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About Life Cycle Assessment
LCA is a technique for assessing the environmental impacts associated with a product, by
• Compiling an inventory of relevant inputs and outputs of a product system,
• Evaluating the potential environmental impacts associated with those inputs and outputs,
• Interpreting the results of the inventory analysis and impact assessment phases in relation to the objectives of the study.
While this presentation focuses on Global Warming Potential and some other environmental impact categories (blue squares), the full Sphera LCA considered all categories recommended by Product Environmental Footprint Guidelines.
A high level of transparency and offering various sensitivity analysis and scenarios in a LCA is important to allow readers to understand the study design, interpret results and draw their own conclusions.
LCAs today are mostly linear instead of applying circular thinking, which would be more appropriate for fast moving consumer goods such as beverage packaging.

That is why Ball is sponsoring a multi-year PhD program at the University of Barcelona to research limitations of packaging LCAs and develop new and scientifically sound approaches to overcome these limitations.

Ball will build on these findings and initiate discussions with stakeholders to ensure future LCAs adequately capture the true sustainability performance of beverage packaging.
Sphera Comparative LCA Study
Critical Peer Review Panel

Prof. Dr. Pere Fullana i Palmer
Director of the UNESCO Chair in Life Cycle and Climate Change

Dr. Ivo Mersiowsky
Sustainability and leadership consultant, LCA expert (focus chemical and plastics industry)

Angela Schindler
Environmental management consultant, LCA expert (focus modelling, packaging), reviewer for the International Journal of Life Cycle Assessment
GLOBAL WARMING POTENTIAL (CARBON FOOTPRINT) PER LITRE

Carbon footprint comparison per litre


Climate change exl. biogenic carbon (% CO₂ eq.) per litre of fill volume cradle-to-grave incl. transports EU, PEF, CFF.
SUMMARY OF SEVERAL ENVIRONMENTAL IMPACT CATEGORIES, BIGGER FORMAT CONTAINERS

MATERIAL CIRCULARITY INDICATOR (MCI): 0.1 = LINEAR, 1 = FULLY CIRCULAR


Note: MCI methodology includes non-recycled renewables fibres as circular. Other methodologies do not.
SUMMARY AND CONCLUSIONS FOR EACH MATERIAL

- Good performance on Global Warming Potential (GWP), benefiting from lightweight, high recycling rates and good recycled content.
- Biggest opportunity to decrease further GWP by increasing recycling rates and recycled content, reaching the same values of cartons and non-carbonated water PET bottles (recycling cartons adds GWP impact).
- **Best material circularity score** (~0.7) of all single-use packaging options.

- Low weight non-carbonated water PET bottles come with the **lowest overall carbon footprint**, benefiting from the low weight compared to heavier PET bottles for carbonated drinks and other bottles such as tea, juice or premium water.
- Carbonated PET bottles and cans come with **very similar carbon footprints** – on other environmental impact categories, sometimes cans come with lower impacts (e.g. resource use), and sometimes PET (e.g. acidification).
- Low real recycling rates (42%) and recycled content (0% as per PEF) as well as high recycling yield losses result in **worst material circularity scores** of all substrates for PET (<0.3).

- **Highest environmental impacts** for single-use glass in several categories, driven by heavy weight, and very resource and energy intensive glass production.
- Bad scores on **acidification**.
- **Average material circularity** scores for single-use bottles (~0.45).

- Good results for several impact categories driven by biogenic carbon accounting rules and relatively **small manufacturing impacts** and the fact that integrated pulp and paper mills generate most of their energy from biomass intake such as wood offcuts.
- **Material circularity scores** in the 0.5-0.6 range, benefiting from the MCI methodology which assumes all sustainably sourced fibers are restorative and circular by nature (despite recycling challenges of fiber, plastic and aluminum layers).

Source: Ball summary analysis based on the peer reviewed comparative beverage packaging LCA, Sphera, 2020
| Product Specifications & Main Datasets Used. All containers are real, popular beverages |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Alu 50cl | Alu 33cl | Alu 25cl | PET 50cl (non-carbonated) | PET 50cl (carbonated) | PET 38cl (non-carbonated) | PET 30cl (non-carbonated) | Glass 1L | Glass 25cl | Carton 50cl | Carton 33cl |
| **Purchased In** | DE | DE | UK | UK | DE | UK | UK | UK | DE | DE | UK |
| **Total Container Weight (g)** | 14.5 | 11.9 | 10.3 | 14.9 (bottle, cap, label) | 22.5 (bottle, cap, label) | 27.2 (bottle, cap, label) | 20.9 (bottle, cap, label) | 521 (bottle, cap) | 172 (bottle, cap) | 23.0 | 17.0 |
| **Secondary Packaging** | | | | 4 pack, corrug. board, LDPE (28.5g) | 12 pack, LDPE (16g) | 6 pack, LDPE (8g) | Individual bottle | 6 pack, HDPE crate (1042g) | 4 pack, corrug. Board (44g) | 8 pack, corrug. board (126g) | 4 pack, corrug. board (20g) |
| **Recycled Content** | 55% can body, 3% can end | 0% | 40% | 0% |
| **Recycling rate** | 69% (real recycling) | 42% (real recycling) | 66% (real recycling) | 43% (collection rate!) |
| **Allocation factor** | 0.2 | 0.5 | 0.2 | 0.2 |

*all values as per PEF Guidelines, Annex C. Official collection for recycling rates are revised to real recycling rates as per information from each association except for cartons who do not publish it.
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Sensitivity Analysis
EFFECT OF RECYCLING RATE ON CARBON FOOTPRINT

Carbon footprint as recycling rate increases
(CO₂ eq. per litre)

Source: Ball’s graph based on the sensitivity data from peer reviewed comparative beverage packaging LCA, Sphera, 2020. The PEF CFF formula is too rigid for this sensitivity assessment, so the substitution method has been used as the baseline for this analysis.
EFFECT OF LIGHTWEIGHTING TRENDS FOR 50CL PET AND CANS ON CARBON FOOTPRINT

Carbon footprint comparison of 50cl formats (range of containers weights in the market)

- **PET 50cl (NON-CARBONATED)**
  - Total Container weight: 14.9g

- **PET 50cl (CARBONATED)**
  - Total Container weight: 22.5g

- **Alu 50cl**
  - Total Container weight: 14.4g

- **Heaviest PET 50cl POM**

- **Lightest PET 50cl POM**

- **Heaviest can 50cl POM**

- **Lightest can 50cl POM**

Source: Average weights from INCEPT. Ball’s graph using Incept weights and LCA data consistent with Sphera, 2020.
EFFECT OF REFILL CYCLES OF REFILLABLE GLASS BOTTLES ON CARBON FOOTPRINT

Carbon comparison per litre as number of glass refills increase vs single-use cans

Source: Ball's graph based on the sensitivity data from peer reviewed comparative beverage packaging LCA, Sphera, 2020 for 33cl and 50cl. 1L Glass bottle sensitivity analysis was not included in the Sphera report and has been calculated by Ball at later stage.
Plans to further improve the beverage can
IDENTIFIED OPPORTUNITIES TO DECREASE A 33CL CAN’S CARBON FOOTPRINT IN NEXT 5-10 YEARS (33CL)

Source: Ball’s own calculation based on Instant LCA software and own and industry data.
CANS BENEFIT THE MOST AS SOCIETIES MOVE TOWARDS REAL CIRCULARITY

100% COLLECTION

100% COLLECTION

100% OF THE MATERIALS ARE SORTED

100% RECYCLED CONTENT BACK INTO SAME VALUE PRODUCTS

100% YIELD RECYCLING

REAL CIRCULARITY
A CIRCLE THAT NEVER ENDS
The overall recycling rate for aluminium beverage cans in the European Union, Switzerland, Norway and Iceland increased to a new record level of 74.5% in 2017.

LIKELY DROP OF RECYCLING RATES WITH NEW EU CALCULATION POINT

Source: collection rate from each association: aluminium cans (MPE), PET (PETCORE), glass (FEVE). Real recycling rates are calculated as the ratio between the R2 factor of the PEF discussions (output recycling plant [R2], that can be download [here]) and the collection rate for the aluminium can, PET bottle and glass bottle.
DRS AND OPTIMISED EPR WILL PUSH THE COLLECTION RATE IN EUROPE BEYOND 90% BY 2030

Development of recycling schemes over the next years

Source: FFACT - Aluminium beverage can recycling rate forecasts for 2025 and 2030
ISSUES ACROSS ALL RECYCLING VALUE CHAIN FOR VARIOUS BEVERAGE CONTAINERS

Collection
- Weight
- Breaks
- Minimum collection rate
- Contamination to paper and cardboard
- Low value

Sorting
- Colour
- Breaks
- Black plastics
- Coloured PET
- Export market
- Lack of infrastructure

Extra Sorting
- Fine particles
- Cap, silicone valve, glue, label
- Cap, straw, straw packaging
- Multi-material
- High yield losses
- PolyAl
- Fibre shortening

Treatment
- Opaque / TiO₂
- High yield losses
- Degradation
- High cost
- Multi-material
- High yield losses
- PolyAl
- Fibre shortening

Re-incorporation
- Low value
- Nurdles
- Minimum rPET content
- EFSA guidelines
- End markets
- Non-aluminium labels, ends, widgets

Source: Ball’s own analysis based on experience and interview with various consultants and recycling experts
MATERIAL KEPT IN THE LOOP AS COLLECTION INCREASES: EFFECT OF RECYCLING YIELDS IS WHAT MATTERS

Source: Eunomia’s original idea. Ball’s own analysis based on recycling yields assumptions for each packaging container. Real recycling yields are calculated as the ratio between the R2 factor of the PEF discussions (output recycling plant [R2], that can be download here) and the ‘collection for recycling’ rate for the aluminium can, PET bottle and glass bottle.

Number of containers that can be made from the material remaining in the loop from one collected container, in multiple recycling cycles (it takes into account the recycling losses and it depends on the collection rate)
FURTHER OPPORTUNITIES TO DECREASE CARBON FOOTPRINT OF VIRGIN ALUMINIUM

Emissions per ton of aluminium produced per production step - Ton CO₂ / Ton aluminium

- In scope of roadmap

Decarbonisation of grid

Decarbonisation of alumina production

Inert anode technologies

0.6
0.1
1.6
0.9
0.5
1.7
0.1
6.6
3.9
1.5-12.5

Other
Bauxite mining
Process heat (alumina)
Transport
Anode production
Direct emissions
Casting
TOTAL
Electricity emissions

Source: Material Economic analysis via data from International Aluminium Institute, 2019 (http://www.world-aluminium.org/statistics/)
IMPACT OF VARIOUS VIRGIN ALUMINIUM SEMI-FINISHED GOODS COMPARED WITH RECYCLING

Questions?