



GLASS HALF FULL

Are glass bottles a feel-good choice that misses the environmental mark?

The milk bottle is a useful example of the challenges the plastic industry is facing in the court of public opinion. Consumers tend to favour glass bottles due to perceived higher quality levels and better environmental profile.

Research indicates, however, that these perceptions are largely misperceptions. Specifically, studies show that there is no quality or taste differential and plastic coated milk cartons and plastic bottles are superior to glass bottles in environmental terms.

This article will seek to answer the question: is the use of glass bottles a gesture of ‘green’ goodwill that does more to make us feel good than actually minimise our environmental footprint?

INCREASING USE OF GLASS BOTTLES

The use of glass bottles for the transportation and the storage of milk has declined steadily for many years. Glass now makes up only a small proportion of the overall market. According to Saputo Dairy UK, formerly ‘Dairy Crest Limited’, the contribution of glass to the UK’s milk container market had fallen from as high as **94% in 1975 to 4% in 2012**. It appears to have remained flat since 2012 according to statistics from Dairy UK shown in **Figure 1**.

Figure 1. The UK milk container market segmented by packaging material.

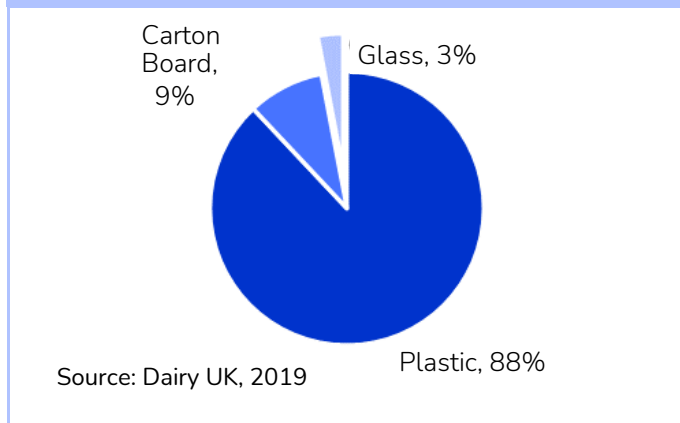


Figure 2. Main forms of milk packaging: plastic coated (Tetra Pak®) carton, high density polyethylene (‘HDPE’) plastic bottle, and traditional glass bottle.

There is evidence of a resurgence in glass milk bottle usage. Milk & More, a business that delivers more than 100 million pints of milk in glass bottles every year, reported that 90% of the 15,000 new customers attracted in the first quarter of 2018 ordered milk in glass bottles. A complementary study concluded that Seventeen out of twenty dairy businesses saw a rise in sales of glass milk bottles. Furthermore, statistics from the Telegraph, a UK newspaper, released in 2018 reported an increase in doorstep deliveries to **1 million glass bottles** of milk compared to 800,000 in 2016.

Figure 3. The preference for glass milk bottles on the basis of quality and environmental reasons.

“Ethically, doorstep delivery of milk in glass bottles ticks the box of ‘re-use not recycle’... ‘there is a feel-good factor in changing to milk in glass bottles and also the milk tastes better.’”

Source: ‘Milk in Glass Bottles’, MSE Forum

PERCEPTIONS OF HIGHER QUALITY

The recent increased use of glass bottles has been driven by perceptions of the higher quality of glass containers and the lowered perceived environmental impact. The transparency of glass gives a high level of visual product quality assurance which is an enormous benefit given the easily spoilable nature of milk.

Perceptions of higher quality are arguably based on links to premium goods that are often served in glass. The premium beverage market uses the weight of glass to communicate the premium attributes of their products. For example, alcohols, such as wines and spirits, alongside non-alcoholic beverages such as probiotic drinks, cold coffee and kombucha are increasingly packaged in glass. Other premium products, such as high-end skincare and personal care products, are sometimes also in glass. For example, in May 2024, Bormioli Luigi launched Reverre, a refillable glass jar intended for the personal care market.

Consumers believe that glass keeps the milk ‘pure’ whereas plastic can contaminate the contents of the milk. Peer reviewed research points towards the presence of microplastics in milk. Research from the Free University of Amsterdam, commissioned by the Plastic Soup Federation, revealed plastic in 18 of 25

milk samples. Albeit, no plastic particles were detected above the lowest concentration at which they could be reliably detected.

Indeed, glass is the only packaging material that is considered completely safe by the United States Food and Drug Administration (“US FDA”). In other words, glass is viewed as a better alternative given the growing concern over the risks of microplastics.

These sentiments are demonstrated by the consumer quotes in Figures 3 and 4, which show that consumers perceive glass as higher quality.

There is little factual evidence of quality difference between glass and plastic.

Several studies indicate that the preference for glass milk bottles on the basis of higher quality is rooted in perception rather than a reality. According to a study by the Catholic University of the Sacred Heart in Milan, released in 2015, consumers rated enjoyment and quality of product higher for milk out of glass packages, compared with plastic. When the consumers made these judgments, they did not know that they were repeatedly tasting the same product, placed in different containers for the purpose of the taste test. A similar report from North Carolina State University in 2023 revealed that there was **no distinguishable taste** difference for milk stored in glass, HDPE and polyethylene terephthalate (“PET”) after 10 days.

Figure 3. Description of the link between product quality and glass.

Samantha Juna, manager of category and consumer insights at TricorBraun.

“The clarity of glass is perfect to visually showcase what’s inside the package. And the weight, reusability, and recyclability of glass makes the package feel like it is high-quality and will last a long time.”

Source: ‘Premium beverage categories turning to glass packaging.’ Beverage Industry.

ENVIRONMENTAL IMPACT

Studies show that glass has a more negative environmental impact than plastic and much more negative environmental impact than cartons even when the glass is recycled multiple times.

At first glance, the environmental credentials of glass milk bottles far outweigh those of plastic bottles. They are theoretically indefinitely recyclable with little risk to quality; limited concerns over leaching or environmental degradation due to its natural raw material composition (55% silica sand, 25% soda ash, and 20% limestone); and have a wide range of applications when reused.

There are, however, significant problems with the use and reuse of glass, which is much heavier and more expensive to manufacture. Research shows that **glass milk bottles are actually inferior** to alternatives in environmental terms. Specifically:

- ReLondon concluded that single use glass was found to **equate to 6 times the carbon emissions of the HDPE bottles** with reusable glass generating 1.5 times the carbon emissions.

- A study from the University of Salerno released in 2021 concluded that **‘the positive perception for glass bottles is completely unfounded’**.
- A study in Detritus, a multidisciplinary, peer-reviewed journal, focused on waste resources and residue management in transporting milk. **The results displayed in Table 1 show that glass bottles are the least environmentally friendly container for milk, compared to HDPE bottles and Tetra Pak® cartons. Even the 100% recycled glass bottle was the second most damaging in all but one category.**
- A 2020 study commissioned by the Alliance for Beverage Cartons and the Environment (“ACE”), a European platform for the promotion of the usage of beverage cartons, concluded that the packaging efficiency of single-use and reusable glass bottles was **significantly lower than that of alternatives**. The study revealed that 25-41% more milk can be transported using beverage cartons and plastic bottles compared to glass bottles.

Table 1. Results from a study announced in Detritus (a multidisciplinary journal) ranking different types of packaging across a range of environmental impact categories

	GLASS BOTTLE	100% RECYCLED GLASS BOTTLE	HDPE BOTTLE	MILK CARTON
Acidification potential—average Europe				
Climate change—GWP 100				
Depletion of abiotic resources—fossil fuel				
Eutrophication—generic				
Freshwater aquatic ecotoxicity				
Human toxicity				
Ozone layer depletion				
Photochemical oxidisation				
Terrestrial ecotoxicity				
Marine aquatic toxicity				

Key



Most Negatively Impactful



Least Negatively Impactful

REDUCING ENVIRONMENTAL IMPACT

One of the reasons for the worse environmental profile of glass is a disconnect between the recycling potential of glass milk bottles and **how many times the bottle circulates around the reuse loop** of Figure 5 on a practical basis. Wrap, a waste charity, reported that bottles need 20 reuses for them to gain an environmental edge on alternatives, but that in the UK they only reach a maximum of 18 times.

Glass bottle re-usage can be increased. This means increasing the number of times glass milk bottles pass through the reuse loop shown in Figure 5. Milk & More have implemented several schemes to increase bottle reuse by 15% and take 500,000 glass milk bottles out of circulation. For example, they have adjusted machinery to **reduce contact between the bottles and the side of filling lines** to reduce damage. They have also installed scanners to remove bottles selectively that are reaching the end of their life rather than replacing them en-masse after a predetermined length of time. Glass bottle usage can also be increased by making them more **damage resistant**.

Improved data-led conclusions can only be obtained when more research is undertaken into the amount of times a glass bottle must be reused to become more environmentally friendly than its alternatives such as cartons or plastic bottles. This may lead companies to invest in ways to re-use the bottles more times. If there proves to be no way to ensure that glass bottles are at least as environmentally friendly as alternatives, this may change consumer behaviour and encourage the development of even better green options. Increased research into the sustainability of glass

bottles or lack thereof could increase the development of innovative new materials.

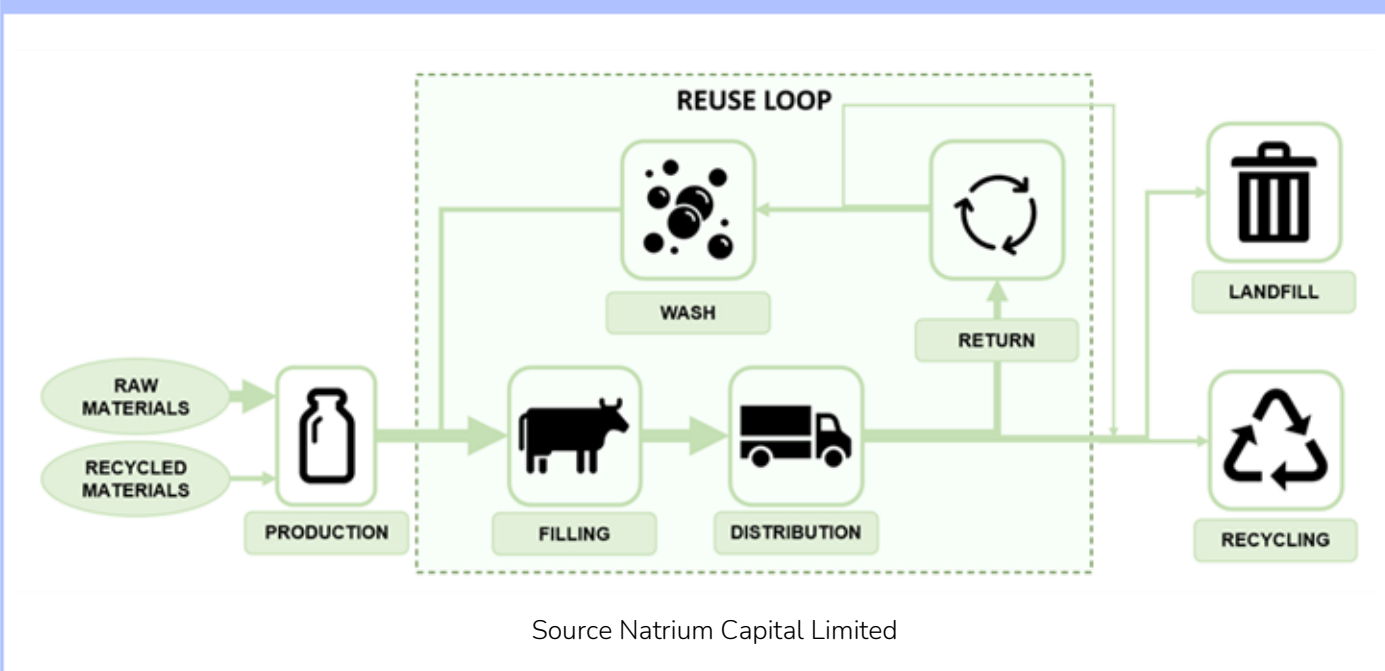
The environmental footprint of a glass milk bottle can also be reduced by making it **lighter weight** and by **reducing the distances** it is transported.

There is **significant untapped potential** for emissions reduction within the beverage, food and cosmetic industry. However, this will require a shift in consumer attitudes that realises the environmental leadership of the current alternatives and shatters the 'green' fallacy of glass.

Milk cartons, such as TetraPak®, have an improved environmental profile compared to glass in transport emissions and consumption of non-renewable resources terms, as illustrated in Table 1. The **reduced packaging to product mass ratio of TetraPak® means that emissions associated with their transport are significantly lower**. It could be argued that increasing the use of these cartons is a better solution than increasing the use of glass bottles.

Cartons appear to be a better option than plastic milk bottles with regards to consumption of non-renewable materials. An analysis of the virgin plastic requirements of a 1L container of HDPE compared to TetraPak® indicated that the vast majority of a beverage carton was from renewable resources. The remaining plastic requirements of the carton were less than that of a partly recycled HDPE bottle (5-12g of plastic vs 34g of virgin plastic). This was before considering recycled plastics in the beverage carton.

Figure 5. Simplified life cycle schematic of a recycled glass bottle



Source Natrium Capital Limited

NEW MATERIALS

The introduction of Abel & Cole's reusable plastic milk bottle based on polypropylene is one of a few **innovative materials** that could change the container packaging landscape. The material, which is around 20% of the weight of a glass bottle, is claimed to **halve the carbon footprint** of the company's single-use milk bottles within 4 reuses. This compares to 15 returns for glass bottles. The scheme is expected to save 60 tonnes of carbon when compared to a glass alternative on an annual basis and save up to 23 tonnes of plastic.

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CONCLUSION

Whilst the evidence is fragmented, multiple studies point toward the superior environmental profile of plastic cartons to glass bottles. This is not a matter of cost but a perception of the superiority of the product stored in glass.

Consumers could promote a more circular approach to materials by advocating for the use of sustainable beverage packaging as standard practise in everyday life. This circular approach could involve rolling out alternative materials as much as could encourage responsible end-of-life management.

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<p>UNDISCLOSED</p> <p>ADVISOR TO</p> <p>In the sale of its European Fiber Glass business to</p>	<p>UNDISCLOSED</p> <p>ADVISOR TO</p> <p>In the sale of its European Fiber Glass business to</p>	<p>UNDISCLOSED</p> <p>ADVISOR TO</p> <p>Sale of 3B Europe</p>	<p>\$360m</p> <p>ADVISOR TO</p> <p>in the acquisition of</p>

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