Decarbonisation of Single Use Beverage Packaging

Investigating 1.5ºC aligned carbon budgets for aluminum, PET and glass beverage containers in the EU

Executive Summary

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eunomia

ZERO WASTE EUROPE

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This study builds upon Eunomia's previous investigation into materials decarbonisation pathways in the report *"Is Net Zero Enough for the Material Production Sector?"*[1]. Focussing on the four materials with the greatest emissions globally, the study found that each will have great difficulty in reducing GHG emissions in line with a 1.5°C future by 2050, particularly if mass consumption continues and increases. Whilst studying the global material picture provides valuable insights; policymakers may find it more useful to have the same approach applied at the product level. Therefore, this study delves into the Net Zero pathways of aluminium, PET, and glass when utilised in beverage packaging within the EU, evaluating their potential performance within a cumulative GHG emissions budget that aligns with the goal of limiting global warming to 1.5°C.

Approach

As the focus of this report shifts from raw materials to products, some simplifications have been necessary. It is important to note that the results presented should not be considered a comprehensive cradle-to-gate assessment. Instead, they provide an initial overview of the key material greenhouse gas (GHG) impacts during the critical 30-year period ahead.

Similar to the previous study, published net-zero strategies have been utilised whenever possible. Existing analyses for aluminium and PET (plastic) have been adapted to specifically address beverage containers. Regarding glass, the analysis is primarily based on a single published Net Zero strategy by British Glass with additional support from academic papers.

It is important to acknowledge that some key technological interventions, such as Carbon Capture, Utilization, and Storage (CCUS), as well as the deployment of green hydrogen as a fuel source, have not yet been proven at a commercially viable scale. Furthermore, there may be risks associated with costly interventions (e.g., electrification of glass furnaces). Therefore, a risk rating has been assigned to each technological intervention to account for the potential of not fully realising their intended benefits.

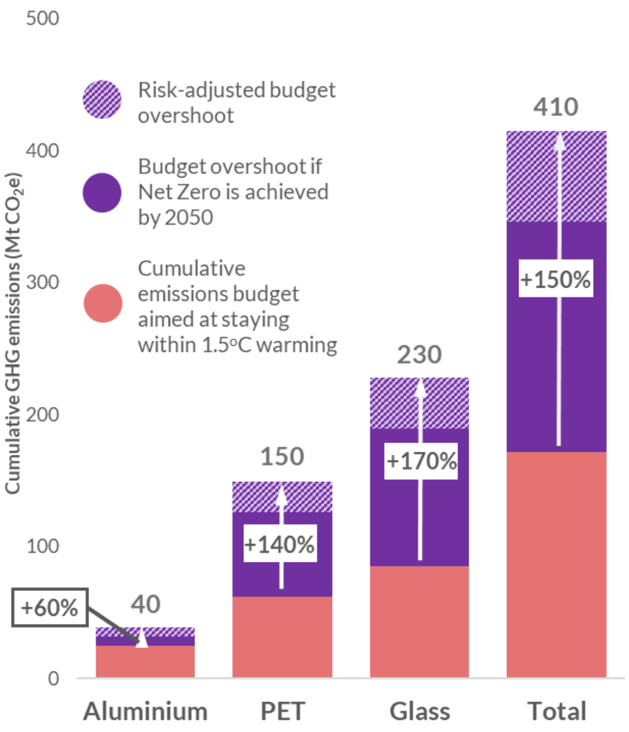
Results

Figure E- 1 illustrates the cumulative GHG emissions of each material compared to the 1.5°C aligned budget, including the combined budget for beverage packaging using these three materials. The projections indicate that, collectively, the materials are expected to surpass the allocated budget by +150% including risk adjustment, with glass and PET being significant contributors to this exceedance at +170% and +140% respectively. Aluminium's budget overshot is estimated to be around 60%.

The growth rate for the consumption of all materials by the beverage packaging sector is assumed to be zero (i.e. the same demand in 2050 as 2020). It is considered unlikely that overall container use can continue to grow indefinitely. Alongside this, the EU population is expected to be lower by 2050 than it is today, and we would expect container use to have a close relationship to population size. Nevertheless, the results show that even with no growth in material consumption, the beverage container industry is likely to significantly overshoot the proposed cumulative emissions budget aimed at staying within 1.5°C warming.

[1] https://zerowasteeurope.eu/wp-content/uploads/2022/11/Is-Net-Zero-Enough-for-the-Materials-Sector-Report-1.pdf

Figure E- 1: Cumulative EU Beverage Container GHG Emissions to 2050



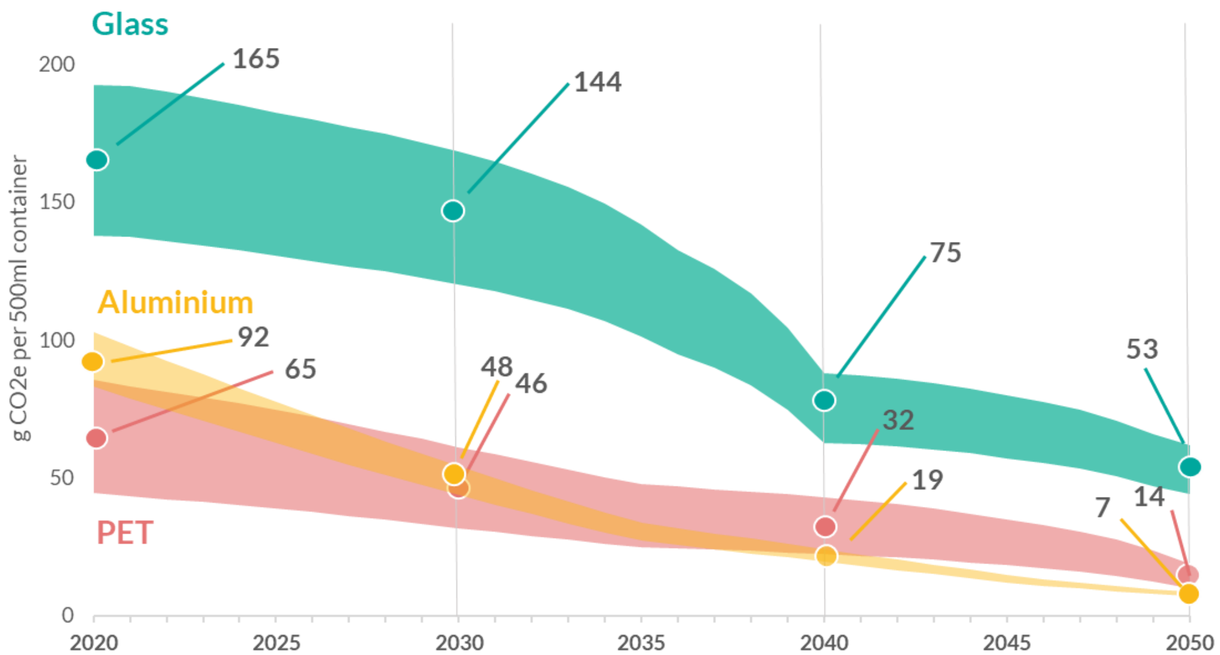
To provide further context regarding the differences between materials, results are shown in Figure E- 2 per container rather than as total industry emissions shown in the previous sections.

This figure considers the projected GHG emissions for each year, ***including the risk factor***, divided by the weight of material used in a hypothetical 500ml container. Different typical weight ranges for containers of each material are considered, particularly for PET, where packaging weight limitations are often more technical than commercial. Aluminium exhibits a narrower weight range per container due to the need for pressurisation in all cans, resulting in greater standardisation across brands. In contrast, glass containers have a wider weight range as they can vary significantly between brands and drink types with limited standardisation.

These results indicate that the GHG emissions per unit of packaging material are consistently three to four times higher for glass bottles compared to aluminium and PET throughout the decarbonisation pathway. Even when accounting for uncertainties in each material's pathway, it seems unlikely that this performance gap can be bridged, especially considering that glass's projected endpoint by 2050 is similar to or higher than the emissions of aluminium and PET by 2030. Such a significant difference in magnitude would pose a considerable challenge to overcome.

Both aluminium and PET exhibit similar trends along the pathway, and the speed and effectiveness of decarbonisation interventions could lead to one outperforming the other, particularly from 2030 onwards. However, both materials need to prioritize the development of credible pathways towards net-zero emissions since they are expected to exceed their respective budgets.

Figure E- 2: EU Beverage Container Decarbonisation Projections – per Typical 500ml Container Range



1.1 Key findings

The following summarises the key findings of this report:

- All three materials face significant challenges in decarbonization, posing a risk to achieving net-zero emissions by 2050. The most pressing challenges are as follows:
  - ***Aluminium*** **–** Transitioning the smelting process to run on green energy will necessitate substantial investments due to its high energy requirement (~15MWh/tonne).
  - ***PET*** **–** A fundamental shift in the value chain to bio-based feedstock is necessary, but technical hurdles currently exist and may conflict with the fossil-focused nature of the industry.
  - ***Glass*** **–** electrifying gas furnaces will require either a costly and complete infrastructure upgrade or a gradual replacement of legacy systems. Despite efforts, glass manufacturing will continue to have high energy consumption (~2MWh/tonne).
- All three materials are projected to surpass their allocated carbon budget, with glass exhibiting the highest proportional exceedance. The beverage packaging sector in the EU as a whole is expected to exceed its total carbon budget. It is evident that sustaining or increasing current demand for beverage packaging materials is incongruent with achieving a future of less than 1.5°C global warming.
- The findings consistently demonstrate that the production of glass bottles results in three to four times higher greenhouse gas (GHG) emissions compared to aluminium and PET throughout their respective decarbonisation pathways.
- Enhancing recycling and circularity practices appears to be of utmost importance for aluminium and PET, but it holds less significance for glass. This disparity arises from the fact that producing aluminium from recycled content has a significantly lower impact than using virgin materials, whereas PET that is not recycled is often incinerated. In contrast, glass lacks these drivers, and substantial energy consumption persists even with high levels of recycled content.
- Recycled glass still requires 75% of the energy needed for virgin glass production, whereas aluminium only requires approximately 10%. Consequently, both materials require approximately 1.5MWh/tonne for recycling. However, it's important to note that aluminium cans fulfil the same container function as glass while requiring significantly less mass. These characteristics are inherent to the properties of the materials and are unlikely to change over time.

1.2 Recommendations

The challenge lies in the fact that all the materials in this study require significant technological investment to transition towards Net Zero. Equally, significant progress can be made with current technologies by investing in green energy. Each industry will benefit not just from a faster and more concerted transition to Net Zero grids within the countries they are buying electricity from, but a necessary increase in capacity as electricity is increasingly used in place of direct burning of fossil fuels. This is likely to be the single biggest and important short-term action for governments.

However, it is evident that reducing material demand should also be a top priority. This clearly conflicts with current business models in a market-driven economy, hence, it is crucial to separate the amount of material sold from the value derived from it. Developing reuse systems for beverage containers appears to be the most promising approach to achieve this goal. Nonetheless, it is important to ensure that reduced material demand does not result in a transfer of emissions burdens elsewhere, including sectors outside of material production.

Furthermore, it is evident that both PET and aluminium offer more compelling options compared to glass *in single use applications*. From a purely climate change perspective, switching to these materials may be preferable, but will not solve the long term problem. Given that glass is highly suitable for reuse, adopting a system that promotes reuse is likely to significantly decrease overall material demand. Therefore, it would be informative to further examine decarbonisation pathways for beverage container materials while accounting for reuse.

Moreover, it is essential to conduct comparative studies that consider the decarbonisation pathways rather than focusing on a single point in time, typically the present day. Such studies will provide a more comprehensive understanding, particularly when the burdens shift from material to energy in reuse systems (e.g. reducing materials, but increasing transport). This aspect warrants further investigation, along with broader efforts to optimise reuse systems.

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