Concise Consumer Communication through Robust Labels for Bio-based Systems

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State-of-the-art report on consumer behaviour towards sustainable products

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☐	**DEC**	Websites, patent fillings, videos, etc.	☐	**CI**	Classified, information as referred to in Commission Decision 1001/844/EC
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Publishable executive summary

The goal of the 3-CO project (https://3co-project.eu/) is to develop and demonstrate the viability of a supportive framework for Label and Certification Schemes (LCSs) on Business-to-Consumers (B2C) communication for industrial bio-based products (BBPs) that enables and supports consumers to make more sustainable purchasing choices. The focus is on consumer-oriented labelling options for industrial BBPs that are sustainable and circular in using resources, processes, and materials during their entire lifecycle. The supportive framework will consist of actionable guidelines for LCS owners that reflect consumers' and other stakeholders' needs, digital solutions to support better-informed decision-making processes of consumers, and policy recommendations on deploying social measures.

This report presents state-of-the-art knowledge related to consumer behaviour towards sustainable products. The report is based on an extensive analysis of two literature streams: academic literature (scientific peer-reviewed papers) and grey literature (research reports). The academic literature is approached with a systematic literature review (SLR) approach and the grey literature with purposive sampling, utilizing experts drawing on their previous knowledge over relevant and recent research reports. The findings from both approaches are described in distinct chapters, followed by a synthesis in the form of recommendations to support consumers' sustainable behaviour.

This report focuses on factors that affect consumer behaviour towards sustainable products, mainly on factors positively affecting the willingness to pay or buy sustainable products and the identified barriers that hinder consumers from choosing sustainable products. The most common factors in the literature refer to consumers' environmental concerns and green consciousness, highlighting consumers' environmental awareness and sustainable practices. In addition, consumers' scepticism towards sustainable production was identified as the most common barrier. Eco-labelling is suggested as a crucial tool in the transition towards sustainability for consumers, retailers, and policymakers.

The findings from this report will further support the upcoming tasks of 3-CO, especially the development of the quantitative survey to be conducted in T2.3, aiming at gaining deeper insight into consumers' drivers and concerns regarding sustainability issues and willingness to use labelling systems for sustainable decision-making among EU consumers.

1   Introduction

1.1   Objectives of 3-CO

The main goal of the 3-CO project is to develop and demonstrate the viability of a supportive framework for Label and Certification Schemes (LCS) on Business-to-Consumers (B2C) communication for industrial bio-based products (BBPs) that enables and supports consumers to make more sustainable purchasing choices. The focus of 3-CO is on consumer-oriented labelling options for industrial BBPs that are sustainable and circular in terms of resources, processes and materials used in their entire lifecycle. The supportive framework will consist of actionable guidelines for LCS owners that reflect consumers' and other stakeholders' needs, digital solutions to support better-informed decision-making processes of consumers, and policy recommendations on deploying social measures. The project aims to improve bio-based systems' sustainability performance and competitiveness, focusing on ten bio-based value chains (Table 1). The procedure of choosing these value chains in Table 1 is detailed in 3-CO Deliverable 1.1 *Selection of ten bio-based value chains* describing the selection criteria, including current and future market size, their contribution to the bioeconomy and their potential environmental and social impacts.

Table 1: 3-CO product value chains

#	3-CO product value chains
1	Baby clothing
2	T-Shirts
3	Shampoo
4	Wooden houses (Cross Laminated Timber or wooden frame houses)
5	Furniture
6	Cosmetics (make-up, etc.)
7	Biodegradable plant pots
8	Biobased plastic toys
9	Bio-based PET/PEF bottles
10	Mattress

The ten selected value chains are the focus of several 3-CO activities, also in WP2.

1.2   Objectives of WP2

Work Package 2 (WP2) *Improving consumer behaviour and developing smart solutions to support sustainable consumption* helps the 3-CO project to understand consumers' decision-making processes and motivation towards

sustainable consumption. Existing LCS will be tested and evaluated, and consumers' needs and requirements for future labelling of BBPs will be defined. Further, WP2 will develop smart digital solutions for consumers, supporting the decision-making process and behavioural change.

The WP2 begins with Task 2.1, *Consumer behaviour towards sustainable products*, which supports all the other tasks of the WP2. Specifically, it examines and analyses existing literature regarding consumer behaviour and expectations towards sustainable products. The focus is on factors affecting the consumer's purchasing behaviour, consumer appreciation regarding BBPs in general and the identified challenges hindering the consumers from choosing sustainable products (e.g. confusing terminology or knowledge gaps). The conducted literature review supports the development of a quantitative consumer study to be conducted in Task 2.3 and other tasks later in the project by providing a comprehensive view of the current knowledge on factors affecting consumer behaviour towards sustainable products.

1.3   Scope of the report

This report summarises the literature review results on consumer behaviour and expectations towards sustainable products. The analysis provides state-of-the-art knowledge on factors affecting consumers' purchasing behaviour regarding sustainable products, and the identified challenges or barriers preventing consumers to choose sustainable products.

The research questions guiding the work were:

- RQ1. What factors affect consumer's purchasing behaviour (concerning BBPs/Sustainable products)?
- RQ2. What barriers are identified in sustainable consumption behaviour (BBPs/ Sustainable products)?

The research questions were tackled by reviewing the current knowledge on consumer behaviour from academic literature (peer-reviewed articles in international academic journals) and so-called grey literature (research reports, such as deliverables of EU-funded projects). This report will provide valuable knowledge for the upcoming tasks in the 3-CO project. Notably, it will support the development of the quantitative study conducted in 3-CO Task 2.3., which aims to gain insight into consumer drivers and concerns regarding sustainability issues and willingness to use labelling systems for sustainable decision-making among EU consumers.

The report is structured as follows: after this introductory Chapter, the second Chapter will focus on the methodology utilised. The third Chapter presents the academic and grey literature review findings separately. In the final fourth Chapter, we present relevant conclusions and recommendations for the later parts of the 3-CO project.

2   Methodology

This report presents the outcome of an analysis of two different literature sources – academic literature (peer-reviewed articles in international academic journals) and grey literature (research reports, such as deliverables of EU-funded projects). Analysing the literature sources is further referred to as a *Systematic literature review* (academic literature) and *Grey literature review* (grey literature). Both processes are described in more detail in the sub-chapters below.

2.1   Systematic literature review

A detailed academic literature review was conducted altogether on 199 papers. The systematic literature review (SLR) followed the commonly utilised PRISMA procedure (Page et al., 2021; Paul et al., 2023). PRISMA, or Preferred Reporting Items for Systematic Reviews and Meta-Analyses, is a preferred method to report items for systematic reviews and meta-analyses. It is a checklist that guides how to report systematic reviews and meta-analyses. The method is designed to help researchers conduct high-quality systematic reviews that are transparent and reproducible. To that end, PRISMA offers guidelines for conducting a literature search, such as selecting studies for inclusion in the review, extracting data from the studies, and assessing the quality of the studies.

The conducted PRISMA process is described in more detail in **Annex A**. In brief, the review began with a literature database search to select studies to review. The 3-CO project experts were first consulted to create relevant keywords concerning consumers and their perspectives regarding bio-based products. After discussions, an initial set of keywords related to these issues was prepared to consist of the four words *bio*, *label*, *consumers*, and *behaviour*. A set of keyword strings was supplemented by synonym dictionaries, confirmed among team members, and tested in the SCOPUS academic database[1]. As an initial result, a set of 14 070 records was obtained using the following string described in figure 1.

> (bio* OR eco OR ecol * OR green* OR environ* OR sustainab *) AND
> (label* OR certific * OR symbol* OR logo* OR signag * OR
> information* OR package* OR tag* OR produce * OR brand *) AND
> (consumer* OR customer* OR client* OR shopper* OR buyer* OR
> purchaser* OR acquirer*) AND (purchas * OR buy* OR consum * OR
> behav * OR attitude* OR percept* OR insight* OR adopt* OR willing*
> OR intent* OR acqui * OR perceiv *)

Figure 1. Keyword string utilized in SCOPUS

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[1] https://www.scopus.com/

Following the PRISMA procedure, this early dataset was then subjected to several testing and cleaning stages to refine the articles to contain information immediately relevant for 3-CO purposes. The keywords were corrected, and the central inclusion and exclusion criteria were added during the process (e.g. language, type, field, product category).

After the refinement of the dataset, a collection of 861 abstracts were included in a Scopus bibliographic database. The suitability of abstracts for the full text review was assessed in an excel database according to the following criteria by researchers from University of Warsaw and VTT:

- A – acceptable: the purpose of a paper refers to factors that influence/predict consumer behaviour or attitude toward bio-based or green circular or eco or sustainable products
- I – interesting: the purpose of a paper is complementary to A
- U – useless: research doesn't cover consumers' green attitude or behaviour OR refers to food market (*food marked was excluded from the SLR, as the 3-CO project is not dealing with the food value chain*).

Articles marked I or U were subjected to additional review (double-check) by another investigator to check eligibility and the final decision whether the article was suitable for full review or should be excluded. After this stage, articles rated A (Acceptable) were qualified for full-text review. The data set consisted of *280 records*. Articles were retrieved from academic full-text databases, mainly EBSCO, Science Direct as well as Google Scholar and Research gate. 7 articles could not be downloaded, resulting in a final set of *273 articles* to be included in the full-text review. After the full text review 74 papers were still excluded from the final analysis due to the market context (food, beverages), research objects (organizations, packaging, advertising messages) or theoretical character not suited for the purpose of the study. Finally, *199 papers* were analyzed in the SLR. The dataset compiled from the detailed review will later be utilised also for publishing scientific papers in the 3-CO project.

The analysis revealed that the scientific papers concerned various products that were consequently grouped into 25 product categories. The dominant product category was *green products in general* (78 papers). In papers concerning this category, the products were not specified in detail. The second largest product category was *clothing* (40 papers), and the third largest was *cosmetics* (18 papers). The remaining studies concerned various product types, such as electronics, home appliances and detergents. **Annex B** presents a more detailed list of categorisations, showing the product categories, the products assigned to them, the number of articles in which the study was conducted in a given market context, and the countries in which the data was collected. It is worth noting that the European market is not well represented in these studies. Instead, the data were mainly collected in India (23), China (21 cases), the United States (12), Pakistan (11), and Malaysia (10).

In Table 2, we map the product value chains included in the 3-CO project to their equivalent product categories identified in the SLR. As suspected, comparing the detected categories with the ten product value chains chosen for the 3-CO project (Table 1), we recognise that all product categories are not considered by previous academic research. For example, previous research has not covered two 3-CO product value chains (biodegradable plant pots and mattresses). Table 2 presents product categories from which research conclusions can be used to explain consumers' purchasing decisions.

Table 2: 3-CO product value chains and product categories identified in SLR.

Products incorporated in 3-CO	Product categories identified in SLR
Baby clothing	Clothing
T-shirts	Clothing
Shampoo	Cosmetics
Wooden houses (CLT or wooden frame houses)	Building housing products
Furniture	Furniture
Cosmetics (make-up, etc.)	Cosmetics
Biodegradable plant pots	N/A
Bio-based plastic toys	Plastic-based products
Biobased PET/PEF bottles	Packaging
Mattresses	N/A

In addition to the above mentioned product categories, we will also refer to the most general product category later in the text, as *Green products (GENERAL)*.

When establishing hypotheses or research questions related to consumer behaviour towards sustainable products in the reviewed papers, the researchers primarily referred to the *Theory of Planned Behaviour* (TPB) and *Theory of Reasoned Action* (TRA), the base model for TPB. The concept of *Willingness To Pay* (WTP) was also very often applied. TBP and TRA are commonly used social-psychological models of customer behaviour, suggesting that human actions can be predicted by attitudes towards behaviour, subjective norms and, additionally considered in TPB as an extension of TRA, perceived behavioural control (Ajzen, 1991). These theories assume that an individual's attitude constitutes learned and consistent dispositions for a favourable or unfavourable way of reacting to a given object, the perception of social norms reflects the sense of pressure from surrounding people to undertake (or give up) specific behaviours and perceived control is understood as the consumer's predictions as to the effectiveness of the planned activities (Fishbein & Ajzen, 1975).

In addition to TPB and TRA, the reviewed studies concerning consumer behaviour often refer to Willingness To Pay (WTP), a central concept in behavioural economic theory. WTP accommodates the finding that a customer receives contingent, hedonic value from a product or service beyond its utility (Hanemann, 1994). This complex

additional value to consumers includes environmentalism (Vlosky et al., 1999), ethics (De Pelsmacker et al., 2005), and security (Laroche et al., 2001), to name a few. WTP is widely used in economics, marketing and product pricing because it helps uncover the highest price a consumer is willing to pay for a product or service. Until recently, environmentally friendly products have typically been more expensive than conventional, functionally similar products. WTP of green products thus limits the extra expense consumers are willing to absorb for the sake of environmentalism. However, different valuations of products are contingent and not universally shared.

Many scientists have built their own models based on different scales. When studying the social value believed to exist in Green products, it is essential to take note of the scales that characterize the characteristics of perceived consumer value are outlined in the Theory of Consumer Value (TCV). The Theory of Consumer Value conceptualises consumers' multidimensional valuations from utilitarian, hedonic and social elements and price (Holbrook & Hirschman, 1982; Sheth et al., 1991; Sweeney & Soutar, 2001). The Theory of Consumer Value thus illustrates the inherently entangled nature of consumption values as separate but interrelated. It provides the tools to tease out constituents of consumer decision-making from a multiplicity of elements.

The Value-Belief-Norm theory (VBN) (Stern et al., 1999), which explains the link between pro-environmental views, personal norms, and pro-environmental behaviours, has also been used by scientists. Additionally, the Norm Activation Model (NAM), developed by Schwartz (1977), has been applied to identify the drivers of consumers' intentions to engage in altruistic and environmentally friendly actions. The main theories and concepts found in the SLR are summarized in Table 3.

Table 3: Main theories and concepts found in the SLR

Theory	Author	Antecedents	Decisions	Outcomes
Theory of Reasoned Action (TRA)	Fishbein and Ajzen, 1975;		Attitude toward behavior Subjective norms ⬇ Behavioural intentions ⬇ Behaviour	
Theory of Planned Behavior (TPB)	Fishbein and Ajzen, 1985, 1991;		Attitude toward behavior Subjective norms Perceived control ⬇ Behavioural intentions ⬇ Behaviour	
Willingness to pay (WTP)	Hanemann, 1994; Vlosky et		Different price levels vs. different sets of product features ⬇	

	al., 1999; De Pelsmacker et al., 2005	Willingness to pay for a product ------------- Moderated by other variables, mainly demographic
Theory of Consumer Value (TCV)	Holbrook, 1982; Sheth et al., 1991; Sweeney and Soutar, 2001	Different dimensions of perceived value associated with a product or with its consumption: Hedonic vs utilitarian Or Social, emotional, functional (quality/performance and price/value for money) ⬇ Willingness to buy (Or willingness to pay / or actual buying)
Value-Belief-Norm Theory (VBN)	Stern et al., 1999;	Personal values (Altruistic, Egoistic, Biospheric) ⬇ Beliefs (Ecological worldview according to NEP, Awareness of consequences, Ascription of responsibility ⬇ Pro-environmental personal norm ⬇ Behaviour (Social movements)
Norm Activation Model (NAM)	Schwartz, 1977;	Adverse consequence, Ascribed responsibility ⬇ Personal norms ⬇ Altruistic and Pro-environmental behaviour

As for the most commonly used methods to collect data in the analysis of previous research, quantitative surveys were mainly utilised. In addition, focus group discussions, experiments, in-depth interviews, ethnography or desk research were utilised. The main findings from the analysed papers are presented in Chapter 3.1.

2.2   Grey literature review

The systematic literature review was supplemented with reports produced outside academic publishing channels as a grey literature review. The review was conducted by 3-CO experts using the purposive sampling method (Spiggle, 1994). In the 3-CO framework, purposive sampling refers to experts drawing from their previous knowledge of relevant and recent research reports. Purposive sampling is a non-probabilistic sampling method suitable when the target literature is small, like when the field is new or when there are few central publications.

Narrowing down from 14 candidates, 10 reports were finally included in the grey literature review. The analysed collection of publications fell mainly in the context of the EU Horizon 2020 Research and Innovation Framework Programme and research projects funded by national funding agencies such as the German Environmental Agency and the German Federal Ministry of Education and Research. In addition, the results of a survey "What do Germans think about the bioeconomy?" conducted by the German Koerber Foundation and the National Academy of Science and Engineering have been considered. All reports dealt with BBPs or the bio-economy in general serving the purpose of this report well. The detailed list of the analysed reports is found in **Annex C**. The 3-CO experts read through the reports and analysed relevant factors influencing the consumer's attitude or perception towards BBPs or bio-economy, also focusing on WTP for BBPs.

3 Findings

3.1 Systematic literature review

3.1.1 Factors positively affecting the purchasing behaviour of BBPs

Based on the systematic literature review (SLR) of academic journal articles, we found several factors that positively affect the consumers' willingness to pay (WTP) and purchasing behaviour concerning BBPs or sustainable products (referred here as predictors). The factors predicting and positively affecting willingness to buy or pay for green products, also considering the product category relevant to the 3-CO project, are listed in Table 4, with exemplary references to publications.

Table 4: Factors predicting and positively affecting willingness to buy or pay for green products

Related 3-CO product category	Predictors	Exemplary references
Clothing	• Clear communication with green terms like "Fair Trade" and "eco" (Evans & Peirson-Smith, 2018) • Trust building and respect toward sustainable brands that provide clear and transparent messages (Copeland & Bhaduri, 2020; Evans & Peirson-Smith, 2018) • Eco-labels can potentially reduce information asymmetry between producers and consumers, which is essential, especially for younger consumers (Feuß et al., 2022; Goswami, 2008; Rahman & Kharb, 2022) • Corporate Social Responsibility and brands' pro-environmental initiatives (Copeland & Bhaduri, 2020; Vătămănescu et al., 2021) • Positive corporate reputation (Vătămănescu et al., 2021) • High customer participation, especially for influencing consumers with low environmental concerns (Wei et al., 2018) • High environmental concern (Apaolaza et al., 2022; Bizuneh et al., 2021; Dangelico et al., 2022; Lee, 2011) • Conspicuous consumption motives, social norm and trends (Apaolaza et al., 2022; Asmi et al., 2022; Bakış & Kitapçı, 2023)	Evans & Peirson-Smith, 2018; Copeland & Bhaduri, 2020; Feuß et al., 2022; Goswami, 2008, Rahman & Kharb, 2022; Vătămănescu et al., 2021; Wei et al., 2018; Apaolaza et al., 2022; Bizuneh et al., 2022; Dangelico et al., 2022; Lee, 2011
Cosmetics	• Attitude towards green cosmetics, subjective norm and perceived behavioural control (Arli et al., 2018) • Pro-environmental self-identity (Arli et al., 2018) • Green consciousness / subjective environmental knowledge (Ewe & Tjiptono, 2023; Gong & Wang, 2022) • Health and environmental consciousness (Kim & Seock, 2009) • Ethical obligation (Arli et al., 2018) • Positive environmental information (Borin et al., 2011)	Arli et al., 2018; Ewe & Tjiptono, 2023; Gong & Wang, 2022

	• Communicating pro-environmental initiatives (Herédia-Colaço, 2023) • Eco-brand familiarity/awareness (Ewe & Tjiptono, 2023) • Environmental concern (Gong & Wang, 2022) • Social crowding (Wenting et al., 2022), • Green peripheral attributes in utilitarian products (in the utilitarian product category) (Gong & Wang, 2022) • Green core attributes in hedonic products (in the hedonic product category) (Gong & Wang, 2022)	
Building housing products	• Consumer perception of green building housing products (Huang, 2022) • Consumer attitude, purchase intention (Huang, 2022)	Huang, 2022
Furniture	• Transparency and specificity of environmental claims (Orazi & Chan, 2020) • Corporate credibility (Orazi & Chan, 2020) • Gender: female consumers are more likely to pay a higher price for children's furniture (Wan & Toppinen, 2016) • Higher education level (Wan & Toppinen, 2016), • Lifestyles of Health and Sustainability (Wan & Toppinen, 2016) • Perceived intangible product quality attributes like brand and environmental quality (Wan & Toppinen, 2016)	Orazi & Chan, 2020; Wan & Toppinen, 2016
Plastic-based products	• Strong sustainability interest (Magnier et al., 2019) • Product category (durables and fast-moving consumer goods packages) (Magnier et al., 2019) • Biodegradability (within six months), material preference, information about climate protection (more than about being free of pollutants) (Notaro et al., 2022) • Intrinsic and prosocial motivation (Pham et al., 2022) • Green self-identity, demographics (older consumers and consumers with past purchase experience of eco-products) (Russo et al., 2019) • Perceived product quality and value (Suhartanto et al., 2021) • Environmental concern and knowledge (Suhartanto et al., 2023).	Magnier et al., 2019; Notaro et al., 2022; Pham et al., 2022; Russo et al., 2019; Suhartanto et al., 2021
Eco-packaging	• Consumer knowledge and responsibility (Shimul & Cheah, 2023) • High propensity to gain additional information (Testa et al., 2020) • Adoption of pro-environmental behaviours (Testa et al., 2020) • Brand attitude (Gahlot Sarkar et al., 2019)	Gahlot Sarkar et al., 2019; Shimul & Cheah, 2023; Testa et al., 2020

Green products (GENERAL)	• Positive attitude towards green products (in line with the Theory of Reasoned Action) (Roxas & Marte, 2022; Salam et al., 2022; Wang et al., 2022) • Higher income and education (Shuai et al., 2014) • Positive emotional factors (framing of green products, emotional value of the offer) (Khan & Mohsin, 2017; Ulusoy & Barretta, 2016) • Brand trust and environmental concern (Ulusoy & Barretta, 2016) • Retailer reputation (especially for low-involvement green products) • Brand strength (for high-involvement green products) (Wang et al., 2022) • Support for environmental protection and responsibility (Kumar & Ghodeswar, 2015) • Environmental awareness, social impact and individual altruism (Gandhi, 2020) • Green trust (triggered by recyclability and consumers' perception of involvement in environmental protection) (Khan & Mohsin, 2017) • Green advertising (Khandelwal & Bajpai, 2011) • Eco-label itself influences consumer preferences for eco-labelled products, their environmental awareness, and their trust in environmental information (Kikuchi-Uehara et al., 2016)	(Gandhi, 2020; Khan & Mohsin, 2017; Khandelwal & Bajpai, 2011; Kikuchi-Uehara et al., 2016; Kumar & Ghodeswar, 2015; Roxas & Marte, 2022; Salam et al., 2022; Shuai et al., 2014; Ulusoy & Barretta, 2016; X. Wang et al., 2022; Y. M. Wang et al., 2022

Numerous determinants regularly affect consumer preferences and behaviour across various product categories. **Consumer environmental concern and green consciousness** are among the most common, appearing in nine separate studies and highlighting the value consumers place on environmental awareness and sustainable practices. Three studies have underlined the importance of **trust and transparency in sustainable businesses**, underscoring the value customers place on companies that are clear about their environmental activities. In three studies, **eco-labels** are also mentioned, highlighting their importance in bridging the information gap between producers and consumers. The frequent mentions of **corporate social responsibility** and **pro-environmental initiatives** demonstrate the importance of business ethics and responsibility in influencing purchase decisions. Some studies have noted how **positive attitudes towards brands and brand perception**, as well as **demographic variables** like gender and educational level, influence consumer purchases.

It may be summarised that previous studies confirmed that consumers seek transparency and dependability in the products they buy. By eliminating information asymmetry and empowering customers to make decisions based on

environmental effects, eco-labels are an essential tool and a key component for brands wanting to attract today's eco-conscious consumers, given the significance of environmental concern and the desire for transparency.

3.1.2   Barriers to purchasing BBPs

Based on the systematic literature review of academic journal articles, we found several factors that may constitute barriers because of their negative impact or lack of motivating power to purchase sustainable products. The main barriers related to the product categories relevant to the 3-CO project are listed in Table 5 below, with exemplary references to publications.

Table 5: Factors constituting as barriers to willingness to buy or pay for green products

Related 3-CO product category	Barriers	Exemplary publications
Clothing	- Confusion over most green lexicon terms (Evans & Peirson-Smith, 2018) - Inadequate information and lack of credibility of firms' claims (Evans & Peirson-Smith, 2018) - The belief that individual actions have little impact on sustainability (Evans & Peirson-Smith, 2018) - Low consumer environmental concern (Wei et al., 2018) - Consumer scepticism toward sustainable fashion production, especially regarding higher pricing and marketing claims (Ritch, 2022) - Lack of knowledge about apparel production and how sustainability translates into quality parameters (Bizuneh et al., 2021) - Greenwashing (Apaolaza et al., 2022)	Apaolaza et al., 2022; Bizuneh et al., 2022; Evans & Peirson-Smith, 2018; Ritch, 2022; Wei et al., 2018
Cosmetics	- Negative environmental information (Borin et al., 2011) - Green scepticism (by reducing their environmental concern and knowledge about environmental issues (Gong & Wang, 2022) - Attitude towards green cosmetic products doesn't translate into purchasing intention (Singhal & Malik, 2018) - Altruistic value, which doesn't significantly affect pro-environmental belief (Jaini et al., 2020) - Perceived sense of responsibility doesn't translate into purchasing intention (Arli et al., 2018) - Understanding of greenwashing practices (the more aware the consumers are of greenwashing practices, the more careful they	Arli et al., 2018; Borin et al., 2011; Gong & Wang, 2022; Jaini et al., 2020; Jog & Singhal, 2020; Singhal & Malik, 2018

Deliverable Arli et al., 2018; Borin et al., 2011; Gong & Wang, 2022; Jaini et al., 2020; Jog & Singhal, 2020; Singhal & Malik, 2018

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	are when making purchasing decision on green cosmetics) (Jog & Singhal, 2020)	
Building housing products	• Positive perception of green building housing products doesn't translate into a willingness to pay (Huang, 2022)	Huang, 2022
Furniture	• Specific external disconfirming information (Orazi & Chan, 2020), green scepticism (Orazi & Chan, 2020), and tangible product attribute preferences are the priority (Wan & Toppinen, 2016)	Orazi & Chan, 2020; Wan & Toppinen, 2016
Plastic-based products	• Product category (such as textiles) may not be expected by consumers to be plastic-based (Magnier et al., 2019) • Price (Notaro et al., 2022) • Perceived risk associated with purchasing a green, plastic-based product (Russo et al., 2019; Suhartanto et al., 2021)	Magnier et al., 2019; Notaro et al., 2022; Russo et al., 2019; Suhartanto et al., 2021, 2023
Eco-packaging	• High innovativeness (consumers who have higher innovativeness are less likely to purchase circular packaging) (Testa et al., 2020) • Perception of greenwashing might negatively impact consumers' willingness to engage with a product or brand (Testa et al., 2020).	Testa et al., 2020
Green products (GENERAL)	• Negative framing of green products (as it triggers fear) (Ulusoy & Barretta, 2016) • Negative trust in brands that were advertised with a claim to be green (Ulusoy & Barretta, 2016) • Low willingness to pay, in general, constitutes a significant barrier to the adoption of sustainable consumption (Nath & Agrawal, 2023) • Low availability of sustainable products (Nath & Agrawal, 2023) • The low functional performance of sustainable products (Nath & Agrawal, 2023) • The difficulty of integrating green products into consumers' day-to-day lives and routines (much effort to search for such products and adjust lifestyles to accommodate them) (Nath & Agrawal, 2023) • Higher income per individual doesn't translate into a more positive attitude towards green products (Kumar & Ghodeswar, 2015)	Ferreira Gaspar & Fernandes, 2022; Kumar & Ghodeswar, 2015; Nath & Agrawal, 2023; Ulusoy & Barretta, 2016

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> - Perceived advertising spend doesn't translate into a more sustainable brand image or environmental consciousness (Gaspar Ferreira & Fernandes, 2022)

Several challenges related to buying BBPs stand out because they are frequently mentioned. **Consumer scepticism** towards sustainable production and green scepticism (3 occurrences) is a noteworthy hurdle that keeps coming up. This scepticism is frequently a result of **questions over the veracity of green product claims** and the concrete environmental advantages of such products. Another critical barrier is **greenwashing awareness and perception** (confirmed by 3 studies). Customers are becoming more aware of false environmental claims, making them less trusting of companies and goods that make such claims. A further challenge (3 occurrences in SLR studies) is that **attitude and perception do not translate into a want to buy or a willingness to pay**. In other words, although customers may have favourable opinions about green products, this does not necessarily translate into purchasing behaviour in practice. Consumers may view sustainable products as dangerous in terms of quality, effectiveness, or financial worth, according to **perceived risk** (mentioned by 2 researchers).

In conclusion, genuineness and transparency might lessen scepticism and worries about greenwashing. Eco-labels should offer trustworthy, comprehensible information to bridge the gap between favourable attitudes and purchase behaviour. Consumer confidence can be increased by reducing perceived risks by ensuring that eco-labelled items meet quality and performance standards.

3.2   Grey literature review

Based on the review of grey literature, mainly focusing on the results of recent European research projects, multiple factors influence the general perception of consumers' on biobased products and their willingness to pay for them. According to a comprehensive study on the social acceptance of a bio-based economy in Germany, highlighting the need for citizens to have more information and background knowledge to form their opinions, it was found that there is an insufficient understanding of the bioeconomy concept among the general population as well as concerns about potential risks of novel technologies. Moreover, there are sceptical perspectives concerning the outcomes of shifting towards a bio-based economy, encompassing worries about potential cost escalations and a potential reduction in living standards resulting from this transformative shift (Hempel et al., 2019).

The media plays a significant role in shaping consumer behaviour. An analysis of media texts on bioeconomy-related topics in Germany revealed two main perspectives on the bioeconomy:

- Positive Perspective: Some contributions express excitement about the new products (e.g., fashion made from milk, tires made from dandelions) and highlight the environmental benefits, resource conservation,

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innovation, and competitiveness associated with the bioeconomy. The focus is primarily on using biomass as material without addressing potential limitations and risks.

- Critical Perspective: Other contributions address conflicts related to the bioeconomy, such as the trade-off between land requirements and global food security, poverty alleviation, and the impact on natural resources in the Global South. These critical perspectives also raise concerns about land grabbing, deforestation, conflicts with nature conservation, and the influence of technology, genetic engineering, and corporate power. The level of research funding and subsidies for the bioeconomy is also questioned (Kiresiewa et al., 2019).

Willingness to pay, i.e., the price a buyer is willing to pay for a particular product, is a value that allows one to focus on any "additional value" that a product creates compared to a conventional product. This is a strategy often recognised in sustainable consumption. For example, highlighting the environmental benefits of a bio-based product instead of a fossil-based one can help consumers make a more sustainable purchase choice. According to a study conducted in the Biobridges project, the large majority of consumers (70.8 %) are willing to pay a bit more for BBPs (Sabini et al., 2020). In a recent survey among Irish and Dutch consumers, conducted in the BioSwitch project, the sectors in which they would be willing to pay the highest green premium for bio-based products (25 % - 50 %) included disposable products, cosmetics, and personal care products (Kymäläinen et al., 2021).

In a study by Kainz (2016), where the effects of consumers' WTP for durable biomass-based plastic products were measured, it was concluded that the level of information the consumer has about the product substantially influences the consumer's buying decision and the WTP. However, it is not easy to measure the actual effect. How significant these information effects are at the point of sale depends on factors such as the consumer's level of involvement with the product, prior information about the product and the information provided on the product. Sufficient information about the unique properties of a product is vital when the products in question can be classified as credence goods. Goods with qualities that are hard or impossible to be observed by the consumer, especially compared to similar goods without these qualities, are called credence goods. Goods with certain qualities or properties (e.g., bio-based) must signal this information to the consumer to justifiably distinguish from their ordinary counterparts. (Kainz, 2016)

The same study concluded that the WTP was generally significantly higher for bio-based polymer products than their conventional counterparts. Bio-based polymer products struck a basic interest of the study participants, but it takes much effort to raise sufficient awareness and create acceptance for these products. Information provided on a short-term basis during the experiment only partly affected the WTP and was judged too complex and uninteresting. Hence, providing necessary information on the complex topic of bio-based products needs to happen in a simple, easy-to-digest way to increase the consumer's WTP and acceptance of bio-based products. (Kainz, 2016)

WTP is a relevant issue for a procurement decision only in those cases where bio-based products will be more expensive and better product functionalities do not compensate for the higher price. In a meta-study conducted in the RoadToBio project, it was discovered that a significant percentage of participants (between 55% and 64%) would be willing to pay a little bit more for a bio-based product than for a conventional product, mainly if the benefits of the resource base are clear to them (Pfau et al., 2017). However, sustainability was not the only option that affects consumer choice: the fact that a product is bio-based is only one aspect that influences buying decisions. The results also found WTP to be related to consumers' personal interests, e.g. health and the concern of consumers about the environment, welfare and future generations. This suggests that a higher WTP is mainly found in a niche market (Pfau et al., 2017). To conclude, WTP remains relevant for consumers' purchase decisions when BBPs are more expensive and better product functionalities do not compensate for the higher price.

According to a consumer study conducted by the German Environmental Agency (Fischer et al., 2019), there is a demand for reducing the variety of labels related to sustainable textiles. Many consumers expressed the desire for well-established, recognisable labels. Two-dimensional labels that represent both environmental and social standards are preferred. However, individual priorities vary. Health aspects, particularly the absence of chemicals, are paramount for some. Others prioritise social standards.

According to a telephone survey among citizens in Germany (Hampel et al., 2020), the utilisation of renewable resources for industrial production receives high approval among consumers in Germany. This positive perception of using renewable resources in production can directly impact the acceptance of bio-based products. The knowledge that the product is made from renewable resources can create a sense of trust and appeal, leading to increased acceptance and preference for such products. At the same time, consumers predominantly reject green genetic engineering. Only a minority (20.9%) sees benefits in genetic breeding methods, while two-thirds of the respondents (66.4%) consider the risks relatively high or even very high. (ibid.) As a result, products or technologies involving green genetic engineering may face significant consumer resistance or scepticism.

The study by Kainz (2016) concluded that biopolymer products are of a higher value to the participants in the study (hypothetically consumers) regardless of evaluating the conventional product before learning about the bio-based product or receiving general or label information beforehand. The type of raw material itself seems to be of value to consumers. At the same time, Hempel and colleagues (2019) found a group of more sceptical consumers concerned about the potential adverse environmental impacts of biomass utilisation for non-food purposes, maize monocultures, or biodiversity loss. According to a study conducted in the Biobridges project, packaging, single-use products, food, and fashion and textiles were the most preferred sectors in terms of consumer interest and attention to sustainability. These sectors are particularly relevant because discussions about sustainability and

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environmental impacts are increasingly prevalent. Consumers are increasingly aware of these sectors' environmental consequences and actively seek more sustainable alternatives (Sabini et al., 2020).

In the RoadToBio meta-study on the public perception of bio-based products, it was found that consumers who are generally drawn to environmentally friendly products also have a more positive attitude towards bio-based products and are willing to pay more for them (Pfau et al., 2017). In 2018, when the BioCannDo project assessed reasons for not buying bio-based consumer products, unawareness, ignorance, unavailability, and lack of opportunity stood out. Price was sometimes mentioned as a hurdle (Vos et al., n.d.).

According to a study conducted in the Biobridges project, younger consumers are more willing to pay a higher price for BBPs. Specifically, younger students up to 24 years of age showed a significant willingness to pay up to an additional 20% for a BBP compared to its counterpart. The variations in willingness to pay among different generations can be attributed to two potential factors or a combination of both. Firstly, younger generations may have a higher perception or awareness of environmental challenges, leading to a more excellent value placed on sustainable products. Secondly, the source of monetary resources utilised for shopping, whether parental subsidies or personal incomes, could also influence differences in WTP for BBPs among different generations. (Sabini et al., 2020)

According to the literature reviewed in the RoadToBio project, most consumers are relatively unaffected by the fact that a product is bio-based. It counts as an additional benefit, but personal benefits (lower prices, health benefits, safe to use, no toxic ingredients, good conscience, feeling of doing something good, being more eco-friendly, green lifestyle, and convenience) are far more critical in the consumption decision (Pfau et al., 2017). In consumer surveys by BioCannDo, altruistic arguments, personal benefits, and convenience were mentioned multiple times (Vos et al., n.d.). A market study conducted in the BIOFOREVER project (Carus et al., 2019) found that consuming bio-based products allows consumers to upgrade their image and demonstrate higher social status.

When evaluating influences to buy a BBP or not, respondents in BioCannDo's consumer surveys mention the same set of parameters (environment, personal benefits/disadvantages, other drivers) but come to somewhat different (opposite) conclusions (Vos et al., n.d.). The factors affecting the consumer's WTP according to reviewed grey literature are summarised in Table 6.

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Table 6: Factors affecting consumers' WTP in the grey literature

Related product category	Factors affecting WTP	Reference
All (general)	Insufficient understanding of the bio-based concept	Hempel et al, 2019
All (general)	Media influence	Kiresiewa et al., 2019
Plastics	Availability and level of information	Kainz, U. (2016)
Household cleaning products, insulation materials and food packaging	Lack of awareness Unavailability/Lack of opportunity	Vos et al., 2018
All (general)	Clarity of bio-based benefits	Pfau et al., 2017
Electronic small appliances, functional clothing, furniture, and laundry detergents	Quantity and quality of labels	Fischer et al., 2019
All (general)	Positive perception of using renewable sources	TechnikRadar, 2020
All (general)	Concern of environmental impact of bio-based products	Hempel et al., 2019; Kiresiewa et al., 2019; Pfau et al., 2017
All (general)	Demographics	Sabini et al. 2020
Consumer products made from either 1G or 2G biomass feedstock	Possibility to demonstrate higher social status	Carus et al., 2019
All (general)	Personal benefits (lower price, health benefits, safety of use, non-toxic ingredients, good conscious and feeling of doing something good, being more eco-friendly, green lifestyle)	Pfau et al., 2017
Household cleaning products, insulation materials and food packaging	Altruistic arguments, personal benefits, and convenience	Vos et al., 2018

3.3 Recommendations to support sustainable consumer behaviour

Various recommendations for supporting sustainable consumer behaviour were found in the reviewed literature. In the SLR, it was highlighted, that *transparent communication* should be enhanced by disclosing manufacturer information to customers (Rausch et al., 2021). Consumers should also be *educated on sustainability* and what makes a product or production sustainable (Ritch, 2022). In addition, its recommended to highlight the *consumers' environmental and social impact in purchasing sustainable products* (Rausch et al. 2021). Consumers should be convinced that their little efforts towards sustainability impact the environment (Arli et al., 2018). *Customer participation and engagement* are recommended to incentivise consumers who are sceptical about choosing green products (Wei et al., 2018). Green scepticism should be addressed (Gong & Wang, 2022), and *public consumer awareness should be raised* by using public campaigns to stimulate sustainable consumption (Rausch et al., 2021). Consumers should be given *more information about green products' economic, social, hedonic and altruistic values* to enhance their purchase intention (Huang, 2022). *The hedonic value should be incorporated into communication activities* to emphasise sensory gratification and affective experiences associated with green products (Jaini et al., 2020). The *positive emotions associated with the bio-based offer should be highlighted* (Magnier et al., 2019). As consumers seek self-expression from consumption situations, *self-expressive and emotional appeals in green brand messages should be utilized* (Gahlot Sarkar et al., 2019; Shimul & Cheah, 2023). Utilizing targeted customer segments and *considering different consumer groups in marketing efforts is recommended*, especially in markets with lower green awareness (Kumar et al., 2021). *Financial incentives*, e.g., combining price premiums with discounts for eco-labelled products, should be considered to support sustainable behaviour (Feuß et al., 2022; Pham et al., 2022).

Recommendations for providing information on sustainable products to consumers were also found in the SLR. *Certified eco-labels should be utilized* to enhance trust and raise environmental consciousness and knowledge (Goh & Balaji, 2016; Gaspar Ferreira & Fernandes, 2022). *Consumers should also be educated about eco-label information* to encourage green behaviour. *Third-party certifications* increase eco-labels' credibility (Taufique et al., 2017). The *benefits and positive effects of green products should be clearly communicated* - information on the environmental and health-related benefits of green products should be emphasized (Notaro et al., 2022; Pudaruth et al., 2015; Papista & Dimitriadis, 2019; Tong et al., 2021; Suhartanto et al., 2023). *Consumers should be provided with different solutions to access information (e.g., QR-codes)* and should be given *ways to verify green claims* so that consumers are given accurate information about how products affect the environment (Testa et al., 2020; D'Souza et al., 2023). Drawing from the SLR, these recommendations are described in more detail according to related product categories in **Annex D.**

In addition to the recommendations from the SLR, the listed grey literature was analysed for recommendations on what specific information on bio-based products to provide consumers. To help develop a communication strategy

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on bio-based products, the BIOFOREVER project proposes a rough division of consumers into the following four types: a) Healthy optimisers, b) Lifestyle posers, c) Acetic moralists and d). Pragmatists. Each consumer type has its own relation to BBPs, from which different communication strategies for BBPs products can be deduced. Both the "Healthy optimizers" and "Ascetic moralists" expect sound communication (hence "deep knowledge") regarding a product's healthiness, quality or environmental friendliness to pay a higher price for it. Conversely, for the "Lifestyle posers" and "Pragmatists", marketing as a "modern trend product" or an easy-to-understand and visible label suffices as a communication tool (Carus et al., 2019).

To improve the marketability of sustainable BBPs, the Biobridges project recommends specific actions, for example, regarding information provision and the use of (eco)labels. Sabini et al. (2020) observe that labels can guide consumers to choose BBPs instead of fossil-based ones. Information on BBPs – that could also be provided through labels – is more effective in motivating consumers' choices than reducing the product price. Consumers ask to be informed through labels regarding the raw materials used for creating the BBP and the products' end-of-life. Proposed actions include: (a) investing further in the standardisation and labelling of bio-based products; (b) creating more informative and standard labelling; (c) impose to producers and brands a requirement to provide specific information in the label, improving the current EU legislation; and (d) define a recognizable label for BBPs. The EU-funded projects RoadToBio and BioCannDo also provided concluding recommendations on communicating BBPs (Vos et al., n.d.). Firstly, providing simple and reliable access to crucial information is recommended. End consumers may be willing to buy BBPs, but few want to invest much time gathering and evaluating product information. Communication strategies should, therefore, provide easy and reliable access to essential information and benefits. Informational cues such as labels, logos, infographics and stories can better represent the concept and the benefits in terms of clarity, understanding and attractiveness.

Secondly, it is noted that labels are highly appreciated for their ease, but they are expensive, manifold and not always transparent. Labelling systems are easy and quick tools to differentiate between products and help specify and communicate the properties of BBPs clearly and unambiguously. Labels or alternative communication formats should tell the whole story. Besides giving information on the bio-based content, they should inform about attributes of personal benefit for the consumer, altruistic motives, and the origin of the raw material.

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4   Conclusions and implications for LCSs

According to the findings from the SLR (scientific peer-reviewed papers), the main factors affecting consumers' willingness to buy BBPs and pay a premium for them and make use of bio-labels relate to the clarity of communicating green claims, building trust, transparency of messages, using eco-labels, CRS initiatives of brands and positive reputation companies (corporate credibility), high customer participation, high environmental concern and knowledge, health consciousness, social norms and trends, attitude towards green products, familiarity with eco-brands, strong interest in sustainability, product category, green self-identity, demographics, perceived product quality and value, propensity to gain information, income and education, and individual altruism. The most common factors in the academic literature were consumer environmental concern and green consciousness, which highlight the value consumers place on environmental awareness and sustainable practices.

The related barriers that may negatively affect sustainable buying behaviour include green scepticism, confusion over green lexicon terms, inadequate information and lack of credibility, lack of belief in individual consumer impact, low environmental concern and lack of knowledge, understanding of greenwashing practices, product category, price, perceived risks, negative trust in brands and low availability of sustainable products. In addition, the attitude and perception of consumers do not always translate into willingness to pay, even though they might favour the thought of green products in general. The most common barriers in the literature were consumer scepticism towards sustainable production and green scepticism.

These conclusions are further supported by the grey literature review, where we analysed research reports, for example from previous EU Horizon 2020-funded projects. These reports had a particular focus on bio-based products. According to the studies and research conducted, several factors affect the consumers' willingness to pay, including consumers' concern for the environment and health, positive perception of renewable sources, possibility to demonstrate higher social status, influence of media and the discourse around bioeconomy, demographics, general understanding of the bio-based concept, level of awareness, availability and level of information, clarity of bio-based benefits, concern of the environmental impacts of bio-based products, and the availability of bio-based products. The analysis of the grey literature further shows that the same set of parameters (environment, personal benefits/disadvantages, other drivers) can lead to different perceptions and opposite buying behaviour regarding BBPs.

Further, the fact that a product is bio-based is only one aspect influencing buying decisions. Most consumers are relatively unaffected by the fact that a product is bio-based. Many - mainly theoretical - studies show that most respondents would be willing to pay slightly more for a BBP than a conventional product. Multiple factors influence the general perception of consumers on BBPs and their WTP for them. Consumers' WTP is related to personal interests, e.g., health and concern about the environment, welfare and future generations. In surveys,

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consumers indicate the highest WTP for BBPs in product categories such as disposable products, cosmetics, and personal care products. Lack of information, for example, about a product's environmental impact or benefits, can negatively influence the consumption decision. Goods with certain qualities or properties (e.g. bio-based) must signal this information to the consumer to justifiably distinguish from their ordinary counterparts. Information must be provided in a simple, easy-to-digest way to increase the consumer's WTP and acceptance of bio-based products.

Based on these conclusions drawn from the reviewed research papers and reports, it can be suggested that eco-labels or green certificates have the potential to play a significant role in influencing consumer willingness to buy and pay for sustainable and eco-friendly products. Eco-labels or certificates that provide specific information about a product's environmental impact can positively influence consumer willingness to buy and pay, as they help reduce the information asymmetry between producers and consumers, making it easier for consumers (especially those that are committed to sustainability) to understand the environmental impact of the products they purchase. Eco-label information can serve as a trustworthy source of information, however, consumers should be offered ways to verify the green claim information. In addition, consumers should be provided with different solutions to access information. Third-party eco-labelling schemes achieve higher levels of consumer trust than corporate-based information. However, consumers appreciate quantitative information on a product's environmental contribution even over third-party certification. Eco-labels can be combined effectively with Country-of-Origin ecological images. Eco-labels and favourable product pricing can increase producers' purchase probability of eco-labelled products. They can also guide consumers towards making more environmentally friendly purchases by assisting their decision-making.

Eco-labelling has the potential to be a crucial tool in the transition toward sustainability for consumers, retailers, and policymakers. However, eco-labels' credibility significantly influences green brands' credibility by fostering the effect of information completeness, persuasiveness, and credibility on green brand evaluation. Labels with health ratings and social ratings may significantly impact purchase intention. Different customer segments are more sensitive to the product label promises, either public benefits, private benefits, or both. The more knowledgeable customers are about greenwashing, the more cautious they are when making their green product purchases, and eco-labels can help to omit greenwashing practices by confirming the reliability of the information. In addition, eco-labels or certificates can be crucial in reducing green scepticism and enhancing corporate credibility, positively influencing consumer willingness to buy and pay for sustainable and eco-friendly products. Eco-labels may highlight the environmental quality attributes of a product and can be particularly influential for consumers oriented towards lifestyles of health and sustainability. Finally, to determine how customers' perceptions of eco-labelling affect their reactions to eco-friendly products and environmental information, the focus should be on dimensions such as consumer knowledge, awareness, involvement, credibility, trust, design, visibility, persuasiveness, information clarity, and private benefit.

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From the results of the SLR, it can be concluded that labels can act as a means to motivate and direct consumers to purchase BBPs. Effort should thus be made in developing the labels so that they respond to the consumer requirements for simplicity, clarity, transparency and reliability. The barriers identified in the SLR, e.g. confusion over green terminology and lack of credibility (Evans & Peirson-Smith, 2018), fear of greenwashing (Testa et al., 2020) and the too large variety and number of labels (Fischer et al., 2019) should be considered in label design. Improved and well-established labels, providing an easy-to-understand message on the benefits of the product, further knowledge on the production methods and origin of raw materials and trustworthy source of information (e.g. 3rd party certifications), can steer consumers to purchase BBPs instead of fossil-based ones, by making the product more attractive in their eyes.

Considering to the product categories identified in the SLR relevant to the focus of 3-CO (see table 2), some recommendations that should be considered in the design of labels can be made. Below are the product group specific aspects found in the SLR that should be highlighted in consumer communication via labels:

Clothing

- Transparency of manufacturing process (Rausch et al., 2021)
- Sustainability of the product & production methods (Ritch, 2022)
- The environmental impact of eco-conscious consumption (Rausch et al., 2021)
- The impact of purchasing sustainable clothing to social aspects (Rausch et al., 2021)
- Communication on CSR initiatives (e.g. animal rights, ethical sourcing) (Rolling et al., 2021)
- Well-established, recognisable labels that represent both environmental and social standards (Fischer et al., 2019)

Cosmetics

- The impact of green cosmetics and cosmetics with no harmful ingredients to the environment (Borin et al., 2011; Kim & Seock, 2009; Papista & Dimitriadis, 2019)
- Creating messages to address different consumer segments (Kumar et al., 2021)
- Providing simple sustainability metrics (O'Rourke & Ringer, 2016)
- Associated health benefits of green cosmetics (Pudaruth et al., 2015)
- Bio-degradability (of packaging) (Pudaruth et al., 2015)
- Hedonic value in green cosmetics (Jaini et al., 2020)

Building house products

- Waste reduction, energy conservation and consumer health benefits (Huang, 2022)
- Support from public disclosure for green-certified products (Huang, 2022)
- Details of materials of green building products (Huang, 2022)

Furniture

- Sustainability of wood as material (Wan & Toppinen, 2016)
- Sustainability performance of domestic and international wood product suppliers (Wan & Toppinen, 2016)

Plastic-based products

- Environmental impact of reduction of single-use plastics (Magnier et al., 2019
- Origin of ocean plastic or biodegradable bioplastics (Notaro et al., 2022)
- Safety of products (Magnier et al., 2019)
- Climate protection information (Notaro et al., 2022)
- Cerfitications (Suhartanto et al., 2021)
- Benefit to environment, community and consumers (Suhartanto et al., 2023)
- Reliable attributes of circular packaging (Testa et al., 2020)

Eco-packaging

- Innovation aspect of circular packaging (Testa et al., 2020)
- Decrease of global ecological footprint (Shimul & Cheah, 2023)
- Emotional appeals (Gahlot Sarkar et al., 2019)
- Tailored message to different customer segments (Shimul & Cheah, 2023)
- Detailed product information (D'Souza et al., 2023)
- Cerfitications (Goh & Balaji, 2016)

The SLR findings show how the base theories usually taken as research frameworks in scientific papers explain reality. Consumers' widespread environmental concern and green consciousness align with the Theory of Planned Behaviour's emphasis on attitude towards behaviour. The highlighted significance of trust, transparency, and eco-labels, which are comparable to the subjective norms that affect purchasing decisions, also resonate with this theory. Meanwhile, barriers such as scepticism towards sustainable production underscore the challenges of perceived behavioural control. However, the observed gap between positive attitudes and purchasing decisions highlights the intricacies of the willingness to buy or pay for BBP. It should also be mentioned that the multifaceted determinants of green consumer behaviour, emphasizing factors like environmental concern, transparency, or brand perception, are in line with the Theory of Consumer Value, suggesting that consumers derive value not just from the utilitarian aspect of the product but also from hedonic and social elements. Eco-labels can be seen as adding both utilitarian (informing about the product's sustainability) and hedonic (feeling good about making an eco-friendly choice) value.

Deliverable Ferreira Gaspar & Fernandes, 2022; Kumar & Ghodeswar, 2015; Nath & Agrawal, 2023; Ulusoy & Barretta, 2016

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Concluding, both primary research questions have been thoroughly addressed through the review of academic and grey literature. Referring to the first one, several variables impacting customers' purchase decisions regarding BBPs and sustainable goods have been identified, while the second research question has outlined obstacles to sustainable consumption. However, a significant study gap is revealed when these elements are considered in the complex interactions across many cultural and socioeconomic situations. Notably, no research was found that explores the use of digital tools to improve BBP purchasing or to increase understanding of bio-labels. *The potential of digital solutions to improve the usability and intuitiveness of bio-certificates for customers is still unexplored*. The lack of studies on the relationship between technology and sustainable consumption emphasizes the need for original research. Aiming to make it easier for customers to comprehend and accept sustainable products, such a study would try to take advantage of technological breakthroughs in this area.

5   Final remarks

T2.1 has compiled state-of-the-art knowledge on consumer behaviour towards BBPs, mainly on factors supporting and hindering the willingness to pay for green or sustainable products. The findings from the literature review serve as a starting point for Task 2.3, aiming to gain insight into consumer drivers and concerns regarding sustainability issues and willingness to use labelling systems for sustainable decision-making among EU consumers. Our findings also support the overall goal of 3-CO – developing a supportive framework for Label and Certification Schemes for B2C communication that supports consumers' purchasing choices. Solutions providing reliable and informative knowledge on the environmental impacts of BBPs are called for to enable more sustainable decision-making among consumers.

Deliverable Ferreira Gaspar & Fernandes, 2022; Kumar & Ghodeswar, 2015; Nath & Agrawal, 2023; Ulusoy & Barretta, 2016

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6 List of abbreviations

Abbreviation	Description
B2C	Business-to-Consumer
BBP	Bio-based Product
LCS	Labelling and Certification Schemes
NAM	Norm Activation Model
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
SLR	Systematic Literature Review
TCV	Theory of Consumer Value
TPB	Theory of Planned Behaviour
TRA	Theory of Reasoned Action
VBN	Value-Belief-Norm
WP	Work Package
WTP	Willingness-to-pay

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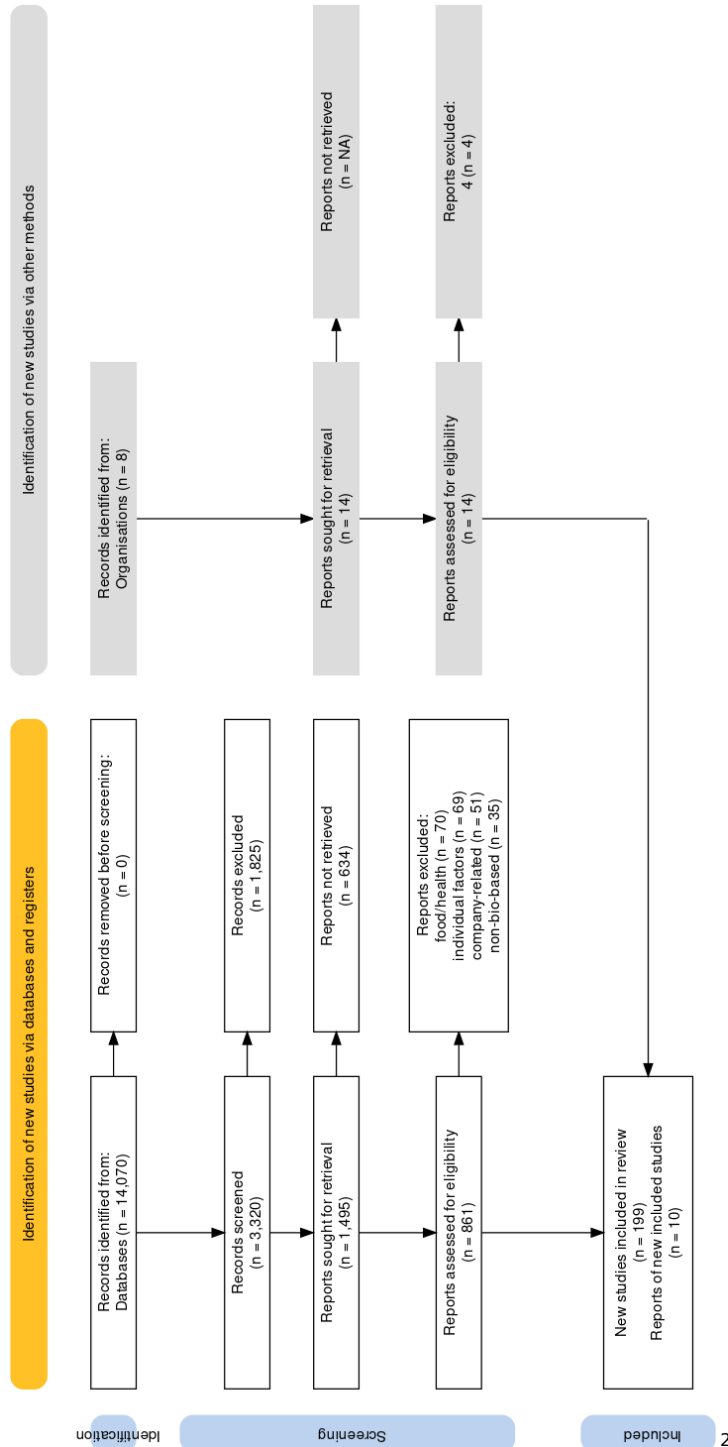State-of-the-art report on consumer behaviour towards sustainable products

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Annex A: PRISMA procedure

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[2] Haddaway, N. R., Page, M. J., Pritchard, C. C., & McGuinness, L. A. (2022). PRISMA2020: An R package and Shiny app for producing PRISMA 2020-compliant flow diagrams, with interactivity for optimised digital transparency and Open Synthesis Campbell Systematic Reviews, 18, e1230. https://doi.org/10.1002/cl2.1230

Annex B: Detailed list of article categorisations

Product category	Types of products included in the category	No. of papers	Country of collecting data
Green products	green products, eco-friendly products, environmental commodities, products with or without eco certificates, green FMCG products, products from sustainable brands, eco-innovations, ecofriendly products, eco-products, carbon labelled products, sustainable products, sustainable products, ecolabeled and nonlabeled products, pro-environmental products, low-carbon products, carbon-labeled products, eco-friendly designed product, ecological products, sustainable luxury brands, remanufactured products	78	Australia, Brazil, China, Colombia, Costa Rica, Ecuador, Egypt, Finland, Germany, Greece, India, Indonesia, Iran, Islamabad, Japan, Latin America (Colombia, Mexico, Peru, Others), Malaysia, Pakistan, Philippines, Portugal, Slovenia, Spain, Sweden, Switzerland, Taiwan, United Kingdom, United States, Vietnam
Clothing	apparel, clothing, fashion, denim jeans, eco-fashion, textile, sustainable customised garment, eco-friendly apparel, fast-fashion clothing, green apparel, green clothing, green luxury fashion, secondhand clothing, sustainable apparel, sustainable clothing, sustainable fashion, jacket, sustainable plastic clothing, sustainable polyester clothing (derived from recycled plastic bottles), swimwear, T-shirt made from eco-friendly materials	40	Australia, China, Cyprus, Denmark, Ethiopia, France, Germany, Hong Kong, India, Italy, Japan, Korea, Russia, Scotland, South Africa, Turkey, United Kingdom, United States
Cosmetics	soaps, bar soap, eco-friendly shampoo, fragrance, body lotion, shampoo, personal care product, cosmetics, natural beauty products, environmentally-friendly cosmetic, hand soap, natural cosmetics, eco-friendly cosmetics, green cosmetics	18	China, Greece, India, Indonesia, Italy, Malaysia, Mauritius, United States

Home appliances	household appliances, housewares with a short purchase cycle and low price, green home appliance, appliances, air conditioners	13	China, Korea, Malaysia, Pakistan, South Africa, Switzerland, United States
Detergents	laundry detergents, dishwashing liquids, detergents, dish detergent, kitchen cleaner, natural laundry detergent	10	China, Denmark, France, Indonesia, Italy, Turkey, United States
Electronics	green laptop, MP3, headphones, personal computer, smartwatch, electronics, all-in-one inkjet printer, remanufactured camera, innovative smartphone, sustainable and innovative smartphone, laptop, cell phone	10	China, France, Germany, New Zealand, South Africa, United States
Vehicles	electric vehicles, new vehicle technologies, automobiles, car, new energy vehicles	9	Canada, China, India, Iran, Korea, United Kingdom
Energy technologies	photovoltaics (pv) systems, energy-efficient lighting in the home, solar panels (renewable energy technology, electricity, solar energy, energy, light bulb, energy efficient equipment, energy-efficient led light bulbs	8	France, India, Italy, New Zealand, Pakistan, United States
Plastic-based products	bioplastic jacket, disposable cups made of bioplastics, green plastic products, pha-based bioplastics (bio-waste products), products made of recycled ocean plastic, single-use plastic products	6	Indonesia, Italy, Netherlands, United Kingdom, Vietnam
Household paper	paper towels, toilet paper, household paper, paper	5	Denmark, France, Italy, United States
Packaging	food bags, circular packaging, packaging, recyclable shopping bags, bio-based plastic drink bottle for bicycles	5	Australia, Germany, India, Italy
Service	hotels, bike-sharing, lodging, transportation	5	Canada, Germany, United States
Batteries	batteries, green batteries	3	China, France, Germany, Italy
Chemicals	green chemicals, household chemicals	2	France, Germany, Greece, Spain
Furniture	furniture, children furniture	2	China, United States

Shoes	Boots, running shoe with a bio-based sole	2	Denmark, Germany, Sweden
Tires	bicycle tire, tires	2	Turkey
Backpack	backpack	1	China
Building housing products	building housing products	1	Taiwan
Forest products	environmentally certified forest products	1	United States
Fuel	fuel from second-generation, nature-inspired lignocellulose processing systems	1	United States
Housing	housing	1	Hong Kong
Plants	fruit-producing plants	1	Not indicated
Stationery	colored pens	1	Italy
Wood products	wood products	1	United States

Some papers were connected in more than one country or product context.

Annex C: Grey literature reports

Authors	Year	Publisher	Title of report	Related product value chain
Carus et al.	2019	BIOFOREVER project	BIOFOREVER Market analysis (D7.2)	Consumer products made from either 1G or 2G biomass feedstock
Fischer et al.	2019	UBA	Nachhaltige Produkte – attraktiv für Verbraucherinnen und Verbraucher? Eine Untersuchung am Beispiel von elektronischen Kleingeräten, Funktionsbekleidung, Möbeln und Waschmitteln [In EN: Sustainable Products - Attractive to Consumers?]	Clothing, furniture, electronic small appliances, furniture, and laundry detergents
Hempel et al.	2019	Thünen-Institut	Bioökonomie aus Sicht der Bevölkerung (In EN: The Public's Perspective on the Bioeconomy)	ALL
Kainz, Ulla	2016	TU München	Consumers' Willingness to Pay for Durable Biobased Plastic Products: Findings from an Experimental Auction	Plastics
Kiresiewa et al.	2019	UBA	Bioökonomiekonzepte und Diskursanalyse. Teilbericht (AP1) des Projekts "Nachhaltige Ressourcennutzung – Anforderungen an eine nachhaltige Bioökonomie aus der Agenda 2030/SDG-Umsetzung". Umweltbundesamt: Dessau-Roßlau.	ALL
Kymäläinen et al.	2021	BIOSWITCH project	Report on consumer drivers and motivations (Deliverable 1.3)	ALL
Pfau et al.	2017	RoadToBio project	Public perception of bio-based products	ALL
Sabini et al.	2020	Biobridges Project	Biobridges Action Plan for raising consumers' awareness	ALL

Deliverable Ferreira Gaspar & Fernandes, 2022; Kumar & Ghodeswar, 2015; Nath & Agrawal, 2023; Ulusoy & Barretta, 2016

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Hampel et al.	2020	National Academy of Science and Engineering & Koerber Foundation	Technikradar 2020. Was die Deutschen über die Technik denken? Schwerpunkt Bioökonomie. [In EN: Technic Radar 2020, What do Germans think about technic: Bioeconomy]	GENERAL bioeconomy
Vos et al.	2019	BioCannDo project	Report on market survey interviews and research results on public perception of bio-based products. Deliverable D5.7 (confidential)	ALL

Annex D. Product category specific recommendations for supporting sustainable consumer behaviour

Product category	Recommendation	Description and related reference
Clothing	Enhancing transparency	Manufacturers should disclose information for transparent communication with customers (Rausch et al., 2021)
	Educating consumers on sustainability	Fashion sustainability marketing should educate consumers on what makes a product or production sustainable (Ritch, 2022).
	Utilizing sustainable labelling schemes	Sustainable labelling schemes should be utilised to inform consumers about eco-conscious consumption and environmental impact (Rausch et al., 2021)
	Highlighting the role of consumer impact	Retailers should highlight consumers' environmental and social impact when purchasing sustainable clothing (Rausch et al., 2021)
	Customer engagement and co-creation	High levels of customer participation and engagement should be applied to incentivise consumers who are sceptical about choosing green products (Wei et al., 2018). Co-created experience-based interactions should be enhanced sustainable (Ritch, 2022).
	Utilizing storytelling on websites and social media	Brands should actively communicate their CSR initiatives, including animal rights and ethical sourcing, through storytelling on their websites and social media platforms to enhance consumer knowledge and create a competitive edge (Rolling et al., 2021).
	Combining price premiums with discounts for eco-labelled products	Effective marketing strategies for eco-labelled products should base on a pricing strategy that combines higher price premiums with discounts (Feuß et al., 2022).
	Raising public consumer awareness	Policymakers should use public campaigns to stimulate sustainable clothing consumption by raising consumer awareness of the environmental impact of conventional clothing compared to sustainable clothing through public campaigns (Rausch et al., 2021)
Cosmetics	Utilizing "internal drivers" in marketing	Consumers are likely to purchase green products when they believe that such behaviour will gain the acceptance of the social group they belong to or aspire to. It is recommended to convince consumers that their little efforts towards sustainability impact the environment. (Arli et al., 2018)
	Providing clear information on environmental benefits	Information to consumers should be clear and explain why cosmetics free from harmful ingredients do not negatively impact

	the environment. At the same time, non-organic cosmetics should be required to disclose the harmful effects of their ingredients. (Borin et al., 2011)
Utilizing regulatory pressure and environmental awareness	Marketers should develop brand awareness in the context of environmental awareness and regulatory pressure. (Ewe & Tjiptono, 2023)
Omitting greenwashing practices and false messages	Marketers should steer clear of greenwashing techniques, especially when approaching educated, genuine green consumers, since consumers increasingly understand false messages. (Jog & Singhal, 2020)
Utilizing targeted customer segments and considering different consumer groups in marketing efforts	Marketers should consider health and environmental consciousness when segmenting the market and targeting consumers of natural beauty products. Marketers should be cautious of misleading labels and unsupported claims about natural beauty products' health and environmental benefits, as consumers are willing to pay higher prices based on their positive attitudes. (Kim & Seock, 2009) Additional marketing support may be required when entering markets (or targeting segments) where green awareness is lower to ensure that environmental information is properly comprehended and gradually gain credibility. ((Kumar et al., 2021)).
Simplifying sustainability metrics for communication	Sustainability metrics should be simplified and communicated effectively to consumers. Sustainability information should be connected to actual purchasing processes and should leverage peer influence and habit formation. (O'Rourke & Ringer, 2016)
Providing information about the advantages of green products, raising awareness	To counteract consumers' lack of faith in green cosmetics, managers should inform consumers about the advantages of green products in general and foster customer trust, loyalty and consumer-green brand. Green brand managers should invest in raising consumer awareness of the environment. (Papista & Dimitriadis, 2019)
Emphasizing health benefits	To encourage females' ethical ideas, cosmetic and beauty care organisations should raise awareness of green cosmetics and beauty care products and their associated health benefits. (Pudaruth et al., 2015).
Emphasizing eco-labels and biodegradable packaging	To maintain female consumers' belief in eco-friendly cosmetics and beauty care goods, marketers of those products should strongly emphasise eco-labels and biodegradable packaging. (Pudaruth et al., 2015).

Deliverable Ferreira Gaspar & Fernandes, 2022; Kumar & Ghodeswar, 2015; Nath & Agrawal, 2023; Ulusoy & Barretta, 2016

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	Utilizing celebrities to promote green lifestyle	Celebrities can be used by cosmetics and beauty care marketers to promote a greener lifestyle, increasing the number of female consumers of these products. ((Pudaruth et al., 2015).
	Addressing green skepticism	To increase the credibility and persuasiveness of the green message, marketing professionals should link the green attribute information with the products being sold. Consumer's green scepticism should be addressed (Gong & Wang, 2022)
	Highlighting hedonic value and experiences	The hedonic value should be incorporated into communication activities to emphasise sensory gratification and affective experiences associated with green cosmetics products, targeting new market segments and fulfilling consumer demands. ((Jaini et al., 2020).
Building house products	Educating consumers and providing more information	Consumers should be educated and provided with more information about the economic, social, hedonic and altruistic values of green building residential products for the environment, waste reduction, energy conservation and consumer health, thus enhancing purchase intention (Huang, 2022)
	Utilizing public disclosure on green-certified housing products	Public disclosure of green-certified housing products will help customers make better decisions and reduce the perception that understanding green building housing products requires a high level of expertise. (Huang, 2022)
	Providing specific details of green building housing on websites	The information posted on housing transaction websites should include specific details about the facilities or materials of green building housing products to increase the transparency of market transactions and decrease consumers' low intention to purchase green building housing products due to non-arms-length transactions. This would increase the likelihood of a purchase by enabling consumers to obtain information about a green building home product openly. (Huang, 2022)
Furniture	Informing consumers about the irresponsibility companies	Detailed accounts of corporate environmental irresponsibility should be released and circulated among consumers (Orazi & Chan, 2020)
	Raising consumer awareness on material sustainability and other sustainability efforts	Companies should raise consumer awareness and recognition of the importance of wood raw material sustainability and legality (Wan & Toppinen, 2016). Companies should consider responsible branding and communicate their sustainability efforts to enhance consumer awareness and buying behaviour (Wan & Toppinen, 2016)

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	Examining consumer expectations on sustainability	Consumer expectations regarding the sustainability performance of domestic and international wood product suppliers should be investigated (Wan & Toppinen, 2016).
Plastic-based products	Emphasizing positive emotions	Companies should emphasise the positive emotions associated with their bioplastic-based offer (like reducing single-use plastics as exciting and pleasant thing or psychological benefits of enjoyment) (Magnier et al., 2019; Pham et al., 2022)
	Communicating about the origin of material	Companies that offer products made of ocean plastic or biodegradable bioplastic products should communicate their origin (Magnier et al., 2019; Notaro et al., 2022)
	Promoting unbiased safety information	Businesses should promote safety by providing unbiased evidence of the safety of products made from ocean plastic (Magnier et al., 2019)
	Using labels and certifications to provide information	Companies should provide information about climate protection to attract consumers. Labels should provide much additional information (Notaro et al., 2022). Green plastic managers should use green certification to support any environmental claims they make on product labels (Suhartanto et al., 2021)
	Utilizing financial incentives	Marketers should consider financial incentives to influence less single-use plastic consumption (Pham et al., 2022)
	Emphasizing the benefits of green products	Managers should emphasise that using green plastic products will benefit the environment, the community, and consumers (Suhartanto et al., 2023).
	Ensuring environmental consistency between products and packaging	Companies should ensure and communicate that there is consistency between the environmental features of products and packaging to prevent trade-offs in consumers' decision-making processes (Testa et al., 2020)
	Providing different ways of accessing information	Unambiguous information on the circular characteristics of packaging should be provided, utilising different solutions like barcodes or QR codes to access information (Testa et al., 2020)
	Providing reliable information on labels	Labels should provide reliable information on circular packaging attributes, and efforts should be made to increase consumer knowledge and avoid confusion (Testa et al., 2020)
Eco-packaging	Emphasizing the innovativeness of circular packaging	Information on how circular packaging can be seen as an innovative solution should be highlighted (e.g. by providing examples of packaging being transformed into other objects or utilising processing residues) (Testa et al., 2020)
	Utilizing self-expressive appeals in marketing to consumers	Marketers should consider incorporating self-expressive appeals in their green brand messages as consumers seek self-expression from consumption situations (Gahlot Sarkar et al., 2019).

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	Educating consumers and utilizing emotional appeals in marketing efforts	Consumer scepticism and potential greenwashing should be addressed by educating consumers, promoting environmentally responsible behaviour, and using appropriate emotional appeals in marketing messages (Shimul & Cheah, 2023)
	Considering different customer segments	Communication messages should be tailored to fit the target audience's characteristics and align with their purchase criteria (Shimul & Cheah, 2023)
		Develop strategies that inspire consumers to decrease the global ecological footprint of packaging should be developed (Shimul & Cheah, 2023).
	Using certified eco-labels in communication efforts	Using eco-labels in all communication tools is recommended to build sustainable brand associations and raise environmental consciousness and knowledge, as they are more effective than advertising campaigns. (Gaspar Ferreira & Fernandes, 2022)
	Educating consumers about eco-label information	It is recommended to educate consumers about eco-label information to encourage green behaviour. Certified eco-labels can enhance trust and differentiate products from competitors' offerings (Goh & Balaji, 2016)
	Providing detailed information on products	Detailed information should be provided, and product disclosure practices on green products should be implemented to elevate purchase intention and reinforce consumer self-confidence (D'Souza et al., 2023)
Green products (GENERAL)	Creating product-specific environmental claims	It is recommended that marketers use product-specific environmental claims to reduce skepticism and increase credibility and simultaneously seek third-party certifications and eco-labels to enhance the credibility of environmental messages (D'Souza et al., 2023)
	Utilizing third-party certifications to increase credibility	Educating consumers about both general environmental knowledge and specific eco-labels is recommended. Third-party certifications should be implemented to increase the credibility of eco-labels (Taufique et al., 2017).
	Emphasizing the positive impact of green products and the consequences of ignoring environment	Companies should emphasise green products' positive effects and benefits in regions with more environmental problems. In regions with less prominent environmental problems, companies should emphasise the serious consequences of ignoring the environment and the potential impacts of not using green products (Tong et al., 2021)
	Utilizing media initiatives to promote green products	Marketers should strategically promote green products at the point of sale and through media initiatives, relying on eco-label information to facilitate informed consumer choice and stimulate

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		decision-making. It is recommended to avoid making ambiguous or misleading green claims. (D'Souza et al., 2023).
	Providing ways for consumers to verify green claims	Marketers should give consumers ways to verify green claims so that consumers are given accurate information about how products affect the environment (D'Souza et al., 2023).