In our opinion, although the comparative LCA study is formally correct according to ISO 14040/44, there are some specific limitations and assumptions that could negatively affect the reliability and robustness of comparisons for the analyzed packaging systems. These limitations are mainly related to the time coverage, quality and uncertainty of steel can data, quality of recycling data for food/beverage cartons, goal and scope, specifications of packaging materials. These limitations are detailed as follows.

Specifications of packaging systems (cf. Section 2.2, IFEU 2020). Regarding the mass specifications of the competing packaging systems, these are “virtual typical packaging systems for Europe”, determined by IFEU and checked by Tetra Pak based on specifications of different packaging systems available in various European countries. The review panel notices that the measuring methods are not described and that data are listed transparently, appearing plausible in terms of scale. Further, the Review Panel observes that “*Regarding the choice of competing products for the EU study, the reviewers did not have access to the data and information regarding the representativeness*” (cf. Section 3.1, Critical Review Statement). Specifications of packaging systems are clearly presented in tabular form, however, from the available data and information it is not possible to verify the representativeness of each competing “virtual packaging system” in each market segment**.**

Even if the Review Panel observes that *“As differences < 10 % of the result data are not taken into account in the interpretation, the CR panel expects that the small variations of the packaging composition will not lead to misinterpretations”* (cf. Section 3.3, Critical Review Statement), however, this is not discussed nor proven therefore a sensitivity analysis on specifications of primary packaging elements is clearly missing.

As shown in Table 3, **the mass of the steel can used in IFEU 2020 is almost the 15% heavier than the average weight of steel cans of comparable size from different EU production sites** (MPE, 2022). The average weight from the MPE can be considered robust and representative of this EU market segment as it is derived from primary data from different metal packaging producers across Europe representing a significant EU production quota (see MPE, 2022 for details).

The weight of the primary packaging is a key parameter affecting the LCIA results at all life cycle stages. **Therefore, the comparison between the steel can and the Tetra Recart is only valid in the context of the IFEU, 2020 study and cannot be extended, for example, to a generic liquid food steel can vs food Tetra Recart in the EU market**.

Table 3. Comparison of steel can primary packaging specifications from different references.

Parameter	Unit of measure	IFEU, 2020	MPE, 2022
Reference year	Year	2019	2018
Geographical location		Europe	Europe
Reference product		Average EU product	Average of multiple EU production sites (MPE members)
Food content		Liquid food	n.a.
Volume	ml	390	425
Tinplate body (botton end + body)	g	50.0	38.6
Tinplate closure (top end)	g	7.0	11.0
Steel can (sum of body and closure)	**g**	**57.0**	**49.6**
Label (paper)	g	2.0	n.a.
Primary packaging (sum of steel can and label)	g	59.0	n.a.
Reference		Table 25, IFEU 2020	Table 15, MPE, 2022.

Tinplate production (cf. 3.3, IFEU 2020). Tinplate production data are obtained from Worldsteel, refers to the year 2014 and are weighted averages of EU site-specific data representing approximately 95% of annual EU production. Tinplate production is the most important life cycle stage of steel cans, controlling environmental impacts in most impact categories (cf. Sections 4.13 and 4.14, IFEU 2020).

Converting of steel can (cf. Section 3.9.5, IFEU 2020). **The literature data used to model the production of the tinplate steel can dates from 1996, 23 years before the reference year of the study**, with background datasets updated using data from the internal IFEU database**.** As in the previous study, the report states, citing a personal communication from 2008, that according to APEAL this was the only dataset available at the time of publication. However, a LCA of steel food can has been developed by The European Metal Packaging Association (EMPAC) and made available in 2016 (Packaging News, 2016). In the base scenario for steel cans, the 'converting' step is not a marginal contributor to the overall environmental impact in some impact categories, such as ozone depletion potential (cf. Sections 4.13.1 and 4.14.1, IFEU 2020). The use of outdated data is a limitation of the study (given that Empac made its LCA available in 2016, four years before the IFEU study) which limits the equivalence of data quality for steel cans and Tetra Recart (see the previous comment in section 2.2.2)**.**

Filling (cf. Section 3.11, IFEU 2020). According to the report, the filling processes for beverage and liquid food cartons and alternative packaging systems are similar in terms of energy and material flows. Data for beverage and food cartons are provided by Tetra Pak and refers to 2019. Filling data for aluminium cans is derived from the internal IFEU database.

Conversely, according to the report, "*Filling data for the analysed steel can were provided by Tetra Recart based on machine consumption data specifications referring to the year 2005. Within this study the same data were used*". Presumably, the same proxy dataset used in the previous study (IFEU, 2017) was adopted for the steel can. It is expected that some filling process data may differ between steel can and carton packaging systems (see the previous comment in Section 2.2.2). In addition, while the filling data for carton packaging are updated with respect to the previous study, it is not clear why the proxy data for steel cans related to Tetra Recart are not updated. Manufacturers and industry associations report significantly different speeds for filling machines for steel cans and Tetra Recart (see the previous comment in section 2.2.2). The higher filling efficiency of steel cans would significantly reduce the energy consumption per functional unit compared to the proxy inventory, which may therefore overestimate the associated environmental impacts in the energy-related impact categories. **Therefore, the use of an outdated and unrepresentative proxy (14 years old) for the filling of the steel can is a limitation of the LCI of the steel can, which affects the equivalence of the data quality for the steel can (proxy data, 2005) and Tetra Recart (primary data, 2019).** It may also contribute to an overestimation of the associated environmental impacts of steel packaging.

End-of-Life - EoL (cf. Section 2.3 and Section 3.14, IFEU 2020). The collection and recovery rates used to model the EoL of beverage and liquid cartons and alternative packaging are derived from statistics provided by industry associations. Overall, the data on collection and recovery rates for all packaging systems appear reasonable. For the EoL of beverage and liquid food cartons, a collection rate of 53 %, a recycling rate of 48 % (from ACE in 2019) and a recycled fiber recovery rate of 30 % are reported (cf. Figure 12, IFEU 2020). The recycling rate and, therefore, the recycled fiber recovery rate, is overestimated compared to more recent ACE data, with a collection rate of 52 % in 2021 (ACE, 2024) and a recycling rate of around 30 % in 2020 (ACE, 2022) in Europe, due to the use of the new EU methodology of Commission Decision 2005/270/EC, as amended by Commission Decision 2019/665/EC. The new methodology requires contaminations (food, dirt, etc.) to be excluded when assessing the recycling rate. Globally, Tetra Pak reports lower collection and recycling rates of 26 % (Tetra Pak, 2022a) and 20 % (Tetra Pak, 2022b) respectively.

Therefore**, the amount of recycled paper fibre at the EoL may be overestimated compared to more recent data, resulting in higher credits from recycling and lower burdens from recycling and disposal in different impact categories, including Climate Change**. The impact of recycling and disposal on the Climate Change impact category is significant for food cartons, varying according to the packaging system and the EoL allocation factor, 50% and 100%, both assumed in the base scenarios.

Biogenic carbon (cf. Section 1.7.2, IFEU 2020). Biogenic carbon is considered at two points in the study: CO_2 uptake during plant growth, called “CO_2 uptake”, which is fully attributed to the virgin biogenic material (no CO_2 uptake in credits), and re-emissions at EoL due to recovery and disposal of plant-based materials (mainly arising from incineration of plant-based plastics and paper), called “CO_2 regenerative”. **Combined with the allocation factor for the EoL, 50% or 100% allocation, this leads to different results in the Climate Change category, with additional benefits in the Climate Change category for the producer of the primary biogenic material** (for more details regarding biogenic carbon refers to the previous comment in section 2.2.2)**.**

Table 4 shows the Climate Change results (kg $CO_{2\text{-}e}$/1000 l) for each carton packaging system in each segment for the 50% and 100% allocation methods as reported in the IFEU 2020 LCA study. In fact, in the scenario with 50% allocation to the EoL, the amount of CO_2 sequestered by the trees harvested for paper production is re-emitted during the incineration and landfilling of paper at the EoL (term CO_2 reg.), but only the 50% of the emissions from incineration and landfilling are allocated to the product system under study. The “net results”, determined by both fossil and biogenic emissions, receive a significant benefit from the balance of biogenic CO_2 flows (CO_2 uptake + CO_2 reg), which represents from the 24% to the 223% of the net results, depending on the specific food carton packaging. Conversely, in the scenario with 100% allocation at the EoL, 100% of the emissions from incineration and landfilling are attributed to the system, with a smaller benefit for the system compared to the 50% EoL scenario (here the biogenic CO_2 flows represent from the 11% to the 71% of the net results). The “net results” of the Climate Change impact category are determined by both fossil and biogenic emissions.

The reasons for and implications of the approach adopted are transparently described in a dedicated section (cf. 1.7.2 Biogenic carbon) of the LCA report and are appropriately cited when discussing the results for carton packaging systems in "Climate Change" category in each segment (cf. Section 4. Results).

The two-point accounting approach for biogenic carbon is preferable to not accounting for biogenic carbon and is in line with ISO 14040/44, but it is not neutral due to the allocation at the EoL and the assumption of no CO_2 uptake in the credits. It is therefore particularly important that 'climate change' results of different packaging systems are compared and communicated within the LCA framework. This point is particularly emphasized by the review panel, which states that "*It is extremely important that the results of the GWP with consideration of plant-based materials are only communicated in the context of the methodological framework. In order to prevent misinterpretations, the panel expressly points out that readers of the study shall carefully consider the statements in chapter 1.7.2 of the study"*. (cf. 3.2 Scientific and technical validity of the methods used, Critical Review Statement).

Although this choice is compliant with ISO 14040/44 standards, it does have a significant impact on the net results of food cartons in the Climate Change category, determined by both biogenic and fossil carbon flows, and should be clearly stated when presenting the net results to avoid any misinterpretation.

Table 4. LCA results regarding "Climate Change" category (kg $CO_{2\text{-e}}$/1000 L) per each food carton product in each segment, for 50% and 100% allocation methods, as reported in IFEU 2020 LCA study; where "CO_2 reg. (EoL)" are CO_2 emissions from incineration of plant-based and renewable materials at the EoL and "CO_2 uptake" is the uptake of CO_2 during the plant growth phase. In addition, the balance of positive and negative emissions is provided as fossil net results (Burdens + Credits), biogenic net results (CO_2 reg. + CO_2 uptake), and total net results (sum of fossil and biogenic net results, i.e. the net results shown in IFEU, 2020).

Segment	Tetra Pak product	Climate change [kg $CO_{2\text{-e}}$/1000 L]													
		50 % allocation							100 % allocation						
		Positive and negative emissions				Balance			Positive and negative emissions				Balance		
		Burdens	CO_2 reg. (EoL)	Credits	CO_2 uptake	Total - Net results	Fossil - Net results	Biogenic – Net results	Burdens	CO_2 reg. (EoL)	Credits	CO_2 uptake	Total - Net results	Fossil - Net results	Biogenic – Net results
Dairy family pack chilled	TR OSO 34 1000 ml	80.93	16.56	-16.92	-44.6	35.96	64.01	-28.04	97.21	30.56	-32.92	-44.6	50.24	64.29	-14.04
	TR OSO 34 plant-based 1000 ml	78.36	22.13	-18	-63.78	18.71	60.36	-41.65	89.37	41.14	-34.64	-63.78	32.09	54.73	-22.64
	TT O38 1000 ml	101.64	14.45	-20.96	-38.93	56.21	80.68	-24.48	123.82	26.75	-41.12	-38.93	70.53	82.70	-12.18
Dairy family pack ambient	TBA Edge LC 30 1000 ml	98.79	15.26	-18.44	-41.27	54.35	80.35	-26.01	116.33	28.14	-36.01	-41.27	67.19	80.32	-13.13
	TBA Edge LC 30 plant-based 1000 ml	97.18	18.97	-19.15	-54.11	42.88	78.03	-35.14	111.25	35.18	-37.16	-54.11	55.15	74.09	-18.93
Dairy portion pack chilled	TB Mid Straw 200 ml	128.15	19.21	-24.09	-51.9	71.38	104.06	-32.69	151.72	35.46	-47.09	-51.9	88.19	104.63	-16.44
JNSD family pack ambient	TBA Slim HC 23 1000 ml	100.57	14.88	-19.79	-40.32	55.34	80.78	-25.44	119.66	27.46	-38.74	-40.32	68.07	80.92	-12.86
	TR MiniPlus TC 34 1000 ml	120.67	16.7	-23.22	-44.88	69.28	97.45	-28.18	143.72	30.82	-45.51	-44.88	84.15	98.21	-14.06
JNSD portion pack ambient	TBA Base Straw 200 ml	153.15	19.14	-26.63	-51.68	93.98	126.52	-32.54	177.77	35.32	-52.18	-51.68	109.23	125.59	-16.36
	TPA DC 26 330 ml	199.07	19.25	-34.19	-51.51	132.63	164.88	-32.26	233.46	35.27	-67.29	-51.51	149.94	166.17	-16.24

Segment	Tetra Pak product	Climate change [kg CO_{2-e}/1000 L]													
		50 % allocation							100 % allocation						
		Positive and negative emissions				Balance			Positive and negative emissions				Balance		
		Burdens	CO_2 reg. (EoL)	Credits	CO_2 uptake	Total - Net results	Fossil - Net results	Biogenic – Net results	Burdens	CO_2 reg. (EoL)	Credits	CO_2 uptake	Total - Net results	Fossil - Net results	Biogenic – Net results
Water portion pack ambient	TPA square StreamCap 500 ml	180.41	20.18	-30.13	-53.68	116.79	150.28	-33.5	209.27	36.9	-59.13	-53.68	133.37	150.14	-16.78
	TT Midi C38 plant-based 500 ml	154.3	27.63	-31.19	-83.3	67.43	123.11	-55.67	174.47	51.51	-60.59	-83.3	82.09	113.88	-31.79
Liquid food portion pack ambient	Tetra Recart 390 ml	143.92	20.47	-27.34	-55.81	81.24	116.58	-35.34	168.48	38.01	-53.52	-55.81	97.16	114.96	-17.8

2.4 Discussion and remarks

The comparative LCA studies by IFEU (IFEU, 2017; IFEU, 2020) to assess the environmental performance of beverage and food cartons compared to alternative packaging systems are overall compliant with the requirements of the ISO 14040/44 standards, as confirmed by the two independent Review Panels.

In the IFEU 2017 study, comparing alternative packaging systems for sterilized canned tomatoes, being food carton Tetra Recart, glass jars and steel cans in Germany, Italy and EU28+2 markets in 2016, the results show potential lower environmental impacts for food carton compared to the examined steel can in most impact categories.

The IFEU 2020 study, covering carton packages and competing packages in different beverage segments in the European market in 2019, is designed as a baseline study for the EU market, with additional country-specific supplemental studies focusing only on the climate change category (e.g. IFEU 2020. Supplement for Italy). For the climate change category, beverage and liquid cartons have lower environmental impacts in almost all segments, whereas for the other impact categories, the comparisons with competing packaging systems are more varied so that no general conclusions can be drawn.

In our opinion, although the comparative IFEU 2017 and IFEU 2020 studies are formally correct according to ISO 14040/44, there are some specific limitations that could negatively affect the reliability and robustness of comparisons for the analyzed packaging systems. These limitations are mainly related to the time coverage, quality and uncertainty of steel can data, goal and scope, specifications of packaging materials, quality of recycling data for beverage and food cartons, biogenic carbon accounting and relevant impact categories. These limitations are detailed as follows.

Functional unit and system boundaries. In both studies, the exclusion of the shelf life of the filled packaging system and the losses of food along the supply chain is justified by IFEU due to the lack of data and the uncertainty. **Considering that primary packages aren't equivalent regarding the mechanical protection of packaged food and the shelf life of canned food may last up to five years, this is a limitation that should have been mentioned in the conclusions of the studies**, since the properties of metal packaging in terms of content protection have been underrated.

Packaging specifications. The specifications of primary, secondary and tertiary packaging elements are reported in tabular form, obtained by IFEU and Tetra Pak. In both studies, the selection of competitive packaging systems compared to beverage and food cartons is made by Tetra Pak, mainly based on market relevance. In the IFEU 2017 study, primary packaging specifications are related to specific products purchased at the point of sale and are obtained by Tetra Pak. In the IFEU 2020 study, the specifications of primary packaging elements are determined by IFEU as "virtual typical packaging systems for Europe". However, **the information available in both reports does not allow a discussion on the representativeness of competing packaging systems.** More information on the methodology used to select and quantify the specifications of alternative packaging systems and a sensitivity analysis of some key specifications should have been provided to interpret the results. **In fact, the 400 ml steel cans used in IFEU, 2017 and IFEU, 2020 (57.5 g and 57.0 g, respectively) are more than 15% heavier than the average weight (49.8 g in 2013 and 49.6 g in 2018) of steel cans of comparable. The associated environmental impacts of steel packaging** could be therefore **overestimated.**

LCI of steel can filling step. In IFEU, 2017 and IFEU, 2020, the filling step for steel cans is modelled as a proxy using data provided by Tetra Pak specific to carton packaging and referring to 2005 machine consumption, despite significant differences between the two packaging systems in terms of filling speed. Therefore, in particular in IFEU, 2020, the **use of an outdated and unrepresentative proxy for the filling of the steel can is a limitation of the study which affects the equivalence of the data quality for the analyzed packaging systems. In addition, this limitation** may also contribute to an overestimation of the associated environmental impacts of steel packaging.

LCI of steel can converting. In IFEU, 2017 and 2020, the production of steel cans from tinplate, the "converting step", is modelled on the basis of old literature data referred to 1996 in both studies (BUWAL 1999) despite more specific data was available at the time of the studies. **The use of outdated data is a limitation of the study which affects the comparability of the analyzed packaging systems** (for steel can proxy data from 2005, for Tetra Recart primary data from 2019)**.**

LCI of End-of-life – EoL. In IFEU 2017 and 2020, the collection and recovery rates used to model the EoL of beverage and liquid cartons and alternative packaging are mainly derived from statistics provided by industry associations. However, in case of food and beverage cartons the recycling rate and, therefore, the recycled fiber recovery rate, is overestimated compared to more recent data from the same references (i.e. ACE), due to the use of the new EU methodology in the more recent statistics (Commission Decision 2019/665/EC). This results in higher credits from recycling and lower burdens from recycling and disposal in different impact categories**. Therefore, the availability of significantly different, updated recycling rate data limits the time validity of the LCI of End-of-Life (EoL) for beverage and food cartons**.

Life Cycle Impact Assessment (LCIA). The UBA methodology used in both studies is sufficiently robust and comprehensive, covering many impact categories in line with ISO 14040/44 standards, with two exceptions. A limitation of the IFEU 2017 study is the exclusion of the 'use of nature' category from the comparison of competing packaging systems due to data gaps. This is a relevant impact category for food cartons sourced from forests, so the overall environmental impact of Tetra Recart may be incomplete and underestimated in the comparisons. Additionally, in IFEU 2017 and 2020, the "Water use" indicator is quantified but not considered for comparisons between packaging systems, justified by the lack of data and required information.

Biogenic carbon modelling. Biogenic carbon refers to carbon stored in biomass and bio-based materials, such as food cartons from sustainably managed forests. In both studies, biogenic carbon is considered at two points for bio-based materials, CO_2 uptake during plant growth and re-emission of CO_2 at the EoL**.** Together with the allocation factor for the EoL, 50% or 100% allocation, this leads to different net results in the Climate Change category, with additional benefits in the Climate Change category for the producer of the primary biogenic material. **Although this choice is compliant with ISO 14040/44 standards, it does have a significant impact on the net results of Tetra Recart in the Climate Change category, determined by both biogenic and fossil carbon flows, and should be clearly stated when presenting the total net results to avoid any misinterpretation.**

It is to be emphasized that the results of the studies in both IFEU 2017 and 2020 are only valid in the specific context and assumptions set for the analysed systems and the compared packaging solutions, which in case of the steel and aluminium cans are quite generic and do not necessarily correspond to specific products on the market**.** As such**, the results cannot be extended to situations or packaging solutions other than those considered in the studies.** A variation in some key parameters, assumptions and background data of the studies would probably lead to different results and possibly changing the general outcomes of the comparisons**.**

3. Assessment of Tetra Pak communication claims

3.1 Approach

The assessment of the comparative environmental claims by Tetra Pak between Tetra Recart and steel can for food products refers to communication materials made by Tetra Pak or its customers. The detail of the assessment is limited to the information and materials collected and provided by MPE.

The assessment is based on the following main reference standards:

- Proposal for a Directive on substantiation and communication of explicit environmental claims (Green Claims Directive). European Commission, 2023.
- ISO 14026:2017. Environmental labels and declarations. Principles, requirements and guidelines for communication of footprint information.

A brief overview of the two reference standards is given below. The comparative claims are then first described and evaluated, and then assessed against the requirements of the two standards. Finally, a general discussion and comments are provided.

3.1.1 Green Claims Directive (Proposal)

The proposal for a Directive on Green Claims was adopted by the Commission in March 2023. The proposal includes clear criteria on how companies should substantiate their environmental claims and requirements for these claims to be verified by an independent and accredited verifier.

The proposal targets explicit environmental claims (and environmental labelling schemes) made by companies (traders) about products or traders in business-to-consumer commercial practices that are not covered by other EU legislation (Art. 1, Green Claims Directive). An "explicit environmental claim" is an environmental claim that is in textual form or included in an environmental label (Art. 1, Green Claims Directive). An example of a comparative explicit green claim might be: "The CO_2 emissions of product A are half those of product B".

Companies shall carry out an assessment to substantiate explicit environmental claims. This assessment must meet a number of requirements set out in Art. 3 of the Green Claims Directive. In addition, an assessment for "comparative explicit environmental claims" shall respect additional requirements set out in Art. 4. Furthermore, a number of requirements in Art. 5 are required for the communication of explicit environmental claims. An additional requirement for the communication of comparative claims is reported in Art. 6.

The information used to substantiate explicit environmental claims shall be reviewed and updated by traders no later than five years from the date when the information was provided (Art. 9). The updated explicit environmental claim shall be verified.

3.1.2 ISO 14026: 2017 Environmental labels and declarations – Principles, requirements and guidelines for communication of footprint information

The ISO 14026:2017 Standard provides principles, requirements and guidelines for how an organization can communicate environmental footprints of their products to ensure that only valid, science-based and comparable information is provided. The documents provides requirements for verification procedures.

It should be noted that the words "environmental claim" used in the Green Claims Directive correspond to "footprint communication" in ISO: 14026: 2017. The following definitions are relevant:

- **footprint communication**: “result of preparation, provision and dissemination of the footprint, supporting information, and explanatory statement”;
- **comparative footprint communication**: “footprint communication regarding the superiority or equivalence of one product versus another product, or one product over time, with regard to a single area of concern”.

The principles to be respected by a footprint communication are credibility and reliability, life cycle perspective, comparability, transparency, and regionality. More specifically, different requirements are specified in chapter 6 “Communication requirements” of the document, specifying some general requirements (6.2), intended audience (6.3), identification of area of concern (6.3), information to be provided (6.5), footprint graphics (6.6), access to information (6.8), comparative footprint communications (6.9). Furthermore, chapter 7 reports the requirements for the data used to support the communication. All these elements are considered to verify the comparative claims by Tetra Pak in next section.

3.2 Description and assessment of the comparative environmental claims by Tetra Pak

MPE provided a sample of four comparative environmental claims made by Tetra Pak and two food producers between a specific food carton packaging (i.e. Tetra Recart) and generic competing steel can packaging for different food products. Two comparative claims by Tetra Pak (claims 1 and 2) are the main reference for the assessment. In addition, the claims by two food producers, i.e. Valfrutta (claim 3) and Fege (claim 4), are also analyzed.

The main elements of the four claims are summarized in Table 5. Claim 1 (Figure 1) appeared in a slide presentation by Tetra Pak and claim 2 (Figure 2) on a promotional cardboard box by Tetra Pak. Claims 3 (Figure 3) and 4 (Figure 4) are reported on specific food carton primary packaging for Valfrutta tomato pulp and Fege cannellini beans, respectively. In Table 5 a summary of the four comparative environmental claims is provided.

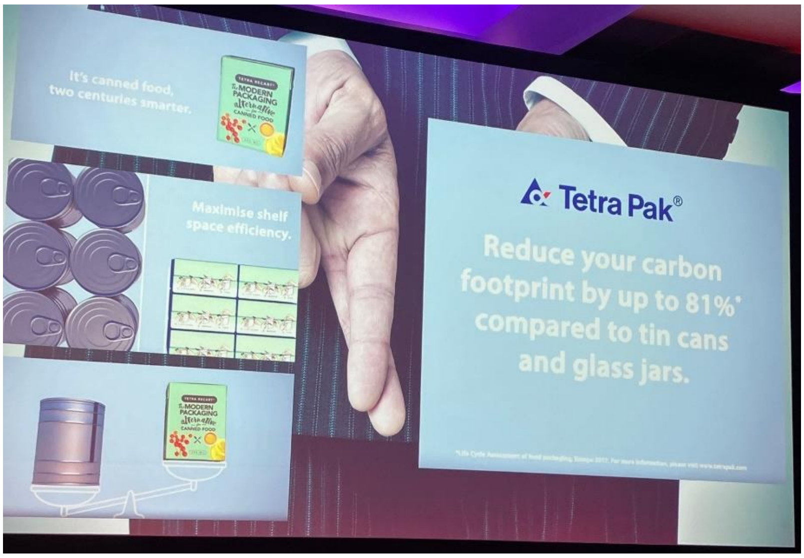

Figure 1. Claim 1: comparative explicit environmental claim between food carton and steel can packaging systems. This example does not refer to a specific product. Food carton producer: Tetra Pak.

Figure 2. Claim 2: comparative explicit environmental claim between food carton and steel can packaging systems. This example does not refer to a specific product. Food carton producer: Tetra Pak.

Figure 3. Claim 3: comparative explicit environmental claim between food carton and steel can packaging systems for tomato pulp: (A) Front of the package; (B) Back of the package. Food carton producer: Tetra Pak. Tomato pulp producer: Valfrutta. Country: Italy.

[B]

Figure 4. Claim 4: comparative explicit environmental claim between food carton and steel can packaging systems for cannellini beans: (A) Front of the package; (B) Detail of the front of package. Food carton producer: Tetra Pak. Cannellini beans producer: Fege. Country: Italy.

All claims make a similar comparative assertion, stating that Tetra Recart has a specified reduction in CO_2 emissions compared to steel cans (and glass jars in some claims).

In all cases, a specific product, i.e. Tetra Recart, is compared with a generic steel can for food packaging, as in claims 1 and 2, or to a specific food product as in claims 3 and 4.

For all claims, the geographical boundaries are correctly specified in the explanatory statements, however, the reference study "IFEU, 2020. Supplement for Italy" for claims 2, 3 and 4 refers to a specific food packaging, namely "ambient portion packs" with a volume of 350 ml containing a liquid food. In the LCA study report (cf. section 6 Limitations, IFEU 2020. Supplement for Italy), **the authors clearly states that the results are valid only for the filling products "liquid food" at ambient temperature and for the examined packaging systems with a precise filling size**:

> *"Limitations concerning packaging system specifications:*
>
> *The results are valid only for the examined packaging systems as defined by the specific system parameters, since any alteration of the latter may potentially change the overall environmental profile. The filling volume and weight of a certain type of packaging can vary considerably for all packaging types that were studied.*
>
> *The volume of each selected packaging system chosen for this study represents the predominant packaging size on the market. It is not possible to transfer the results of this study to packages with other filling volumes or weight specifications.*
>
> *Each packaging system is defined by multiple system parameters, which may potentially alter the overall environmental profile. All packaging specifications of the carton packaging systems were provided by Tetra Pak® and are to represent the typical*

packaging systems used in the analysed market segment. These data have been cross-checked by IFEU.

To some extent, there may be a certain variation of design (i.e. specifications) within a specific packaging system. Packaging specifications different from the ones used in this study cannot be compared directly with the results of this study".

In addition, the reference study IFEU, 2017 for claim 1 refers to a specific steel can containing tomatoes with a volume of around 400 ml (not specified in the European scenario). Again, the LCA study report clearly states that the results are only valid for the filling product 'canned tomatoes' and the packaging system examined with the specific weight and filling volume (see section 8 'Limitations and consistency', IFEU 2017). Furthermore, in the limitations chapter of both studies (see Section 8, "IFEU, 2017" and Section 8, "IFEU, 2020. Supplement for Italy"), it is specified that the results cannot be assumed to be valid for the same packaging at times other than the reference year, i.e. 2016 in the case of IFEU, 2017 and 2020 in the case of IFEU, 2020. Supplement for Italy. In claims 1, 3 and 4 there is no information on the LCA reference year in either the claims or the explanatory statements.

For the reasons above, the claims comparing Tetra Recart and a generic steel can are misleading because extend the results outside the scope of the LCA reference studies.

Table 5. Summary of the sample of comparative environmental claims by Tetra Pak between Tetra Recart and steel can packing systems for food products.

	Claim n.1	**Claim n.2**	**Claim n.3**	**Claim n.4**
Reference pictures	Figure 1	Figure 2	Figure 3	Figure 4
Type of communication	Slides, presentation	Promotional cardboard box	Food product carton packaging	Food product carton packaging
Author	Tetra Pak	Tetra Pak	Valfrutta	Fege
Food producer	Not present	Not present	Valfrutta	Fege
Specific food	Canned food	Food	Tomato pulp	Cannellini beans
Packaging size	Not specified	390 g	Not specified	380 g
Packaging model	Tetra Recart	Tetra Recart	Not specified (Tetra Recart ?)	Tetra Recart
Packaging producer	Tetra Pak	Tetra Pak	Tetra Pak	Tetra Pak
Comparative claim	(a) “Reduce your carbon footprint by up to 81%* compared to tin cans and glass jars”	“Tetra Recart -83 % CO2 vs barattolo in banda stagnata standard easy opening” Steel can: “CO2 518 gr” Tetra Recart: “CO2 86 gr”	Front of package: (a) “Confezione riciclabile con -83 % CO2 emessa*” Back of package (b) “-83 % di CO_2 rispetto a confezioni alternative”	Front of package: “confezione/ packaging/packung -83 % CO2*” “* vs barattolo in banda stagnata/standard easy opening”
LCA Country	Not specified	Italy	Italy	Italy
Reference to LCA study	“Life cycle assessment of food packaging. Europe 2017.” Note: enough information to identify the LCA study	“Fonte: IFEU 2020, Italy, Food category.” Note: enough information to identify the LCA study	“Studio LCA – mercato Italia. Confronto con vasetto vetro/lattina” Note: Not directly identifiable from the above information	“*Studio LCA – Mercato Italia. Confronto con lattina” Note: Not directly identifiable from the above information
Type of reference (QR code, link, other)	Link: www.tetrapak.com Note: Not a direct link to the study.	QR Code	Link: www.tetrapak.com/sustainability/good-choice Note: Not a direct link to the study	Link: www.tetrapack.com/sustainability/good-choice Note: Not a direct link to the study

	Claim n.1	**Claim n.2**	**Claim n.3**	**Claim n.4**
Reference LCA study	IFEU, 2017. Note: The extended study IFEU 2017 is not currently available on Tetra Pak website (Tetrapak/sustainability/life cycle assessment). Only the key findings are reported: https://www.tetrapak.com/content/dam/tetrapak/publicweb/gb/en/packaging/documents/LCA_Tetra-Recart_Key-findings.pdf	IFEU, 2020. Supplement for the Italian market. -83 % is reported in Table 67, pag. 104. Valid for: Liquid food at ambient temperature, 50 % allocation method, Climate change category, Tetra Recart (390 ml) vs steel can (350 ml))	IFEU, 2020. Supplement for the Italian market. Note: the study was identified by checking individual LCA studies (-83 % is reported in Table 67, pag. 104. Valid for: Liquid food at ambient temperature, 50 % allocation method, Climate change category, Tetra Recart (390 ml) vs steel can (350 ml))	IFEU, 2020. Supplement for the Italian market. Note: the study was identified by checking individual LCA studies (-83 % is reported in Table 67, pag. 104. Valid for: Liquid food at ambient temperature, 50 % allocation method, Climate change category, Tetra Recart (390 ml) vs steel can (350 ml))
- Food	Canned tomatoes	Liquid food (ambient temperature)	Liquid food (ambient temperature)	Liquid food (ambient temperature)
- Primary packaging size	Tetra recart (390 g), steel can (400 g)	Tetra Recart (390 ml), steel can (350 ml)	Tetra Recart (390 ml), steel can (350 ml)	Tetra Recart (390 ml), steel can (350 ml)
- Country/region	Europe	Italy	Italy	Italy
- Reference year	2016	2019	2019	2019
Additional elements	Two additional assertions and images: (b) “Maximize shelf space efficiency” with an image (c) “It’s canned food, two centuries smarter” (d) Image of a scale with a steel can and tetra recart	Two images are directly referred to the products: • Tetra Recart: field picture, green and blued colors Steel can: industry image with air emissions, grey scale colors		

Table 6 details the specific elements of the text of each claim. The subject of the claim is Tetra Recart in claims 2, 3, and 4, while in one case is the reader (claim 1 “reduce your”). The core of the claims is the “reduction of CO_2 emissions”, defined by different expressions: claims 2, 3, and 4 refer to “CO_2” or “CO_2 emessa” (i.e. emitted CO_2), while claim 1 refers to “your carbon footprint”.

Table 6. Analysis of the texts of comparative environmental claims by Tetra Pak between Tetra Recart and steel can packing systems for food products.

	Claim	**Subject**	**Assertion: Reduction of CO_2 emissions**	**Compared to**	**Additional elements**
Claim n.1	(a) “Reduce your carbon footprint by up to 81%* compared to tin cans and glass jars”	You (“reduce your”) – meaning for the food produces?	“your carbon footprint by up to 81%”	“compared to tin cans and glass jars”	See Table 5
Claim n.2	“Tetra Recart -83 % CO_2 vs barattolo in banda stagnata standard easy opening” (i.e. Tetra Recart -83 % CO_2 vs standard easy opening tinplate can)	“Tetra Recart”	“-83 % CO_2”	“vs barattolo in banda stagnata standard easy opening” (i.e. standard easy opening tinplate can)	Steel can: “CO_2 518 gr” Tetra Recart: “CO_2 86 gr”
Claim n.3	Claim composed of two sentences: - Front of package “Confezione riciclabile con -83 % CO2 emessa*” (i.e. Recyclable packaging with -83% CO2 emitted) - Back of package “-83 % di CO_2 rispetto a confezioni alternative” (i.e. -83% CO_2 vs alternative packaging)	“Confezione” (i.e. packaging)	“-83 % CO_2 emessa” (i.e. -83% CO2 emitted)	Back of package: - “rispetto a confezioni alternative” (i.e. vs alternative packaging) - And “Confronto con vasetto vetro/lattina” (i.e. Comparison with glass jar / steel can)	“riciclabile” (i.e. recyclable)
Claim n.4	“confezione/ packaging/packung -83 % CO2*” “* vs barattolo in banda stagnata/standard easy opening”	“confezione/ packaging/packung”	“-83 % CO_2”	“* vs barattolo in banda stagnata/standard easy opening”	

In all claims, a reference to the comparative LCA study used to substantiate the respective claim is provided (see Table 5). Claims 1, 3 and 4 provide a link to Tetra Pak's website (https://www.tetrapak.com/sustainability/measuring-and-reporting/life-cycle-assessment) where the list of LCA studies for different regions, years and food or beverage types can be found. However, a direct link to the specific study is not provided, so it is not straightforward to identify and download the referenced study within the list on the Tetra Pak website based on the available information (see Table 5). For instance, claim 3 refers to the study " LCA study - Italian market. Comparison with glass jar/can" without providing any other useful information (e.g. year of publication). Conversely, in claim 2, access to the reference LCA study is provided through a QR code. The reference LCA studies are IFEU, 2020 (Italian supplement) for claims 2, 3 and 4 and IFEU, 2017 (European market) for claim 1.

Furthermore, in claim 2 (see Figure 2), a list of additional environmental statements is provided for Tetra Recart, as these were specific characteristics that only apply to this packaging system. These additional environmental statements are as follows: 1. "Recyclable"; 2. " Composed mainly of paper, a renewable and certified resource "; 3. " Practical, safe and lightweight". While the environmental statement 2 is a specific characteristic of Tetra Recart, environmental statements 1 and 3 may belong to both packaging systems.

In particular, the claim "recyclable" assigned solely to Tetra Recart may mislead the reader, given that steel cans have higher recycling rates than food and beverage cartons. This is confirmed by the recycling rates assumed in the reference study used for claim 2: a 29% recycling rate for food cartons and 79% for steel cans in the Italian market (cf. Table 20, IFEU 2020. Supplement for Italy).

Furthermore, the statement 'Conveniente per l'ambiente e per tutta la filiera fino al consumatore' in claim 2 (i.e. convenient for the environment and for the entire supply chain up to the consumer) is a generic statement not justified by the reference LCA which misleads the reader, and thus not compliant with the Proposal for a Green Claims Directive.

In addition, in claim 2 two images are directly related to the compared products:

- on the left, a grey scale image showing an air emitting industry is referred to the steel can, together with the value of CO_2 emissions obtained in the comparative LCA study (IFEU 2020. Supplement for Italy);
- on the right, a colour image (green and blue) showing a cultivated field is related to Tetra Recart, together with the value of CO_2 emissions obtained in the comparative LCA study.

The two images related to the two products compared by the assertion are of strong communicative power, due to the subject (emissive industry vs. cultivated field) and colours (grey scale vs. green and blue).

3.3 Verification of the comparative claims by Tetra Pak against the requirements of relevant standards

3.3.1 Green Claims Directive (Proposal)

All claims from 1 to 4 can be classified as “explicit comparative environmental claims” (see definition Art. 2, Green Claims Directive) and therefore can be assessed against the requirements of Articles from 3 to 7 of the Green Claims Directive.

“environmental claim” (Article 2, point (o), of Directive 2005/29/EC) means any message or representation which is not mandatory under Union or national law, in any form, including text, pictorial, graphic or symbolic representation, such as labels, brand names, company names or product names, in the context of a commercial communication, and which states or implies that a product, product category, brand or trader has a positive or zero impact on the environment or is less damaging to the environment than other products, product categories, brands or traders, or has improved its impact over time;

“explicit environmental claim” (Article 2, Green Claims Directive) means an environmental claim that is in textual form or contained in an environmental label;

The verification of the four comparative claims is reported in Table 7. **Overall, claims 1 to 4 do not fulfill all the requirements of the proposal of Green Claims Directive for comparative explicit environmental claims.**

Two specific comments are as follows:

The LCA studies "IFEU, 2017" and "IFEU, 2020. Supplement for Italy" comply with some of the requirements of Art. 3 of the Proposal (i.e. requirements for the LCA study). However, the LCA studies do not comply with many requirements of Art. 4 (i.e. requirements for comparative LCA study), mainly due to the fact that data and information quality is not fully equivalent and that data and information are not sourced in an equivalent manner for the competing packaging (steel can and Tetra Recart), as seen in Sections 2.2.2 and 2.3.2.

The communication of the comparative explicit environmental claims does not fully comply with the requirements of Art. 5 and 6 of the Directive. In particular, in each claim, access to the LCA study is provided through a link to Tetra Pak's website (claims 1, 3 and 4) or a direct QR code (claim 2), which allows access to the information reported under Article 5(6), except point 5(6).g. Regarding point 5(6)g, there is no summary of the assessment that is clear and understandable to the consumers targeted by the claim, except for the summary sections of IFEU, 2017 and IFEU, 2020, which are not clear to the general public. It should be noted that the claims related to GHG emissions are supported by the IFEU, 2017 and IFEU, 2020 studies (fulfilling requirement 5.2 of the proposal), but some additional claims, e.g. "Recyclable" in claim 2, are not supported by any study (see claim 2 in Figure 2).

Table 7. Verification of the four comparative explicit environmental claims by Tetra Pak against the requirements of the Green Claims Directive Proposal.

Art. comma. Letter	Content	Verification (YES- y; NO – n; not applicable - n.a.)			
		Claim 1 (Figure 1)	Claim 2 (Figure 2)	Claim 3 (Figure 3)	Claim 4 (Figure 4)
Art 3. Substantiation of explicit environmental claims					
3.1.	Member States shall ensure that traders carry out an assessment to substantiate explicit environmental claims. This assessment shall:	n.a.	n.a.	n.a.	n.a.
3.1.a	specify if the claim is related to the whole product, part of a product or certain aspects of a product, or to all activities of a trader or a certain part or aspect of these activities, as relevant to the claim;	y	y	y	y
3.1.b	rely on widely recognised scientific evidence, use accurate information and take into account relevant international standards;	y	y	y	y
3.1.c	demonstrate that environmental impacts, environmental aspects or environmental performance that are subject to the claim are significant from a life-cycle perspective;	y	y	y	y
3.1.d	where a claim is made on environmental performance, take into account all environmental aspects or environmental impacts which are significant to assessing the environmental performance;	n	n	n	n
3.1.e	demonstrate that the claim is not equivalent to requirements imposed by law on products within the product group, or traders within the sector;	y	y	y	y
3.1.f	provide information whether the product or trader which is subject to the claim performs significantly better regarding environmental impacts, environmental aspects or environmental performance which is subject to the claim than what is common practice for products in the relevant product group or traders in the relevant sector;	y	y	y	y
3.1.g	identify whether improving environmental impacts, environmental aspects or environmental performance subject to the claim leads to significant harm in relation to environmental impacts on climate change, resource consumption and circularity, sustainable use and protection of water and marine resources, pollution, biodiversity, animal welfare and ecosystems;	y	y	y	y
3.1.h	separate any greenhouse gas emissions offsets used from greenhouse gas emissions as additional environmental information, specify whether those offsets relate to emission reductions or removals, and describe how the offsets relied upon are of high integrity and accounted for correctly to reflect the claimed impact on climate;	n.a.	n.a.	n.a.	n.a.
3.1.i	include primary information available to the trader for environmental impacts, environmental aspects or environmental performance, which are subject to the claim;	y	y	y	y
3.1.j	include relevant secondary information for environmental impacts, environmental aspects, or environmental performance which is representative of the specific value chain of the product or the trader on which a claim is made, in cases where no primary information is available.	n	n	n	n
3.2	Where it is demonstrated that significant environmental impacts that are not subject to the claim exist but there is no widely recognised scientific evidence to perform the assessment referred to in point (c) of paragraph 1, the trader making the claim on another aspect shall take account of available information and, if necessary, update the assessment in accordance with paragraph 1 once widely recognised scientific evidence is available.	n.a.	n.a.	n.a.	n.a.
3.3.	Not relevant	-	-	-	-

3.4	Not relevant	-	-	-	-
3.5	Not relevant	-	-	-	-
Art. 4 Substantiation of comparative explicit environmental claims					
4.1	The substantiation of explicit environmental claims that state or imply that a product or trader has less environmental impacts or a better environmental performance than other products or traders ('comparative environmental claims') shall, in addition to the requirements set out in Article 3, comply with the following requirements:	-	-	-	-
4.1.a	the information and data used for assessing the environmental impacts, environmental aspects or environmental performance of the products or traders against which the comparison is made, are equivalent to the information and data used for assessing the environmental impacts, environmental aspects or environmental performance of the product or trader which is subject to the claim;	**n***	**n***	**n***	**n***
4.1.b	the data used for assessing the environmental impacts, environmental aspects or environmental performance of the products or traders is generated or sourced in an equivalent manner as the data used for assessing the environmental impacts, environmental aspects or environmental performance of the products or traders against which the comparison is made;	**n***	**n***	**n***	**n***
4.1.c	the coverage of the stages along the value chain is equivalent for the products and traders compared and ensures that the most significant stages are taken into account for all products and traders;	**n***	**n***	**n***	**n***
4.1.d	the coverage of environmental impacts, environmental aspects or environmental performances is equivalent for the products and traders compared and ensures that the most significant environmental impacts, environmental aspects or environmental performances are taken into account for all products and traders;	n	n	n	n
4.1.e	assumptions used for the comparison are set in an equivalent manner for the products and traders compared.	n	n	n	n
4.2	Where a comparative environmental claim relates to an improvement in terms of environmental impacts, environmental aspects or environmental performance of a product that is subject to the claim compared to environmental impacts, environmental aspects or environmental performance of another product from the same trader, from a competing trader that is no longer active on the market or from a trader that no longer sells to consumers, the substantiation of the claim shall explain how that improvement affects other relevant environmental impacts, environmental aspects or environmental performance of the product subject to the claim and shall clearly state the baseline year for the comparison.	n.a.	n.a.	n.a.	n.a.
4.3	Not relevant	-	-	-	-
Art. 5 Communication of explicit environmental claims					
5.1	Member States shall ensure that a trader is required to communicate an explicit environmental claim in accordance with the requirements set out in this Article.	-	-	-	-
5.2	Explicit environmental claims may only cover environmental impacts, environmental aspects or environmental performance that are substantiated in accordance with the requirements laid down in Articles 3, 4 and 5 and that are identified as significant for the product or trader concerned in accordance with Article 3 paragraph (1) point (c) or (d).	y	n	y	y
5.3	Where the explicit environmental claim is related to a final product, and the use phase is among the most relevant life-cycle stages of that product, the claim shall include information on how the consumer should use the product in order to achieve the expected environmental performance of that product. That information shall be made available together with the claim.	n.a.	n.a.	n.a.	n.a.

5.4	Where the explicit environmental claim is related to future environmental performance of a product or trader it shall include a time-bound commitment for improvements inside own operations and value chains.	n.a.	n.a.	n.a.	n.a.
5.5	Explicit environmental claims on the cumulative environmental impacts of a product or trader based on an aggregated indicator of environmental impacts can be made only on the basis of rules to calculate such aggregated indicator that are established in the Union law.	n.a.	n.a.	n.a.	n.a.
5.6	Information on the product or the trader that is the subject of the explicit environmental claim and on the substantiation shall be made available together with the claim in a physical form or in the form of a weblink, QR code or equivalent. That information shall include at least the following:	y**	y**	y**	y
5.6.a	environmental aspects, environmental impacts or environmental performance covered by the claim;	y	y	y	y
5.6.b	the relevant Union or the relevant international standards, where appropriate;	y	y	y	y
5.6.c	the underlying studies or calculations used to assess, measure and monitor the environmental impacts, environmental aspects or environmental performance covered by the claim, without omitting the results of such studies or calculations and, explanations of their scope, assumptions and limitations, unless the information is a trade secret in line with Article 2 paragraph 1 of Directive (EU) 2016/94346;	y	y	y	y
5.6.d	a brief explanation how the improvements that are subject to the claim are achieved;	y	y	y	y
5.6.e	the certificate of conformity referred to in Article 10 regarding the substantiation of the claim and the contact information of the verifier that drew up the certificate of conformity;	n.a.	n.a.	n.a.	n.a.
5.6.f	for climate-related explicit environmental claims that rely on greenhouse gas emission offsets, information to which extent they rely on offsets and whether these relate to emissions reductions or removals;	n.a.	n.a.	n.a.	n.a.
5.6.g	a summary of the assessment including the elements listed in this paragraph that is clear and understandable to the consumers targeted by the claim and that is provided in at least one of the official languages of the Member State where the claim is made.	n	n	n	n
5.7	Not relevant	-	-	-	-
5.8	Not relevant	-	-	-	-
Art. 6 Communication of comparative environmental claims					
Comparative environmental claims shall not relate to an improvement of the environmental impacts, environmental aspects or environmental performance of the product that is the subject of the claim compared to the environmental impacts, environmental aspects or environmental performance of another product from the same trader or from a competing trader that is no longer active on the market or from a trader that no longer sells to consumers, unless they are based on evidence proving that the improvement is significant and achieved in the last five years.		n.a.	n.a.	n.a.	n.a.

(*) For more considerations on data quality of LCI of Tetra Pak food cartons and steel can, please refer to Sections 2.2, 2.3, and 2.4.

(**) The reference of the comparative LCA study and a link to the Tetra Pak website where the list of LCA studies is available are provided, but the specific LCA study is not easily found by a general reader from the information available. Further details are given in Table 5 and Section 3.2.

3.3.2 ISO 14026: 2017

Claims from 1 to 4 can be defined as "comparative footprint communication" according to ISO 14026:2017, defined as result of preparation, provision and dissemination of the footprint, supporting information, and explanatory statement.

Overall, the general requirements from a) to j) (cf. section 6.2, ISO 14026) are as follows:

"A footprint communication shall be based on a footprint study which is based on ISO 14044 and, when required within this document, PCR developed in accordance with ISO/TS 14027. The footprint communication shall:

- *a) Be accurate, verifiable and not misleading;*
- *b) Be relevant to the particular product and used only in an appropriate context or setting;*
- *c) Be specific to the area of concern which is quantified;*
- *d) Be unlikely to result in misinterpretation;*
- *e) Clearly state the life cycle stages included;*
- *f) Be presented as discrete footprint information modules if sub-systems of the product system are reported separately in a footprint communication*
- *g) Not imply that the footprint communication is endorsed or verified by an independent third-party organization when is not;*
- *h) Not, either directly or by implication, exaggerate the significance of the area of concern to which the footprint communication relates;*
- *i) Be reassessed and updated as necessary to reflect changes in the product or in the manufacturing technology for the product, in LCA methodologies or other circumstances that could alter the information contained in the footprint communication;*
- *j) Include qualitative or quantitative information about uncertainties of the footprint to be communicated."*

Claims 1 to 4 regarding the carbon footprint of Tetra Recart are based on ISO14044 verified footprint studies and fulfil most of the general requirements from a) to j) as not point e) and j) are not fulfilled.

Regarding the requirements for the "intended audience" (cf. section 6.3, ISO 14026), the claims clearly state "where supporting information can be accessed and read". The comparative LCA studies (IFEU, 2017; IFEU, 2020. Supplement for Italy) provide all the required information and are publicly available on the Tetra Pak website. A link to the website is provided in claims 1, 3 and 4 and a QR code is provided in claim 2. A list of LCA studies is provided on the Tetra Pak website. As noted above, in claims 3 and 4 the reference to the study is simply "Studio LCA - Mercato Italia" without any other identifying information (e.g. year of publication) which makes it not possible for a consumer to directly identify the reference study in the list.

With regard to the "identification of the area of concern" (cf. section 6.4, ISO 14026), the terms "CO_2 emessa" (claim 3), "CO_2" (claims 2 and 4), "carbon footprint" (claim 1) refer to the area of concern "climate change" which is covered by the supporting LCA studies. However, there is an inaccuracy in the terms "CO_2" and "CO_2 emessa": the unit used in the impact category "climate change" in the UBA LCIA methodology is $CO_{2\text{-e}}$, which refers to all greenhouse gases, not just carbon dioxide. Instead, the term "$CO_{2\text{-e}}$" for "carbon dioxide equivalent" should have been used in claims 2, 3 and 4.

Concerning the information to be provided (cf. section 6.5, ISO 14026), a footprint communication shall consist of three elements: the footprint and related information, along with explanatory statements, where necessary. A footprint, that may be placed on the main body of the packaging or the publicity, shall include specific information:

- a) a clear indication of the area of concern;
- b) the functional unit or declared unit to which the footprint communication refers;
- c) identification of the life cycle stages covered by the footprint communication;
- d) an unambiguous indication (e.g. link to a website or a QR code) to access the supporting information (publicly available).

In addition, the standard clearly states that “the information required in a) to d) forms part of the footprint and shall be presented in a manner that clearly indicates that is intended to be read together with the footprint metric. It shall be of reasonable size and in reasonable proximity to the metric” (cf. section 6.5, ISO 14026).

Information a) about the clear indication of the area of concern is provided in all claims.

Information b) about the functional unit or declared unit to which the footprint communication refers, and is 1000 L of food packaging volume at the point of sale, is not indicated in any of the four claims.

Information c) about the identification of the life cycle stages covered by the footprint communication is not provided in any of the four claims.

Information d) is provided in acceptable forms in all claims.

Therefore, the footprint communications reported in claims 1 to 4 are incomplete regarding the required information from a) to d) according to ISO 14026.

Furthermore, " words, numbers or graphics used for other purposes shall not be used in a manner that is likely to be misunderstood as being part of that footprint communication" (cf. section 6.5, ISO 14026). In claim 2 (see Figure 2), a real steel can and a Tetra Recart package are included in the advertisement along with their CO_{2e} emissions as captions ("CO_2 518 gr" and "CO_2 86 g" respectively). As long as the functional unit of the reference study (information c)) is not included, the images of the individual packages may be easily misinterpreted by a reader, as the reported emissions may be related to an individual package instead of the reference functional unit (1000 L of food packaging volume).

In addition, the background images of the "emitting industry" and the "cultivated field", which refer to the steel can and Tetra Recart respectively, could easily be misunderstood as part of the footprint communication. Therefore, the images can be considered misleading for the footprint communication. The same observation refers to the list of additional environmental statements, that is only provided for Tetra Recart in claim 2 and that appear as part of the main comparative environmental claims: 1. "Riciclabile" (Recyclable); 2. "Composta prevalentemente da carta, una risorsa rinnovabile e certificata" (Composed mainly of paper, a renewable and certified resource); 3. "Pratica, sicura e leggera" (Practical, safe and light).

While the environmental statement 2 is a specific trait of Tetra Recart, claims 1 and 3 may belong to both packaging systems. **The claim "Riciclabile" (i.e. recyclable) is misleading for a reader, who is induced to attribute the property only to the single Tetra Recart packaging system.**

Regarding the supporting information (cf. section 6.5.2, ISO 14026), a third party study report in accordance with ISO 14044: 2006 is provided for all claims, including all information from a) to j), except for information d), as no expiry date (validity) is given for the studies in any case (see section 3.2).

Regarding the specific requirements for comparative footprint communication (see section 6.9, ISO 14026), a comparative footprint communication at the point of sale includes quantitative information and an explanatory statement. In all claims, the quantitative information is provided with one or more explanatory statements. In addition, the reference LCA studies "IFEU, 2017" and "IFEU, 2020. Supplement for Italy" were critically reviewed, as required for comparisons with products from other organizations.

Finally, the data to support the comparative footprint communications were quantified using the same functional unit and methodology, and verified by a critical review in both comparative studies. However, as noted above, there may be some concerns about the timeliness of some of the data sets related to steel can production.

However, in section 6.9 of ISO14026, it is reported that *"The footprint of different products shall only be compared in footprint communications if the calculation of the footprint for the products to be compared follows the same footprint quantification and communication rules and if the principle of comparability set out in 5.3. is met."* Where the principle of comparability, set in 5.3. is as follows: "*Footprint communications are intended to enable comparison, based on the area of concern, between products in the same product category and having the same functional unit or declared unit".*

Despite the footprint communications in claims 1 to 4 follow the same "footprint quantification rules", the "same communication rules" are not applied to both steel cans and Tetra Recart. In fact, the footprint results for steel can obtained in IFEU, 2017 and IFEU, 2020 studies are communicated outside the framework of both studies. For instance, the results for "steel can" in IFEU 2017 are only valid for steel cans containing canned tomatoes, of approximately 400 ml size, with mass specifications of a single product collected at the point of sale, obtained in 2016, etc. (see section 2.2 for details). In claim 1, based on IFEU 2017, the results are extended to a generic food steel can in the current EU market (see Figure 1 and Table 5).

In summary, the results of the steel can in the IFEU, 2017 and IFEU, 2020 studies could be communicated in accordance to ISO14026, but are communicated as representative for all the current segment market of steel cans for food in Europe and/or Italy, as intended in claims 1 to 4.

3.4 Discussion and remarks

MPE provided a sample of four comparative environmental claims made by Tetra Pak and two food manufacturers (Valfrutta and Fege) between a specific food carton (i.e. Tetra Recart) and generic competing steel cans for different food products. All claims make a similar comparative assertion that a specific food carton, i.e. Tetra Recart, has a specified reduction in CO_2 emissions compared to a generic steel food can.

In general, all claims report the comparative assertions, together with some explanatory statements and a reference to the comparative LCA studies, that are publicly available listed on Tetra Pak website.

There are however some important items that make the communication not completely compliant with the ISO standards and EU legislation, nor completely correct and potentially misleading for the consumer.

Proposal for a Green Claims Directive:

- Inequivalent information and data quality for steel can and Tetra Recart

The information and data used to assess the environmental impact of steel cans and Tetra Recart are not fully equivalent (see Article 4(1) letter a) and b), Green Claims Directive proposal). Tetra Recart, modelled with specific, mainly primary and mainly updated data, is compared to steel can, modelled with generic, secondary and often older data (e.g. old data in the LCI for tinplate converting and proxy data for steel can filling).

- Incomplete communication of the comparative explicit environmental claims

There is no summary of the assessment that is clear and understandable to the consumers targeted by the claim, except for the summary sections of IFEU, 2017 and IFEU, 2020, which are not clear to the general public. Although the claims related to GHG emissions are supported by the IFEU, 2017 and IFEU, 2020 studies, some additional claims, e.g. "Recyclable" in claim 2, are not supported by any study (see claim 2 in Figure 2).

ISO 14026:2017:

- Arbitrary extension of the specific LCA results to a general comparison valid in all circumstances

The comparison between Tetra Recart and a generic steel can is partly outside the scope of the LCA reference studies (IFEU, 2017; IFEU, 2020. Supplement for Italy) and may therefore be misinterpreted by the reader. In the limitation sections of both studies, it is clearly stated that the results of the LCA studies refer to specific filling products and packaging systems with a defined filling volume and weight specifications. Therefore, the LCA results cannot be extrapolated to packaging with other specifications outside the geographical boundaries and the reference year. Although the supporting comparative LCA studies comply with the requirements of ISO 14040/44 and provide results that could be communicated in accordance with the Green Claims Directive and ISO 14026:2017, **the communication of the LCA results in the comparative claims is outside the scope of the LCA studies and therefore potentially misleading for the consumer.**

- Incorrect association of background images

Furthermore, " words, numbers or graphics used for other purposes shall not be used in a manner that is likely to be misunderstood as being part of that footprint communication" (cf. section 6.5, ISO 14026). In claim 2 (see Figure 2), a real steel can and a Tetra Recart package are included in the ad with their CO_{2e} emissions as captions. In addition, the generic background images of the "emitting industry" and the "cultivated field", which refer to the steel can and Tetra Recart respectively, could easily be misunderstood as part of the comparative environmental claim (i.e. footprint communication). Therefore, the generic images can be considered misleading.

- Incomplete presentation of environmental properties

Similarly, the statement “recyclable” in claim 2, which refers only to Tetra Pak**, is misleading for a reader who is led to attribute this property only to the Tetra Recart** packaging system.

4. Conclusion

The comparative LCA studies by IFEU (IFEU, 2017; IFEU, 2020) assess the environmental performance of beverage and food cartons compared to alternative packaging systems and are overall compliant with the requirements of the ISO 14040/44 standards, as confirmed by the two independent Review Panels.

In the IFEU 2017 study, the results show potential lower environmental impacts for food carton compared to the examined steel can in most impact categories, valid within the study framework. In the IFEU 2020 study, for the climate change category, beverage and liquid cartons have lower environmental impacts in almost all segments, whereas for the other impact categories, the comparisons with competing packaging systems are more varied so that no general conclusions can be drawn.

In our opinion there are some relevant limitations on data quality and methodology that could negatively affect the reliability and robustness of comparisons for the analyzed packaging systems. These limitations are mainly related to the time coverage, quality and uncertainty of steel can data, goal and scope, specifications of packaging materials, quality of recycling data for beverage and food cartons, biogenic carbon accounting and impact categories considered. These limitations are detailed as follows.

Functional unit and system boundaries. The exclusion of shelf life and food losses from the scope of the analysis appears questionable, considering that primary packages aren't equivalent regarding the mechanical protection of packaged food and that the shelf life of canned food may last up to five years. This limitation should have been mentioned in the study report as it affects the comparability of the analyzed packaging systems. **The properties of metal packaging in terms of content protection are therefore underrated.**

Packaging specifications. In the IFEU 2017 study, primary packaging specifications are related to specific products purchased at the point of sale and are obtained by Tetra Pak. In the IFEU 2020 study, the specifications of primary packaging elements are determined by IFEU as "virtual typical packaging systems for Europe". The information available in both reports does not allow for a discussion on the representativeness of competing packaging systems. **In fact, the 400 ml steel cans used in IFEU, 2017 and IFEU, 2020** (57.5 g and 57.0 g, respectively) **are more than 15% heavier than the average weight** (49.8 g in 2013 and 49.6 g in 2018) **of steel cans of comparable size from different EU production sites** (MPE, 2022). The weight of the primary packaging in relation to the weight of the food it contains is a key parameter at all life cycle stages, determining the quantity of raw materials extracted and processed, as well as the quantity of packaging produced, transported, distributed and disposed of/recycled at the EoL. **The associated environmental impacts of steel packaging could be therefore overestimated**.

LCI of steel can filling step. In IFEU, 2017 and 2020, the filling step for steel cans is modelled as a proxy using data provided by Tetra Pak specific to carton packaging and referring to 2005 machine consumption, despite significant differences between the two packaging systems in terms of filling speed. **The use of an outdated and unrepresentative proxy for the filling of the steel can is a limitation** of the study which affects the equivalence of the data quality for the analyzed packaging systems. **It may also contribute to an overestimation of the associated environmental impacts of steel packaging**.

LCI of steel can converting. In IFEU, 2017 and 2020, the production of steel cans from tinplate is modelled on the basis of old literature data referred to 1996 in both studies (BUWAL 1999). **The use of outdated data is a limitation of the study which may overestimate the impacts of metal packaging and affect the comparability of the analyzed packaging systems**.

LCI of End-of-life – EoL. In IFEU 2017 and 2020, the collection and recovery rates used to model the EoL of beverage and liquid cartons are overestimated compared to more recent data from the same references (i.e. ACE), due to the use of the new EU methodology in the more recent statistics (Commission Decision 2019/665/EC). This results in higher credits from recycling and lower burdens from recycling and disposal in different impact categories, hence in a potential **underestimation of the environmental impacts of the cartons**. Therefore, the availability of significantly different, updated recycling rate data limits the time validity of the LCI of End-of-Life (EoL) for beverage and food cartons.

Life Cycle Impact Assessment (LCIA) - the UBA methodology used in both studies is sufficiently robust and comprehensive, covering many impact categories in line with ISO 14040/44 standards, with two exceptions. In IFEU 2017 study, the 'use of nature' category is excluded from the comparison of competing packaging systems due to data gaps. This is a relevant impact category for food cartons sourced from forests, so **the overall environmental impact of Tetra Recart may be incomplete and underestimated in the comparisons**. In IFEU 2017 and 2020, the "Water use" indicator is quantified but not considered for comparisons between packaging systems, justified by the lack of data and required information. The exclusion of these indicators represents another limitation of the study, since they are both relevant in paper production systems and therefore **potentially affecting the comparison** with metal packaging materials.

Biogenic carbon modelling. biogenic carbon is considered at two points for bio-based materials, CO_2 uptake during plant growth and re-emission of CO_2 at the EoL, where CO_2 uptake is not included in the credits (secondary bio-based raw materials). **This assumption has a significant impact on the reduction of climate change impacts of carton packaging** and should have been taken into account when interpreting the results.

In summary, the results of the studies in both IFEU 2017 and IFEU 2020 **are only valid in the specific context** of the systems analysed and the packaging solutions compared, which in case of the **steel and aluminium cans are quite generic and do not necessarily correspond to specific products on the market**. As such and according to ISO standards 14040/44, **the results cannot be extended to situations or packaging solutions other than those considered in the studies**. A variation in some key parameters, assumptions and background data of the studies would probably lead to different results and possibly changing the general outcomes of the comparisons.

Regarding the four comparative environmental claims by Tetra Pak showing a specified reduction in CO_2 emissions between a specific food carton by Tetra Pak (i.e. Tetra Recart) and generic competing steel cans for different food products, all the claims report the comparative assertions, together with some explanatory statements and a reference to the comparative LCA studies available on Tetra Pak website. However, there are some important items that make the communication not completely compliant with the ISO standard 14026 and the EU proposal for Geen Claims Directive, and to some extent incorrect and potentially misleading to consumers.

- **Arbitrary extension of the specific LCA results to a general comparison valid in all circumstances**

The comparison between Tetra Recart and a generic steel can is partly outside the scope of the LCA reference studies (IFEU, 2017; IFEU, 2020. Supplement for Italy) and may therefore be misinterpreted by the reader. The results of the LCA studies refer to specific filling products and packaging systems with a defined filling volume and weight specifications. Therefore, the LCA results cannot be extrapolated to packaging with other specifications outside the geographical boundaries and the reference year.

- **Inequivalent information and data quality for steel can and Tetra Recart**

The information and data used to assess the environmental impact of steel cans and Tetra Recart are not fully equivalent (see Article 4(1) letter a) and b), Green Claims Directive proposal). Tetra Recart, modelled with specific, mainly primary and mainly updated data, is compared to steel can, modelled with generic, secondary and often older data (e.g. old data in the LCI for tinplate converting and proxy data for steel can filling).

- **Incomplete communication of the comparative explicit environmental claims**

There is no summary of the assessment that is clear and understandable to the consumers targeted by the claim, except for the introductory sections of IFEU, 2017 and IFEU, 2020, which are not clear to the general public.

- **Incomplete presentation of environmental properties**

The statement “recyclable” in claim 2, which refers only to Tetra Pak, is misleading for a reader who is led to attribute this property only to the Tetra Recart packaging system. Furthermore, this additional claim is not supported by any study (see claim 2 in Figure 2).

- **Incorrect association of background images**

Furthermore, " words, numbers or graphics used for other purposes shall not be used in a manner that is likely to be misunderstood as being part of that footprint communication" (cf. section 6.5, ISO 14026). In claim 2 (see Figure 2), a real steel can and a Tetra Recart package are included in the ad with their CO_{2e} emissions as captions. In addition, the generic background images of the "emitting industry" and the "cultivated field", which refer to the steel can and Tetra Recart respectively, could easily be misunderstood as part of the comparative environmental claim (i.e. footprint communication). Therefore, the generic images are misleading for the consumer.

5. References

ACE, 2021. Beverage carton. Recycling facts & figures. Available at https://www.beveragecarton.eu/wp-content/uploads/2021/10/ACE-Recycling_BROCHURE_September-2021.pdf.

ACE, 2022. Impact assessment study of an EU-wide collection for recycling target of beverage cartons. Available at ACE-Impact-assessment-study-of-an-EU-wide-collection-for-recycling-target-of-beverage-cartons-Roland-Berger.pdf (beveragecarton.eu).

ACE, 2024. Beverage carton. Recycling facts & figures. Available at ACE-Recycling_BROCHURE_Jan-2024_compressed.pdf (extr-act.eu).

APEAL, 2018. Steel For Packaging. Available at: https://www.steelforpackaging.org/.

Eunomia, 2020. Recycling of multilayer composite packaging: the beverage carton A report on the recycling rates of beverage cartons in Germany, Spain, Sweden and the UK. Available at https://zerowasteeurope.eu/wp-content/uploads/2020/12/zero_waste_europe_report_-beverage-carton_en.pdf.

European Commission, 2023. Proposal for a Directive on substantiation and communication of explicit environmental claims (Green Claims Directive). March 22, 2023. Available at https://environment.ec.europa.eu/publications/proposal-directive-green-claims_en.

FFact, 2022. Aluminium beverage can recycling rates 2020. FF/FH 22.012. Available at https://european-aluminium.eu/wp-content/uploads/2022/12/14-12-2022_European-Aluminium_Report-alumnium-beverage-can-recycling-rates-2020.pdf.

IFEU, 2017. Comparative Life Cycle Assessment of shelf stable canned food packaging, Final Report. Heidelberg, December 2017. Available at https://www.tetrapak.com/it-it/sustainability/measuring-and-reporting/life-cycle-assessment.

IFEU, 2020. Comparative Life Cycle Assessment of Tetra Pak® carton packages and alternative packaging systems for beverages and liquid food on the European market. Final report. Heidelberg, March 9, 2020. Available at https://www.tetrapak.com/content/dam/tetrapak/publicweb/gb/en/sustainability/documents/2020-lca-tetra-pak-european-market.pdf.

IFEU, 2020. Comparative Life Cycle Assessment of Tetra Pak® carton packages and alternative packaging systems for beverages and liquid food on the Italian market. Supplement to Comparative Life Cycle Assessment of Tetra Pak® carton packages and alternative packaging systems for beverages and liquid food on the European market. Available at https://www.tetrapak.com/content/dam/tetrapak/publicweb/gb/en/sustainability/documents/lca/LCA%20TP_Italy_CR.pdf.

International Organization for Standardization, 2022. Environmental statements and programmes for products. Principles and general requirements. (ISO Standard No. 14020:2022). Available at https://www.iso.org/standard/79479.html.

International Organization for Standardization, 2017. Environmental labels and declarations. Principles, requirements and guidelines for communication of footprint information. (ISO Standard No. 14026:2017). Available at https://www.iso.org/standard/67401.html.

International Organization for Standardization, 2006. Environmental management. Life cycle assessment. Principles and framework. (ISO Standard No. 14040:2006). Available at https://www.iso.org/standard/37456.html.

International Organization for Standardization, 2006. Environmental management. Life cycle assessment. Requirements and guidelines. (ISO Standard No. 14044:2006). Available at https://www.iso.org/standard/38498.html.

Sivertsvik, M. 2021. Worth knowing about canned food. Available at https://nofima.com/worth-knowing/worth-knowing-about-canned-food/#ib-toc-anchor-3.

Metal Packaging Europe (MPE), 2022. Life Cycle Assessment of metal packaging in Europe – Update Metal Packaging Europe. Extended report by RDC Environment.

Packaging News, 2016. Study shows decrease in metal packaging's European carbon footprint. Available at https://www.packagingnews.co.uk/news/environment/study-shows-decrease-in-metal-packagings-european-carbon-footprint-26-09-2016.

Packaging Today, 2013. Empac reports metal packaging industry 'on target' with carbon reductions. Available at https://www.packagingtoday.co.uk/news/newsempac-reports-metal-packaging-industry-on-target-with-carbon-reductions.

Tetra Pak a. Food carton packages. How to achieve 24 months' shelf life without adding preservatives. Available at https://www.tetrapak.com/solutions/packaging/packages/food-packages.

Tetra Pak b. Tetra Pak® R2 for Tetra Recart. Available at https://www.tetrapak.com/solutions/integrated-solutions-equipment/filling-machines/tetra-pak-r2.

Tetra Pak c. Tetra Recart®. Available at https://productxplorer.tetrapak.com/packages/tetra-recart.

Tetra Pak, 2022a. Protects What's Good. Sustainability report 2022. Available at https://www.tetrapak.com/content/dam/tetrapak/media-box/global/en/documents/SustainabilityReport-2022.pdf.

Tetra Pak, 2022b. Sustainability report FY22. Available at https://www.tetrapak.com/content/dam/tetrapak/media-box/global/en/documents/sustainability-report-FY22-download.pdf.

USDA - U.S. Department of Agriculture. 2023. How long can you keep canned goods? Knowledge article. Available at https://ask.usda.gov/s/article/How-long-can-you-keep-canned-goods#:~:text=High%20acid%20foods%20such%20as,worst%20danger%20in%20canned%20goods.