Zero-waste shops

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How can a minimization of product packaging in zero-waste shops save CO_2-emissions today and how big is their theoretical impact in the future?

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Abstract

In 2020, 93 percent of all food products in supermarkets were packaged. All package materials are the cause of CO_2-emissions, their height depending on the material. In zero-waste shops, the goal is to offer an alternative with as less product packaging as possible. With the research question 'How can a minimization of product packaging in zero-waste shops save CO_2-emissions today and how big is their theoretical impact in the future?', this paper shows the impact of the zero-waste concept measured in CO_2-emissions using three scenarios (see figure 1). The main findings include a clear reduction potential if the food product demand in Germany was satisfied by zero-waste shops ('zero-waste potential') and possible improvements to this solution ('optimal solution'), which can lower the current CO_2-emissions of food packaging by 38%.

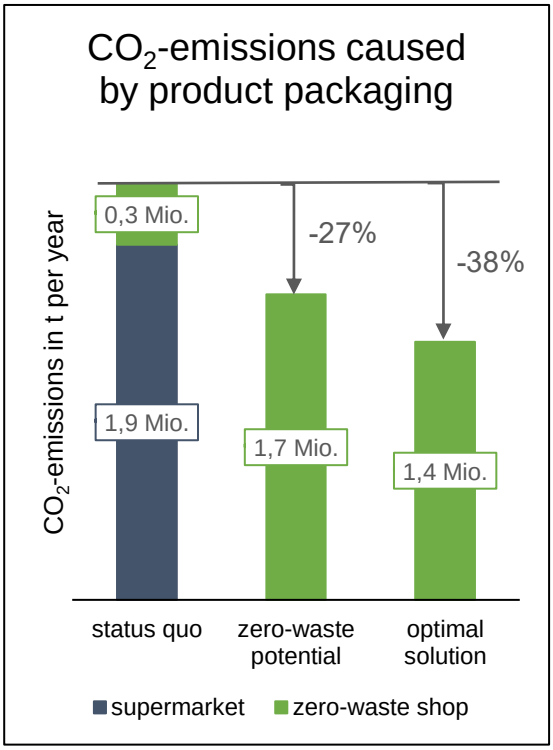

Figure 1: CO2-emissions caused by product packaging

Introduction

The climate crisis effects many areas of daily living. Many of those are yet unknown to the wide public, as their impact on climate change is not as obvious as in other areas. The food industry is one of these areas. Some of its problems are widely known, such as the amounts of food that goes to waste in developed countries. Another example is the amount of packaging that is produced and used for hygienic and food safety reasons. One alternative to grocery shopping in supermarkets is a zero-waste shop. This concept aims to minimize the amount of food packaging in general and plastic waste in particular. In this concept, customers bring their own containers, which they fill with unpackaged goods in the shop. This typically functions with dry goods such as rice or flour. Other items like fruits and vegetables are offered without

packaging and milk and milk products come in glass bottles. Zero-waste shops usually offer a wide pallet of items, which usually also include hygiene products or laundry detergent. However, items are offered in a limited variety. Changing customer behaviour towards buying groceries in a zero-waste shop is regarded as sufficient. In zero-waste shops, customers find a place to buy food products with no or minimal packaging, as well as a place to connect with other customers and shop owners, which is enhanced by the friendly and opening atmosphere and mindset of shop owners.

Nowadays, zero-waste shops can be found in nearly every city in Germany and the concept has become known to the public, as 72 percent of the German population have already visited a zero-waste shop (Sandra Ahrens 2023). Since the opening of the first zero-waste shop in Kiel 2014 (Sandra Ahrens 2023), the number of zero-waste shops has risen to over 477 in 2022 (Hanna Kastendieck 2022). In 2020, the concept experienced a boom in Germany, however, the number of shops has declined to 360 shops in 2023 (unverpackt e.v. (Hrsg.)). Reasons are the severe crises of the last years, namely Covid-19, and war in the Ukraine and its consequences. For many zero-waste shops, building and maintaining a successful business has become impossible.

Despite their current problems, zero-waste shops present a solution to the problems of the food industry. This paper examines the impact of zero-waste shops as well as their theoretical maximum potential in the future by calculating CO_2-emissions due to packaging and comparing the outcomes of supermarkets and zero-waste shops. It furthermore gives general recommendations to policymakers to promote zero-waste shops.

Method

The method for this work consists of the calculation of CO_2-emissions of product packaging with values provided by a literature review. For comparison, three scenarios are created: First, the ‘status-quo’-scenario describes the current CO_2-emissions of the packaging of goods sold in supermarkets and compares this to the emissions caused by the packaging used in zero-waste shops. Second, the second scenario ‘zero-waste potential’ shows the theoretical impact of zero-waste shops in Germany in the theoretical situation that they satisfy the total food demand in Germany. As there can be seen, there is potential to optimize the result shown in scenario 2. For this reason, scenario 3, ‘optimal solution’ is built.

For the calculation of the CO_2-emissions, the same approach was followed in each scenario. Different goods are offered in different containers and different materials are used for their packaging, depending on the type of product and vendor. This makes a creation of categories necessary. For this paper, the categories ‘vegetables’, ‘fruits’, ‘dried goods’, ‘milk’, ‘milk products’, ‘meat and meat products’, ‘sweets’ and ‘canned goods’ were created. For each

category and type of packaging, the number of sold goods could be found (Statista (Hrsg.)). Additionally, data for the percentages of used materials for packaging is available (Sandra Ahrens 2020a). For example, 51 percent of sold vegetables in 2020 was packaged in plastic, 19 percent in paper and 28 percent came without packaging. Using this information, the amount of goods sold in Germany in a year in each category with each material can be calculated. In the next step, the assumed weight of the packaging per kg of good is used to calculate the total weight of packaging as a preparation for the calculation of CO_2-emissions. In zero-waste shops, goods are delivered in bulk containers, which usually include 20-25 kg of the product. A research project by the university of applied sciences Eberswalde has already given numbers regarding this topic, which are used in this paper (M. Kröger et. al 2020). In supermarkets, goods are also delivered wrapped in additional packaging. As there is no data available, this factor has to be excluded from the calculation. The CO_2-emissions of different types of materials used in food packaging can be found in the table below:

Aluminium (disposable)	7,57	kg CO_2 per kg packaging material
White tin (disposable)	3,11	kg CO_2 per kg packaging material
Plastic (disposable)	2	kg CO_2 per kg packaging material
Glass (disposable)	0,82	kg CO_2 per kg packaging material
Cardboard (disposable)	0,53	kg CO_2 per kg packaging material
Glass (reusable)	0,04	kg CO_2 per kg packaging material
PET (reusable)	0,03	kg CO_2 per kg packaging material

Table 1: CO_2-emissions of packaging materials (V. Pawlik 2023)

Lastly, CO_2-emissions of every used material in every category can be calculated. In scenario 2 and 3, a comparison to scenario 1 was additionally drawn.

Results

The results of the different scenarios are clear. For scenario 1 (‘Status-Quo’), it is found that emissions of packaging of products in supermarkets exceed those in zero-waste shop considerably. As for the total emissions, packaging sold in supermarkets accounted for 1,9 Mio. t CO_2 per year, packaging in zero-waste shops for 0,3 Mio. t CO_2 per year. The category canned goods stands out the most (see figure 1). This is due to the high environmental footprint of white tin, which is the material used most in supermarkets for packaging in comparison to disposable glass, which is used as the dominant packaging material for canned goods in zero-waste shops.

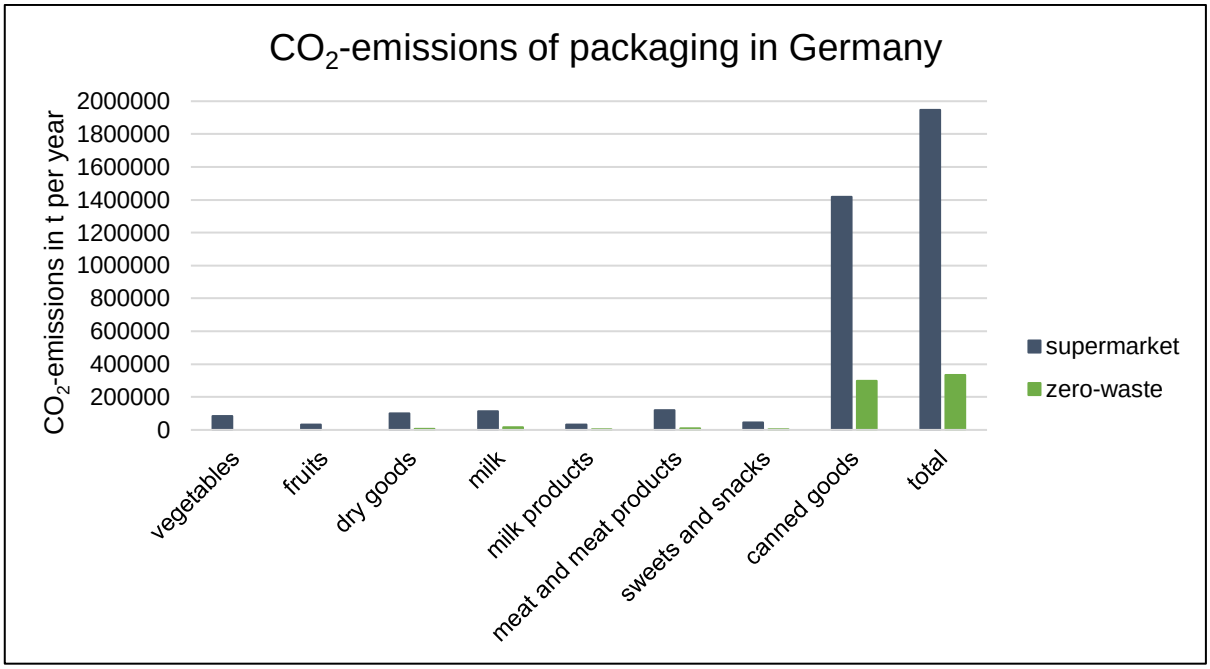

Figure 2: CO_2-emissions of packaging in scenario 1

However, the amount of sold products in supermarkets is higher than in zero-waste shops. In fact, 80 percent of purchases is made in a supermarket (Sandra Ahrens 2020b). For this reason, figures that allow a better relative comparison between the alternatives are created:

Emissions of packaging per 1 kg product		Average emissions per 1 kg packaging	
Supermarket	Zero-waste shop	Supermarket	Zero-waste shop
0,06 kg CO_2	0,04 kg CO_2	1,97 kg CO_2	0,47 kg CO_2

Table 2: average CO_2-emissions of product packaging in supermarkets and zero-waste shops

As table 2 displays, in the emissions of packaging in zero-waste shops are lower because of the lower emissions caused by the product per packaging in general. This is achieved on the one hand with increasing packaging sizes. On the other hand, as the average emissions per kg packaging show, the materials used are in general more environmentally friendly than those used in supermarkets.

So far, the results have shown that zero-waste shops are more environmentally friendly in terms of CO_2-emissions than today's supermarkets. But how would the total CO_2-emissions change if supermarkets would be replaced with zero-waste shops in Germany? Scenario 2 shows this theoretical situation. In fact, in all categories, CO_2-emissions could be saved, adding up to a total of 0,6 Mio. t CO_2 not emitted per year. However, this scenario does not represent the optimal solution regarding absolute emissions. In the categories milch, milk products, meat and meat products and canned goods, there is still potential to save emissions. Scenario 3 accounts for adaptions in these categories, which include a further reduction of package material. In scenario 3, a maximum value of 0,87 Mio. t CO_2 can be saved in one year in

Germany. The comparison of the savings in emissions of scenario 2 and 3 can is displayed in the graph below.

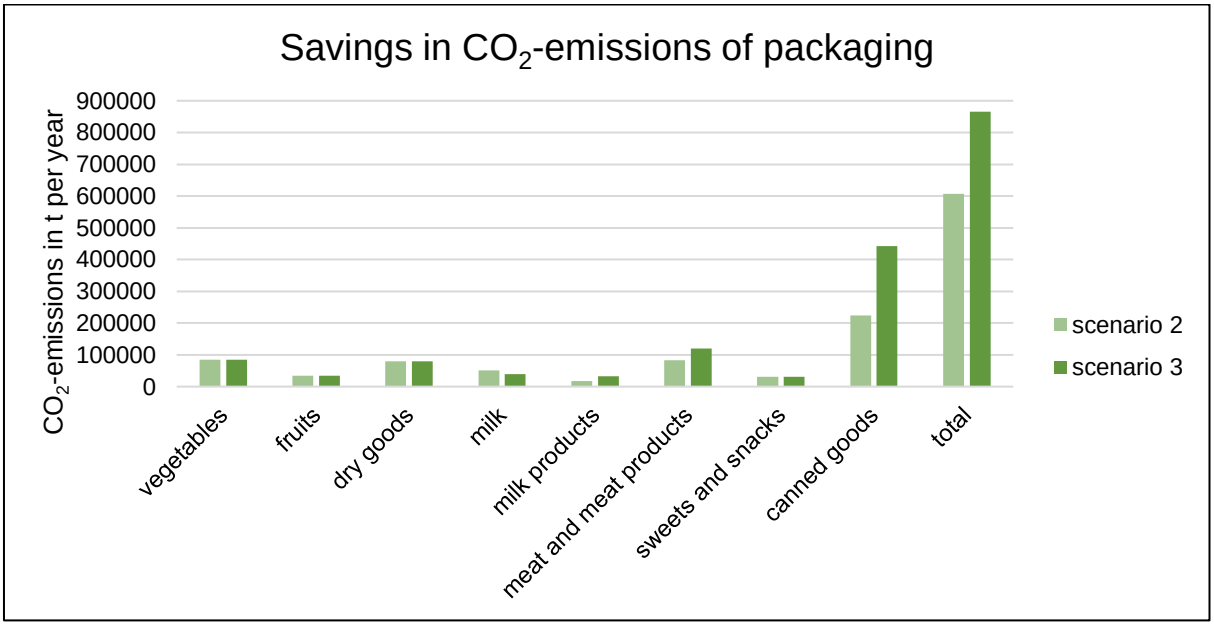

Figure 3: Savings in CO_2-emissions of packaging

In total, ca. 600.000 t CO_2 are saved in scenario 2 in one year in Germany, resulting in a decrease in emissions of 26,6% compared to the status quo shown in scenario 1. In scenario 3, ca. 870.000 t CO_2 are saved, which results in a decline of 38% compared to scenario 1.

Discussion

While this paper gives a general overview and calculates theoretical scenarios regarding the comparison of packaging in the food industry, there is potential to investigate the topic even further. One example is the impact of containers that need to be brought to the shop when shopping in a zero-waste shop. This factor is not included in this work, as it is assumed that these containers are in use for a long time in the household they come from. This assumption makes their impact negligible. However, to improve the level of depth of the calculation, a collection of data and an implementation into the calculation can be undertaken.

In a scenario in which products would be sold primarily without packaging, the demand for food containers would also rise. A transition to such a system will come with an increased production of those containers, which would also influence the environmental impact. Additionally, customers would need to plan their shopping trip carefully, spontaneous purchases would become rarer. In modern supermarkets many things are purposefully designed to encourage spontaneous purchases. In this sense, supermarkets have an interest in not offering their products without packaging. For this and other reasons, the transition to a zero-waste system is a long process and comes with many challenges that need to be addressed. To make a first

step in this direction, further research in general is necessary as well as research on policy measures to improve the current and future number and situation of zero-waste shops. Political measures could include the following points:

- Because not many local grocers sell products with paper packaging or without packaging (Christoph Wöhrle 2020), one important step is the building of a network of those grocers and owners of zero-waste shop. It is important to increase the number of zero-waste friendly grocers by setting incentives of offering products with minimal packaging.
- Prices in zero-waste shops are in average higher than in supermarkets and discounters (Christoph Wöhrle 2020). With a financial mechanism to counter this difference, zero-waste shops could get attractive to all customer segments.
- When starting a zero-waste shop, business owners face a series of questions and decisions that are different from starting other food-related businesses, for example regarding hygiene and food safety regulations. While there is a guideline of unverpackt e.v., the zero-waste shop association in Germany, a guide or regulations from a ministry would give the desired clarifications for first-time business owners.
- Finally, marketing is important, but often underrepresented in the daily business of zero-waste shop owners due to staff and financial shortages. However, enhancing public awareness of related topics such as food waste, environmental impact of materials and food packaging and climate change is something universally important, which partly lays in the responsibility of the states. Practice examples for this could be excursions of schools, universities and kindergartens to zero-waste shops or information campaigns in education as well as in public.

Conclusion

This paper aimed at calculating the current impact of zero-waste shops and possible future impact, measured in CO_2-emissions. The current CO_2-emissions of supermarkets are calculated to 1,9 Mio t CO_2, those of the current number of zero-waste shops to 0,33 Mio. t CO_2. While zero-waste shops have struggled with problems recently, their impact on making the food market more sustainable can be substantial. This paper shows that it is possible to reduce the current CO_2-emissions of product packaging by 26,6% if the zero-waste concept would be used to satisfy food product demand in Germany. If further improvements to this are implemented, a maximal decrease in CO_2-emissions of 38% can be achieved, as shown in scenario 3. However, to foster current zero-waste shops and to implement the positive aspects of the concept on a wider scale, political support as well as additional research is necessary.

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