

WHITE PAPER

THE ENVIRONMENTAL IMPACT OF PACKAGING FORMATS

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THE CONTAINER COMPANY

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EXECUTIVE SUMMARY

Packaging contributes 40% to the carbon footprint of a beverage's life cycle. However, this percentage can substantially vary depending on the packaging format, the most common being single-use glass bottles, aluminum cans, reusable bottles, or kegs. The carbon footprint of each beverage packaging option decreases in this order: single-use glass bottles ≈ aluminum cans > steel cans > reused bottles > kegs (providing they are reusable).

The differences are quite significant; the greenhouse gas emissions associated with the use of single use glass bottles are around 0.45kgCO2eq. per liter of product, whereas the use of returnable stainless steel kegs reduces this value into the range of 0.05kgCO2eq. per liter of product, which is 9 times lower. Therefore, stainless steel kegs are the essential tool to reduce a beverage's environmental impact.

WHAT CAN YOUR BREWERY DO TO REDUCE ITS CARBON FOOTPRINT?

THE ENVIRONMENTAL IMPACT OF PACKAGING FORMATS USING BEER AS AN EXAMPLE

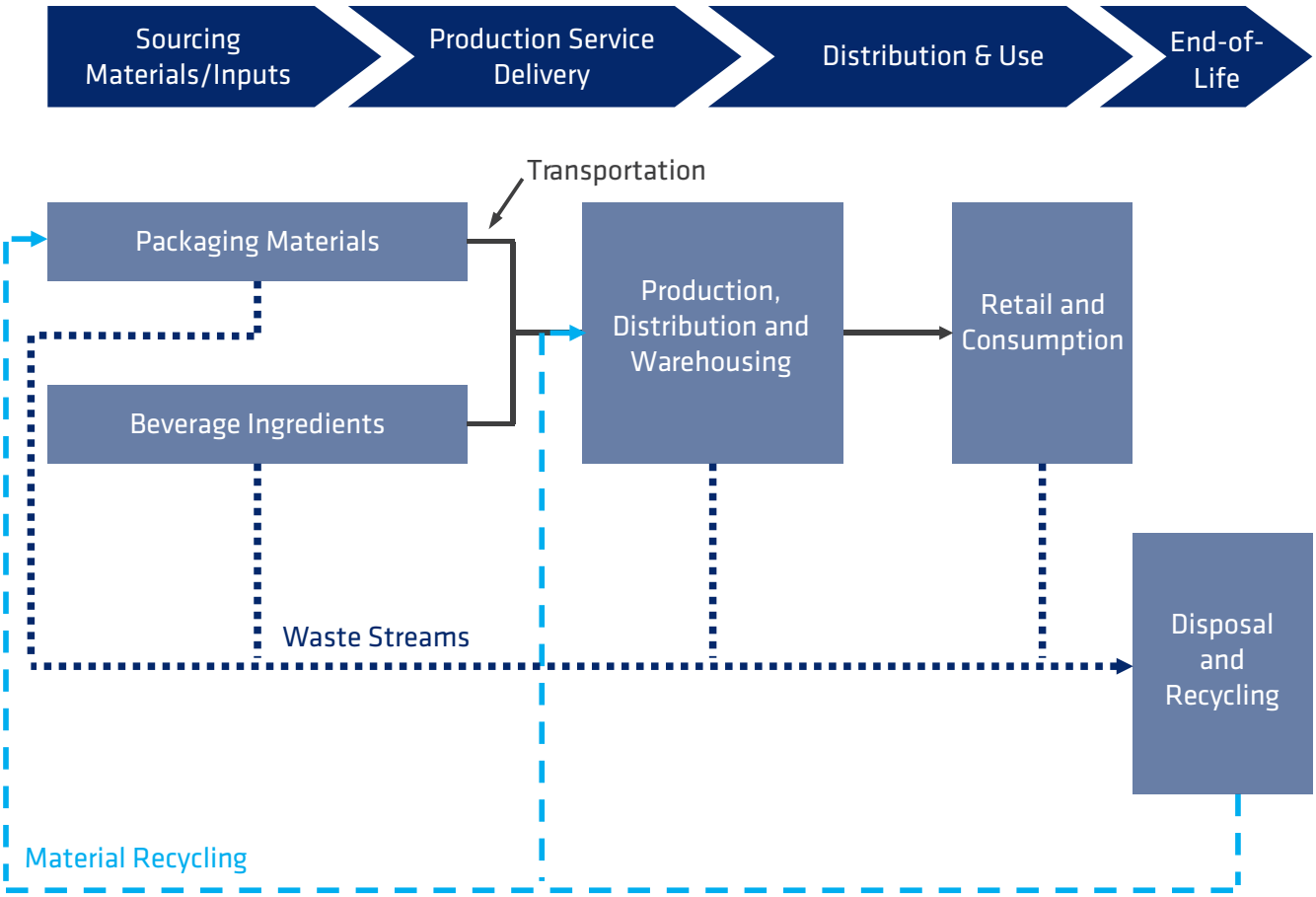
Soft drinks and alcoholic beverages account for 0.9 and 0.6% of the Global Warming Potential (GWP) impact category of total products respectively.[1] As a result, the beverage sector has started implementing a number of strategies to reduce its impact on the environment, such as the Beverage Industry Environmental Roundtable (BIER). This committee examined the GWP of beer with regard to different factors, including packaging.[2] They found that choosing the right material within which to transport and serve beer is key to reducing the carbon footprint of a brewery, making a thorough analysis crucial.

1 https://ec.europa.eu/environment/ipp/pdf/eipro_report.pdf
2 http://media.wix.com/ugd/49d7a0_70726e8dc94c456caf8a10771fc31625.pdf

DEFINING PRODUCT CARBON FOOTPRINT

Wright, Kemp, and Williams define carbon footprint as a measure of the total amount of carbon dioxide (CO_2) and methane (CH_4) emissions produced by a defined population, system or activity, considering all relevant sources. This is then calculated as carbon dioxide equivalent using the relevant 100-year GWP. [3]

A product's carbon footprint is an evaluation of the emission of Greenhouse Gases (GHG) across its life cycle (raw material inputs, transportation streams, manufacturing, and the disposal or recycling of materials). The figure below summarizes the aggregated GHG emissions from all activities related to a beverage from the extraction of basic raw materials, through manufacturing and distribution, consumer use and end of life (recycling/disposal).[4]



3 https://www.tandfonline.com/doi/full/10.4155/cmt.10.39

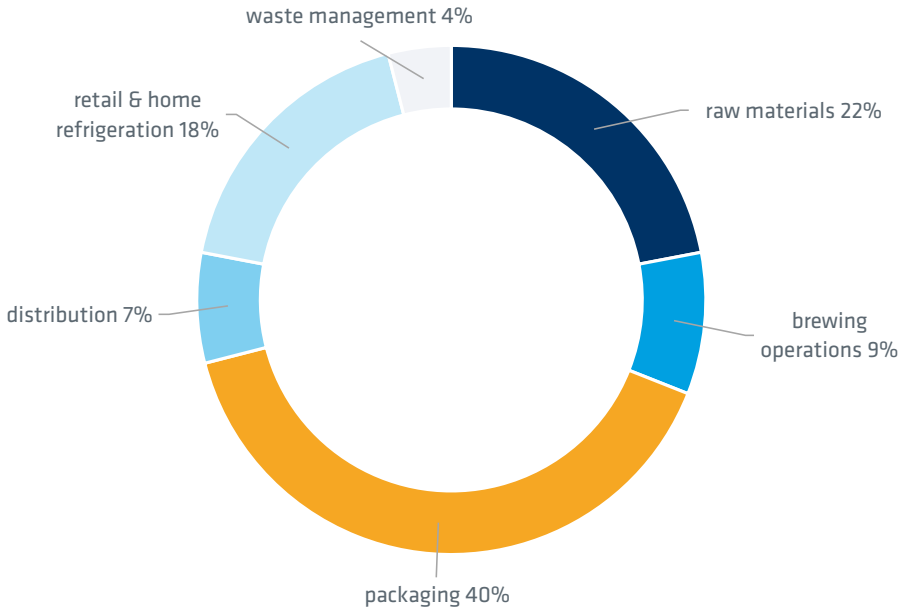
4 http://media.wix.com/ugd/49d7a0_70726e8dc94c456caf8a10771fc31625.pdf

THE EFFECT OF PACKAGING ON ENVIRONMENTAL IMPACT

Though applicable to other beverages or foodstuffs, beer is a useful reference for this analysis as it is the most-consumed alcoholic beverage globally.[5],[6] Understanding the life cycle of beer and the carbon footprint (GHG emissions) of each phase can help focus attention on areas with the greatest potential for reducing environmental impact.[7]



Carbon footprint by life cycle phase of beer:



The chart above shows an average contribution to the carbon footprint of beer for each life cycle phase, based on the available literature. In general, production of raw materials (dominated by malted barley), packaging, and refrigerated storage emerge as the most important life cycle stages for a variety of environmental impact categories. As illustrated, packaging is the phase that contributes the most to the product's total carbon footprint.[8] Such is the weight packaging has on environmental impact that available Life Cycle Assessment (LCA) studies show variability largely dependent on what packaging or delivery format is being used.

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5 https://www.statista.com/topics/1709/alcoholic-beverages/

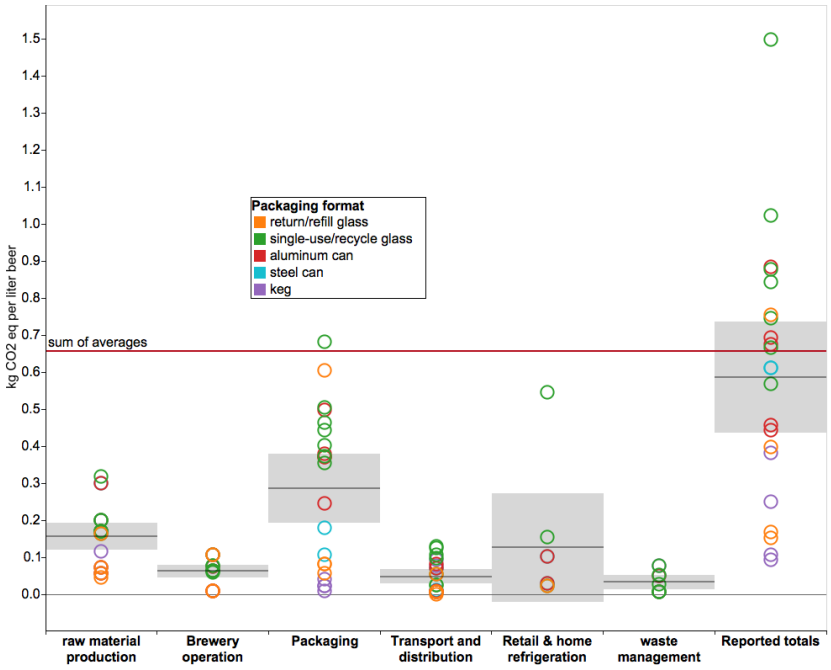
6 https://www.researchgate.net/publication/292946412_Life_cycle_environmental_impacts_and_costs_of_beer_production_and_consumption_in_the_UK

7 https://www.oregon.gov/deq/FilterDocs/PEF-Beer-FullReport.pdf

8 Ibid

ENVIRONMENTAL IMPACT OF DIFFERENT PACKAGING FORMATS

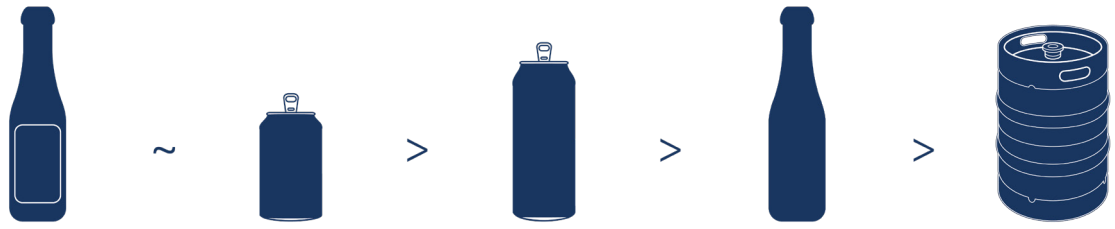
The figure below provides an aggregated look at the distribution of greenhouse gas emissions across major life cycle stages for the production and consumption of one liter of beer. Color coding of the packaging format demonstrates a distinguishing trend in the packaging stage.[9]



Circles represent individual scenario results, offering a sense of the data spread or cluster. Horizontal grey bars represent averages for each stage, and grey blocks are 95% confidence intervals around the averages. The "Reported totals" column shows totals for a given scenario, although it is important to recognize that not all studies include the full life cycle stages represented here. The red bar indicates the sum of the averages from each life cycle stage.

Most single-use glass and aluminum can scenarios have larger carbon footprints than average for the stage, whereas steel can and keg delivery are below this average. The glass bottle scenarios below the average are returnable refillable glass; the one high return/refill scenario assumes only a 51% return, meaning every other filled bottle is newly made.[10]

Generally speaking, the environmental impact of common beer packaging decreases in this order: single-use glass bottles ≈ aluminum cans > steel cans > reused bottles > kegs.[11]



The impact of packaging materials was the minimum in the case of kegs, by virtue of the high reuse coefficient and the high product/packaging ratio.[12] However, the material of the keg is also important, as it must be reusable.

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9 https://www.oregon.gov/deq/FilterDocs/PEF-Beer-FullReport.pdf

10 Ibid.

11 Ibid.

12 https://www.sciencedirect.com/science/article/abs/pii/S0959652615007933

REUSED STAINLESS STEEL VS. PLASTIC KEGS

Reusable kegs are made from stainless steel. However, there are other types of kegs available, namely single-use plastic kegs. Therefore, the next stage will be to compare the carbon footprint of a stainless steel keg vs. its single-use plastic counterpart.

THIELMANN conducted an LCA of stainless steel and plastic kegs to calculate their carbon footprint for one single use. This considered all raw materials, transport, production processes, usage, and disposal of a given product. The results were as follows:

Carbon footprint ($kgCO_2eq$) related to the functional unit used once:

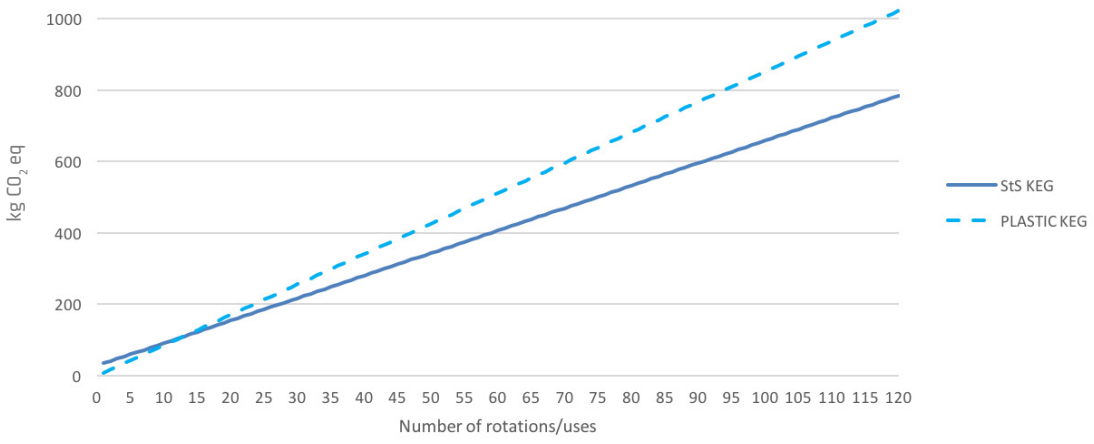
	Life cycle considering one single use	Manufacturing (Phase 1)	Washing (Phase 3)	Transport (Phases 2, 4, 5)
StS keg	34.38	26.68	0.49	7.21
Plastic keg	8.52	4.31	0	4.21

For a complete list of theoretical calculations, please consult the complete whitepaper, *Reducing Carbon Footprint with Stainless Steel*.[13]

Although the production, maintenance, and transport of a stainless steel keg was more carbon intensive, it is essential that their refillable character is taken into account. This means their carbon footprint will not increase across all the phases of each use cycle. However, phases 1–5 will apply for the plastic keg every time because of their single-use nature.

Previous studies and experiences establish an average 60–80 rotations before the disposal of a stainless keg, reaching up to 120 cycles (4 rotations/year in 30 years). This considered, stainless steel kegs amass a lower carbon footprint than one-way plastic kegs after 12 uses, as expressed in the graph below. This can be achieved in 3–4 years on average, and from that moment on, every use will result in the reduction of the product's environmental impact.

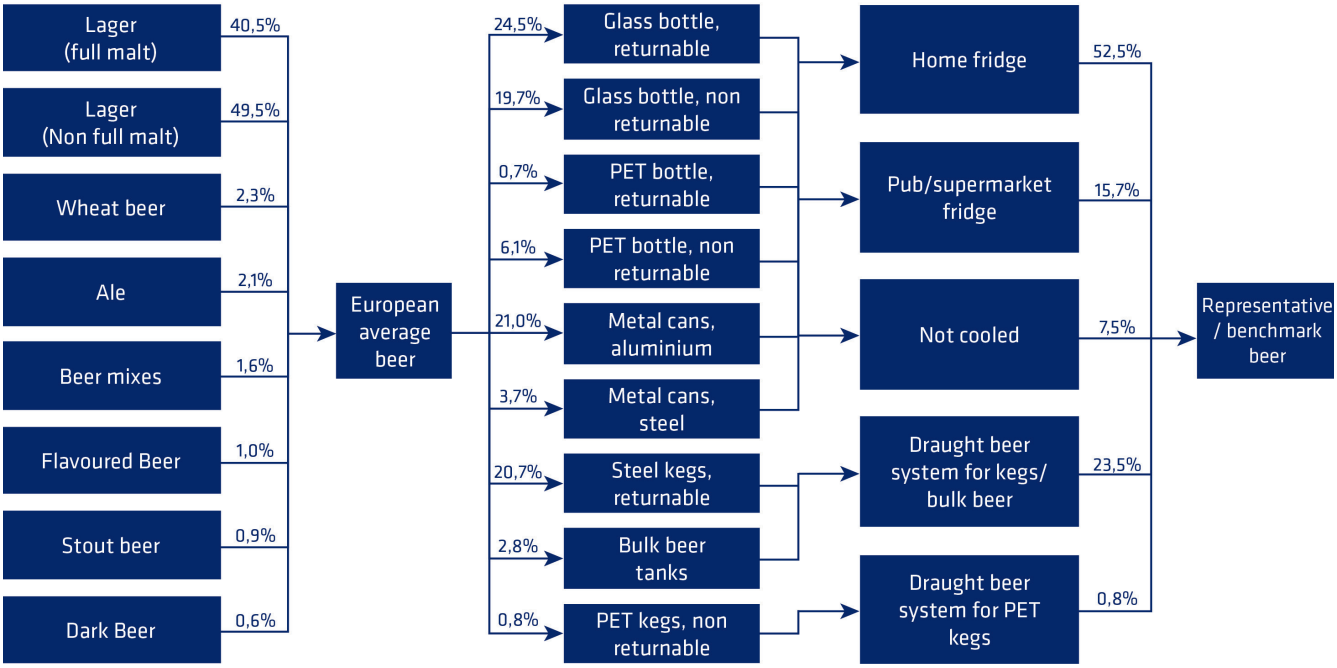
Carbon footprint considering the returnable or non-returnable character of the kegs:



13 https://www.thielmann.com/en/knowledge-base/reducing-carbon-footprint-with-stainless-steel

STAINLESS STEEL IS THE SUSTAINABLE SOLUTION

Despite this fact, the use of returnable stainless steel kegs represents approximately 20% of the European beer packaging mix, [14] so considering that Europeans consume 26% of beer globally, 189 million kiloliters),[15,16] there is still substantial scope to keep reducing the environmental impact of our beverage of choice.



More widespread usage of reusable stainless steel kegs is the essential tool to realize this objective. This is in spite of the greater carbon footprint of their production, as this is offset throughout their life cycle compared to plastic alternatives. The final step for brewers is to choose a keg manufacturer that places sustainability at the core of their mission – like THIELMANN.

14 https://ec.europa.eu/environment/eussd/smgp/pdf/Beer%20PEFCR%20June%202018%20final.pdf

15 https://www.kirinholdings.co.jp/english/news/2019/1224_01.html

16 https://worldpopulationreview.com/country-rankings/beer-consumption-by-country

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