Concise Consumer Communication through Robust Labels for Bio-based Systems

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Report on the role of labels and smart solutions in supporting responsible consumption

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☐	DEM	Demonstrator, pilot, prototype	☐	SEN	Sensitive, limited under the conditions of the Grant Agreement
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List of abbreviations

Abbreviation	Description
B2C	Business-to-customer
BBP	Bio-based product
D	Deliverable
LCS	Labelling and certification schemes
ATS	Attitude toward sustainability
CAWI	Computer Assisted Web Interviewing
FGD	Focus Group Discussion
SPSS	Statistical Package for the Social Sciences
T	Task
WP	Work Package
WTP	Willingness-to-pay

Publishable executive summary

The objective 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 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 the findings of empirical research conducted in Task 2.3 *Consumer views and behaviour towards sustainable products – role of LCS*. The report focuses on the role of labels and digital smart solutions in supporting responsible consumption. The research was conducted in three phases: 1) quantitative questionnaire study (with Computer-Assisted Web Interviewing -survey method, conducted in 10 European countries); 2) qualitative consumer research (Focus Group Discussions conducted in 4 European countries) and preparation of service mock-ups for co-creation activities; and 3) evaluation of digital solution mock-ups developed in Task 2.4 (by utilising an online digital platform with consumers from 4 European countries). The goal of this report is to discuss the role of labels and smart solutions in supporting responsible consumption, by identifying consumer segments based on attitudes towards sustainability and providing empirical insight on consumer perceptions and behaviours related to responsible consumption and BBPs. The report describes the consumers' motivations and concerns regarding BBPs and their willingness to utilise labelling systems when making purchasing decisions across EU markets. In addition, it provides insight to consumer requirements and expectations towards digital solutions that support sustainable consumption.

From the quantitative questionnaire study, three consumer segments were identified based on their attitude towards sustainability: 1) Passive Sceptics, 2) Active Advocates, and 3) Convenience seekers. The Passive Sceptics group have rather low knowledge of BBPs and of environmental impact and show little concern regarding the BBPs impact on health and the future of the planet. The Active Advocates group are highly motivated towards BBPs and indicate deep understanding and belief on the benefits of BBPs, while the Convenience seekers have mixed level of engagement with BBPs but still high level of awareness of BBPs' positive impact on the environment. From the questionnaire results it can be concluded that many consumers are not well-informed about BBPs, indicating the need for providing

more knowledge on the subject. The recognition of certificates confirming a product's biological origin was also low to moderate, indicating a potential area for improvement in product labelling and education. The results showed that the willingness to utilise LCSs varies between consumer segments; the Active Advocates have high readiness to utilise LCSs and buy BBPs, the Convenience seekers have moderate readiness; and the Passive Sceptics indicated low readiness. This gap highlights the importance of increasing the visibility of labels and certifications, and of educating consumers on the meaning and benefits of BBPs. To support the already informed Active Advocates segment, maintaining clear labels should be continued. Developing market strategies addressing the segment specific motivations and barriers would be beneficial in changing purchasing behaviours. The consumers can be supported with digital solutions to increase their ability and willingness to buy BBPs, as it can make the LCSs more visible.

In the qualitative consumer research conducted with Focus Group Discussions (FGDs), the consumers highlighted that while they value labels and certifications as identifiers of sustainable products, the reliability and clarity of LCSs should be ensured. It was concluded that there is a need for more availability and display of BBPs in the retail environment. The FGDs confirmed, that a digital solution could be a potential solution for providing more information to consumers to support their decision-making processes. There was a high preference for a mobile apps, as indicated by the various solutions co-created with consumers during the discussions.

In the online evaluation of the digital solution mock-ups created in Task 2.4, the consumers provided various improvement suggestions for the user interface, content, accessibility and navigation possibilities. Generally, the consumers preferred user-friendly and visually appealing digital solutions, providing comprehensive and reliable product information and possibilities to engage with a wider community (e.g. through product reviews). From the evaluation of digital solution mock-ups, it can be concluded that the solution being developed in 3-CO can act as a means to engage consumers in more sustainable purchasing behaviour, as the majority of participating consumers reported that the application would support them in making more sustainable purchasing choices and evaluated the likelihood of using such an app as high.

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).

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

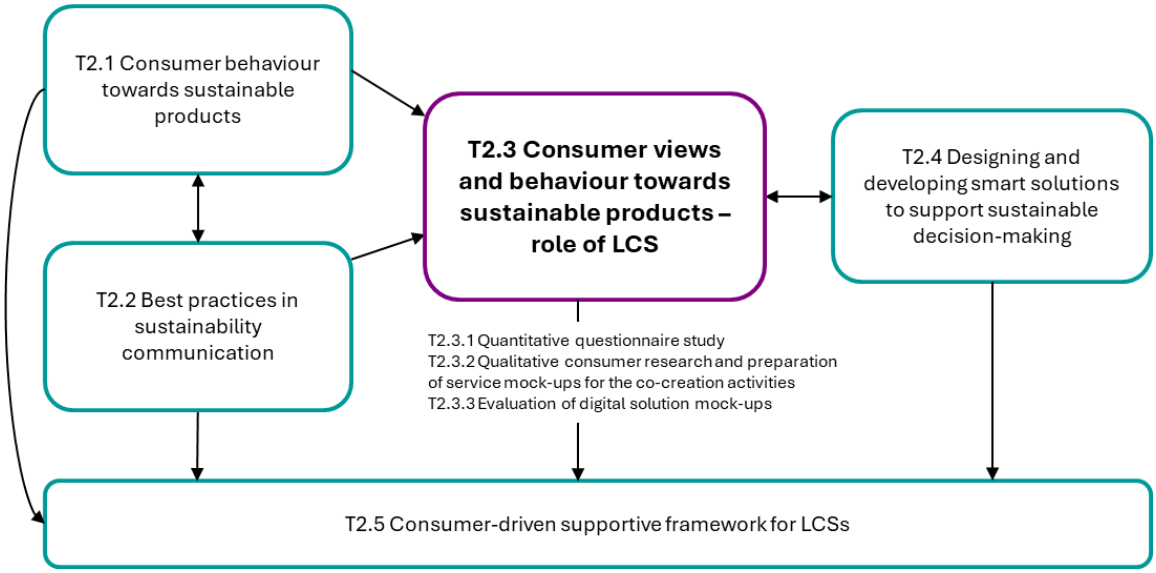
These ten selected value chains are the focus of several 3-CO activities, also in Work Package 2, which will be described next.

1.2 Objectives of WP2

Work Package 2 (WP2) *Improving consumer behaviour and developing smart solutions to support sustainable consumption* focuses on understanding consumers' decision-making processes and motivation towards sustainable consumption. Existing LCSs 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 includes Task 2.3. (T2.3) *Consumer views and behaviour towards sustainable products – role of LCS*, which builds upon previous work in the WP (T2.1 *Consumer behaviour towards sustainable products*, reported in D2.1 State-of-the-art report on consumer behaviour towards sustainable products, and T2.2 *Best practices in sustainability communication*, reported in D2.2 Report on best practices in sustainability communication among LCS). By utilising the lessons learned in previous tasks, T2.3 focuses on empirical research on consumers' perspectives towards sustainable consumption, BBPs and LCSs. The task is further divided into three subtasks: T2.3.1 Quantitative questionnaire study; T2.3.2 Qualitative consumer research and preparation of service mock-ups for the co-creation activities; and T2.3.3 Evaluation of digital solution mock-ups. See figure 1 below.

Figure 1: The Structure of WP2



T2.3 collaborates closely with development of digital solutions done in T2.4, *Designing and developing smart solutions to support sustainable decision-making*, as the 3-CO project adopts an iterative process to develop digital solutions by engaging consumers in co-creation. The content of the digital solution mock-ups are defined based on consumer needs and feedback. T2.3 focuses on supporting the development of the mock-ups by studying the expectations and preferences of potential end users of the solutions, i.e. the consumers. T2.3 and T2.4 are thus closely interlinked.

In addition, T2.3 has an important role in contributing to T2.5, *Consumer-driven supportive framework for LCSs*. which combines all results received in WP2. and T2.3 provides valuable knowledge on consumers' perspective towards BBPs, LCSs and digital solutions supporting sustainable purchasing behaviour. The work will be reported in D2.5 Guidelines on the design of labels for BBPs from the consumer viewpoint. D2.5 will further support the overall goal of 3-CO, creating a supportive framework for LCSs on B2C communication for industrial BBPs, with 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.

1.3 Scope of the report

This report focuses on the role of labels and digital smart solutions in supporting responsible consumption. It presents the findings of empirical research conducted in T2.3 on consumer behaviour and expectations regarding BBPs, and a digital solution designed to facilitate the purchase of BBPs. By definition, BBPs serve as alternative solutions to traditional fossil-based products and are either wholly or partially derived from materials of biological origin, for example plants, fungi and yeast (EC, 2018; EC 2024). The empirical study provides insights into existing consumer segments based on their attitudes toward sustainability, as well as their perceptions and behaviours related to responsible consumption and BBPs. The study delves into consumers' motivations and concerns about sustainability and their willingness to rely on labelling systems when making purchasing decisions across EU markets. Additionally, it identifies consumer needs and expectations for digital solutions that support biobased product purchases.

The research was conducted in three phases, following the subtasks described in the previous chapter: T2.3.1 Quantitative questionnaire study; T2.3.2 Qualitative consumer research and preparation of service

mock-ups for the co-creation activities; and T2.3.3 Evaluation of digital solution mock-ups. The objectives and research questions for each stage are detailed in the methodology section. This report summarizes the insights from the research to develop recommendations for measures to stimulate the purchasing of BBPs and for designing a digital solution to support consumers in the decision-making process.

2 Methodology

Three different approaches were chosen to study consumer views in T2.3. These were: 1) a quantitative consumer survey, conducted using the Computer-Assisted Web Interviewing (CAWI) method (*for T2.3.1*); 2) qualitative consumer research and the development of service mock-ups for co-creation activities, conducted through online Focus Group Discussions (FGDs) (*for T2.3.2*); and 3) evaluation of the digital solution mock-ups developed in T2.4 through an online co-creation platform (for *T2.3.3*). This iterative structure allowed for a comprehensive exploration of consumer insights and the evaluation of potential smart digital solutions. Each phase is described in more detail below and Annex A specifies the data samples of the studies.

2.1 CAWI

A CAWI method was used to collect quantitative data from a large sample of consumers across ten European countries: Poland, Finland, the Netherlands, Spain, Germany, Belgium, the United Kingdom, Italy, France, and Denmark. The CAWI approach was selected for its efficiency in reaching a broad and geographically dispersed audience, allowing for standardized data collection on consumer attitudes towards sustainability and bio-based/green products. The logic behind the selection of countries was to ensure that the study captured a broad spectrum of consumer perceptions across the European market. By including countries from various regions of Europe, we aimed to encompass a diverse range of economic, social, and market conditions. This approach provided a comprehensive understanding of consumer attitudes toward bio-based products, reflecting the overall variability present in the European market as a whole. The primary aim of this study was to gain insight on consumer drivers and concerns regarding sustainability issues and willingness to use labelling system for sustainable decision-making among EU consumers. Specifically, the main goal was to identify and profile consumer segments based on their attitudes towards sustainability. This segmentation guided the planning of the recruitments of respondents for the next phases of the research, the focus group discussions (FGDs) and the online

evaluation of digital solution mock-ups. The survey was conducted during a response period of two weeks, in the beginning of January 2024.

The survey sample comprised of 3,000 respondents, with 300 participants from each of the 10 target countries. The respondents were recruited by an external market research company, Bilendi Oy, to ensure a representative sample from each country. Efforts were made to ensure demographic diversity within each country's sample, capturing a wide range of consumer views to enhance the generalizability of the findings. Data collection was conducted online, leveraging the advantages of the CAWI method to efficiently administer the questionnaire across multiple countries and languages. The survey instrument incorporated the 3x3 Attitudes Towards Sustainability (3x3ATS) scale (Wiśniewska 2023), a validated tool used to segment consumers based on their sustainability attitudes. This scale provided a nuanced understanding of consumer perspectives, facilitating the identification of distinct segments within the broader population. The respondents were presented with specific statements, which were assessed with a Likert scale of 1 to 7, where 1 reflected their definite disagreement with a statement, and 7 reflected their definite agreement with a statement. For data analysis, the Statistical Package for the Social Sciences (SPSS) was utilized. The K-means clustering method with iterative refinement was applied to segment the consumers effectively. This method allowed for the grouping of respondents based on similarities in their attitudes towards sustainability, providing valuable insights into the factors influencing consumer choices related to sustainable and bio-based products. The clustering process involved multiple iterations to optimize the segmentation, ensuring that the clusters were as distinct and informative as possible. This rigorous analytical approach contributed to the reliability and validity of the study's findings, enabling the research team to draw meaningful conclusions about consumer attitudes across different cultural and geographical contexts.

By employing the CAWI method, the study efficiently gathered large-scale quantitative data, which was crucial for robust statistical analysis and segmentation. During the survey consumers were reminded of the definition of bio-based products: "*Bio-based products*" *refer to non-food products made entirely or partially from natural, biological materials (you may consider bio-based clothing, cosmetics, furniture, toys, and packaging, to name a few).*" The collaboration with international partners and the use of advanced statistical techniques enhanced the methodological rigor of the study, providing insights for stakeholders aiming to promote sustainable consumption patterns across Europe.

2.2 Focus Group Discussions

A Focus Group Discussion (FGD) method was utilised to collect qualitative data from consumer groups in four countries, Finland, Poland, the Netherlands, and Spain. By including these countries, we aimed to capture a range of perspectives that could help identify common themes and simultaneously generate original ideas for engaging consumers with bio-based products. This approach ensured that the focus groups provided not only insights into existing attitudes but also creative suggestions for a digital solution. The FGD approach was selected for its ability to elicit detailed responses and facilitate in-depth discussions, making it ideal for exploring complex issues like responsible consumption and bio-based products. The primary aim of the study was to gain a more comprehensive view of the motivations and factors promoting or hindering changes in consumption patterns toward a more socially and environmentally responsible direction. Additionally, the study sought to co-create smart solutions for LCSs as part of Task 2.4. The focus groups also discussed the role of labels in making more sustainable choices and the role of smart solutions in encouraging responsible, knowledge-based consumer purchasing decisions. The main research question for the FGDs was: What are the expectations of consumers regarding technological solutions that support bio-based purchasing?

The objectives of the FGDs were:

- To understand the experiences of consumers in purchasing bio-based products, especially the difficulties and barriers in buying them
- To probe whether LCSs are noticed and used, and what are the challenges in using them
- To better understand what type of digital solutions are used in the consumers' purchasing processes
- To co-create a digital solution for checking labels and certificates confirming the credibility of bio-based products
- To understand the role of gamification elements in the proposed digital solutions, as well as their trustworthiness and consumers' willingness to pay for it

More specifically, the FGDs were carefully structured into six thematic sections, each addressing a different aspect of consumption of BBPs:

1. Introduction (Project's Purpose, FGD's Scope and Participants)
2. Bio-based Products Consumption
3. Labels and Certification Schemes
4. Use of Digital Solutions

5. Co-Creation of Digital Solutions
6. Wrap-Up

At the beginning of the survey, consumers were presented with the following definition of bio-based products: "*By 'bio-based products' we refer to non-food products that are made entirely or partially from natural, biological materials, such as plants, trees, or animal-derived materials (e.g., wood, plant oils, silk, feathers, wool, beeswax, chitin, etc.). These natural materials may have undergone various physical, chemical, or biological processes. You can find bio-based products across a wide range of product categories, including but not limited to clothing made out of cotton, wool, bamboo, cosmetics including extracts from fruits, vegetables, herbs, wooden furniture, or bio-based plastic toys and packaging, to name a few.*"

A comprehensive set of 43 questions, including guiding and supporting questions, was developed to steer the discussions. These questions were carefully designed to cover all relevant aspects of consumer perceptions, ensuring a thorough exploration of the research topics. To ensure consistency and reliability across all FGD sessions, a detailed interview guide was developed. This guide included structured instructions for the interviewers and an interview presentation with visual aids designed to support the discussions. The use of standardized materials and procedures across sessions contributed to the study's methodological rigor and the reliability of the findings.

The study engaged over 40 participants. The pre-cocreation on-site workshop in Spain involved 10 participants and the on-line pilot study sample in Poland involved 5 participants. The workshops conducted in Spain and Poland served as pilot studies aimed at testing the focus group discussion (FGD) scenario and the planned techniques. In addition, the workshop in Poland specifically evaluated the respondents' ability to work with the Mural interactive board, ensuring that this tool was user-friendly and did not pose unnecessary challenges during the discussions. Both workshops provided valuable insights that allowed for the refinement of the FGD scenario, including the elimination of redundant questions, the optimization of time allocated to individual tasks, and the addition of detailed instructions for moderators. These instructions were designed to ensure consistency in facilitating discussions and to guide moderators in effectively managing tasks and engaging participants, thereby improving the overall reliability and quality of the data collection process. The main study sample comprised altogether 34 participants from the four target countries. The recruitment of participants done by the external market research company Bilendi Oy, was carried out with attention to demographic diversity, aiming

to capture a wide range of consumer views within the target populations. For the focus groups, the participants were chosen from consumers who expressed interest in the environment and sustainable consumption. Mainly two demographic segments were considered: 18-35 years old (i.e. Gen Z and younger Millennials) and 40-55 years old (Generation X). These two groups were selected because they constitute a possible early adopter segment and possess great potential as future customers in the market. However, regarding the use of new mobile applications, these groups differ. Early Millennials and younger are heavy users of mobile applications including social media, with a strong presence on platforms like Instagram, Snapchat, and TikTok5. They tend to spend more time on mobiles and social media than Gen Xers[1].

The focus group sessions were conducted in April 2024. The breakdown of participants was as follows:

- Finland:
  - Age group 18–35: 5 participants
  - Age group 40–55: 4 participants
- Poland:
  - Age group 18–35: 7 participants
  - Age group 40–55: 7 participants
- The Netherlands:
  - Age group 18–35: 2 participants
  - Age group 40–55: 5 participants
- Spain:
  - Age group 18–35: 0 participants
  - Age group 40–55: 4 participants

The target was to arrange eight focus groups, but ultimately seven focus group interviews were conducted. The Spanish age group 18-35 was left without participants, despite multiple efforts to mobilise participants to take part in the discussion. This was primarily due to challenges in recruitment, which included a lack of response from potential participants despite extensive outreach through various channels. Additionally, the timing and scheduling constraints of the target demographic, as well as potential competing commitments, may have contributed to the low level of engagement. While every effort was made to ensure participation, these factors ultimately prevented the group from being organized. The FGDs were conducted in the participant's native language online, using Zoom and Microsoft Teams platforms, facilitating seamless interaction between participants and researchers regardless of geographical location. The use of the Mural platform (illustrated in Annex B), with its preset scenario and interactive boards, further enhanced the discussions by enabling participants to collaborate

[1] https://www.pewresearch.org/short-reads/2019/09/09/us-generations-technology-use/

effectively and visualize concepts during the sessions. Additionally, an interview guide composed of instructions for interviewers and an interview presentation supplementing the discussion were utilized to support the process. Each focus group session lasted approximately 90 minutes, providing ample time for in-depth discussion of the topics of interest. All sessions were recorded and transcribed verbatim by the moderators, ensuring the accuracy and richness of the qualitative data.

The qualitative data from the focus group discussions were analysed using the framework developed by Gioia et al. (2012). This approach involved systematically identifying and coding relevant themes and patterns within the data. The essence of this method is in its dual coding process, which facilitates the movement from raw data to theoretical constructs, ultimately allowing researchers to derive meaningful interpretations from their findings.

2.3 Evaluation of digital solution mock-ups

The evaluation of digital solution mock-ups was done by utilising an online discussion platform, to collect qualitative data from consumer groups in the same four countries as in the previous research phase, Finland, Poland, the Netherlands, and Spain. The method was chosen for its ability to engage a large number of participants asynchronously, allowing for detailed feedback on the digital solution mock-ups developed in T2.4. This approach was ideal for evaluating consumer preferences regarding digital tools designed to support bio-based purchasing. The primary aim of this study was to evaluate the digital solutions developed and co-created in 3-CO with consumers—potential end-users of these solutions—and to identify detailed consumer preferences and recommendations for improvement. The main research question was: Which of the presented digital solution mock-ups do consumers prefer, and what are their detailed preferences regarding its features?

Building upon the ideas generated from the previously conducted FGDs, which served as co-creation workshops and highlighted a strong preference for mobile applications, three mock-ups of digital solutions were developed in Task T2.4. These mock-ups were then presented to consumers for evaluation using the online discussion platform. To ensure a comprehensive evaluation, the study engaged 191 participants from the four countries, representing a diverse range of consumers. Recruitment of participants was carried out, by the same external market research company, with attention to demographic diversity, aiming to capture a wide array of consumer views within the environmentally-conscious target segment.

The evaluations were conducted online using the Howspace platform[2], which facilitated asynchronous interaction and allowed participants to provide feedback at their convenience. The platform's interactive features enabled participants to engage with the mock-ups directly and share their opinions by writing and voting. Standardized materials and clear instructions were provided on the platform to guide participants through the evaluation process, enhancing the study's methodological rigour and the reliability of the findings. The platform operated in the native language of the participants.

Participants had flexible access to the Howspace platform for two weeks, ensuring ample time for thoughtful engagement with the digital solutions. All the written interactions and feedback were saved to the platform, ensuring the accuracy and richness of the qualitative data collected. The qualitative data were analysed by using qualitative content analysis methods. This approach involved systematically identifying and coding themes and patterns within the participants' feedback. The analysis provided clear insights into consumer preferences and led to the selection of the most preferred digital mock-up, along with a comprehensive list of detailed recommendations. This feedback was instrumental in refining the digital solution to better meet consumer needs and preferences.

By leveraging the capabilities of the Howspace platform and engaging a diverse group of consumers, the study effectively evaluated the digital solutions developed in Task T2.4. The findings offered valuable insights into consumer expectations and preferences, guiding the development of digital tools that support bio-based purchasing.

[2] https://howspace.com/

3 Findings

3.1 Consumers' drivers and concerns toward BBPs purchasing and LCSs – results from CAWI

In this chapter, the findings from the CAWI-research are presented. The focus is on consumer segmentation and consumers' willingness to purchase BBPs and rely on LCSs. The numbers presented within brackets refer to the average value of the research participants' responses to statements on a Likert scale of 1 to 7. This chapter also presents a consumer persona created to support the development of digital solutions in T2.4 of the WP. Each sub-chapter presents recommendations relevant for the design of LCSs for BBPs.

3.1.1 Identified segments

Using a scale for consumer attitude toward sustainability, all respondents (N=3000) were segmented by applying cluster analysis. After the analysis, all segments were confirmed in individual countries. Three segments were identified as follows:

Segment 1: Passive Sceptics

Passive Sceptics display ambivalence towards sustainable development, showing neither strong positive nor negative attitudes. While they are aware of sustainability issues, their behaviour does not consistently align with sustainable practices. This group is typically male, younger (below 34 years), and tends to perceive their financial situation as "average" or polarized between "very poor" and "very good."

Figure 2: Visualization of a Typical Representative of the Passive Sceptics Segment

Source: drawn by Chat GPT after providing detailed description

Segment 2: Active Advocates

This segment demonstrates a proactive and positive stance on sustainability, aligning beliefs, feelings, and behaviours with environmental goals. Active Advocates are predominantly female, over 55 years old, and have a balanced financial outlook, predominantly "average" or "good."

Figure 3: Visualization of a Typical Representative of the Active Advocates Segment

Source: drawn by Chat GPT after providing detailed description

Segment 3: Convenience Seekers

While Convenience Seekers show intellectual and emotional support for sustainability, their behaviours are inconsistent. They value sustainability in theory but face practical barriers in adopting sustainable products, often due to convenience or lack of habituation. This group consists mostly of females aged 35-44 and reflects "poor" or "very good" financial conditions.

Figure 4: Visualization of a Typical Representative of the Convenience Seekers Segment

Source: drawn by Chat GPT after providing detailed description

3.1.2 Consumer drivers and concerns within segments

The segment of Passive Sceptics (S1) demonstrates a generally low engagement with BBPs. The key drivers include moderate capabilities, with the only notable strength being no difficulty finding important information about the product on the packaging (4.11). Their knowledge of BBPs and awareness of their environmental impact are rather low, scoring between 3.35 and 3.85. These consumers also show limited concern about health impacts and future planetary benefits from BBPs, with scores around 3.64 and 3.85, respectively. Barriers in this segment stem primarily from social and environmental factors. Passive Sceptics feel little pressure from coworkers, friends, or family to adopt BBPs (with scores of 2.68 and 2.85). Additionally, they perceive minimal influence from marketing campaigns and information availability, as both factors score below 4. Their motivations for using BBPs are similarly low, reflecting scepticism about the personal and societal benefits of purchasing these products. The main drivers and concerns for Passive sceptics to purchase BBPs are presented in the Table 2, below.

Table 2: Main drivers and concerns for Passive sceptics

Main Drivers	Concerns (Barriers)
Moderate belief in BBPs' positive environmental impact	Low self-reported knowledge about BBPs
Perceive eco-friendliness as somewhat fashionable	Difficulty recognizing BBP certifications
Preference for symbols over plain text on packaging	Limited social influence to use BBPs
	Low perceived personal benefits from BBPs
	Not accustomed to buying eco-friendly products

The segment of Active Advocates (S2) is highly motivated and knowledgeable about bio-based products, and shows strong engagement across all key drivers. General knowledge, recognition of certificates, and perceptions of environmental and health impacts all score significantly above 4.5, indicating a deep understanding and belief in the benefits of BBPs. These consumers also have quite good label-reading abilities (4.91) and high awareness of the planet's future (5.72). Family bio-pressure (4.45) and the influence of marketing campaigns (4.70) act as positive reinforcements for their bio-purchasing behaviour. Despite these drivers, Active Advocates still experience some barriers, mainly around peer pressure from coworkers and friends (3.38) and people's recommendations (3.94). These barriers, however, are relatively weak compared to the high levels of motivation this segment demonstrates. Main drivers and concerns for Active Advocates to purchase BBPs are presented in the Table 3, below.

Table 3: Main drivers and concerns for Active Advocates

Main Drivers	Concerns (Barriers)
High awareness and knowledge about BBPs	No peers or coworkers pressure felt to use BBPs
Strong conviction in BBPs' environmental impact	
Believe BBPs benefit health and planet's future	
Feel eco-friendliness is highly fashionable	
Encouraged by family and friends to use BBPs	
See personal benefits and gain self-satisfaction from BBPs	
BBPs make a good impression; habitual purchasers	

Convenience Seekers (S3) have a mixed level of engagement with BBPs, driven largely by their perception of the environmental and health benefits of these products. While their general knowledge of BBPs (3.45) and recognition of certificates (3.66) are relatively low, they belief in BBPs' positive impact on the environment (4.92) and the planet's future (5.15). Convenience, as their name implies, is important for this group, and their ability to read labels (4.28) supports their decision-making. The main barriers for this group are social influences and limited social visibility of BBP purchases. Coworker and friend pressure (2.13) and family pressure (3.03) to purchase BBPs are minimal, and recommendations from others score very low (2.53). The availability of information on BBPs also acts as a moderate barrier (3.51), though marketing efforts around eco-trends show some influence (4.04), aligning with their interest in convenient, visible options. Main drivers and concerns for Convenience Seekers to purchase BBPs are presented in the Table 4, below.

Table 4: Main drivers and concerns of Convenience Seekers

Main Drivers	Concerns (Barriers)
Believe in BBPs' positive impact on environment and health	Moderate knowledge levels about BBPs
Agree eco-friendliness is fashionable	Limited social encouragement to use BBPs
Some ability to recognize BBP certifications	Less habitual purchasing of eco-friendly products
Perceive personal benefits in using BBPs	BBPs don't enhance reputation or self-satisfaction

Additionally, based on the above presented results some general conclusion may be drawn. First of all, there is a moderate level of awareness and engagement with BBPs across all consumer segments. Many consumers do not feel well-informed about BBPs, with scores ranging from 3.35 among Passive Sceptics to 3.45 for Convenience Seekers. Recognition of certificates confirming a product's biological origin is also low to moderate, indicating a potential area for improvement in product labelling and education. While there is a general belief that using BBPs positively impacts the environment, health, and the future of our planet, this conviction is significantly stronger among Active Advocates. The majority of consumers perceive being eco-friendly as fashionable, but this does not necessarily translate into habitual purchasing behaviour, especially among Passive Sceptics and Convenience Seekers.

To sum up, key barriers include:

- Many consumers **lack sufficient information about BBPs** and have **difficulty recognizing eco-certifications**, which hinders their ability to make informed purchasing decisions.
- There is minimal encouragement from family and friends to purchase BBPs, and consumers **do not feel significant pressure from their social circles**.
- Lower scores on perceived personal benefits and self-satisfaction suggest that consumers may **not fully understand the advantages of BBPs** for themselves.
- The transition from recognizing the importance of BBPs to incorporating them into regular purchasing habits is lacking, as indicated by **lower scores on habitual behaviour**.

Recommendations to address these barriers:

- **Enhance consumer knowledge** about BBPs through informative marketing and educational initiatives that highlight both environmental and personal benefits.
- **Improve the visibility and understanding of eco-certifications** on product packaging to build trust and recognition.
- **Leverage social influence** by encouraging word-of-mouth recommendations and endorsements from family and friends.
- **Simplify access to important product information** by utilizing preferred communication methods, such as symbols over plain text to cater to consumer preferences.

3.1.3 Willingness to purchase BBP and rely on LCSs

The willingness to purchase bio-based products and use labelling and certificates systems is a crucial indicator of the market potential of these products. An analysis of the survey results allows for understanding the readiness level of each consumer segment to purchase BBP and rely on LCSs. Passive Sceptics show little willingness to purchase BBP (3.35). Their trust in BBP certificates is low (3.33), and their willingness to rely on them when making purchasing decisions is also low (3.52). They are the least inclined to use digital solutions to obtain information (3.05). Their low trust in certificates and reluctance to use technology suggest the need for alternative communication and education strategies to increase their engagement.

Active Advocates are the most willing to purchase BBP (5.17). They have high trust in BBP certificates (5.22) and readily rely on them (5.17). They are open to using digital solutions to obtain information (4.92). Their high trust in certificates and openness to technology make them an ideal segment for implementing advanced marketing strategies, including digital informational tools. Convenience Seekers have a moderate willingness to purchase BBP (4.13). Their trust in certificates is average (4.23), and their willingness to rely on them is moderate (4.38). They are moderately inclined to use digital solutions (3.70). They are open to purchasing BBP. Their trust in certificates is moderate, along with their willingness to use technology, indicates the possibility of utilizing digital solutions while shopping.

The conclusions from the analysis suggest that for Active Advocates, it is crucial to maintain a high level of trust by continuing transparency in communication regarding certificates and the benefits of BBP, and utilizing technology by developing mobile applications and interactive informational platforms. For Convenience Seekers, it is essential to emphasize convenience and availability providing easy-to-use informational tools. For Passive Sceptics, education and building trust are necessary through organizing informational campaigns and using traditional media, as well as personalizing communication focusing on benefits.

In conclusion, the willingness to purchase BBPs and rely on LCSs varies among consumer segments. Active Advocates show high readiness to purchase and use certificates, Convenience Seekers have moderate readiness, and Passive Sceptics low. Referring to consumers' past purchasing behaviour, Table 5 presents the percentage of respondents that represent different segments who confirm that they have purchased a product (within the value chains at focus in the 3-CO project) category during the specified period.

Table 5: Percentage of individuals in each segment who purchased a product category during the specified period

Did you purchase any of the products within the time period specified in the brackets?				
	Passive Sceptics	Active Advocates	Convenience Seekers	ALL
shampoo (Last 6 months)	77%	86%	85%	83%
cosmetics (Last 6 months)	32%	49%	44%	43%
products in plastic bottles (Last 6 months)	70%	73%	79%	74%
baby clothing (Last 1 year)	10%	14%	15%	13%
t-shirts (Last 1 year)	55%	58%	63%	58%
plant pots (Last 1 year)	17%	25%	21%	21%
plastic toys (Last 1 year)	18%	22%	24%	22%
wooden houses (Last 5 years)	3%	5%	3%	4%
furniture (Last 5 years)	38%	42%	47%	42%
mattresses (Last 5 years)	26%	33%	32%	31%

As expected, across all segments, everyday fast-moving consumer goods (FMCG), such as shampoo and products in plastic bottles, have the highest purchase rates, which may be explained by their status as widely used essentials. In contrast, slow-moving consumer goods (SMCG), like wooden houses, or specialized, less frequently needed items like baby clothing, have significantly lower purchase rates across all groups. Attention to certifications confirming the bio-based share of a product varies significantly among the segments. Table 6 presents the percentage of individuals who considered certifications when purchasing the products in each category during the specified period.

Table 6: Percentage of individuals who considered certifications among those who purchased a product category during the specified period

During any of your purchases in this period, did you pay attention to certificates confirming the bio-based share of the products?				
	Passive Sceptics	Active Advocates	Convenience Seekers	ALL
shampoo	20%	52%	31%	37%
cosmetics	26%	60%	31%	45%
products in plastic bottles	13%	34%	16%	23%
baby clothing	44%	59%	31%	47%
t-shirts	16%	38%	20%	27%
plant pots	25%	33%	10%	25%
plastic toys	15%	33%	13%	23%
wooden houses	69%	73%	57%	69%
furniture	10%	34%	11%	21%
mattresses	10%	32%	13%	21%

The data indicates that the Active Advocate segment consistently shows a higher percentage of individuals who paid attention to certifications confirming the bio-based share of products, especially in categories like cosmetics (60%) and shampoo (52%). In contrast, Passive Sceptics and Convenience Seekers display lower consideration for certifications, indicating potential areas for increasing awareness and education. Examining the purchase of bio-based products themselves, Table 7 illustrates the percentage of consumers who purchased the bio-based version of a product among those who bought a product category during the specified period.

Table 7: Percentage of consumers who purchased the bio-based version of a product among those who bought a product category during the specified period

During any of your purchases, did you buy a bio-based version of a product?				
	Passive Sceptics	Active Advocates	Convenience Seekers	ALL
fully bio-based shampoo (Last 6 months)	14%	42%	22%	29%
fully bio-based cosmetics (Last 6 months)	20%	42%	22%	31%
products in bio-based plastic bottles (Last 6 months)	14%	28%	16%	21%
bio-based baby clothing (Last 1 year)	30%	42%	27%	35%
bio-based t-shirts (Last 1 year)	12%	27%	17%	20%
biodegradable plant pots (Last 1 year)	18%	30%	13%	23%
bio-based plastic toys (Last 1 year)	11%	23%	6%	15%
wooden houses (Last 5 years)	38%	51%	33%	44%
bio-based furniture (Last 5 years)	5%	18%	6%	11%
bio-based mattresses (Last 5 years)	5%	19%	6%	12%

As expected, the data indicates that Active Advocates are more likely to purchase bio-based versions of products across all categories, with particularly high percentages in fully bio-based shampoo and cosmetics (both at 42%). what reflects their proactive approach towards sustainable consumption. Passive Sceptics and Convenience Seekers show lower purchase rates of bio-based products, suggesting a need for targeted strategies to encourage adoption in these segments.

As a conclusion several insights may be provided:

- FMCG items like shampoo and cosmetics have higher bio-based purchase rates among Active Advocates, suggesting opportunities to promote bio-based alternatives in daily essentials.
- SMCG items like wooden houses have lower overall purchase rates but higher consideration of certifications, possibly due to the significant investment and long-term use associated with these products, as well as the prevalence of certifications within this product group.
- The significant gap between Active Advocates and other segments in considering certifications underscores the importance of increasing certification visibility. Educating consumers about the meaning and benefits of bio-based certifications could enhance trust and drive adoption among Passive Sceptics and Convenience Seekers.
- Active Advocates are already attentive to certifications and consider them during purchases. Maintaining clear labels will continue to support their environmentally conscious choices. Simultaneously for Passive Sceptics and Convenience Seekers, who show lower attention to certifications, increasing the visibility of labels and certificates on packaging can draw their attention.

Some recommendations may be given:

- **Educational campaigns** highlighting the benefits of bio-based products and certifications can address scepticism and lack of knowledge.
- Prominent placement of bio-based products and **clear labelling** can attract attention from all consumer segments.
- Developing **marketing strategies** that address the unique motivations and barriers of each segment will be more effective in changing purchasing behaviours.
- Supporting consumers with **digital solution** can increase their ability and willingness to buy bio-based products as it can make certifications more noticeable.

3.1.4 PERSONA for Mock-up of a digital solution

Based on the findings on Convenience Seekers PERSONA for mock-up of digital solution has been created as follows. The procedure included:

- in-depth analysis of the features of the Convenience Seekers segment after CAWI
- identification of characteristics distinguishing Convenience Seekers from other segments
- generalization of opinions and behaviors based on those reported in FGDs
- assigning the PERSONA an identity (name, exact age, family situation, occupation)

As a result, the following PERSONA was proposed:

Figure 5: PERSONA

Source: drawn by Chat GPT after providing detailed description

PERSONA's name: Anna
Age: 40 years old
Gender: Female
Family: Husband Thomas; daughter Olivia (11 years old)
Geographical Location: EU country
Occupation: Mid-level professional in sectors not directly related to environmental sustainability
Education Level: Moderate to high, with a general focus rather than specialization in environmental studies
Financial Situation: Perceives her financial status as average
Psychographics:

- Demonstrates intellectual and emotional support for sustainable development, yet there's a notable gap between this support and her actual purchasing behaviours.
- Recognizes the importance of sustainability, but prioritizes convenience and cost in decision-making.
- Exhibits a generally positive attitude towards sustainability in discussions, which doesn't always translate into consistent sustainable consumer behaviour.
- Aspires to make sustainable choices, provided they are convenient and integrate smoothly with her current lifestyle.

Behavioural Traits:

- While aware of sustainability issues, her actions do not always align with sustainable practices.
- Shows interest in sustainable products but is less diligent in verifying claims or seeking certifications than more proactive advocates.
- Prioritizes convenience in shopping, preferring easily accessible and straightforward solutions.

Attitude Toward Bio-Based Products:

- Exhibits a positive attitude towards bio-based products, although tempered by concerns over information clarity, product quality, and economic considerations. Afraid of greenwashing.

- Owns bio-based items such as a wooden house and has purchased bio-based cosmetics, shampoo, and baby clothing for a friend's child, paying attention to certificates. However, she has not considered bio-based alternatives for products like plastic toys, furniture, or mattresses.

Challenges:

- **Awareness:** Experiences confusion about the definition of bio-based products.
- **Knowledge:** Lacks sufficient information on the benefits of bio-based products.
- **Recognition of Certifications**: Faces challenges in recognizing certificates that confirm the biological origin of products.
- **Social Influence and Support:** Limited influence from both close and broader community circles on purchasing and using bio-based products.
- **Perceived Availability:** Experiences difficulty locating bio-based products in stores.
- **Media Presence:** Information about bio-based products is not as visible as necessary to be adequately informed.
- **Personal Benefits and Reputation:** The personal benefits and reputation enhancement from using bio-based products are unclear.
- **Conscience and Personal Satisfaction:** Lacks personal satisfaction from purchasing bio-based products, indicating a disconnect between values and purchasing behaviour.
- **Habit Formation:** Does not feel that choosing environmentally friendly products is an automatic part of her shopping routine, suggesting a lack of habituation.
- **Trust in Certificates:** Demonstrates low trust in certificates and is reluctant to use them during purchasing.
- **Use of Digital Tools for Information:** Shows ambivalence towards using mobile apps or digital solutions to obtain information on bio-based products, highlighting a need for more user-friendly and engaging digital resources.
- **Willingness to Pay:** Unwilling to pay for digital solutions that would help verify bio-certificates.

The purpose of the Persona description was to guide and support the design and development work of the digital solution mock-ups, done in T2.4. *Designing and developing smart solutions to support sustainable decision-making* (reported in D2.4 Report on Digital Solutions).

3.2 Consumer views on LCSs and co-creating digital solutions – results from FGDs

3.2.1 Main insight

The FGDs were aimed at understanding consumer perceptions, experiences, and concerns related to BBPs. The participants were diverse in terms of age, background, and geographical location, providing a broad spectrum of insights. Participants voiced substantial concerns about environmental issues, particularly global warming and the unsustainable consumption of natural resources. Discussions often cantered on BBPs and their potential to lessen environmental harm. Generally, there was a preference for products deemed environmentally friendly, though some scepticism existed regarding the truthfulness of such environmental claims, often referred to as "greenwashing." A recurring theme was the confusion or lack of knowledge about what defines a bio-based product. Participants expressed a need for clearer information and better education on the characteristics of bio-based products and how they are environmentally superior to their non-bio-based counterparts.

There was extensive discussion on the role of labels and certifications in aiding consumers to make informed purchasing decisions. While participants valued these identifiers, they also expressed doubts about their authenticity and the adequacy of regulatory oversight. The reliability of eco-labels and the clarity of certification standards were pointed out as areas needing enhancement. The discussions on the availability of bio-based products revealed mixed experiences. Some participants reported ease of access to these products, whereas others encountered difficulties in finding them in local stores. There was a consensus on the need for greater availability and more prominent display of bio-based products in retail environments.

The cost of BBPs, often higher than conventional alternatives, was a significant concern. Participants acknowledged their willingness to pay a premium for environmentally friendly products, but noted that the higher prices limit broader consumer adoption. Participants shared personal experiences with bio-based products, including items such as clothing and cosmetics. There was enthusiasm for the concept, accompanied by calls for improved functionality and durability to match or exceed conventional products.

The importance of digital tools in enhancing consumer understanding and decision-making was discussed. Suggestions were made for improvements to digital platforms that provide reliable information on bio-based products, including applications and online resources that assist in comparing products and deciphering labels.

In conclusion, the focus groups revealed a positive attitude towards bio-based products, tempered by concerns about information clarity, product quality, and economic factors. Enhancing consumer trust through better education, transparent labelling, and regulatory practices was identified as crucial for wider adoption of bio-based products.

Thus, the main recommendations concluding from the focus groups are:

1. Improve labelling clarity and enforce certification standards.
2. Increase consumer education on bio-based products.
3. Enhance the visibility and availability of bio-based products in retail.
4. Address price concerns through subsidies or incentives for manufacturers.

The FGDs featured a segment where participants brainstormed and discussed together of potential digital solutions that would help consumers navigate and make informed decisions about BBPs. The results of these co-created solutions support the development of the digital mock-ups in T2.4. Below, an overview of the digital solutions conceptualized by consumers is presented, including the main characteristics of their features.

3.2.2 Co-created Solutions in Finland

I. Proposed digital solution by the age group 18-35: "Independent Advisory Service"

The focus group strongly felt that such a digital solution could empower consumers to make more environmentally responsible choices, enhance their shopping experience, and ultimately lead to greater adoption of bio-based products.

Key features and characteristics:

- The digital tool should be readily accessible, possibly through mobile devices and in-store digital kiosks. This would help consumers make informed decisions directly at the point of sale.

- The interface should be user-friendly, catering to all ages and tech-savviness levels, ensuring that even consumers who do not own smartphones or are not proficient with digital technology can utilize the service.
- It is crucial that the information provided by the digital tool is verified and reliable. This could be achieved through partnerships with trustworthy organizations or government bodies that oversee environmental claims and certifications.
- The tool should offer transparency regarding its data sources and the criteria used to verify the sustainability claims of products.
- The service should provide real-time information about products, allowing users to get immediate answers about the sustainability and origins of products while shopping.
- Interactivity is key, with features like a chat option that could begin with AI-driven responses for basic inquiries, and the capability to escalate to real human interaction for more complex questions or personalized assistance.
- Detailed information on the environmental impact, manufacturing process, and lifecycle of products should be readily available. This includes details on how products are sourced, their biodegradability, and the ecological footprint involved in their production and disposal.
- The tool should include educational content to help consumers understand what bio-based products are, the significance of different eco-labels, and how to properly recycle or dispose of products.
- Guidance on how to interpret and trust various certifications and labels found on products, helping consumers navigate often confusing marketing claims.
- Integration of features such as barcode scanning for instant product information and comparisons of similar items to recommend the most sustainable option.
- Options for feedback and community engagement, where users can share their experiences and tips, enhancing the communal knowledge base.
- To maintain trust and objectivity, the digital solution should remain independent of commercial influences, focusing solely on providing unbiased information. This would help avoid conflicts of interest and ensure the advice provided is solely for the benefit of the consumer and the environment.

- **Gamification:**
    - Some participants expressed scepticism and discomfort with the idea of gamifying shopping experiences. They were concerned that gamification could be exploited for

manipulative purposes rather than genuinely helping consumers make sustainable choices. For one participant, the concept of gamification was seen as potentially dystopian and was not appealing as a feature to enhance shopping for bio-based products.

- Despite some scepticism, other participants recognized potential benefits of gamification. They suggested that if implemented thoughtfully, gamification could engage consumers more deeply by providing interactive elements like points, challenges, or leaderboards that could incentivize and track eco-friendly shopping behaviours. This approach was seen as a way to encourage consumers to make more sustainable choices actively.
- There was a concern that relying heavily on gamification could exclude non-tech-savvy individuals or those who are less interested in gamified experiences, potentially limiting the accessibility of the digital tool.

II Proposed Digital Solution by the age group 40-55: "Bioshopper"

The proposed digital solution is an application designed to assist consumers in understanding and selecting bio-based products. The main function of this app is to compile various certificates and information about bio-based products, supporting consumers with detailed product insights. This solution aims to enhance the shopping experience by providing accessible, comprehensive information about the sustainability and origins of products.

This digital solution, as discussed by the focus group, represents a comprehensive tool for enhancing consumer engagement with bio-based products and fostering a more sustainable economy. By providing detailed information about product certifications and materials, the app increases transparency in the bio-based product market. With easy access to detailed product information, consumers can make more informed choices that align with their environmental and sustainability values. By making it easier for consumers to identify and select bio-based products, the app promotes sustainable consumption patterns and supports the broader adoption of environmentally friendly products.

Key features and characteristics

- The app aggregates various eco-certifications and labels to inform consumers about the environmental impact and sustainability practices of products. It includes details about the materials used and the production process.

- A QR code feature allows users to scan product labels in stores to instantly receive detailed information about the product's bio-based content and certifications. This provides a quick and interactive way for shoppers to learn more about the products they are considering.
- The application provides educational material about bio-based products and sustainability. This feature is designed to help consumers understand the significance of different certifications and the benefits of choosing bio-based products.
- The app features a user-friendly interface that is easy to navigate. It ensures that information is accessible to all users, including those with little to no prior knowledge of bio-based materials.
- It integrates with online shopping platforms and brand databases to provide users with information about where they can purchase certified bio-based products online.
- Users can customize the app settings to receive notifications about new bio-based products and special offers related to their interests and previous purchases.
- **Gamification:**
    - The application could include game-like features such as challenges or rewards to increase its attractiveness and engagement. One participant suggested a memory game that involves matching logos of different eco-certificates, which could educate users in a fun way about the various certifications and their meanings.
    - Gamification is seen as a way to make learning about bio-based products and sustainability more interactive and enjoyable. This could potentially attract a wider audience, including families with children, who are often more engaged in recycling and eco-friendly practices.
    - By incorporating elements like point collection and rewards, the app could motivate consumers to make more sustainable choices frequently. This could include rewards for purchasing bio-based products or for participating in educational activities within the app.
    - Some participants expressed concerns about the complexity that gamification might add to the app. There was a desire to keep the app simple to avoid overwhelming users with too much information or too many features. It was suggested that while some users might appreciate gamification, others might prefer a more straightforward informational tool.
    - It was important to balance engaging content with practical utility. The group discussed how gamification should not detract from the core purpose of the app,

which is to educate and inform users about bio-based products. Any game elements should complement the informational aspects rather than overshadow them.

3.2.3 Co-created solutions in Netherlands

I. Proposed digital solution by the age group 18-35: "Bio-Wise"

The proposed digital solution represents a forward-thinking approach to enhancing consumer awareness and access to sustainable products, leveraging technology to promote better environmental choices in everyday shopping. This digital tool aims to be a comprehensive resource for consumers looking to verify and learn about the sustainability of their purchases.

Key features and characteristics:

- An integrated filtering system in major online retail platforms would allow consumers to easily find and identify bio-based products. This system would be designed to sort and display products based on their sustainability credentials, streamlining the shopping process for eco-conscious buyers.
- A mobile application capable of scanning product barcodes to instantly provide detailed information on the product's bio-based components and sustainability credentials. This app would ideally be issued or endorsed by a government body to ensure its trustworthiness and accuracy.
- A centralized database where consumers could search for sustainable products across various categories. This database would list verified products and provide links to retailers, both online and brick-and-mortar, where these products can be purchased. The focus would be on transparency, providing detailed information about the sustainability of each product, including its production process and the origin of its materials.
- The solution would include educational resources to help consumers understand what bio-based and eco-friendly labels mean, including details about production processes and material origins. This feature aims to increase consumer awareness and knowledge, empowering them to make more informed decisions.
- To facilitate adoption and effectiveness, the digital solution would integrate seamlessly into existing retail practices and platforms, enhancing current systems without requiring significant changes or overhauls.

- To combat misinformation and greenwashing, the solution would need to be reliable and possibly regulated or monitored by reputable organizations or governmental bodies. This would ensure the accuracy of the information provided and increase consumer trust in the system
- **Gamification:** Participants expressed a preference for a more straightforward, informative tool rather than one with gamified elements, which they felt might detract from the seriousness and trustworthiness of the platform. They were concerned that gamification could make the app feel more commercialized or trivialize the important issue of sustainability. While there was a brief mention that initial gamification features like quizzes might be fun to increase awareness, the consensus leaned towards keeping the platform focused on providing reliable information without gamification elements to maintain its credibility and professional tone.

II Proposed Digital Solution by the age group 40-55: "Bio-aware"

The digital solution discussed by the focus group is a shopping aid designed to help consumers identify and verify the sustainability credentials of biobased products. The focus group emphasized the importance of simplicity in design and operation to encourage widespread adoption and regular use of the app. They also highlighted the potential for the app to educate consumers about sustainability and influence more environmentally friendly purchasing decisions.

Key Features and Characteristics

- The application utilizes smartphone cameras to scan product labels and certifications. It provides detailed information about the biobased content of products and the credibility of their environmental claims. The app uses a simple interface that allows users to quickly access detailed information by scanning a barcode or a label with their smartphone.
- The app includes comprehensive explanations about various certifications and sustainability labels, helping users understand what each label represents. It offers insights into the production processes and the origin of materials used in the products.
- The app may incorporate augmented reality features to provide an interactive shopping experience, where users can visualize the environmental impact of products. Designed to be user-friendly, it aims to streamline the process of verifying product certifications without overwhelming the user with technical jargon.
- **Gamification:**

- The app could include game-like elements such as points, badges, or challenges to make sustainable shopping more engaging. Users might earn rewards or discounts for making sustainable choices, thereby incentivizing the use of biobased products.
- Some participants saw gamification as a way to make sustainable shopping more engaging. They suggested incorporating elements like badges, points, or challenges to increase user interaction and make the experience more rewarding.
- There was a proposal for a rewards system where users could earn discounts or gifts for achieving certain milestones within the app. This could motivate consumers to consistently choose biobased products.
- Despite the perceived benefits, there was a concern that gamification might become intrusive or annoying. Participants emphasized the need for these features to be well-integrated and not disrupt the shopping experience with pop-ups or unnecessary distractions.
- Participants were cautious about the extent of personal data shared through the app. They were open to sharing purchase data if it directly benefits their experience but were generally wary of extensive data collection.
- Some participants were sceptical about the effectiveness of gamification, doubting whether it would significantly influence their purchasing decisions. They suggested that the app should focus more on providing valuable information rather than relying heavily on game-like elements.

- The app ensures that personal data, if collected, is handled with strict privacy measures. Only necessary data like purchase history might be used to tailor user experiences or rewards.
- To ensure accessibility in areas with poor internet connectivity, the app could offer offline capabilities where basic information is available without needing a live connection. Considering the diverse user base, the app might include multiple language options to cater to a wider audience.

3.2.4 Co-created solutions in Poland

I Proposed Digital Solution by the age group 18-35: An app for searching for bio-based products

The focus group developed a comprehensive digital solution aimed at enhancing the shopping experience for organic and eco-friendly products. This innovative app integrates features like barcode and QR code scanning, augmented reality (AR) to guide shoppers within stores, and access to detailed

product information, including certifications and environmental impact. The application is designed with a user-friendly interface, ensuring minimal lag and efficient navigation to foster a seamless user experience. It also supports personalized shopping by allowing users to set preferences for local or specific products. Additionally, the app aims to educate consumers about sustainability and provide real-time notifications about new products and promotions, thereby making responsible shopping choices more accessible and informed. The emphasis on data security and user privacy ensures that the app is both a reliable and trustworthy tool for consumers looking to make environmentally conscious purchasing decisions.

Key Features and Characteristics

- The primary feature of the digital solution is a mobile application capable of scanning barcodes and QR codes. This function allows users to obtain detailed information about products, including their organic certification, ingredients, and origin.
- Augmented Reality (AR) and Virtual Reality (VR) Integration: Suggestions included AR features to help navigate stores and highlight organic products and VR glasses for an immersive experience that compares products in-store. This could provide a richer, more interactive shopping experience.
- The application aims to leverage digital labels and certifications to confirm product authenticity and ecological compliance. These labels could be accessible via the app, ensuring consumers understand the environmental impact of their purchases.
- The tool is designed to be user-friendly with a simple, intuitive interface. There's an emphasis on minimal lag and quick loading times, which are crucial for usability during shopping.
- The app could offer personalized shopping experiences by allowing users to set preferences for locally produced items or products from specific countries. This feature supports more tailored and conscious shopping habits.
- There's potential for the app to include educational content about sustainable practices and organic certifications. Notifications could alert users about new products or sales on preferred items, enhancing the shopping experience and fostering more informed consumer choices.
- For in-store applications, the digital solution could integrate with existing retail systems to highlight organic products on shelves or through store maps, potentially using the store's Wi-Fi system to provide real-time information.
- The app would ensure high standards of data protection and privacy, addressing potential user concerns about data misuse.

- **Gamification:** The focus group discussed the potential of integrating gamification into the digital solution for purchasing organic products. The participants expressed interest in features like points programs, where users could earn rewards for purchasing eco-friendly products. Gamification could potentially include quizzes about organic products, with prizes for correct answers, fostering a deeper engagement and educational aspect within the app. The idea of integrating a competitive element, where users could compare their achievements or points with others, was also considered to increase motivation and user interaction. However, the specifics on how these gamification elements would be implemented were not detailed, indicating a general interest in the concept without a concrete plan for execution. The group leaned towards features that not only engage but also educate users about sustainable and organic products, adding a layer of interaction that could enhance the shopping experience.

II Proposed Digital Solution by the age group 40-55: Cart scanners

The proposed digital solution encompasses a suite of innovative tools designed to enhance the shopping experience for eco-conscious consumers. At its core, an app equipped with a barcode scanner provides immediate access to detailed product information, including origins, ingredients, and certification explanations, directly on a shopper's mobile device. Complementing this, tablets mounted on shopping carts offer real-time product details and alternatives as items are placed in the cart, integrating seamlessly with store inventory systems. For an immersive experience, VR and AR technologies allow consumers to visualize product journeys and sustainability practices in a compelling visual format. Digital labels and interactive displays positioned throughout the store provide dynamic content such as product comparisons and ecological benefits, enhancing consumer engagement and education. Additionally, integration with loyalty programs rewards shoppers for sustainable purchases, encouraging ongoing commitment to eco-friendly products. The solution also includes a feedback mechanism, enabling a community-driven platform where consumers can share reviews and product ratings, fostering a network of informed and engaged eco-conscious shoppers.

Key Features and Characteristics

- The app includes a scanner that can be used to scan product barcodes or QR codes in-store. Once a product is scanned, the app displays detailed information about the product's certifications, ingredients, and origin. It also describes what each certification means and who issues it, offering transparency and enhancing trust. Designed to be user-friendly, it aims to

provide quick access to information while shopping, reducing the need to search through labels manually.

- Tablets mounted on shopping carts would automatically detect items as they are added to the cart and display relevant product information. The tablet would show information such as nutritional content, organic certification details, and eco-friendly attributes of the products. This feature could be integrated with store inventory systems to provide real-time information about product availability and alternatives.
- **Virtual Reality (VR) and Augmented Reality (AR) features:** Using VR or AR glasses, consumers could see an augmented display of product histories and sourcing practices as they shop. For instance, pointing the AR glasses at a product could display a visual storyboard of the product's journey from farm to store, highlighting sustainable practices. This technology aims to engage users more deeply by providing a visually rich and educational experience.
- Digital labels might be placed on shelves next to products or as interactive kiosks within aisles. These labels could show dynamic content such as detailed product comparisons, ecological benefits, and user reviews. Shoppers could interact with these displays via touch or voice commands to explore product details, making the shopping experience more interactive and informative.
- The digital tools could be linked to a store's loyalty program, where consumers earn points for purchasing certified organic or eco-friendly products. This feature encourages sustainable purchasing by offering rewards such as discounts, special offers, or even donations to environmental causes based on the shopper's choices.
- The proposed digital solutions could include a feedback system where shoppers can leave reviews and rate products directly on the digital platform. This fosters a community of informed consumers who contribute to a database of user-generated content that helps others make better-informed decisions.
- **Gamification:**
    - The participants expressed interest in a system that awards points or rewards for purchasing organic products. This gamification approach could encourage repeated purchases and foster loyalty among consumers by providing tangible incentives, such as discounts on future purchases or special offers on organic products.
    - Although the idea of incorporating competitive elements like leaderboards was briefly discussed, the general consensus was to avoid competitiveness in favour of

collaboration and personal progress tracking. The focus was more on personal achievements and rewards rather than competing against other shoppers.

- The participants saw gamification as a way to increase engagement and interaction with the products and the store. Features such as scanning items to learn more about their eco-friendly attributes and collecting rewards for doing so were viewed positively. This could make the shopping experience more interactive and informative.

3.2.5 Co-created solutions in Spain

I Proposed Digital Solution by the age group 40-55: Mobile application for scanning labels

The focus group developed a comprehensive digital solution designed to enhance consumer knowledge and ease of access to bio-based products. The core of the solution is a mobile application that features a scanning tool capable of interpreting labels and certifications on products. This app aims to demystify the often complex information on sustainable products by providing detailed explanations of each label and its environmental significance. Additionally, the app is designed to be user-friendly and accessible both online and offline, ensuring it is available to consumers regardless of their internet access. It also incorporates educational content on the benefits of bio-based products and a price comparison tool, enhancing its utility. The group emphasized the importance of the app being free to encourage widespread adoption and suggested it be supported by public funds or non-profit organizations to ensure its sustainability and independence. This solution leverages modern digital tools to provide consumers with easy access to essential information, helping them make environmentally and socially responsible choices when purchasing bio-based products.

Key Features and Characteristics

- A scanner for product labels and certifications to provide detailed information about the sustainability and bio-based content of products. The app provides comprehensive details about what each label and certification means, offering transparency and aiding in informed purchasing decisions. Designed to be simple and intuitive, ensuring ease of use for all consumers, regardless of technological proficiency.
- App is compatible with various operating systems to ensure wide accessibility. Functional both online and offline to accommodate environments with limited internet connectivity.

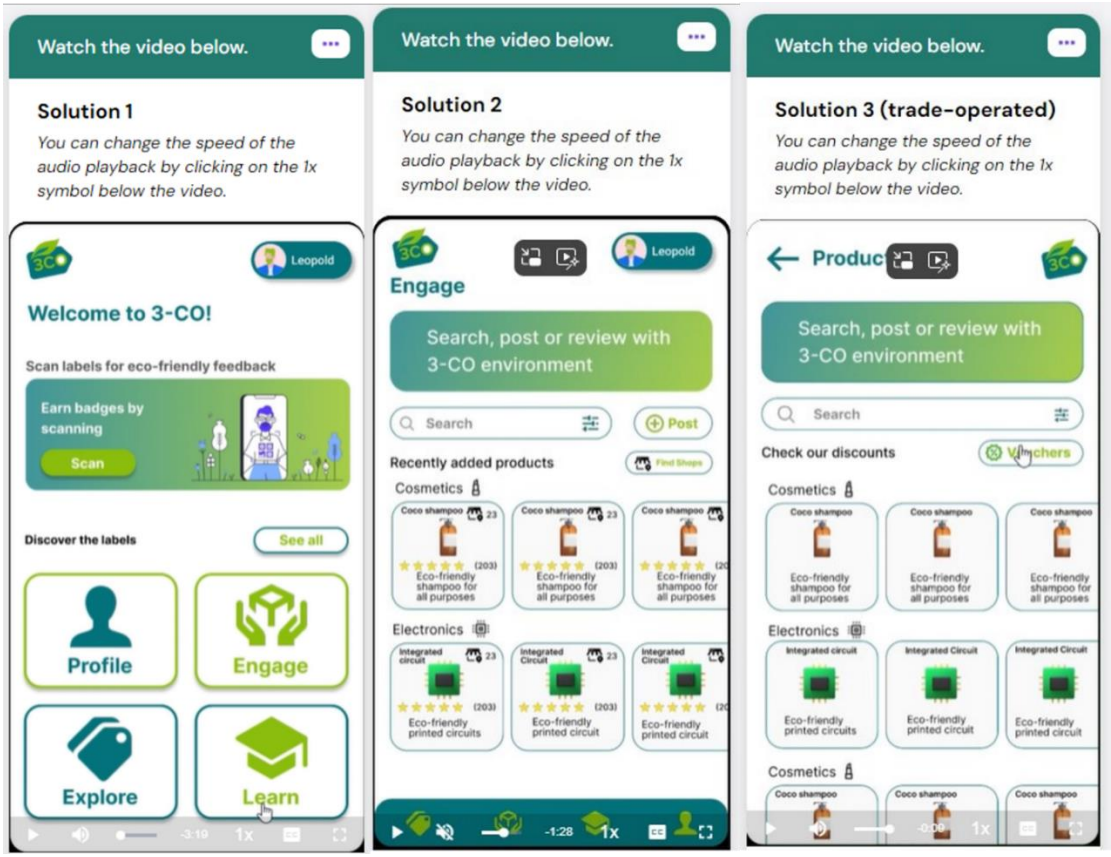
- App includes information on the environmental and health benefits of bio-based products, It features a price comparison tool to help users find the best deals on bio-based products.
- It allows users to read and submit reviews and ratings for products, facilitating community engagement and shared consumer knowledge. It provides promotional offers and discounts to encourage the purchase of sustainable products.
- The app should cover a wide array of certifications and labels, not just the most common ones, to provide a broad spectrum of information. Information should be verified and transparent, possibly backed by reputable organizations to ensure credibility.
- The app should avoid features that do not directly enhance the user's ability to make informed decisions, such as unnecessary advertisements or complicated registration processes.
- The digital solution should ideally be free to maximize accessibility and adoption, possibly supported by governmental or non-profit funding to maintain operation and updates.
- **Gamification:** The focus group revealed a positive attitude towards integrating gamification elements into the digital solution for purchasing bio-based products. The participants expressed that including game-like features, such as points, badges, challenges, and rankings, could make the app more attractive and engaging. They believed that these elements would not only encourage more frequent use of the app but also enhance the educational aspect by making learning about sustainable products more interactive and rewarding. The idea of receiving benefits, such as discounts on organic products, for participating in these gamification features was particularly well-received. The participants felt that such incentives would motivate them to make more conscious purchasing decisions. They stressed, however, that the game elements should be designed to avoid becoming tedious or overly complex, ensuring they add value without detracting from the user experience.

3.3 Digital solution mock-ups – results from consumer evaluation

As a result from the digital concepts visualised by consumers described in the previous section, and the development work conducted in T2.4, three digital solution mock-ups were created for consumers' final evaluation. The process and outcomes of the technical work related to the development are reported in more detail in D2.4. The mock-up evaluation was conducted to assess the consumers' preferences and feedback on three different mobile application designs aimed at supporting sustainable purchasing

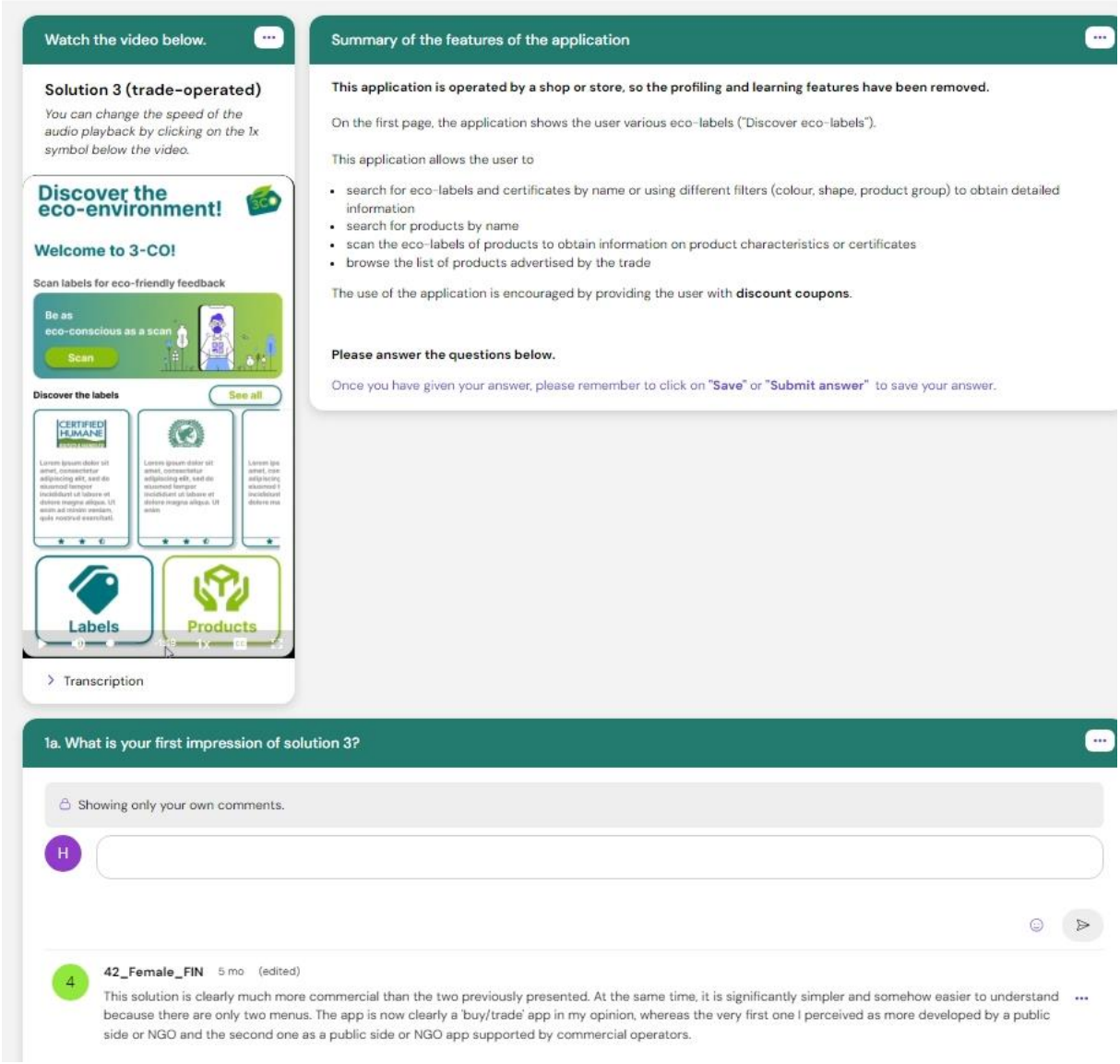
choices. Participants were presented with the mock-ups, labelled as Solution 1, Solution 2, and Solution 3. All the solutions are mobile apps, allowing users to scan eco-labels on products to receive information on product features and certifications. Gamification aspects are used to engage the consumers to frequent use of the app. The ultimate purpose of each is to provide consumers with reliable information on existing labels and product features and to make knowledge-based sustainable purchasing decisions. They differed in additional features, visualisation and the operating model (Solution 3 was operated by a store). The visualisations of the mock-ups is presented in figure 6 below, and the more precise descriptions are presented in D2.4.

Figure 6: Visualisation of digital mock-up solutions



The consumers were presented with the descriptions of each solution in separate pages on Howspace, including a video demonstration of the use of the app, with a voiceover describing the functions of the app in the consumers native language. They were then asked specific questions related to the solutions on the platform. An example of the Howspace-page where the consumers gave their views is presented in Figure 7 below.

Figure 7: An example of the digital evaluation page on Howspace



Respondents provided insights through a series of open questions and surveys, in which they evaluated each solution based on design consistency, usability, necessary features, and clarity of the interface. Participants also suggested improvements and provided feedback on which solution they believed would best help them make more sustainable purchasing decisions. The data collected was synthesized to understand the relative strengths and weaknesses of each solution and to guide the next steps of the development (see table 8 below).

Table 8: Synthesis of evaluation results for each mock-up

Criteria	Solution 1	Solution 2	Solution 3 (Store Managed)
Total User Preference*	52 votes	60 votes	30 votes
Design Consistency	Generally consistent, but some clutter	Highly consistent, clear navigation	Mixed feedback, some layout issues
Readability	Mostly clear, but some text felt overwhelming	Clear, with minor concerns over text size	Adequate, some issues with icon clarity
Icon and Image Clarity	Mostly clear, but icons could be larger	Mostly clear, larger icons suggested	Functional but not visually appealing
Necessary Features	Comprehensive but could use more filtering	Comprehensive, with price monitoring suggested	Missing detailed product comparisons
User Engagement	Strong, with gamification and community focus	High potential, some requests for reviews	Lower engagement, focused on store features
Improvement Suggestions	Simplify interface, reduce text clutter	Simplify interface, improve icon size	Add product comparisons, clarify features
Recommended for Further Steps	Good but behind Solution 2	Best rated solution, chosen for further steps	Limited appeal for wider audience

**Some participants did not indicate their preferred solution*

Solution 1 was appreciated for its wide range of features, including a learning section, gamification, and community participation. However, users felt that it could be overwhelming due to an excess of visible information on each screen. Some suggested that the app could benefit from clearer organization and a reduction of text clutter. Despite these concerns, the app was still seen as highly functional and engaging. Improvements in design clarity and icon size could help make it more appealing to users, but overall, Solution 1 was slightly less favoured compared to Solution 2, which offered a more streamlined experience.

Solution 2 received the highest number of votes and was praised for its well-balanced design, ease of use, and clear navigation. Users found the layout intuitive, with a consistent design throughout the app.

Some areas for improvement were noted, such as making the icons larger and improving visual contrast to ensure greater accessibility. Additionally, users suggested adding price monitoring and more detailed product information to enhance decision-making. Overall, Solution 2 was considered the most user-friendly and effective for promoting sustainable purchasing behaviour, which is why it was chosen for further research and development.

Solution 3 (Store Operated) received fewer votes, primarily because of its limited focus on store operations, which made it less attractive to general users. While the app offered some incentives such as discount coupons and a rewards system, it lacked broader consumer-oriented features like detailed product comparisons and filtering options. Users felt that the app could benefit from more clarity in its layout and a stronger focus on helping consumers make sustainable choices, rather than being overly reliant on store-driven content. Overall, Solution 3 was not favoured for further development.

Based on extensive feedback from respondents, several key recommendations have been identified to enhance the mobile application designed to support consumers in purchasing BBPs. **Solution 2** was selected as the most promising mock-up for further development, receiving the highest rating due to its intuitive design, comprehensive feature set, and ability to aid users in making sustainable purchasing decisions. To refine this solution further, respondents have provided the following suggestions:

User Interface and Design Enhancements

- Respondents consistently recommend streamlining the interface by reducing the amount of text and visible information on each page.
- Participants suggest enhancing the app's visual design by incorporating more striking or varied colours beyond shades of green to make it more modern and attractive.
- Participants recommend improving colour contrast between text and background and using larger fonts to enhance readability.
- Respondents suggest making icons larger and clearer, adding labels or legends to buttons and menus, and changing icon colours to improve visibility and ease of navigation.

Enhanced Product Information

- Respondents express a desire for more detailed product information, including manufacturer details, sustainability certifications, and where to purchase products.
- Participants recommend adding comprehensive product details to help them make more informed purchasing decisions.

- Many respondents request the inclusion of a price comparison feature to see how the cost of sustainable products varies across different stores.

Accessibility Improvements

- Participants suggest adding accessibility features such as voice functionality, a reading function for individuals with visual impairments, or compatibility with screen readers to make the app more inclusive.
- Respondents recommend adding a QR code scanner or the ability to scan product labels using the camera for quick and easy information retrieval.
- Participants suggest expanding language options to include other languages to cater to a broader audience.

Navigation and Usability

- Respondents recommend introducing a home screen with a menu of large icons, more shortcuts to different features, and a clearer menu structure to make navigation more intuitive.
- Participants suggest simplifying the user interface by removing unnecessary functions, pop-ups, and gamification elements that might distract from the app's primary purpose.

Participant Engagement and Community Features

- Participants recommend adding features like product reviews and recommendations to foster a community of informed consumers.
- Respondents suggest connecting the app to social media platforms to enhance engagement and sharing capabilities.
- Participants recommend allowing individuals to leave comments or feedback within the app to improve engagement and provide valuable insights for continuous improvement.

Content and Information

- Respondents emphasize the importance of providing reliable and verified information and suggest manual checks by staff to maintain accuracy.
- Participants want a clear distinction between user-generated content and information added by companies or advertisers to maintain transparency.
- Participants recommend positioning educational content so it doesn't overwhelm the main functionalities.

Customization and Personalization

- Some participants desire the ability to customize app features such as avatars and colour schemes to personalize their experience.

Rewards and Gamification

- Respondents prefer tangible rewards like discounts for eco-certified products over in-app badges or games.
- Participants recommend either improving the gamification aspects to be more engaging or removing them if they do not add significant value.

Technical Considerations

- Participants expect the app to run smoothly without lag or technical issues.
- Given their willingness to provide personal information, respondents expect their data to be handled securely.

Generally, users are seeking a streamlined, user-friendly, and visually appealing application that provides comprehensive product information and supports informed, sustainable purchasing decisions. Key improvements focus on simplifying the interface, enhancing accessibility features, and adding functionalities like price comparisons and product reviews. Users value quick access to reliable information, personalized experiences, and features that facilitate engagement with both the app and the wider community. By implementing these recommendations, the app can better meet user needs, encourage wider adoption among consumers interested in bio-based products, and strengthen its position as a valuable tool for sustainable shopping.

Based on the survey responses from participants regarding their general preferences for a mobile application designed to support consumers in purchasing bio-based products, several key insights emerged in the areas of colour schemes, layout design, filtering methods, and gamification features.

- Participants showed a preference for a colour combination featuring both green and blue for the main buttons, with the option of a green frame and blue icon being the most favoured. Overall, there was a slight inclination towards the colour blue over green.
- When it came to product layouts, preferences were nearly evenly split between horizontal lists (inside boxes) and vertical lists. However, a significant majority preferred having certifications displayed inside boxes rather than without boxes.
- Most users favoured selecting filters for labels—such as shape, colour, or product category—all at once, rather than by clicking on pop-ups. This suggests a desire for a more streamlined and efficient filtering process.

- Scanning labels from product packaging using the application was the most favoured activity for earning points that can be exchanged for rewards. Other activities like buying products with eco certificates and playing in-built games were also popular but to a lesser extent. Suggesting new products to add to the app was the least preferred activity.
- An overwhelming majority of participants preferred to exchange their points for discounts on the purchase of eco-certified products. Other reward options, such as customization of app features, built-in games, in-app badges, and fun facts within the app, were less popular among respondents.
- A strong majority of users were willing to log in to the app by providing basic personal information like their name and email address. Only a small number of participants were unwilling or uncertain about providing this information.

Finally, the consumers were asked to disclose whether they think this kind of an application would support them in making more sustainable purchasing choices and how likely they would use this kind of an application to support sustainable shopping at stores. The majority of respondents (86%) indicated that the application would support them in making more sustainable purchasing choices (as illustrated in figure 8), while the average value for evaluating the likelihood of using such an app while shopping on a scale from 1 to 7 was 5,2 (results illustrated in figure 9). These promising results indicate that the digital solution being developed in the 3-CO project has the potential to enable sustainable consumption by supporting consumers in making more conscious purchasing decisions.

Figure 8: Application in supporting sustainable purchasing choices

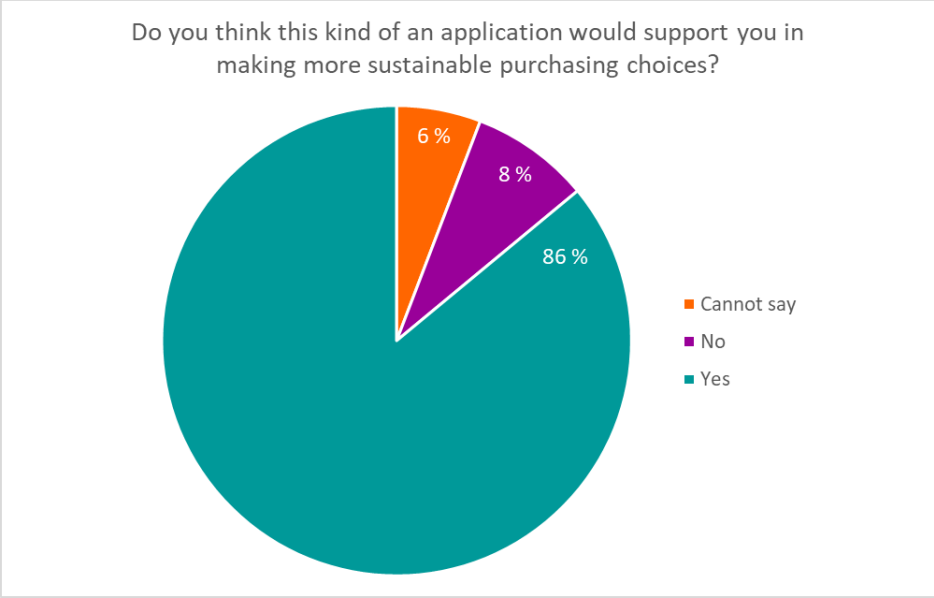
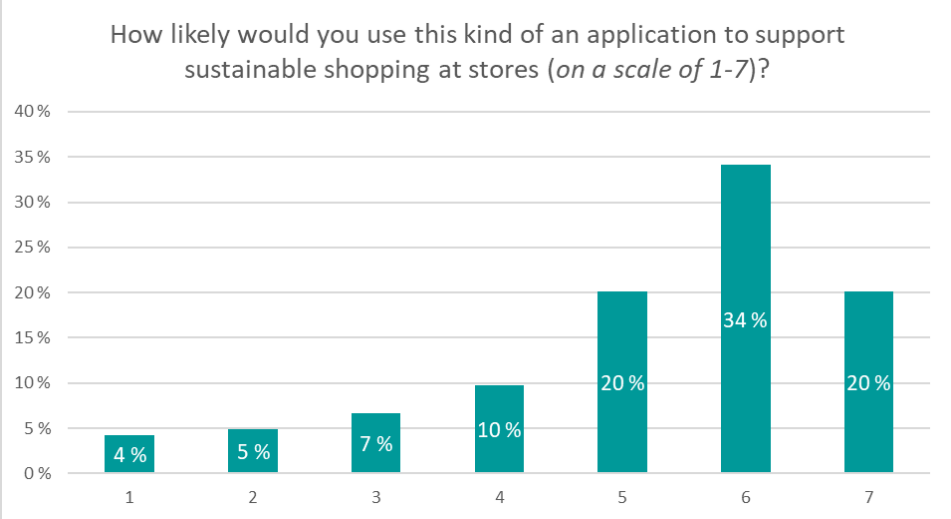


Figure 9: The likelihood of using the app to support sustainable shopping



4 Conclusions and final remarks

The results of the empirical study reported in this deliverable offer valuable insights into consumer priorities and preferences regarding labels and digital smart solutions in supporting responsible consumption. The consumers call for improved clarity of labels and enforced certification standards, to enhance the credibility of LCSs. Emphasis should be put on increasing consumer education on BBPs in general, but also on increasing the visibility and availability of BBPs in retail environments. As the high price of BBPs is a concern for consumers, addressing it should be considered by offering subsidies or incentives for manufacturers. The results also confirmed the need for a digital solution to support consumers in making informed, sustainable purchasing decisions. Furthermore, our results provide important input to digital smart solutions, which could simultaneously be utilised to inform and also refine the development of the DPP that the EU is currently working on. Specifically, our findings highlight the types of information consumers expect from such solutions, including data from value chains. However, consumers also revealed potential barriers, such as information overload or difficulties in interpreting complex data, which the DPP could address to enhance usability. Notably, the strong preference for detailed environmental data underscores growing consumer demand for transparency. Furthermore, our findings suggest that consumers are open to digital solutions that go beyond mere compliance. Features like personalized recommendations, gamification, or integration with apps could significantly increase consumer engagement and broaden the appeal of such tools.

The results reported in this deliverable have an important role in supporting the next phases of the project and the overall goal of 3-CO – developing and demonstrating the viability of a supportive framework for LCSs on B2C communication for industrial BBPs that enables and supports consumers to make more sustainable purchasing choices. T2.3 will contribute to this goal by providing the consumer viewpoint to the label design guidelines for LCS owners, to be developed in WP4 of the project. The guidelines will address different stakeholder requirements for the transparency of BBPs to support the design of bio-based labels that improve the responsible decision-making processes of consumers and improve the sustainability performance and competitiveness of bio-based systems. Moreover, the extensive empirical data collected in T2.3 will be utilized in several publications, including scientific papers.

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Annex A: Sample descriptions

CAWI

Age/Gender		Country										Total
		BE	DK	FI	FR	DE	IT	NL	PL	ES	UK	
18-24 years	M	15	19	10	8	4	5	2	14	10	12	99
	F	14	10	19	15	15	14	29	12	20	12	160
	ALL	29	29	29	23	19	19	31	26	30	24	259
25-34 years	M	26	18	27	20	21	26	21	15	20	26	220
	F	18	32	20	24	24	13	21	31	21	27	231
	ALL	44	50	47	44	45	39	42	46	41	53	451
35-44 years	M	26	27	26	22	23	19	23	33	20	21	240
	F	24	17	20	28	24	26	22	27	32	28	248
	ALL	50	44	46	50	47	45	45	60	52	49	488
45-54 years	M	20	20	25	21	31	30	32	24	37	29	269
	F	30	31	21	27	19	28	22	26	23	26	253
	ALL	50	51	46	48	50	58	54	50	60	55	522
55-64 years	M	23	29	24	28	30	26	27	19	26	22	254
	F	28	19	26	22	27	28	25	29	22	25	251
	ALL	51	48	50	50	57	54	52	48	48	47	505
65+ years	M	39	36	36	38	44	40	45	42	35	41	396
	F	37	42	46	47	38	45	31	28	34	31	379
	ALL	76	78	82	85	82	85	76	70	69	72	775
Total	M	149	149	148	137	153	146	150	147	148	151	1478
	F	151	151	152	163	147	154	150	153	152	149	1522
	ALL	300	300	300	300	300	300	300	300	300	300	3000

FGDs

Country Age/Gender		FI	PL	NL	ES	Total
18-35 years	M	1	4	1	0	6
	F	4	3	1	0	8
	ALL	5	7	2	0	14
40-55 years	M	1	3	3	2	9
	F	3	4	2	2	11
	ALL	4	7	5	4	20
Total	M	2	7	4	2	15
	F	7	7	3	2	19
	ALL	9	14	7	4	34

Mock-up evaluation

Country	Female	Male	TOTAL
SPAIN	**26**	**26**	**52**
FINLAND	**28**	**29**	**57**
NETHERLANDS	**16**	**28**	**44**
POLAND	**17**	**15**	**38**
Total	**87**	**98**	**191**

Annex B: An example of a MURAL whiteboard for FGDs