

FEFCO Q&A: LCA study on recycling vs reuse of packaging

Could the conclusions of the study be misleading? (i.e. one system is better than the other system)

Answer:

The LCA study, which was reviewed by a third-party, clearly demonstrated that the single-use system performed better compared to the multiple-use system in most of the impact categories considered but not in all categories. Therefore, it cannot be argued that the single-use system is better than the multiple-use system in every scenario; subsequently, the conclusions of the study cannot not be misleading.

The results should be interpreted in the specific context of the study as the conclusions drawn apply to the comparison of single-use system and multiple-use system under the described assumptions, boundaries, and scenarios.

Why have all Environmental Footprint (EF) categories not been included in the study?

Answer:

The study included all Environmental Footprint (EF) categories except the EF Land Use impact category. This was excluded because of difficulties in interpreting results due to the following reasons (which are part of the ongoing scientific research): inconsistency between databases, insufficient data on relevant parameters, lack of common agreement on a cause-effect chain for modelling impacts, risk of overestimating or underestimating impacts in large countries.

How was the transport distance EU chosen?

Answer:

An average distance of 840 km was used to represent the intermediate B2B transports (i.e. from a food producer to distribution centers) within Europe. This distance was calculated by dividing exports and domestic distances from EU statistics, using information retrieved by Fruitlogistica and considering the:

- Top six fruit and vegetable producing countries (France, Italy, Greece, The Netherlands, Poland, Spain);
- Top exporter countries overall.

Why/how was the breakage rate (2.5%) chosen?

Answer:

An average breakage rate of plastic crates was established by considering minimum values (no breakage rate = 0%) and maximum values (5%, see Thorbecke et al. 2019) in relevant literature. A literature screening for plastic crates was presented in Lo-Iacono-ferreira et al. 2021. These findings further confirmed this percentage range for breakage rates. A sensitivity analysis was also conducted. This is a typical approach used in LCA to factor variation within a single parameter into the results. This calculated variation ultimately appeared to have no significant impact on the results of all impact

categories considered in the study. Therefore, the percentage selected for this parameter was considered sound.

What are the assumed end-of-life scenarios for the baseline? What is the main source for recycling share at end-of-life?

Answer:

The assumed end-of-life scenarios for the baseline were retrieved from statistics. The recycling rate at end-of-life of post-consumer corrugated boxes and reusable plastic crates was based on European statistical data:

- 82.9% for paper products (source: EUROSTAT).
- 41.8% for plastic products (source: EUROSTAT).

The remaining waste was assumed to be incinerated for energy recovery. This approach is in line with most of scientific publications related to the topic.

How was the recycling process for paper products modelled in the study?

Answer:

According to information from paper industry operators (CEPI and FEFCO 2018), B2B paper-board recycling is mostly a closed-loop process.

Paper recycling was modelled using the Life Cycle Inventory data for wastepaper recycling process, prepared by RISE in 2021 as part of a specific project which was based on the FEFCO LCA report 2018 (CEPI and FEFCO 2018) and adapted to consider information presented in the "Best Available Techniques (BAT) Reference Document for the Production of Pulp, Paper and Board" (Suhr et al. 2015). This data was compiled by RISE on behalf of CEPI and FEFCO and has been checked by a major producer of recycled corrugated materials, considering operating experiences. It was therefore used to model the corrugated board recycling process.

Why do the results present negative values?

Answer:

The LCA used the "Avoided burden approach" for EoL (as baseline scenario) because it:

- 1) Is the preferred approach by ISO standards and is explicitly stated in latest amendment to ISO 14044:2020
- 2) Ensures symmetry in assumptions (i.e. closed-loop approximation for both systems)
- 3) Ensures comparability of systems with inherently different characteristics (i.e. system with high material volume throughput vs. system with low material volume throughput)
- 4) Is in line with several other relevant LCAs and is therefore better suited for a debate surrounding their respective findings
- 5) Is consistent with underlying inventory data for corrugated board (CEPI and FEFCO, 2018), i.e. closed-loop approximation; hence results are not determined by 3rd party systems
- 6) Is used in several LCA studies published in the past five years comparing single-use corrugated board and multiple-use plastic crates (see e.g. Thorbecke *et al.*, 2019; Abejón *et al.*, 2020; Lo-Iacono-ferreira *et al.*, 2021)

This approach considers avoided emissions (credits calculated as avoided emissions at EoL) that may lead to negative results in the event that the avoided emissions are greater than direct emissions. This is due to inherent challenges in using different databases in the same model which is inevitable in some cases.

Are results of this study in line with other LCA studies that compare reusable and single use products? Can this study be compared with other similar studies?

Answer:

Certain assumptions are made in all LCA studies that serve to define the parameters and boundaries of the system(s) being evaluated, such as the functional unit, inventory, background data (i.e. database used for the model), impact categories, LCA methodology, geographic context, etc. Therefore, direct comparisons of LCAs are difficult given this potential range of parameters that can be established in the modelling.

That being said, the results from this LCA are different from other LCA studies that are more product-focused and reveal clearer environmental advantages for multiple-use items compared to their single-use equivalents, as long as a certain minimum number of reuses is reached. These other studies mainly rely on secondary data whereas the study at hand had access to primary data on corrugated board boxes, which explains the differing results. The functional unit and main assumptions (e.g. transport distances, breakage rate, number of reuses, etc.) were derived from Industry and Logistic operators within the value chain. Additionally, all data provided went through very extensive benchmarking and data-consistency sessions.

A study conducted in Germany in 2018 (Fraunhofer Institute for Building Physics IBP 2018) (subsequently referred to as the "SIM" study) presented a comparison of corrugated board boxes and reusable plastic crates. Although a direct comparison of the results of the SIM study with the study conducted by Ramboll, and commissioned by FEFCO, cannot be drawn, in this section, we present a discussion about differences between these two studies.

Regarding methodology, the SIM study considered one **impact category** (Global Warming Potential) – meaning the study only estimated a carbon footprint. The study implemented this impact category modelled via 2007 IPCC report¹ (also called AR4), while Ramboll's study modelled the impacts via EF 2.0 Climate Change, total impact category, which is referred to the 2013 IPCC report² (also called AR5). AR4 and AR5 have different **characterization factors**. For example, fossil methane emissions to air are characterized in the AR4 and AR5 with factors 25 kgCO₂-eq./kg or 36.75 kgCO₂-eq./kg respectively. By using different characterization factors, different results were obtained. Moreover, a study conducted with a single impact category, such as the SIM study, focuses its discussion only on this specific category, which limits the boundaries of a broader discussion. The study conducted by Ramboll considered 15 impact categories³, which provides a broader view on the topic.

To consider the **end-of-life allocation approach**, both studies modelled environmental burdens via the avoided burdens approach (also called system expansion in LCA). The Ramboll's study also

¹ <https://www.ipcc.ch/report/ar4/syr/>

² <https://www.ipcc.ch/report/ar5/wg1/>

³ Climate Change is considered here as single category, although it is constituted of three sub-impact categories: Climate Change, fossil, Climate Change, biogenic, Climate Change, land use and land use change. For the sake of transparency, all these three sub-categories were included in the Ramboll's study and disclosed.

implemented the Circular Footprint Formula, alongside the Avoided burdens approach to increase transparency, which might be considered a methodological difference between the studies. The use of more than one allocation approach expands the possibility to discuss results and robustness of a study.

The two studies differ in terms of **number of reuses** (also called rotations) considered for reusable plastic crates. This is due to different assumptions and different sources of information taken into account: confidential in the SIM study, retrieved from literature in the Ramboll's study. Ramboll's approach utilizes the average number of rotations available in the literature since, to the best of our knowledge, no evidence regarding the number of reuses for plastic crates in Europe has been published. However, since this parameter was considered to be critical by the review-panel, and since it is common practice to investigate the variability of parameters in LCA, a sensitivity analysis was presented by both studies to further investigate variation of output.

The two studies also differ on **the composition of corrugated board boxes**. The SIM study considered boxes composed of 36% kraftliner and 64% semi-chemical fluting; Ramboll's study considered boxes composed of 53% kraftliner and 47% semi-chemical fluting. The latter used information provided by FEFCO on the current average composition of a corrugated board box.

The two studies also utilized different **recycling rates**. For corrugated board boxes, the SIM study used a recycling rate of 85% while Ramboll used 82.9%. Ramboll's more conservative figure was derived from the most recently available information from Eurostat. The studies also had different recycling rates for reusable plastic crates: 77.5% for the SIM study and 41.8% Ramboll study. The recycling rate used by Ramboll's was based on data retrieved from Eurostat, was in line with other publications in the field, and was approved by the third-review panel.

The two studies considered different approaches for **avoided emissions (environmental credits)**. The SIM study reported for corrugated board box that "fibres that are too short are sorted out and used for sanitary paper". However, no further specification was given in the report that could be of help at understanding the modelling of credits. The Ramboll study outlined the substitution approach for recycled pulp via virgin pulps. Justification for the choice of type of pulps (chemical and mechanical), as well as methodology for defining the point of substitution, were further reported for transparency. And reference to the last PEFCR for intermediate paper products was considered.

The presented list of differences can be considered a non-exhaustive and set of examples to engage in a general discussion.

What data sources were used for corrugated board and box production and for the plastic and crate production?

Answer:

The primary data on the corrugated board and box production came from the FEFCO 2018 LCA report (CEPI and FEFCO 2018). The secondary data used on the production of plastic crates was retrieved from scientific literature.

What is the functional unit of the study? Why was it chosen?

Answer:

A functional unit refers to the product, service, or system whose impacts are calculated by a Life Cycle Assessment. The functional unit of the study was the provision of delivery, containment, and display for 1 ton of vegetables (fresh product) by means of functionally equivalent transport containers (single-use corrugated board boxes or multiple-use plastic crates) over a transport distance of 840 km from producer to retailer within the EU in a manner that maintained the safety of the produce and that was consistent with established commercial supply chains.

This functional unit was chosen in line with relevant scientific literature and fulfils the requirements of the ISOs 14040/44. The comparative LCA analyses two systems using the same assumed functional unit (in this case, the same amount of transported goods).

Did the study follow PEF methods?

Answer:

In December 2021, the European Commission (EC) published a “revised Recommendation on the use of Environmental Footprint (EF) methods, helping companies to calculate their environmental performance based on reliable, verifiable and comparable information, and for other actors”. Following this recommendation, and with the aim to improve industry knowledge on how to reduce the environmental emissions of its products, the study considered the following product environmental footprint (PEF) aspects:

- Circular Footprint Formula
- Environmental Footprint impact categories⁴
- Product Environmental Footprint Category Rules (PEFCR)⁵ for paper intermediate products
- Approach for dealing with negative values in the results, as suggested in the PEFCR guidance⁶
- Contribution of impacts to the total impacts, following the PEFCR guidance (presented in the report’s Appendix)

Other aspects of PEF were not applicable to this comparative LCA for methodological reasons (e.g. absence of specific Product Category Rules - PCRs).

Why were 24 reuse cycles assumed for the reusable packaging solution?

Answer:

The number of reuses (or rotations) for the RPC system was established based on an existing comparative study on single-use CBs and RPCs (Thorbecke et al. 2019). The authors assumed 24 rotations for RPCs based on RPC industry experts. In the study, it was understood that RPCs complete one reuse cycle every 3-4 months for 5-6 years. A conservative estimate then assumed that the RPCs were returned 4 times per year over 6 years, resulting in a total number of 24 reuses. This assumption has been discussed with and confirmed by logistic operators. However, since this is a debated parameter in literature, the study conducted by Ramboll presented a break-even analysis for the impact category Climate change.

⁴ https://ec.europa.eu/environment/eussd/smgp/ef_methods.htm

⁵ https://ec.europa.eu/environment/eussd/smgp/pdf/PEFCR_Intermediate%20paper%20product_Feb%202020.pdf

⁶ Source: PEFCR Guidance, available at https://ec.europa.eu/environment/eussd/smgp/pdf/PEFCR_guidance_v6.3.pdf

Why did the study not follow ISO 14025 and publish the dataset?

Answer:

ISO 14025 establishes the principles and specifies the procedures for developing an Environmental Product Declaration (EPD), which is used for the analysis of specific products manufactured by single companies. EPDs are not intended for comparative analysis and rely on specific Product Category Rules (PCRs) that establish the main rules and assumptions (e.g. functional unit, system boundaries, etc.) to be followed in the development of an EPD.

The study conducted by Ramboll and commissioned by FEFCO is not an EPD for the following reasons:

- The study does not focus on a specific product manufactured by a single company; instead, it analyses two systems.
- No category rules are in place for such systems.
- The study is a comparative LCA, which is not possible to perform with an EPD.

References

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