# SUSTAINABLE CIRCULAR PACKAGING DESIGN: A SYSTEMATIC LITERATURE REVIEW ON STRATEGIES AND APPLICATIONS IN THE COSMETICS INDUSTRY

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## ABSTRACT

Packaging protects products, keeps their value and reduces waste. This is especially crucial in domains with perishable goods such as food, medicine or cosmetics. But conventional packaging solutions yield negative environmental impacts. In the EU, the largest share of plastics is used for packaging, causing a corresponding footprint. The application of sustainable strategies to packaging should help to reduce carbon dioxide emissions and promote the development of sustainable consumption. In this paper, a review is conducted on research that brings together circular economy, packaging design and cosmetics industry, by systematic literature review and content analysis. In addition to the current standards of conventional packaging, packaging alternatives are presented, which are categorised according to the R-strategies Refuse, Reduce, Reuse and Recycle.

**Keywords**: Circular economy, Sustainability, User centred design

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## 1 INTRODUCTION

The greatest challenges for humankind of the 21st century include avoiding carbon emissions, protecting habitats and conserving resources. However, the use and purchase of consumer goods have a negative impact on these goals. Plastic packaging in particular has a major impact. The largest share of plastics used throughout the EU, 39.1%, is used for packaging. By comparison, the second largest application area, building and construction, is responsible for 21.3% of plastics (Plastics Europe & EPRO, 2022). The United Nations General Assembly has adopted 17 Sustainable Development Goals, number 12 of which concerns sustainable consumption and production. SDG 12 aims to avoid waste applying circular economy strategies and more sustainable consumption patterns (UN, n. d.). There is potential for savings above all in the area of packaging waste, since currently less than 10 % of the resources used follow a recycling path (ibid.). Moreover, not even 50 % of plastics are recycled as packaging waste is usually not sorted by type (Schuster et al. 2021). In the cosmetics sector, the challenges just mentioned are exacerbated, since, for example, special hygienic requirements are given or social networks motivate increased consumption (Dinh & Lee, 2022). There are already alternatives on the market. Nevertheless, the reasons why customers do not opt for green products are manifold, such as shape, functional properties or personal preferences (Wallner et al. 2022). The design and conception phase of a product determines the entire product life cycle at an early stage and should therefore take purchase decision processes and sustainability strategies into account at an early stage. The functions in protecting the value of the perishable product and reducing product waste need to be set against the packaging footprint (Wikström et al. 2019).

There has been research conducted that deals with the topics of packaging design and circular economy on one hand or with design in cosmetics and hygiene sector separately, but not in conjunction. Recent reviews summarize findings for packaging design in general (Zhu, Liu, Ye, & Batista, 2022; Pettersen, Grøvlen, Evje, & Radusin, 2020) or for example for the food sector (Afif, Rebolledo, & Roy, 2022, see also Wikström et al. 2019). Other works report only on purchase intentions related to green products or packaging design (Acharya, Bali, & Bhatia, 2021; Putri, Wahyuni, & Yasa, 2021; Ritnamkam & Sahachaisaeree, 2012).

In order to close this research gap, this paper examines the current state of research by addressing the following questions:

- Which sustainable packaging concepts exist in the field of cosmetics and hygiene products?
- Which factors influence consumers in the purchase decision process when choosing sustainable cosmetics and hygiene products?

Therefore, the theoretical background will be discussed in the following. In order to gain insights into both questions, a literature search will be conducted and examined by means of content analysis. Conclusions will then be drawn from the findings for the design phase of products.

## 2 THEORETICAL BACKGROUND

While great strides have been made in improving resource efficiency, any system based on consumption rather than regenerative use of resources causes significant losses along the value chain (The Ellen MacArthur Foundation, 2012). In a circular economy, products are designed to be easily reused, disassembled, remanufactured or recycled. It is assumed that the reuse rather than the extraction of resources is the basis for economic growth and thus supply risks are reduced (Andrews, 2015). Based on this concept, strategies should support the implementation of the circular economy. Most common are the R-Strategies. According to Reike et al. (2018), the original 3-R typology 'Reduce, Reuse and Recycle' are most frequently used in the circular economy literature (Reike et al. 2018).

Earlier sustainable design approaches focused primarily on reducing environmental impact by redesigning individual features of products. The concept of eco-design was the first to address the whole life-cycle of products (Ceschin & Gaziulusoy, 2016). Circular product design, which builds on this, also focuses on extending the life of products and creating a cycle through reuse, repair and refurbishment (Willskytt, 2021). A newer concept, product-service systems, comprises a product and a service in its basic elements. The focus of the company is shifted from the development and sale of purely physical products to the sale of a system of products and services (Lofthouse & Bhamra, 2006). Companies thus have control over the entire life cycle and can manage output in open or closed material loops (Andrews, 2015).



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Customers' decisions nowadays are no longer based purely on price and quality as there are no longer significant differences due to supply, instead it is influenced by a product's ability to reinforce personal attributes (Irani & Frankel, 2020). As neuromarketing shows, emotions represent a crucial influencing factor (Irani & Frankel, 2020).
As an explanation for the choice of green products, there is a perception that a number of variables interact. These consist of environmentally friendly values, environmental awareness and trust in green products. Consumers prefer products that are consistent with their values (Kahraman & Kazançoğlu, 2019). These preferences often transform into actual purchasing behaviour.

## 3 METHODOLOGY

In order to identify scientific publications, a systematic literature search was conducted based on Fink's methodology. The literature was extracted from the databases Scopus, Wiley, ScienceDirect and the databases Academic Search Elite, Business Source Complete, Communication & Mass Media Complete, EconLit with Full Text and Green-FILE, accessible on the EBSCO platform, based on their thematic fit with the research topic. In the following step, search terms were selected which should provide an appropriate number of results for the research. Search terms were selected in alignment with the review of Zhu et al. (2022) on general packaging design and circular economy (Zhu et al., 2022). Terms related to cosmetic products (e. g. 'cosmetic*', 'personal care') have been applied in conjunction with the serch terms for packaging design (e. g. 'product packag*', 'packag* design') and circular economy (e. g. 'circular', 'sustainab*'). The search was conducted in title, abstract and keyword. A total of 1348 publications were identified.

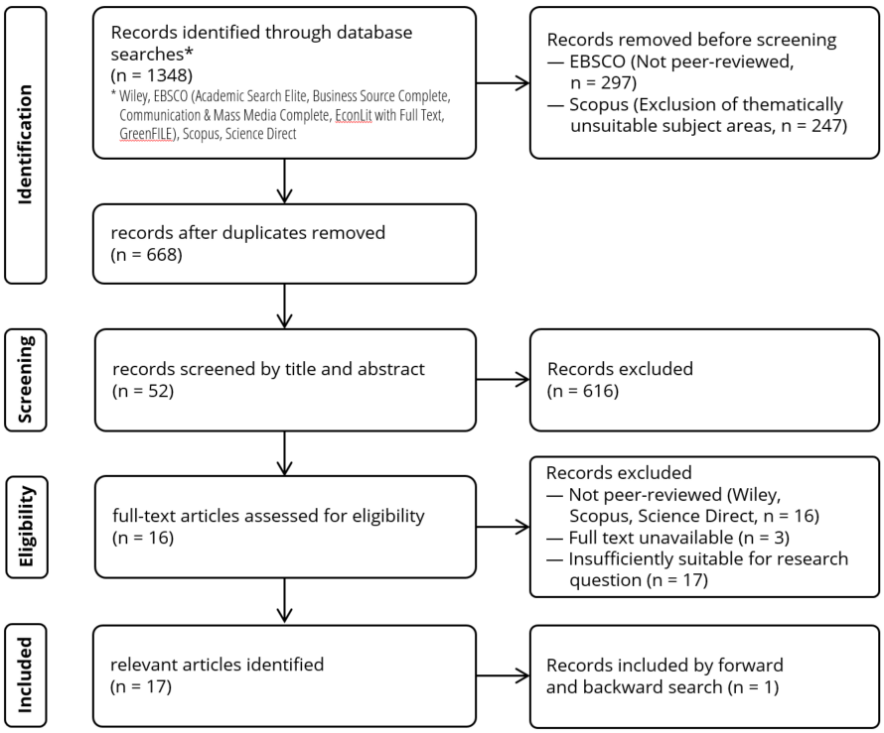


*Figure 1. Search scheme of the systematic literature review based on Page et al. (2021)*

Practical search criteria were then selected in order to narrow down the number of publications in a meaningful way. English-language literature was included in the search, without publication date restrictions. In addition, all types of double-blind peer-reviewed academic literature were included in the search. In a further step, the publications were subjected to a methodological screening after duplicates had been removed. In the first stage, the publications were checked with regard to their title and abstract. In a second stage, the publications were prepared for full text screening and again publications were removed due to lack of availability or rigour. The third stage, full text screening, limited the number to 16 relevant publications (Figure 1). Through the forward and backward search, one additional publication could be located. The sample covers a period from 2006 to 2022, with 70 % of the publications having been published in the last six years.



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The collected literature has been analysed by qualitative content analysis according to Kuckartz (2012), which enables a systematic and rule-guided analysis of text material. For the basic form of content-structuring qualitative content analysis, thematic main categories are deductively developed from the research question and the material is randomly coded according to these main categories. Subsequently, text passages of the same main categories are compiled and subcategories are inductively determined on the material. For the categorisation of packaging alternatives, the R Strategies were followed, with the most basic, the 3 R strategy Reduce, Reuse and Recycle. In the course of the iterative inductive process, this was supplemented by the Refuse strategy due to frequent mentions.

## 4 RESULTS

The results from the systematic literature review cover findings on conventional packaging concepts and packaging alternatives. For the latter, findings on functions, design, features, materials, disposal, risks among others have been identified. Furthermore, factors influencing the purchase decision, among them design factors, have been identified. All of these findings are relevant for further research on sustainable circular packaging design.

### 4.1 Packaging design in the cosmetics sector

Packaging is a by-product and is not bought for its own sake (Lofthouse et al., 2017) but serves to protect the product, prevent losses, ensure quality or facilitate logistical processes (Aguiar et al., 2022; Jaccarini & Refalo, 2017; Lofthouse et al., 2017; Sahota, 2013) or to facilitate logistical processes (Jaccarini & Refalo, 2017; Sahota, 2013). Information about the product should ensure its correct use and function (Aguiar et al., 2022; Jaccarini & Refalo, 2017). In the cosmetics sector it is also increasingly used as a means of communication (Aguiar et al., 2022; Lofthouse et al., 2017; Sahota, 2013). It helps to improve the image of the product and create marketing advantages. Only a few authors explicitly mention the protection of the shielding against microorganisms or product tampering in their comments.

There is a growing recognition that packaging designs that are not environmentally sustainable are a thing of the past. However, most cosmetics currently on the market are still packaged in single-use plastic containers (Gatt & Refalo, 2022; Lofthouse et al., 2017; Ren, Zhang, & Gao, 2022; Wakefield-Rann, 2017; Willskytt, 2021). As a measure against the loss of resources and the emissions caused by production and disposal, the Packaging Directive 94/62/EC was adopted in the European Union in 2021 (Aguiar et al., 2022). It aims for the production of packaging with minimum volume and weight, while ensuring safety, hygiene and consumer acceptance.

Design has the potential to influence purchase and consumption and can promote use behaviour, reuse and recycling. The design phase is crucial for each life cycle phase of cosmetics, as it defines the whole system (Ren et al., 2022). Different LCA conducted on cosmetics packaging show that there are different results when it comes to determining which phase has the greatest impact. The LCA conducted by Ren et al. for glass and PET cosmetic bottles found that the end of life has the most consequential environmental impact at over 50 %, with landfilling of waste being the most severe, followed shortly by manufacturing, transport and use (Ren et al., 2022). Jaccarini & Refalo's (2017) LCA showed that in the case of a transportable cosmetic box with powder and mirror, the raw material extraction phase is the largest contributor of all life cycle phases when only life cycle energy consumption is considered. In the analysis by Civancik-Uslu et al. (2019), raw materials also accounted for 50 % of the total life cycle impact of an ordinary plastic tube, although this LCA, without including any modelling of EoL in the LCA, was carried out. The rationale was to convey the environmental profile of the tubes to the manufacturers. Waste disposal would vary depending on the specific markets in which the tubes are sold. However, even the most environmentally friendly packaging is no good if there is no system to collect and recycle it at end-of- life (Sahota, 2013). Aguiar et al. (2022) direct the perspective additionally to the aspect of water consumption, whereby this is mainly incurred in the cleaning of production facilities, materials and packaging lines, as well as for compliance with hygiene standards.

The use of methods in design should improve environmental performance. Checklists, diagramming tools, CAD programmes, LCA or guidelines can be used for this purpose (Willskytt, 2021). LCA were used in many of the studies reviewed and the importance of using LCA in combination with eco-design strategies to improve the environmental profile was also addressed. This can help to identify key life-cycle stages where the application of eco-design strategies is most efficient (Civancik-Uslu et al., 2019;



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Jaccarini & Refalo, 2017). One of the mains problems with plastics is the impact of marine pollution on the environment, which is a factore usually not considered in a LCA (Civancik-Uslu et al., 2019).
A good overview of eco-design guidelines is provided by Willskytt (2021). The review on eco-design and the circular economy examined the applicability of design guidelines for resource-efficient products to consumer products (Willskytt, 2021). It was identified that a lot of design guidelines exist for packaging, but only a few for the specific packaging of cosmetic products. However, several of the identified guidelines are transferable to cosmetic products and are therefore included in the next section.

### 4.2 Cosmetics packaging design features, materials and disposal

The packaging system should be considered in terms of product characteristics, sterilisation methods (if applicable), sealing, labelling, secondary packaging, handling, shipping, environment, storage, government regulations and end use.
Using recycled materials seeks to minimise the impact of a product. Meanwhile it could also encourage the use of disposable products by giving the appearance that recyclable products cause less damage (Wakefield-Rann, 2017). Additionally small and contaminated packaging, like cosmetic tubes, are particularly difficult to recycle as they still contain cosmetics and end up in the mixed plastic fraction at the packaging sorting plant due to their small size. They are therefore often landfilled or incinerated (Civancik-Uslu et al., 2019). If packaging is intended for incineration in landfills, it should at least be designed to select materials with high energy content and avoid hazardous additives (Willskytt, 2021).
Structural changes such as reducing, strengthening or weakening components can be considered to save material (Willskytt, 2021). Graphic elements and information should be used primarily to illustrate all important features, which can be very extensive (Lofthouse et al., 2017). Information on improved use and disposal on the label has a major impact on purchase and use and should be provided as graphic guidance for better recognition (Aguiar et al., 2022; Ren et al., 2022). At the same time, brand identity must continue to be considered in the aesthetic design. Differentiation within the product family and from the competition is influenced by colours, similar to mood and attention.
Materials that are difficult to separate, such as laminates and composites, should be avoided and instead little to a single material should be used in the product to ensure recyclability and reduce material need (Ren et al., 2022; Willskytt, 2021).
There are significantly fewer design guidelines for food and cosmetic packaging than there are for medical devices (Willskytt, 2021). Nevertheless, there are references in the literature to influential facts that need to be considered in design. An important design consideration is the risk of contamination. There are various risk factors here. For example, if cosmetic products are used in a way other than intended, this can lead to their contamination and consequent unusability. The most common misuses of this type include diluting the product with tap water, mixing products, adding food ingredients and leaving the product open to the environment. However, abuse is difficult to control because the more attractive the packaging, the more likely consumers are to use it for other purposes. To limit product exposure, designers can take some considerations into account at the conceptual stage. For example, smaller packages are safer because they are used for shorter periods of time and the frequency of interaction increases the likelihood of contamination. Furthermore, packaging with larger dispensing openings such as jars, bottles, cosmetic cans tend to be more vulnerable than aerosol cans, airless pumps and sealed systems. For example, Tubes allow for less exposure, but the type of applicator poses a problem as recirculation into the product does not prevent direct contact with skin.
Generally, the applicator and delivery mechanism are considered the most critical components in terms of product exposure. Applicators provide an ideal environment for microorganisms to become trapped and multiply. The structure and composition are critical in determining whether moisture, dirt and sebum can be trapped. Sponge applicators and mascara brushes are at high risk. Ball rollers and eye brushes have a medium susceptibility. Dry powder brushes, swabs, puffs and disposable sponges are the most suitable. Applicators in combination with loose powder minimise the risk. This can be further reduced by a robust preservation system, pre-sterilisation of applicators, incorporation of antimicrobial agents into the applicator material and instructions on proper cleaning and use. It should be mentioned here that there is no single strategy to minimise applicator risk in all cases. For instance, in a case study by Yablonski & Mancuso (2019), it was shown that not all closure systems are equally good, but depend on the use case and user scenario. A flip-cap closure for shampoos was found to be 0% contaminated after use, while the same closure for a hand cream was 39 % contaminated because consumers used the



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product differently. In summary, an ideal opening would be one with easy access and low exposure to the environment. It would reduce dripping or backflow during application, does not allow direct contact with the dispensing mechanism, uses recycled material and is user-friendly.
The awareness of companies to switch to natural, organic materials also poses a risk. It may provide the opportunity for a higher interaction between packaging and product, as a number of antimicrobial agents are naturally present in organic materials. But it may also provide for possible inactivation of preservatives, which can contribute to a faster degradation of the preservative system. Environmentally friendly substances in packaging and formulation may also require the addition of preservatives, as the previously high pH and hostile raw materials were more resistant to microbes and now make the product more vulnerable.
The focus was less on contamination risks in more recent studies. Aguiar et al. (2022) point out that cosmetics without water are less susceptible to microbes, have a longer shelf life and require fewer preservatives due to the high concentration of ingredients. Amberg & Fogarassy (2019) stated that cosmetics need to be protected from microbes to ensure consumer safety and to extend the shelf life of products. Willskytt (2021) mentions that waste potentially contaminated with biological materials must be disposed of in a manner that destroys the biological hazard but also that reusable products must be sterilised according to specific procedures. These publications point out the risk of contamination but do not address design suggestions or general specifications.
Other challenges in specific design to ensure consumer safety include preventing the product from being used in concentrated form. Suggestions for mechanisms from medical design could be adopted for this purpose (Lofthouse & Bhamra, 2006). In addition, the concept of reuse is becoming increasingly popular within R strategies. (Aguiar et al. 2024) point out that this concept has potential, but the products must meet the requirements and withstand this process (Aguiar et al., 2022).

## 4.3 R strategies in circular packaging design

Sustainable and new practices are becoming increasingly important among product developers. A sustainable product alone is not enough to effectively mitigate impacts. Collective thinking is needed to change the main supply systems and infrastructure (Gatt & Refalo, 2022). For this, new approaches from design such as product-service systems could be applied. These aim to achieve integrated functional solutions to meet customer needs. For example, detergent manufacturers go door-to-door with delivery vans and supply their customers by each taking the amount they need in their own container (Lofthouse & Bhamra, 2006). Waste reduction is also addressed in the Packaging Design Guidelines, where there is a wide range of proposals. In the following, different approaches based on the R-strategies will be categorised and presented. Some R-strategies have not been identified in the literature. For example, Refurbishment is a relevant strategy for circular economy also in the cosmetics and personal care sector (Wallner et al., 2022). However, in regard to packaging the Reuse strategy is used to categorise the approaches of using used packaging for new products, no matter if the packaging has been refurbished by the suppliers or reused by the customers.

### *4.3.1 Refuse*

The strategy that is most compatible with the goals of the circular economy is the avoidance of packaging. In this case, the product is designed in such a way that there is no need to package it. Anhydrous formulas offer optimal conditions. They can be packed in small, lightweight packages made of paper or cardboard. This reduces the CO2 footprint, as transport weight and plastic are avoided (Aguiar et al., 2022). Although they appear more expensive to customers, they last longer and replace 3—4 equivalent non-water-free products, reducing purchase frequency and increasing savings (ibid.). Dissolvable packaging is another concept (Willskytt, 2021). One example of this sales strategy is the company LUSH, which claims to sell 65% of its products 'naked' and also uses this strategy in marketing campaigns (Aguiar et al., 2022; Gatt & Refalo, 2022; Sahota, 2013; Wakefield-Rann, 2017). This has enabled them to save more than 450,000 litres of water per year compared to liquid shampoos (Aguiar et al., 2022; Wakefield-Rann, 2017). According to EU Regulation No. 1223/2009, non-pre-packaged products need to be accompanied by product information (Aguiar et al., 2022).

### *4.3.2 Reduce*

The reduction strategy largely focuses on reducing the amount of material through downsizing, weight reduction, structural changes such as reinforcing, folding, splinting, framing, minimising thickness,



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avoiding low-function components and minimising the number of separable components that could end up in waste (Willskytt, 2021). An LCA shows that weight reduction can reduce the overall impact of a plastic tube by 10% on average (Civancik-Uslu et al., 2019). However, the product should be tested for stability, which can be affected by dematerialisation (Gatt & Refalo, 2022).
A differentiated concept is the use of larger packaging. This concept should lead to simplification and reduction of the relationship between product and packaging (Aguiar et al., 2022). However, this concept should be viewed critically. Redesign approaches should be encouraged but do not have a radical impact on the life cycle assessment. While the weight of packaging per unit has decreased, demographic changes, the size of families and the demand for more convenience have led to an increase in the amount of packaging used (Lofthouse & Bhamra, 2006).

#### *4.3.3 Reuse*

Strategies aimed at reusing products are not as widespread as switching to sustainable materials (Sahota, 2013). The packaging guidelines refer to reuse as a process whereby a package is designed to go through a minimum number of cycles during its life cycle or can be re-filled, with or without the help of auxiliary products on the market that enable refilling. Such packaging becomes packaging waste when it is no longer reusable (Aguiar et al., 2022; Gatt & Refalo, 2022).
If used as expected, returnable packaging systems can provide greater environmental benefits and support the transition to a circular economy, which advocates the development of circular material flows (Lofthouse et al., 2017). In addition to saving raw materials, water can also be conserved, which further reduces transport costs. Gatt & Refalo (2022) demonstrated that the positive impact of reusability exceeds that of dematerialisation by 171%, even if the plastic waste of the reusable packaging is not recyclable. On the other hand, applying recyclability to a product that is already reusable does not significantly reduce the environmental impact (Gatt & Refalo, 2022). However, reuse should not necessarily be used as the only strategy. The study by Gatt & Refalo additionally showed that a cosmetic can with a replaceable aluminium tray containing the product that has to be repurchased is less sustainable than repeatedly buying the same can without the aluminium tray. In this case, the reusability could not compensate the negative impact of the aluminium tray (Gatt & Refalo, 2022). Furthermore, there is an overall risk with all reusable products that consumers will recycle this type of product (Wakefield-Rann, 2017) and therefore even lead to higher resource and energy consumption, as this type of packaging is likely to be heavier as it needs to last longer (Lofthouse et al., 2017).
In addition to the reusability challenges already mentioned, the product should be adapted to consumer needs, as in the past the use of reusable packaging has not been successful in some cases (Lofthouse & Bhamra, 2006). A high level of inconvenience and low incentives were seen as the cause. This can be achieved through the concept of emotionally durable design, in that the consumer builds an emotional attachment and is less inclined to replace it (Willskytt, 2021). Attractive packaging that is valuable in the eyes of the consumer will encourage them to refill and keep it rather than throw it away (Lofthouse & Bhamra, 2006). Limited acceptance can also be caused by negative associations such as poor quality and inconvenience (Lofthouse et al., 2017).
Packaging design needs to consider a number of technical issues related to durability, communication, refill mechanism, safety and cleaning. An ideal system should be simple, intuitive and inclusive in refilling (Lofthouse et al., 2017). In addition to usefulness, the aspect of beauty and pampering associated with the appeal of cosmetics must be promoted. To ensure the profitability of the system, it is also necessary to determine the frequency of use, because the system is only successful if the customer also returns the packaging (Lofthouse & Bhamra, 2006).
New pack types can be unfamiliar to the consumer, so the designer's main task is to develop an innovative overall concept. For the consumer, it must be clear from the product that it is a refillable system to avoid customer confusion and an increase due to unintentional waste. Reusability must be clear both at the point of sale and when the product is used (Lofthouse et al., 2017). Safety aspects in particular must be quickly apparent to the customer, as products should not be used in concentrated form, for example (Lofthouse & Bhamra, 2006). Dispenser units and primary packaging need to be appropriately durable, as customers need to buy the unit as well as the product (Lofthouse et al., 2017). The design of the system is therefore crucial, as otherwise it could be more financially attractive to dispose of the product and buy a new one (Lofthouse & Bhamra, 2006).
The packaging should allow the extraction of the entire content. If this is not possible, transparent packaging should be avoided as it is seen as wasteful, which has a negative impact on the perception of



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value for money (Lofthouse et al., 2017). Reuse requires easy cleaning (Ren et al., 2022). It must be clearly communicated to consumers how the system should be treated, which components should remain and how. This is also crucial for material selection, as glass and PET are popular materials in much of Europe that could potentially be recycled (Lofthouse & Bhamra, 2006). In the best case, maintenance should be minimal or not required at all (Lofthouse et al., 2017), which can be accomplished by design, for example if the packaging has a smooth surface (Willskytt, 2021).
Since large openings are more vulnerable from a microbial safety perspective, a refillable package should be designed to restrict access, protect the product and the consumer from overexposure and cross-contamination by minimising direct access to the nozzle. Automatic removal or sealing of the pouch including a new dispensing device on the refill packaging would also be conceivable.

#### *4.3.4 Recycling*

Applying recycling to a single-use product leads to large environmental savings of more than 90 % by using existing materials, reducing the total amount of waste sent to landfills and reducing energy resources (Gatt & Refalo, 2022). Despite these benefits, recycling is still not the most popular EoL option due to the limited economies of scale and the potential contamination at the end of use phase that makes it difficult to recycle a product (Gatt & Refalo, 2022). Therefore, this strategy to design recyclable products should only be used as a last option.
Furthermore, studies show that there is a significant lack of recycling. A 2018 EU study found that only 41.5% of plastic waste generated in Europe is material recycled, while the rest ends up in landfills or is used exclusively for energy recovery (Gatt & Refalo, 2022). Development should take into account the convenience of customers. If recycling procedures are not easy, consumers will not recycle packaging properly (Aguiar et al., 2022).
For a recycling-friendly design should to consider the dismantlability and the process. This can be realised by separable components and fewer materials. In addition, barrier-free instructions demonstrate proper recycling (Ren et al., 2022). Technical recyclability also depends on the choice of materials and should be compatible with recycling techniques (Willskytt, 2021).

### 4.4 Factors influencing the purchase decision

Decisions depend on differently weighted factors of each consumer (Amberg & Fogarassy, 2019). Among the factors that can have an impact on the customer's decision-making are environmental awareness, packaging design, greenwashing, brand identity and price.
Packaging is the most influential tool (Moslehpour et al., 2021). Recent research often suggests that its communication and interaction must lead to highlighting the environmental benefits of the product (Ren et al., 2022). Information on the label about the sustainability of the product and suggestions on how to use it can influence purchases as customers have been shown to have limited knowledge of sustainable products (Aguiar et al., 2022). Ren et al. (2022) found that plastics are underestimated and glass and biodegradable plastics are overestimated.
Moreover, as convenience and effort play a crucial role, customers will opt for small, light-weight packs. Refill packs, which are more suitable for transport, take up less space and are easy to reuse (Lofthouse et al., 2017) and are easy to reuse will be preferred. Ideally, handling should be an experience for the customer (Lofthouse et al., 2017). Structural packaging and graphic elements can invite to touch, turn, feel the product. Packaging design is expected to convey the product's personality through its shape and form and to arouse emotions in the process (Sahota, 2013). LUSH tries to create a personal bond between customer and product by putting stickers of the product producer on the products (Wakefield-Rann, 2017). They have also increased the sensory value of their products by allowing the customer to experience the product without packaging. However, sealed, opaque packaging can appear more hygienic to the customer (Wakefield-Rann, 2017). Customers also have the desire to test the fragrances in the shops, this problem would again be solved by the unpackaged products, whereas this is not possible with sealed or dissolvable refills (Lofthouse et al., 2017).

## 5 DISCUSSION

The literature contains a variety of approaches for the design of sustainable packaging, but often the statements on the design of cosmetic and hygiene products are rather less concrete. Accordingly, they



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rely on the transfer of design guidelines from other sectors such as the food or medical and pharmaceutical industries (Willskytt, 2021).

In relation to the first research question, it was found that the majority of the methods can be found in the area of reuse strategy. Crucial to success is the consideration of the whole system, especially the type of reuse which needs to be made as easy as possible for the consumer. Crucial is also the disposal of the products. As long as the consumer does not know under which conditions the products have a sustainable benefit and the manufacturers do not offer a disposal system, there is a risk that the products will be disposed of in a conventional way (Sahota, 2013). Safety is an important decision point for consumers who are sceptical about new products (Kahraman & Kazançoğlu, 2019). However, the most of the analysed studies almost ignore the safety risk due to microbial contamination, as only two deal with specific design features to reduce a risk. Awareness needs to be raised here for further research, as criticism has been voiced, particularly in relation to recyclable packaging. The importance of user testing and user-centred development was identified as important in this regard, as well as serving to establish user acceptance. The strategy of avoiding packaging, is less represented in the publications, which is due to the fact that most works look for alternatives rather than avoiding them.

The second research question was to identify factors that influence the decision-making process and how these can be implemented through design to enhance the positive impact of green sales. Based on the amount of theory found, there seems to be little research on decision-making for sustainable cosmetics in combination with design recommendations or in combination with prototyping studies. Five factors were identified that can influence the purchase decision process to varying degrees, and subjective perceptual preferences in particular should not be ignored. The investigated factors design, brand identity, price, environmental awareness and manipulation perception can provide intentions for how they can be used by the appropriate design. The price factor in combination with environmental awareness does not provide any directly obvious derivations for the design. It depends on the environmental awareness of the consumer. Those who have a high environmental awareness will be willing to pay more and even demand it because it is a sign of quality for them. The rest of the consumers will demand a similar price as for conventional products. The manufacturers of refill packs partly rely on financial incentives through cheaper overall packaging including the refill pack to motivate all those with a lower willingness to pay to buy.

The results of the study attempt to close the previously identified gap by bringing together the findings of different authors and from different perspectives on the topics of the circular economy, packaging design and the cosmetics industry. In further research, it would be conceivable to collect evaluations from consumers based on the large number of LCA studies and prototype developments identified in order to assess purchasing potentials. In addition, the effects of different points of sale could be investigated more closely, since online retailing does not allow for sensory evaluation by the customer.

## REFERENCES


Acharya, Surabhi; Bali, Santosh; Bhatia, BS (2021): Exploring consumer behavior towards sustainability of green cosmetics, in: International Conference on Advances in Electrical, Computing, Communication and Sustainable Technologies (ICAECT), IEEE, 1–6.

Afif, Karima; Rebolledo, Claudia; Roy, Jacques (2022): Drivers, barriers and performance outcomes of sustainable packaging, in: British Food Journal, Emerald Publishing Limited, 124, Nr. 3, 915–935.

Aguiar, Joana B; Martins, Ana M; Almeida, Cristina; u. a. (2022): Water sustainability: A waterless life cycle for cosmetic products, in: Sustainable Production and Consumption, Elsevier, 32, 35–51.

Amberg, Nora; Fogarassy, Csaba (2019): Green Consumer Behavior in the Cosmetics Market, in: Resources, 8, Nr. 3, 137, https://dx.doi.org/10.3390/resources8030137.

Andrews, Deborah (2015): The circular economy, design thinking and education for sustainability, in: Local Economy: The Journal of the Local Economy Policy Unit, 30, Nr. 3, 305–315.

Ceschin, Fabrizio; Gaziulusoy, Idil (2016): Evolution of design for sustainability: From product design to design for system innovations and transitions, in: Design studies, Elsevier, 47, 118–163.

Civancik-Uslu, Didem; Puig, Rita; Voigt, Stephan; u. a. (2019): Improving the production chain with LCA and eco-design in: Resources, Conservation and Recycling, Elsevier, 151, 104475.

Dinh, Thi Cam Tu; Lee, Yoonjae (2022): "I want to be as trendy as influencers"–how "fear of missing out" leads to buying intention for products endorsed by social media influencers, in: Journal of Research in Interactive Marketing, Emerald Publishing Limited, 16, Nr. 3, 346–364.

Fink, Arlene (2019): Conducting research literature reviews: From the internet to paper, Sage publications.




https://doi.org/10.1017/pds.2023.327 Published online by Cambridge University Press

Gatt, Isaac Jordan; Refalo, Paul (2022): Reusability and recyclability of plastic cosmetic packaging: A life cycle assessment, in: Resources, Conservation & Recycling Advances, Elsevier, 15, 200098.
Irani, Ruzbeh; Frankel, Lois (2020): The role of design in consumer behaviour: How design can influence consumer decision making at a point of purchase, in: Advances in Industrial Design, AHFE 2020, July 16–20, 2020, USA, Springer, 316–322.
Jaccarini, P.; Refalo, P. (2017): Life cycle analysis of a portable cosmetic package, in: 269–276.
Kahraman, Aysun; Kazançoğlu, İpek (2019): Understanding consumers' purchase intentions toward natural-claimed products: A qualitative research in personal care products, in: Business Strategy and the Environment, Wiley Online Library, 28, Nr. 6, 1218–1233.
Kale, Gaurav (2011): Overview of Biodegradable Packaging, Methods, and Current Trends, in: Nava Dayan und Lambros Kromidas (Hrsg.), Formulating, Packaging, and Marketing of Natural Cosmetic Products, Hoboken, NJ, USA: John Wiley & Sons, Inc., 411–419, https://dx.doi.org/10.1002/9781118056806.ch21.
Kuckartz, Udo (2012): Qualitative Inhaltsanalyse: Methoden, Praxis, Computerunterstützung, Beltz Juventa.
Lofthouse, V.A.; Bhamra, T.A. (2006a): Refillable packaging systems: Design considerations, 9th International Design Conference, DESIGN 2006.
Lofthouse, VA; Bhamra, TA (2006b): Refillable packaging systems: design considerations, in: DS 36: Proceedings DESIGN 2006, the 9th International Design Conference, Dubrovnik, Croatia.
Lofthouse, Vicky; Trimingham, Rhoda; Bhamra, Tracy (2017): Reinventing refills: guidelines for design, in: Packaging Technology and Science, Wiley Online Library, 30, Nr. 12, 809–818.
MacArthur Foundation, Ellen (2012): Towards the circular economy – Economic and business rationale for an accelerated transition.
Malea, Anastasia; Tzotzis, Anastasios; Manavis, Athanasios; u. a. (2020): Innovative and sustainable toothpaste packaging design, in: Journal of Graphic Engineering and Design, 11, Nr. 2, 19.
Moslehpour, Massoud; Chaiyapruk, Panita; Faez, Sahand; u. a. (2021): Generation Y's Sustainable Purchasing Intention of Green Personal Care Products, in: Sustainability, 13, Nr. 23, 13385, https://dx.doi.org/10.3390/su132313385.
Page, Matthew J; McKenzie, Joanne E; Bossuyt, Patrick M; u. a. (2021): The PRISMA 2020 statement: an updated guideline for reporting systematic reviews, in: BMJ, n71, https://dx.doi.org/10.1136/bmj.n71.
Pettersen, Marit Kvalvåg; Grøvlen, Magnhild Seim; Evje, Nina; u. a. (2020): Recyclable mono materials for packaging of fresh chicken fillets, in: Packaging Technology and Science, 33, Nr. 11, 485–498.
PlasticsEurope; Epro (2022): Plastics - the Facts 2022.
Putri, Ni Wayan Arika; Wahyuni, Ni Made; Yasa, Putu Ngurah Suyatna (2021): The Effect of Attitude in Mediating Environmental Knowledge towards the Purchase Intention of Green Cosmetic Product, in: Jurnal Ekonomi & Bisnis JAGADITHA, 8, Nr. 2, 202–208.
Reike, Denise; Vermeulen, Walter JV; Witjes, Sjors (2018): The circular economy: new or refurbished as CE 3.0?, in: Resources, conservation and recycling, Elsevier, 135, 246–264.
Ren, Zhongming; Zhang, Doudou; Gao, Zhu (2022): Sustainable Design Strategy of Cosmetic Packaging in China Based on Life Cycle Assessment, in: Sustainability, 14, Nr. 13, 8155, https://dx.doi.org/10.3390/su14138155.
Ritnamkam, Siripuk; Sahachaisaeree, Nopadon (2012): Cosmetic packaging design: A case study on gender distinction, in: Procedia-Social and Behavioral Sciences, Elsevier, 50, 1018–1032.
Rosette, Jack L; Yablonski, John; Mancuso, Sharon; u. a. (2000): Packaging, Cosmetics and Pharmaceuticals, in: Kirk-Othmer Encyclopedia of Chemical Technology, 1–14.
Sahota, Amarjit (Hrsg.) (2013): Sustainability: How the Cosmetics Industry is Greening Up, Wiley.
Schuster, F; Throl, C (2021): Rezyklate: Wie viel Kunststoff wird wirklich recycelt und was kann jeder tun?, Ökotest, [online] https://www.oekotest.de/freizeittechnik/Rezyklate-Wie-viel-Kunststoff-wird-wirklich-recycelt-und-was-kann-jeder-tun_11799_1.html [20.09.2022].
UN (2022): Sustainable Development Goals, [online] https://sdgs.un.org/goals [20.09.2022].
Wakefield-Rann, R (2017): More than skin deep: A service design approach to making the luxury personal care industry more sustainable, in: Sustainable management of luxury, Springer, 211–231.
Wallner, Theresa S.; Snel, Senna; Magnier, Lise; u. a. (2022): Contaminated by Its Prior Use: Strategies to Design and Market Refurbished Personal Care Products, in: Circular Economy and Sustainability.
Wikström, Fredrik; Verghese, Karli; Auras, Rafael; u. a. (2019): Packaging Strategies That Save Food: A Research Agenda for 2030, in: Journal of Industrial Ecology, 23, Nr. 3, 532–540, https://dx.doi.org/10.1111/jiec.12769.
Willskytt, Siri (2021): Design of consumables in a resource-efficient economy—a literature review, in: Sustainability, MDPI, 13, Nr. 3, 1036.
Yablonski, John I; Mancuso, Sharon E (2011): Microbial risks and eco-friendly packaging, Wiley.
Zhu, Zicheng; Liu, Wei; Ye, Songhe; u. a. (2022): Packaging design for the circular economy: A systematic review, in: Sustainable Production and Consumption, Elsevier.



https://doi.org/10.1017/pds.2023.327 Published online by Cambridge University Press