Towards a Fully Circular Plastics Packaging Industry – Exploring Challenges and Development Potential

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Abstract

Plastic waste has detrimental effects on our environment and long-term on people's health. Even though we know of these negative effects of plastic waste, in the EU annually only about 37 % of plastic waste per person is recycled and kept in the cycle of plastic production. Thus, most plastic packaging waste is discarded. Thinking in circular business models, and thus a circular economy, instead of linear ones could combat plastic packaging waste. However, the amount of yearly plastic packaging waste suggests that principles of circular economy, such as circular business models, are not applied to their full capabilities. In a series of qualitative in-depth expert interviews, we identify challenges in the adoption of circular economy practices and circular business models while exploring possible solutions to these challenges. Our study contributes to research on circular business models and has several implications for companies in the plastics packaging industry and policy makers.

Keywords: Circular economy, business models, plastic industry

Track: Social Responsibility & Ethics

1. Introduction

In 2022, global plastic waste reached 391 million tons while the OECD predicts that global waste will reach 1.231 million tons in 2060 (OECD, 2022). In addition to the burden on the environment, this detrimental development is harmful to our health as in 2022, each person has already ingested 1.972 microplastic particles (WWF, 2022). Although alternative plastic sources, such as bio-based plastics, are available, 90 % of the global plastic production in 2021 was fossil-based while only 8 % stems from post-consumer recycled plastics (Plastic Europe, 2022). Thus, global plastic production has a huge, currently under-used potential to switch its sourcing from fossil-based to post-consumer recycled plastics. Relying more on post-consumer recycled or bio-based plastics could also address environmental concerns as the raw materials to produce plastic are limited, and their extraction is harmful to the environment, as is plastic waste if not disposed of properly.

A solution to the demand for plastic products and the growing concern around their environmental impact could lie in moving from a linear plastics economy towards a circular plastics economy. We define the circular economy as an economic system that is based on holistically sustainable business models with closed production loops that maximize efficiency and profit while minimizing waste by approaching all resources from the perspective of the 10R framework (Friant, Lakerveld, Vermeulen, and Salomone, 2022). While current standard practice in the plastics packaging industry focuses on recycling, as in, for example, the deposit system for single-use plastic bottles in Austria and Germany, the 10R framework goes beyond recycling and urges consumers and companies alike to recover, repurpose, remanufacture, refurbish, repair, reuse, reduce, rethink and refuse (new) products and materials (Friant et al., 2022).

Germany and Austria's economic strength, innovation, environmental awareness, regulatory environment, waste management infrastructure, industry collaboration, and global influence make them important countries in discussing the circular economy in the plastic packaging industry. Their actions and policies can serve as benchmarks for sustainable practices and influence the broader discourse on circular economy principles. In our paper, we thus explore the challenges companies in Austria and Germany face in switching from linear to circular business models. We thus employ semi-structured interviews with experts in the plastics packaging industry which focus on how they define circular economy, how companies can integrate circular practices into their existing business models as well as how companies can measure the success of their circular economy initiatives. Thereby, we aim to

show how small- and medium-sized companies can engage in circular economy by gradually shifting their business models to secure long-term viability and thus increasing the share of companies which engage in circular practices and the circular economy.

2. Conceptual Background

To achieve environmental goals, increasing recycling rates and plastics which are held in the cycle are essential (Bendix et al., 2022). As the specific plastic used can vary from industry to industry, successful circular economy practices should focus on one industry at a time (Bendix et al., 2022; European Commission, 2018;). We focus on the plastics packaging industry because out of 34.6 kg plastic packaging waste generated per person in the EU in 2020, only 13 kg remained in the plastics cycle and were recycled (Eurostat, 2023). However, as the 10R framework (Friant et al., 2022) establishes, circular economy practices reach beyond recycling. Circular business models are those business models which apply the concepts of the 10R framework (Friant et al., 2022) and the principles of circular economy in a broader sense (Lewandowski, 2016).

Prior research has already established different types of circular business models which can broadly be classified along six criteria (Lewandowski, 2016): regenerate, e.g., recovering energy or building efficient buildings, share, e.g., leasing products or sharing platforms, optimize, e.g., on demand production or reducing waste, loop, e.g., recycling or upcycling, virtualize, e.g., dematerializing services, exchange, e.g., replace old by new technology. Lüdeke-Freund, Gold, and Bocken (2019) find that circular business models create value through closed-loop supply chains and by reversing material cycles. Even though research highlights how companies can engage in the circular economy and how circular business models should be designed, the relatively low recycling quotas for plastic packaging waste within the EU (Eurostat, 2023) suggest that companies might face challenges in adopting circular practices.

3. Method and Analysis

We designed a semi-structured interview study to understand which challenges companies face in adopting a circular business strategy (Gehman et al., 2018; Glaser & Strauss, 1967). For our analysis, we employed qualitative content analysis (Mayring, 2000).

3.1 Data collection

First, we followed a theoretical sampling approach (Glaser & Strauss, 1967) to identify knowledgeable informants, i.e. experts. In contrast to quantitative research aimed at sampling a representative subsample, qualitative research requires sampling to provide deep insights into relevant concepts complementing existing theory (Eisenhardt, 1989; Gehman et al., 2018; Gioia, Corley, and Hamilton, 2013). In our case, we selected knowledgeable informants with experience in the plastics packaging industry who had connections in the field of circular economy in Germany and Austria. We contacted possible informants via email. In total, we were able to recruit 14 informants who are experts on plastics and circular economy as they, for example, advise plastics companies on how to implement aspects of circular economy into their existing business models or implement circular business models within their own companies.

Interviews ranged from 31 minutes to 1 hour 27 minutes while the average duration was 47 minutes. In interviews 13 and 14, two experts joined the interview. Some experts hold multiple job titles which is indicated in the overview of our experts (Table 1). We conducted semi-structured interviews, to allow for emergent insights and individual informants' expertise while simultaneously ensuring that the interviews covered similar areas (Flick, 2014; Gioia et al., 2013). Two interviewers, one in Germany and one in Austria, conducted the interviews via video chat in German from April to June 2023.

# Interview	Expert's Job Title	Country	Interview Duration
1	Section Management – Environment and Circular Economy	Austria	59 min.
2	Executive Director	Austria	48 min.
3	CEO	Austria	31 min.
4	Head of Study Program on Sustainable Production and Circular Economy	Austria	43 min.
5	Scientific Director	Austria	38 min.
6	Head of Sustainability	Germany	1 h 27 min.
7	Sustainability Advisor, Circularity and Materials Expert	Germany	1 h 4 min.
8	Group Director Sales Division Sorting Recycling	Germany	35 min.
9	CEO	Germany	47 min.
10	Project Manager	Germany	35 min.
11	Team Lead Environmental Consulting	Germany	33 min.

12	Managing Director	Germany	52 min.
13	CEO, Marketing Manager Recycling	Germany	44 min.
14	Specialist Corporate Responsibility, Manager National Sustainability	Germany	38 min.

Table 1. Interview Informants

Our questions focused on whether and to which extent informants had accompanied the implementation of circular business models, the challenges they faced during this process, whether and how they measured the success of their circular business models, and whether and which benefits they recorded by switching from a linear to a circular business model. In addition, we asked informants about their view on the future of circular economy and what governments should do to support the transformation towards circular economy beyond current policies or which regulations hinder the transformation towards circular economy. By specifically interviewing informants with experience in the plastics packaging industry, we could uncover desired adjustments to current policies and regulations, challenges in implementing circular economy business models, and challenges to measure the success of such business models. Overall, based on our interviews, we obtained a first understanding of the underlying mechanisms and barriers hindering the adoption of circular business models in the plastics packaging industry. We are currently in the process of conducting complementary interviews diving deeper into how circular plastics products should be marketed to be successful as well as technical challenges of circular plastics products.

3.2 Data preparation and analysis

All interviews were recorded, anonymized, and transcribed verbatim to ensure accuracy and consistency in our data (Flick, 2014). After having transcribed the interviews, we employed deductive category application (Mayring, 2000). We used a step model of deductive category application (Mayring, 2000) and developed a coding agenda with definitions, examples, and coding rules for each deductive category, determining exactly under which circumstances a text passage can be coded with a certain category (Mayring, 2000). Category definitions, exemplary text passages, and rules for distinguishing different categories were formulated based on theory and material (Mayring, 2000). Category definitions are completed step by step and revised during the process of analysis (Mayring, 2000). Two researchers independently coded the material and discussed the coded segments

to achieve unity. After coding, selected segments were translated from German to English to incorporate them in the presentation of our results.

By revising the coded categories, we derived subcategories from our data to explicate challenges in adopting circular business models as well as potential strategies to grow the adoption of those models in the plastics packaging industry (*Figure 1*).

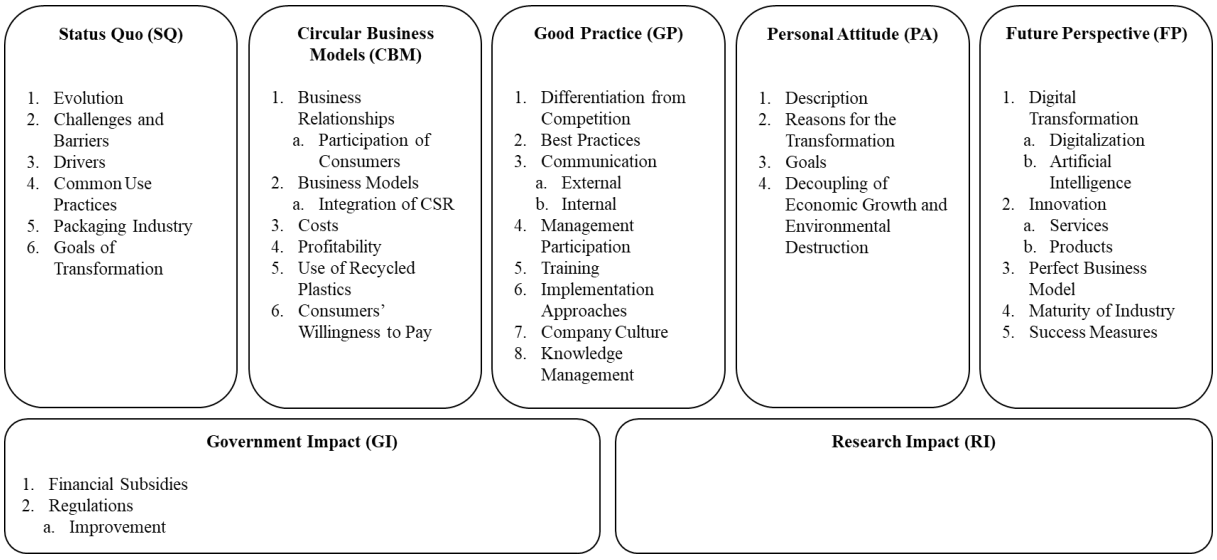

Figure 1. Structure of Categories and Subcategories for Expert Interviews on Circular Economy in the Plastics Packaging Industry in Austria and Germany

Following the structure of our guiding questions, we derived seven categories from the expert interviews. These categories cover the status quo of circular economy in plastics packaging in Austria and Germany, circular business models which are in place, good practice standards of circular economy, experts' personal attitude toward circular economy as well as what the future of circular economy might encompass. In addition, experts also noted how the government, for example through regulations, or research, for example through the development of innovative solutions, impact circular economy.

For example, when asked about the status quo of circular economy, many experts noted that it has come a long way in the past years but that there is still room for improvement as this quote illustrates: "There is still a long way to go, as you can see from the fact that not much is yet recycled" (Interview 8).

With respect to circular business models, most experts noted that they do not have a fully functioning circular business model yet with many citing that recycled materials are more expensive than virgin material or that regulations do not allow them to use recycled materials as they cannot guarantee that the purity of these materials meets necessary standards. One expert noted that they want to enter into cooperations to exchange raw materials directly with other companies

> "Are there opportunities to enter into cooperations through the exchange of raw materials, which then have an effect on the business model? Um, but I think the greatest leverage is then mostly in the enablement through the product design for recyclability, for reparability, for disassembly, for return and then recycling, that's where we make or where we mostly put the focus then. I would say" (Interview 12).

When asked about whether good practices like training of employees, management participation or company culture were important to implement circular economy practices, many experts agreed and highlighted that they are vital to advance circular economy practices in a company. Experts underlined that good practice in circular economy for plastic packaging is to use as little material as possible, to choose mono-materials over multi-layer materials, and to recycle as much as possible. This quote underlines the importance of recycling for companies engaging in circular economy also from a financial point of view

> "As I said, we have been using our own recyclates in the circular economy for decades, simply because it is cheaper. Recently, we have also been increasingly using reprocessed post-consumer recyclates in areas where this is allowed, which, as I said, is not permitted in the cosmetics, food and pharmaceuticals sectors, and will be very difficult to do in the next few years. The share is increasing" (Interview 9).

On the future of circular economy, experts agreed that innovations in materials, digitalization as well as artificial intelligence would advance current circular practices. Some experts highlighted how digitalization might optimize material flow:

> "Digitization in the form of digital product passports so that collected waste can be optimally sorted and assigned to the optimum material flow, whereby it is important that the corresponding processing fractions can still be read out, as there have also been technical developments recently" (Interview 8).

While others explained how artificial intelligence might advance circular economy for plastics:

> "In the future, AI will probably also play a role in the area of sorting itself. This means that I can use AI to separate some streams of articles that I was previously unable to separate based on the attributes of plastic type or color, because it may be possible to recognize certain characteristics on the bottles or articles (...) and group them" (Interview 10).

Experts also agreed that circular economy in plastics packaging has come a long way in the past year but has not yet reached its full potential: "Compared to other industries, I think we've come a long way" (Interview 12).

Additionally, to gain a comprehensive understanding of circular economy practices in the plastics packaging industry, and how these practices are influenced by external factors, we also asked experts which impact governmental intervention or regulation and research output has on circular economy practices. Experts highlighted that starting to transform business models towards circularity can be a financial burden for companies and that government funding for such initiatives could help resolve this conflict:

> "I think that's the task, to provide or support that start-up funding so that the inhibition threshold for transformation is as low as possible" (Interview 1).

Other experts pointed out that governments should craft legal frameworks to encourage and guide companies towards implementing circular practices:

> "[T]he EU legal framework for the transformation in the circular economy is a very, very massive and very important pillar of the Green Deal and is also covered by a large number of directives, regulations and guidelines and is intended to encourage companies to […] actually implement this transformation and no longer just talk about it, but to actually do it" (Interview 2).

According to experts, research also affects companies' transformation towards circularity. For example, experts emphasize that business research should compare the costs of transforming from a linear to a circular business model to the costs of not adapting to growing environmental challenges:

> "what impact [companies] would actually have on […] the circular economy and also on the costs, but also on the avoidable costs. There is a total lack of imagination as to how you could become significantly more efficient […] for all those involved. And to give [companies] assistance so they can better assess this from a business perspective" (Interview 13).

Additionally, experts point out that research drives innovation for the circular economy which companies can implement:

> "We have research projects within research programs […] to drive innovation forward. [They] also create solutions that then just also help them and which are then perhaps also somehow scalable, because there are simply more ideas in the field" (Interview 12).

4. Discussion and Future Research

With our interviews, we show that companies face a multitude of challenges when engaging in the circular economy. For example, our experts pointed out that reclaimed plastic is often hard to come by in the desired quantities and might be more expensive than virgin material. However, we could also gain knowledge on how companies mitigate the risk of transforming form a linear to a circular business model. For example, many informants reported that a gradual approach works in their companies.

As we further fill our category structure with results from the interviews, we aim to inform (1) research, (2) practice, and (3) public policy on the challenges companies face when implementing circular business models, which opportunities lie in circular business models and how companies could successfully implement circular business models despite challenges. (1) Among others, we aim to stimulate and propose research efforts on the following questions:

(1.1) How can companies effectively engage employees to develop circular business models and to better identify market shifts and react to them?

(1.2) How can companies offset the costs associated with developing and implementing circular business models?

(1.3) How can marketing foster consumer engagement with circular plastic products over linear plastic products?

(2) Besides marketing research which plays a vital role in exploring how companies adapt to the challenges of circular business models, based on our preliminary findings, we propose how companies can act to mitigate the challenges of circular business models and the circular economy:

(2.1) Companies should invest in the training of their employees on the circular economy to generate ideas for circular business models, increase internal acceptance of the change towards circular business models, as well as external acceptance by consumers.

(2.2) Companies should cooperate with research to generate new ideas for circular business models to keep their products up to the market's sustainability standards and how to implement them into the company's current business model.

(2.3) Companies should start with small changes towards circularity in existing business models to start the process of developing circular business models gradually and keep entry barriers low.

(3) In addition, policy makers have an obligation to create a better world (Shultz et al., 2022). Environmental pollution through plastic waste and climate change are detrimental to the environment and all life on earth. Therefore, we offer several propositions for public policy:

(3.1) As circular business models in the plastic packaging industry play a central role in decreasing plastic waste, legal barriers to the circularity of plastic products must strike a healthy balance between allowing for reasonable (im)purity of the recycled plastics and keeping citizens safe from harmful products.

(3.2) As the transformation towards circularity is associated with high costs for companies, public policy should develop financial incentives for companies that reduce their own emissions and plastic waste and whose products aim to reduce plastic waste along the value chain, to keep possible price decreases acceptable for consumers.

(3.3) As research on the circular economy, circular business models, and circular plastics can help to establish the mainstream adoption of circular practices, public policy should foster research in this area.

We plan to conduct further interviews with different stakeholders who can inform us about the technical and commercial aspects of implementing circular business models while also further analyzing the expert interviews we already conducted. With our insights on circular business models in small- and medium-sized companies, we aim to inform different stakeholders, i.e., public policy, research, and companies, on the challenges of transforming from linear to circular business models as well as the opportunities of circular business models thereby fostering innovation in companies and ensuring their long-term sustainability.

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