

Life Cycle Analysis of Beverage Packaging

The following is a summary of **independent research** initiated and conducted by Alice Brock and Ian Williams of the **University of Southampton** Faculty of Engineering and the Environment.

It was published on 5 October 2020 in the academic publication 'Detritus', the Multidisciplinary Journal for Waste Resources & Residues.

This summary is published with the full consent and approval of the authors.

Executive Summary

Introduction

A Life Cycle Assessment (LCA) to compare the environmental impacts of different types of beverage packaging, has concluded that **beverage cartons have the lowest impact on the environment in their main categories (milk and fruit juice), by a significant margin, compared to glass and plastic bottles.**

LCA studies ensure the whole life cycle of a product is assessed, from raw material to end-of-life to give a clear, data-based assessment of the sustainability of comparable products.

The independent study, conducted by Alice Brock and Ian Williams from the Faculty of Engineering and the Environment, University of Southampton, compared different types of packaging for beverages in three categories: commonly used containers for milk, fruit juice and pressurised 'fizzy' drinks.

Review methodology

The researchers used CML methodology, which complies with ISO 14040:2006 and ISO 14044:2006 standards for life cycle assessment. This methodology was developed by the Institute of Environmental Sciences at the University of Leiden in the Netherlands and is one of the most widely used and respected methodologies in life cycle assessments.

The study aimed to:

- i) **Review the costs, benefits, advantages and disadvantages of plastics as packaging materials**
- ii) **Use life cycle assessment to determine if there are less environmentally impactful alternatives to plastic bottles**

The packaging types examined were glass bottles, aluminium cans, beverage cartons (the researchers differentiated between refrigerated beverage cartons which they termed 'milk cartons' [non-aseptic beverage cartons] and aseptic cartons i.e. for non-refrigerated fruit juice, which they referred to as 'Tetra Pak'), polyethylene terephthalate (PET) bottles and high-density polythene (HDPE) bottles.

The CML impact categories included:

- Global warming potential/climate change
- Human toxicity
- Ozone layer depletion
- Depletion of resources
- Marine aquatic toxicity

Transport was not included as an impact category in the study due to the complexity and variability of transportation methods. Transport can have high impact due to fuel usage and emissions so inaccuracy could alter the results significantly. Furthermore, it is difficult to accurately quantify the distances the packaging would have to travel and so for these reasons the study did not include transportation.

The authors did point out that in other studies, which have attempted to quantify the impact of transport, **it is widely accepted that heavier, packaging types require more fuel and energy to transport.**

Key reporting findings

In the fruit juice category, the **aseptic beverage carton** (termed 'Tetra Pak' in the study) **had the lowest environmental impact, by some margin.**

Glass bottles were highest ranked overall for environmental impacts with PET bottles in the middle.

Fruit juice category impacts:

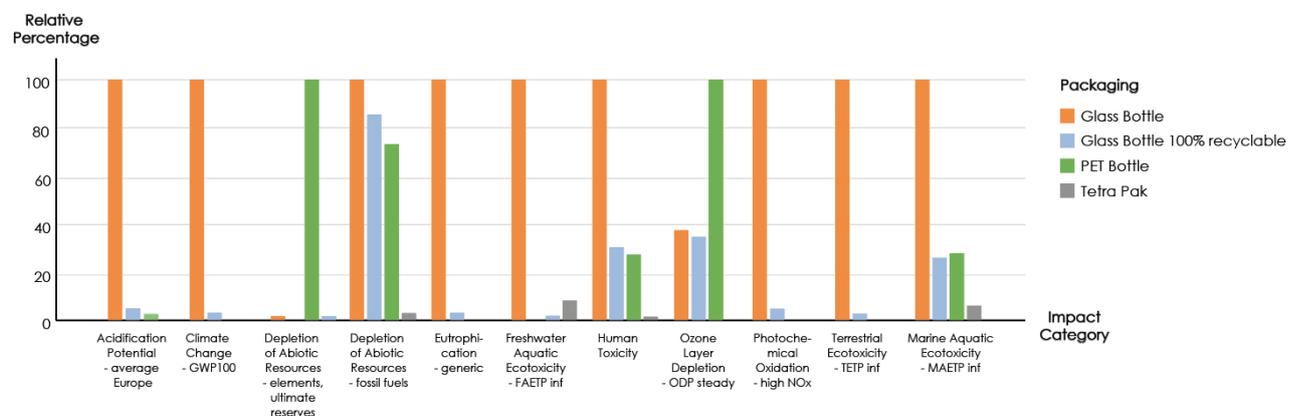


FIGURE 1: Relative results from Fruit Juice Packaging category CML impact methods. Maximum indicator is set to 100% and other variants displayed in relation to this result indicating differences from maximum impact indicator.

In the milk category, **non-aseptic beverage cartons** (termed milk cartons in the study) **again had the lowest environmental impact across almost all measures.**

In this category **the glass bottle was the highest ranked overall for environmental impacts across all measures, with the 100% recycled glass bottle the second most impactful and the HDPE bottle third ranked.**

Milk packaging category impacts:

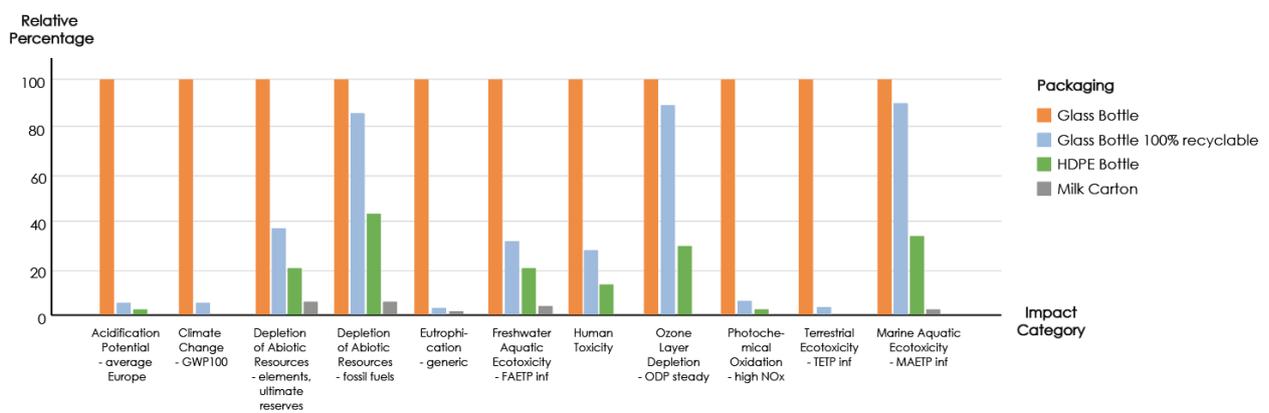


FIGURE 2: Relative results from the Milk Packaging category CML impact methods. Maximum indicator is set to 100% and other variants displayed in relation to this result indicating differences from maximum impact indicator.

Conclusions

In both categories in which they were included, beverage cartons were ranked as the most sustainable packaging type with the lowest environmental impact.

Glass and recycled glass bottles had the highest environmental impacts of the packaging types assessed, and both PET and HDPE plastic bottles had lower environmental impacts than glass bottles but higher impacts than beverage cartons.

As previously mentioned, this study **does not include transport emissions**, which if considered could potentially mean **heavier packaging materials having an even greater environmental impact than already demonstrated.**

The study makes the point that:

“[Aseptic beverage cartons] low impacts are due to the fact that around 75% of [their] packaging is made of paper, which unlike the other materials used in beverage packaging, is renewable.”



The report concludes:

“It is recommended that the packaging types identified as the least impactful in each category [ie beverage cartons] are used in situations where single use packaging is required.”

The full report is available here:

[Life Cycle Assessment of Beverage Packaging](#)