

Bio-based plastics gain consumer favor over fossil fuels

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Credit: Pixabay/CC0 Public Domain




When it comes to enhancing the sustainability of plastic beverage bottles, consumers are willing to pay a bonus for bio-based alternatives—the more so when the alternative is visually distinctive.

This follows from research by Ph.D. candidate Maria Zwicker as part of the RIBIPOL project where novel rigid bio-based polyesters are being developed for potential large scale applications, such as beverage bottles. Her findings have been published in the January issue of the journal *Sustainable Production and Consumption*.

The Ph.D. research of Maria Zwicker is supervised both by Prof. Frenk van Harreveld and Dr. Cameron Brick of the research group Social Psychology (faculty of Social and Behavioral Sciences) and Prof. Gert-Jan Gruter of the research group Industrial Sustainable Chemistry (Van 't Hoff Institute for Molecular Sciences, faculty of Science). It is part of an ongoing cooperation between the two groups motivated by the fact that there is more to establishing a sustainability transition in plastics than just developing alternatives for traditional fossil-based products.

"Consumers' use of these alternatives is determined not only by technical product and brand characteristics, but also by [psychological factors](#)," says Zwicker, "which, for instance, include feelings evoked by a product, or a perceived social norm in relation to buying and using the product."

When it comes to bio-based products, there's only limited literature on such factors, she says. On the one hand, consumers seem to be positive about bio-based plastics and willing to pay more for it, on the other hand, mixed or [negative feelings](#) have also been reported and consumers have misconceptions about these materials. These might be due to a lack of knowledge or a cynical attitude towards the plastics industry.

Bottle Type	Description
<p>PET plastic</p> 	<p>You know the plastic that water bottles are made of? That is PET. PET's uses range from packaging, polyester clothing, fabrics, films, car parts, electronics, to many other products. PET can be recycled; however, a lot of single-use plastic still finds its way into the environment and only a small percentage of the recycled plastic can be made into the same product again.</p> <hr/> <p><i>Downsides:</i></p> <p>PET is made from fossil feedstock such as oil and natural gas. Plastic production alone makes up 6% of global oil consumption, about the same as the entire global aviation sector. During its life cycle, PET releases large amounts of CO₂ into the atmosphere and thereby substantially contributes to global warming. PET bottles are not biodegradable and take about 450 years to decompose. Other products made from PET can take up to 1000 years to decompose.</p>
<p>PEF plastic</p> 	<p>PEF is very similar to PET both chemically and visually, but is derived from 100% renewable raw materials such as wood, straw, sugar, maize, algae, or bio-waste. PEF bottles require less material and can be lighter than PET as they are stronger. PEF can also easily hold carbonated drinks like soda or beer for long periods of time because of better barrier properties than other plastics. The carbon footprint of PEF is also 50-70% smaller than that of PET. PEF typically biodegrades within 5 years (PET: 450 years), so PEF will not endlessly accumulate in nature. It can also be recycled just like the current PET plastic bottles. Additionally, PEF can be incinerated in an environmentally friendly manner (generating electricity), as no additional fossil-based CO₂ emissions are produced.</p> <hr/> <p><i>Downsides:</i></p> <p>PEF cannot be produced on an industrial scale yet. While there are pilot production plants, the quantities are currently too small to replace PET.</p>
<p>Paper PEF</p> 	<p>Because traditional PET does not hold liquids as well as the newer materials, bottles made from PEF could use less plastic and still hold carbonated drinks like soda and beer. However, bottles that are too thin become floppy. One solution is to provide structure and stability by adding an outer paper/cardboard structure (see image). This way, the bottle is stable and even less PEF is needed, making paper PEF bottles even more sustainable than bottles made just of PEF plastic. Because the paper and plastic layer are separable, paper PEF bottles can also be recycled. Using only a very thin layer of PEF also allows for even faster biodegradation.</p> <hr/> <p><i>Downsides:</i></p> <p>Paper PEF bottles have the same downsides as bottles made from only PEF. However, because much less PEF is used in the paper PEF bottle, more bottles can be produced at less cost.</p>

The respondents were thoroughly informed about the pros and cons of the three bottle choices. Image taken from the paper. Credit: University of Amsterdam

A clear preference for bio-based

In her research, Zwicker investigated preferences for three types of plastic bottles: a conventional fossil-based bottle (PET plastic), a visually identical bio-based bottle (PEF plastic), and a visually distinct bio-based bottle with a paper outer layer (paper PEF). It showed that people clearly preferred the bio-based bottles over the conventional one. The strongest preference was for the bottle that was recognizable as bio-based. The [test subjects](#) were willing to pay up to 40 % more for the bio-based bottles.

Because of the COVID-19 pandemic, it was not feasible to conduct a field or laboratory study to let participants handle the actual bottles. Zwicker held an [online survey](#) among 529 respondents instead, creating a realistic and immersive purchase choice situation, as is common in [psychological research](#) on decision-making. "The results are therefore more a reflection of attitudes and intentions rather than actual behavior," she says. "But the high willingness of the consumers to pay a bonus for bio-based product clearly indicates that there is a demand for these alternatives."

Zwicker also investigated the extent to which an [individual choice](#) is influenced by other people witnessing the choice. There was, however, no clear relation, so a social norm did not seem as relevant in this study. The findings thus signal to companies that there is a consumer demand for sustainable products, and that there might be a commercial upside to providing more sustainable bio-based plastic products.

A more meaningful choice

To Prof. Van Harreveld it is striking that the preference for a [bio-based](#) alternative is even stronger when the product is visually distinct. "It suggests that when a sustainable choice is literally more tangible, it is psychologically closer to people and feels more meaningful." Prof. Gruter finds the results very valuable as they provide insight into the future market for sustainable plastics. "The plastics transition is not just a technological transition. Better understanding the buying drivers of consumers are extremely important, especially in early phase when the sustainable alternatives are still relatively expensive."

More information: Maria V. Zwicker et al, Consumer attitudes and willingness to pay for novel bio-based products using hypothetical bottle choice, *Sustainable Production and Consumption* (2022). [DOI: 10.1016/j.spc.2022.10.021](#)

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