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### Authors

**Name**

Alessandro Cascavilla  
Annarita Colasante  
Teresa Turzo

**Organisation**

UnitelmaSapienza  
UnitelmaSapienza  
UnitelmaSapienza

**Email**

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- ☐ **DEM** Demonstrator, pilot, prototype
- ☐ **DEC** Websites, patent fillings, videos, etc.
- ☐ **Other**

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**Internal reviewer(s)**

| Name                     | Organization | Email |
|--------------------------|--------------|-------|
| Lucía González Monjardin | CETAQUA      |       |

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## **Publishable executive summary**

The current report outlines all the activities performed to conduct the socio-economic analysis to adapt existing certification schemes based on stakeholders' needs. Some of the key stakeholders defined at the beginning of the project (i.e., consumers and industries) have been involved in two rounds of the Delphi survey to assess their preferences and necessities in terms of certification schemes requirements.

The continuous communication between stakeholders and the BioReCer communities constitutes a pivotal point also for the socio-economic analysis described in the current report. Indeed, the main goal of the analysis was to identify a new requirement that can be incorporated into the existing certification scheme. To reach this goal, we collected the opinions of: stakeholders already registered in the Bioresources Stakeholder Platform (BRSP) who are aware of both the main objectives and the main achievements of the project; experts in the field of circular and bioeconomy who have a strong background also in terms of certification schemes and their importance; consumers across 4 European countries who do not have previous information regarding the BioReCer project. All these stakeholders were involved in various activities to both validate the importance of certification schemes and offer suggestions for their further improvement.

The main results collected provide an interesting picture. Firstly, the stakeholders' needs align with the Green Deal's main goal: reducing carbon emissions by 2030. Indeed, consumers and industries agreed to add a new requirement to the existing certification scheme to measure emissions. Secondly, we assessed the positive and significant impact on consumers' willingness to pay for bioproducts when they are certified. This is an important hint that is in line with the main objective of the BioReCer project, which is to guarantee the traceability of the whole value chain and to increase the consumers' acceptance of such products.

The results collected so far will serve as feedback to develop a complete set of guidelines for standardization as a roadmap for the integration of the BioReCer assessment framework in current certification schemes. Furthermore, these results can be considered to further explore consumers' acceptance of bioproducts and the role of certification in shaping their attitudes and purchase intentions (PI).

# 1 Introduction

## 1.1 Stakeholders' involvement in the Sustainability Certification Scheme

Certification Schemes help users to assess whether a product or service complies with specific criteria. The International Organization for Standardization (ISO) defines certification as “the provision by an independent body of written assurance (a certificate) that the product, service or system in question meets specific requirements”.<sup>1</sup> Sustainable Certification Schemes could improve sustainability awareness of users, especially consumers, by providing environmental and social performances of the products they are willing to buy. In turn, consumer purchase decisions will shape, in turn, industries' and governments' decisions to improve their social and environmental performances (Acosta, 2014). Hence, consumers' behaviour is crucial to determine the “success” of sustainable Certification Schemes (see, for instance, Huertas et al., 2010).

Even if the positive effects of Certification Schemes are quite obvious, there is a debate in the literature about the real benefits. Some authors argue that the increasing number of Certification Schemes could lead to lower confidence among stakeholders, resulting in lower acceptance and confusion (see, for instance, Scarlat and Dallemand, 2011). Furthermore, since different Certification Schemes consider several requirements, this could lead to a loss of performance standards and a lack of reliability.

To shed light on the overall positive impact of Certification Schemes adoption, Barry et al. (2012) considered four specific sectors (i.e., agriculture, forestry, fisheries and aquaculture) and they conducted a critical review in which the positive impact of Certification Schemes on social, environmental and economic indicators has been highlighted. Such benefits go through positive changes in management systems and production practices (e.g., reduction of pesticides and herbicides used in certified organic farms has a direct positive environmental impact on regional biodiversity).

One of the key aspects to have a high-quality Sustainable Certification Schemes is the stakeholders' engagement and cooperation in the developing, monitoring and reviewing phases (ISEAL Alliance, 2013; Mori Junior et al., 2015). This also constitutes a strength for the BioReCer project: the creation of the Bioresources Innovation Ecosystem (BRIE) living-lab (LL) and the BioResources Stakeholders Platform (BRSP) as a pillar of the LL allowed for a continuous interaction with stakeholders. In fact, multiple group activities to identify the needs of the key actors and transfer and disseminate the knowledge generated in the project have been organized since the launch of the project. One of the most

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<sup>1</sup> <https://www.iso.org/certification.html>

challenging objectives of the project was to create consensus about new requirements developed in the BioReCer framework to be incorporated into the existing certification schemes. To reach this goal, several activities with stakeholders have been carried out. The detailed description of the activities as well as of the results will be provided in Sections 3, 4 and 5 of the current document.

## 1.2 Main goal of the socio-economic analysis

The aim of the socio-economic analysis conducted in the framework of Task 3 (of the WP4) was to identify the most valuable requirement useful for the adaptation of the existing certification schemes according to consumers' and industry's needs. The summary of this socio-economic analysis will serve to draw a set of guidelines for standardisation with the final goal of integrating the BioReCer assessment framework in certification schemes.

We have structured the activities to collect the opinions of different stakeholders in order to have a 360-degree view of the foremost requirement to be added. To gather the opinion, we deployed different tools.

The Delphi survey is a qualitative analysis deployed to find a consensus among people with divergent or conflicting opinions. In this phase, we involved both industries (representing the supply side) and consumers (representing the demand side) regarding the new requirement to be added to the existing certification schemes. Based on the cross-comparison of different existing certification schemes in the framework of WP2, a list of requirements that could be integrated into the Sustainable Certification Schemes was identified. We selected 7 of these requirements, prioritizing those not yet covered by existing certification schemes, considered measurable, and relevant across environmental, social, and economic pillars. Then, we submitted them to relevant stakeholders by means of a Delphi survey. Section 2.2 provides a detailed explanation of the selection process. At the end of the two rounds of the survey, we observed a stakeholders' convergence on the following requirement: "The company measures its carbon emissions and has established a reduction plan".<sup>2</sup> Section 3 is devoted to the detailed description of data collection and the main results obtained.

The Analytic Hierarchy Process (AHP) is a quantitative tool useful to identify a list of priorities through pairwise comparisons. In particular, we involved a group of experts in the field of bioeconomy and sustainability to assess their opinion about the most important requirement. This exercise was useful for comparing the experts' point of view with the consumers and industries opinions. In a sense, we aim to compare what ought to be according to the "theory" and what the market needs. The AHP analysis provides an

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<sup>2</sup> The list of all requirements is provided in Section 2.2.

interesting result: experts' evaluation matched with the stakeholders' point of view. An exhaustive analysis of the results is provided in Section 4.

Finally, we analysed the opinion of a wider set of consumers who were (presumably) not aware of the BioReCer project before participating in the study. By means of an experiment, we collected their feedback to assess the validity of the certification schemes in fostering the acceptance of bioproducts. In particular, we designed an innovative experimental design to elicit consumers' willingness to pay for specific products that are strictly related to the BioReCer case studies (CSs). We focused on the potential impact on consumers' acceptance, considering two certification schemes: International Sustainability and Carbon Certification (ISCC PLUS) and Roundtable on Sustainable Biomaterials (RSB). Results show that the presence of certifications positively influences consumer preferences across all product categories (e.g., shampoo, cosmetic cream, fertilizer). Certification consistently increases both willingness to pay (WTP) and purchase intention (PI), confirming its effectiveness as a signal of trust and environmental value. In fact, consumers seem to be willing to pay more and are more likely to buy certified bio-based products compared to uncertified ones. Moreover, the results show the role of certifications in reducing the perceived risks of consumers, since certified bioproducts are consistently associated with lower levels of performance, health and environmental risks when compared to both conventional products and bioproduct alternatives. The description of the procedure, as well as the main results, is described in Section 5.

### 1.3 Contribution of the socio-economic analysis to the project

All the activities undertaken in the framework of Task 3 significantly contributed to the achievement of the general objectives of the projects as well as to specific objectives (SO). In particular:

- SO3: "To integrate the environmental and T&T assessment framework (SO2) into established biological resources' certification schemes."<sup>3</sup>

The specific contribution coming from the relevant stakeholders and, hence, from the BRSP, is the involvement of both industries and consumers to align their needs to be represented by an additional requirement to be included in the existing certification scheme. To achieve this goal, we organised different activities (e.g., Delphi survey, AHP), and the results coming from these activities will feed into the preparation of the guide on practical integration of the BioReCer environmental and traceability assessment framework into established biobased certification schemes.

- SO4: "To validate the developed impact assessment framework in 4 case studies representing the main incipient bioproduct supply chains in Europe".

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<sup>3</sup> Notice that T&T stands for Tracking and traceability

To accomplish this objective, we involved the stakeholders in the key regions related to the CSs in the activities described so far (i.e., Delphi survey, AHP and Experiment), the stakeholders in the key regions related to the CSs. The feedback collected in such group tasks will guarantee the quality of the certification schemes.

- SO6: "To maximize outreach and beneficial influence of the project results and reach the target users (primary producers, trade bodies, bioproduct industries, certifiers, local distributors, retailers, consumer organisations and local public authorities) through an effectively established communication and dissemination plan, including innovative training capsules."

To reach this goal, after the initial step consisting of creating a community of stakeholders (BRSP), the community needs to be kept alive by organizing different activities to gather and provide feedback. In particular, after gathering consumers' and industries' opinions about requirements, we presented the obtained results in a virtual workshop. Other activities are being organized and will continue to be organized until the end of the project, also in the framework of other WPs.

To carry out all the actions described above, almost all BioReCer partners were involved either directly contacting stakeholders or supporting UNITELMA in the set-up of the activities.

## 2 Requirements identification

A certification scheme is a structured framework that establishes the conditions for an entity to be certified according to a specific standard. Every certification scheme comes up with a set of requirements, criteria, and indicators. Requirements represent the obligations that an entity must fulfil to obtain and maintain certification. These obligations may be procedural, technical, or documentary in nature. Criteria correspond to the specific conditions or objectives that must be achieved to demonstrate alignment with the scope of the standard. Indicators are measurable parameters used to evaluate whether the established criteria have been met. For instance, with reference to ISCC PLUS and in relation to traceability, certified entities are required to implement a mass balance system that ensures the alignment of input and output quantities of sustainable materials. They must also maintain accurate and auditable records of all transactions and supply chain steps, and provide supporting documentation that connects each batch of material to its certified origin. These requirements are designed to operationalise the traceability criterion and to ensure that claims made about the sustainability of bioproducts are both verifiable and credible.

### 2.1 Synthesis of the desk analysis conducted in the framework of WP2

The first goal of the overall activities described in Task 3 was to identify specific requirements that meet the needs of both consumers and industries. To this extent, we selected a list of requirements to be assessed by stakeholders: the requirements identification process was based on the desk analysis carried out in the framework of WP2 (Task 2.2). Indeed, the desk analysis provided us with a list of both sustainability and circularity requirements that served as a base to select the requirements that have been finally brought to the attention of consumers and industries.

The starting point of the desk analysis was the previously explored Material Flow Analysis (MFA) of European biological feedstocks that were useful for identifying limitations in tracking by-products due to their smaller quantities compared to fossil fuel counterparts. Once the MFA was outlined, the activities carried out in the framework of Task 2.2 aimed at addressing gaps in existing documentation for creating sustainability and circularity frameworks applicable to certification schemes. To identify the list of requirements, certification schemes, European directives, standards, and initiative reports, a list of requirements has been reviewed (see Deliverable D2.2 for more details).

Considering the multidisciplinary feature of BioReCer, the principles, criteria, and requirements of certification systems have been identified using a bottom-up approach. Following this method, the first step was the definition of the consortium's requirements along with relevant actions from the collection of various documents. The selection of

requirements was continuously under assessment with the incorporation of documents, as well as a filtering process considering the results from bibliometric analysis. The final selection was based on both: i) an automatic tool that did not include requirements that were not considered in at least in 10% of the certification schemes under study; ii) a validation using the BioReCer case studies and the creation of an expertise panel inside WP2. The filtered requirements were then validated through a questionnaire sent to case study leaders and relevant stakeholders.

The bottom-up process ended up with: a total of 42 sustainability requirements based on 4 principles (i.e., Protection of ecosystems, Safe and sustainable use of resources, Business models and value creation, Working conditions and society) and 16 circularity requirements based on 6 principles (i.e., Elimination of waste and pollution, Systems thinking and business model, Social procurement, Availability of resources by keeping them at their highest value and utility at all times, Protect and contribute to the resilience and regeneration of natural capital, Value creation).

## 2.2 Gap analysis to identify the list of requirements for the Delphi survey

The requirements to be included in the Delphi survey were initially drawn from the file Annex A of Deliverable D2.2, which contains the above-mentioned sustainability and circularity requirements across environmental, socio-economic, and social pillars. To narrow down this extensive list, we applied a specific filter based on the “Number of times considered on certification schemes”. Requirements with a value of zero for these items have been selected, indicating that these were not currently referenced in existing certification schemes and, thus, represented requirements that could be considered for potential inclusion. This initial selection ensured the focus on requirements that are not yet integrated into current frameworks.

Subsequently, the preliminary list was refined with the assistance of MEO Carbon Solution (MCS). Their expertise was needed to prioritize requirements that were more measurable, aligning with the need for clear criteria in certification processes. Before finalizing the requirements list for the Delphi survey, a further alignment was sought with colleagues from Universidad de Santiago de Compostela (USC) to ensure consistency and relevance. During this exchange, several key points were addressed:

1. **Validation of selected requirements:** USC collaborated in understanding the requirements and adapting their language for easier understanding.
2. **Classification of requirements:** USC and CETAQUA provided insights into the categorization of the requirements as mandatory/basic or advanced, aiding in their contextual understanding and prioritization.

3. **Clarity and accessibility of requirements:** to improve participant comprehension, USC suggested rephrasing some of the requirements to make them shorter and clearer. These revisions were incorporated to ensure that the logic and intent of each requirement were easily understood.

Once this feedback was included, and in line with the principles of sustainability and circularity across environmental, economic, and social pillars, the final list included the following 7 requirements:

1. *"The company measures its carbon emissions and has established a reduction plan."*
2. *"The company promotes the use of materials with a biobased origin."*
3. *"The company allocates resources to research and develop circular economy strategies within its value chain."*
4. *"The company achieves goals of reduction or substitution of resources."*
5. *"The company can demonstrate that its products have comparable characteristics and quality to its conventional counterpart."*
6. *"The company has defined strategies to promote a systems thinking of processes and the analysis of material loops."*
7. *"The company has programmed training activities for workers in order to tackle the specifics of circular technologies and/or strategies."*

This rigorous selection process ensured that the requirements to be evaluated in the Delphi survey were both innovative and not even cited in documents, addressing the gaps in existing certification schemes and maintaining a balance across sustainability and circularity requirements. Once the requirements were identified, we also conducted a desk analysis to define potential drivers and barriers for the selected requirements. The list of drivers and barriers is presented in Section 3.2.

## 3 Delphi survey

### 3.1 Theoretical foundation about what Delphi is and how the Delphi survey works

The Delphi survey method is a systematic research technique used to gather and refine expert opinions through multiple rounds of structured feedback (Hasson et al., 2000). Originally developed by Dalkey and Helmer (1963) for technological forecasting, it has been applied in various fields, including business, healthcare, and social sciences. According to Belton et al. (2019, p. 73), "The Delphi procedure is defined by four basic principles: anonymity, iteration, controlled feedback of responses to all group members, and statistical aggregation of individuals' responses." These principles ensure that experts can freely express their opinions without external pressures, progressively refine their views based on structured feedback, and collectively reach a well-informed consensus.

The Delphi survey method typically involves multiple rounds of surveys, where a panel of selected experts evaluates specific issues or forecasts future trends. In each round, responses are collected, aggregated, and shared anonymously with the participants, who then can reconsider their initial opinions in light of the collective input of the group (Beiderbeck et al., 2021). This process continues until a convergence of views is reached, indicating a stable consensus or a clear delineation of differing perspectives. Unlike traditional group decision-making methods, such as focus groups or brainstorming sessions, the Delphi method prevents the dominance of certain individuals, reduces the risks of groupthink, and allows for a more objective synthesis of expert knowledge (Belton et al., 2019). Moreover, "The Delphi is therefore an iterative multistage process designed to combine opinion into group consensus," (Hasson et al., 2000, p. 1009), making it particularly useful in scenarios where empirical data are scarce and expert judgment is required.

One of the main advantages of the Delphi survey method is its flexibility, as it allows researchers to structure surveys in various formats, including qualitative open-ended questions and quantitative Likert-scale assessments (Belton et al., 2019). Since experts are not required to meet in person or interact with each other, the method is particularly effective for involving experts based in different countries (Beiderbeck et al., 2021).

Despite its benefits, the Delphi survey method presents several challenges. Selecting a panel of experts who possess the appropriate level of knowledge is essential, as including individuals with inadequate expertise can undermine the reliability of the results (Hasson et al., 2000). Additionally, if the panel lacks diversity, the study may be biased toward a particular perspective, limiting the generalizability of the findings. Another challenge is participant attrition, which can occur across multiple rounds and affect the

stability of the conclusions (Belton et al., 2019). Researchers must also define clear criteria for establishing consensus, as there is no universally accepted threshold. Depending on the study objectives, they may rely on statistical measures such as median rankings, interquartile ranges, or percentage agreement (Hasson et al., 2000).

A Delphi survey follows three main phases: preparation, execution, and analysis (Beiderbeck et al., 2021). The preparation phase lays the foundation for a successful study and begins with a clear definition of the research objectives, which guide the selection of experts and the formulation of the survey questions. Researchers must then identify and recruit a panel of experts who have in-depth knowledge of the subject matter. The selection criteria should ensure that participants bring diverse perspectives to enhance the reliability of the results. Once the panel is formed, the next step is designing the initial questionnaire. This requires a thorough literature review and, in some cases, preliminary expert consultations to refine the research questions (Belton et al., 2019). The questionnaire should be structured to allow both quantitative assessments (e.g., Likert scales) and qualitative insights (e.g., open-ended questions) to capture a comprehensive understanding of the topic (Beiderbeck et al., 2021).

The execution phase consists of multiple rounds of data collection, where experts evaluate predefined statements or questions. In the first round, participants provide their independent assessments. Their responses are then aggregated and analysed to identify emerging patterns (Hasson et al., 2000). In subsequent rounds, participants receive controlled feedback, which includes statistical summaries of the group's responses as well as qualitative comments (Beiderbeck et al., 2021). They are then invited to reassess their initial judgments, considering the perspectives of their peers. This iterative process continues until a predefined stopping criterion is met. The study can conclude once a sufficient level of consensus is reached or when responses stabilize across rounds (Hasson et al., 2000).

The final phase, analysis, involves interpreting the collected data and drawing meaningful conclusions. If necessary, researchers may apply advanced analytical techniques, such as sentiment analysis, clustering, or scenario modelling, to extract further insights (Beiderbeck et al., 2021).

### 3.2 Stakeholder selection and preparatory phase

The final aim of the Delphi survey in the framework of Task 3 is to identify consumers and industries requirements to be incorporated in the certification scheme. As explained in the previous sub-sections (3.1), Delphi survey is a powerful qualitative method to assess stakeholders' opinion and to find an agreement among them based on multiple (indirect) interactions. To achieve our goal, in the study we solely involved two stakeholders

categories, named consumers and industries. We ran two rounds of the survey to identify stakeholders' opinions about the most important requirement to be added in the certification scheme.

As extensively described in Deliverable D4.1, BioReCer is constantly in contact with relevant stakeholders thanks to the BRSP, and, also for running this kind of analysis, we got in contact with them. Indeed, once we identified the list of requirements following the process described in Section 2.2, we invited the stakeholders to take part in the study. In September 2024, the BRSP included 99 of stakeholders and we classify them according to both their role and to their country of origin. The percentage of stakeholders belonging to different categories is shown in Figure 1.

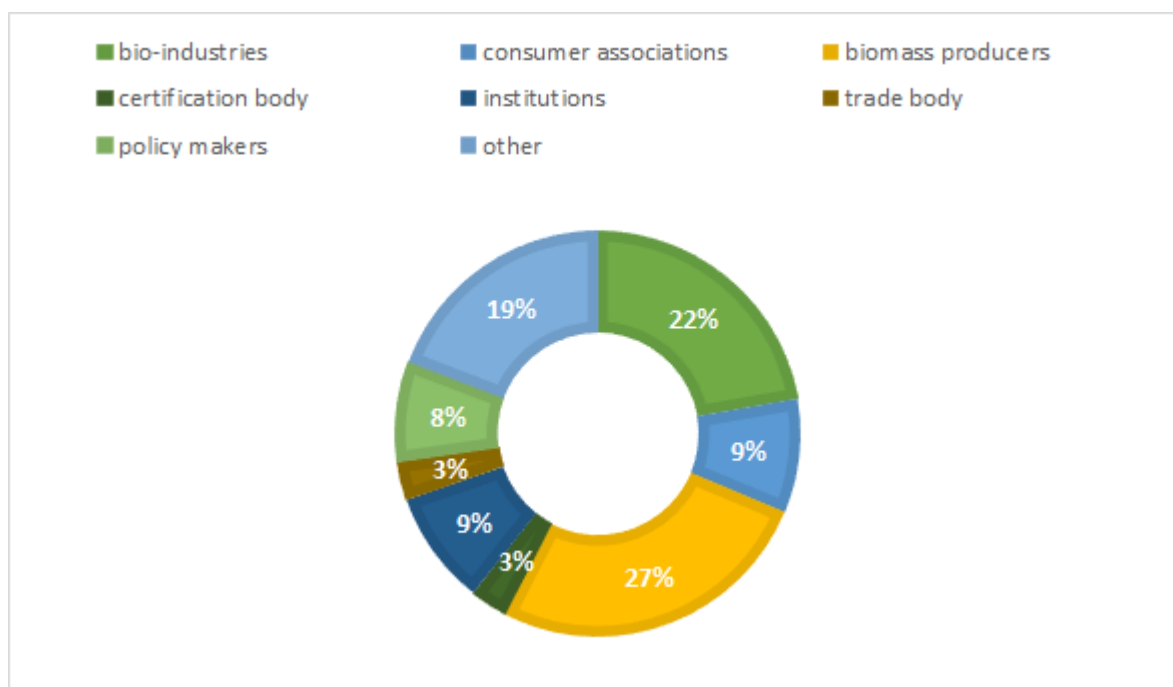


Figure 1. Number of stakeholders registered in the BRSP belonging to each category.

Once the stakeholders list was defined, the case study leaders were involved, firstly, to translate the whole questionnaire in their languages and, secondly, to help in reaching the selected stakeholders. Since the distribution of both consumers and industries was heterogeneous across countries, CS leaders were also tasked with spreading the questionnaire to other potential stakeholders in order to maximize the number of respondents.

The Delphi survey consisted of two rounds. As explained in Section 3.1, the aim of the first round was to collect respondents' personal opinion about the topic whereas the goal of the second round of the survey was to find an agreement among respondents. To this extent, in the second round the average responses collected in the first round were presented. Figure 2 presents an overview of the main structure of the Delphi Survey we carried on.

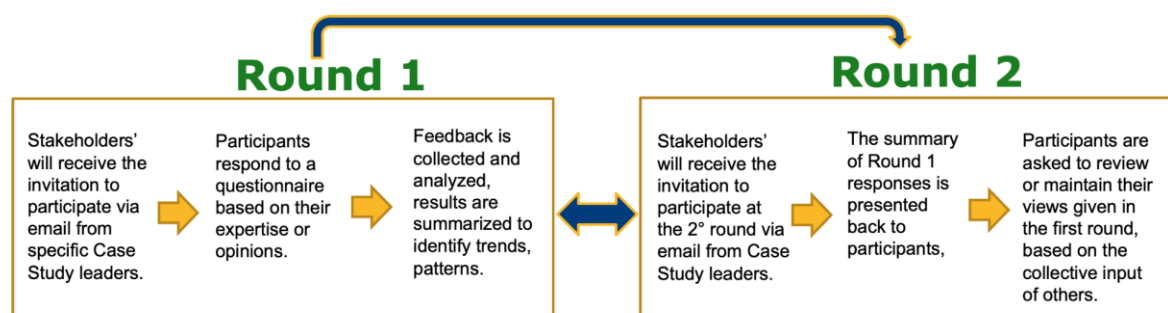


Figure 2. Overview of the Delphi survey conducted to grasp consumers and industries opinion about a new requirement to be introduced in the existing certification schemes.

The questionnaire we deployed for the Delphi survey was structured as follows: for each of the selected requirements (see Section 2.2 for more details), we ask them to

1. rate, on a 10 point-value scale, the importance to introduce that requirement in existing certification scheme;
2. rate, on a 5 point-value scale, the importance of the identified barriers for the potential inclusion in the certification schemes;
3. rate, on a 5 point-value scale, the importance of the identified drivers for the potential inclusion in the certification schemes.

Table 1 shows the list of requirements, barriers and drivers.

Table 1. List of requirements, barriers and drivers for which we ask stakeholders' opinion in the Delphi survey

| Requirements                                                                                                                        | Barriers                                                                    | Drivers                                                                                              |
|-------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|
| <b>Requirement n.1:</b> The company measures its carbon emissions and has established a reduction plan.                             | Presents high implementation costs                                          | Boosts corporate public image (reputation) and brand value                                           |
| <b>Requirement n.2:</b> The company promotes the use of materials with bio-base origin.                                             | Adds complexity to existing processes and management systems                | Provides a competitive advantage over companies who are not compliant with this specific requirement |
| <b>Requirement n.3:</b> The company allocates resources to research and develop circular economy strategies within its value chain. | Involves ongoing costs to maintain compliance with the specific requirement | Attracts investment from capital providers (investors) with a higher commitment to sustainability    |

|                                                                                                                                                                 |                                                                                                                                                |                                                                                                               |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|
| <b>Requirement n.4:</b> The company achieves goals of reduction or substitution of resources.                                                                   | Compliance with the requirement may lead to an increased price for consumers                                                                   | Improves the quality and the safety of products offered, ensuring consumer protection.                        |
| <b>Requirement n.5:</b> The company can demonstrate that its products have comparable characteristics and quality to its conventional counterpart.              | Consumers may not easily recognize the benefits in terms of health, safety, and ethics generated by the compliance to the specific requirement | Promotes responsible innovation and new products and processes development                                    |
| <b>Requirement n.6:</b> The company has defined strategies to promote a system thinking of processes and the analysis of material loops.                        | Adds to the administrative burden of compliance/Requires extensive documentation                                                               | Promotes more efficient use of resources                                                                      |
| <b>Requirement n.7:</b> The company has programmed training activities for workers in order to tackle the specifics of circular technologies and/or strategies. | Challenges in ensuring compliance along the whole supply chain                                                                                 | Leads to long-term cost savings for the industry and, hence, has the potential to reduce prices for consumers |

The distribution of the questionnaire was originally scheduled in M22 (July, 2024). Based on the brainstorming during the monthly meetings with both WP4 and WP2 members we realized that the Delphi survey methodology and its scope could not be easily understood by all the involved stakeholders. For this reason, we decided to present and explain how it works during the event with stakeholders organized in the framework of the 3rd Project Coordination meeting that was held in Milan from October 1st to 3rd 2024.<sup>4</sup> We launched the first round of the survey just after the event by sending to the stakeholders a link to open the survey on the platform Qualtrics<sup>5</sup>. The survey was translated in Spanish, Italian, Greek, and Swedish to improve the understanding of the text.

Each stakeholder involved in the survey had 15 days to answer the questionnaire. Once we collected the results from the first round we analyzed them and shared them with the stakeholders in a virtual meeting (see Section 3.4 for a detailed description of the event). For each stakeholder category (i.e., consumers and industries), we identify the

<sup>4</sup> [https://biorecer.eu/wp-content/uploads/2024/09/24-09-12\\_biorecer\\_agenda\\_3.pdf](https://biorecer.eu/wp-content/uploads/2024/09/24-09-12_biorecer_agenda_3.pdf)

<sup>5</sup> <https://www.qualtrics.com>

requirement that was chosen from the majority of the respondents. This information was used to prepare the second round of the survey in which respondents could see the most selected requirement and decide if they finally stick with the majority or not. Also, for the second-round, stakeholders had 10 days to send their response back. The detailed results of the two rounds of the Delphi survey are described in Sections 3.3 and 3.5, respectively.

### 3.2 First round: results

We delivered the questionnaires, translated in the national language, to both industry representatives (16 participants) and to a group of consumer representatives (40 participants) in each of the 4 countries.<sup>6</sup> We collected a total 56 responses and Figure 3 shows the number of respondents per country.

Based on participants' responses, we analyzed the ranking of importance of the requirements for both consumers and industries. The ranking is based on the respondents' answer to the question: "Please rate on a scale from 1 (not at all) to 10 (a great deal) how much you think it is important to include the following requirement in the existing certification schemes".



Figure 3. Summary of the answers to the first round of the Delphi survey for each country and each stakeholder categories.

Regarding the consumers from Italy (IT), Spain (ES) and Sweden (SE), the most voted requirement was: "The company measures its carbon emissions and has established a reduction plan", with a mean value of 8.25, 7.2 and 8.45, respectively. As regards the evaluation of consumers from Greece (GR), these have expressed the most preferred requirement n.7: "The company has programmed training activities for workers in order to tackle the specifics of circular technologies and/or strategies", with a value of 8.2. A

<sup>6</sup> Notice that consumers answers were mainly collected with the support of consumers associations and online. We stopped the data collection when we reached a number of answers similar across case studies.

summary of the average values registered for each requirement in all countries is shown in Figure 4.

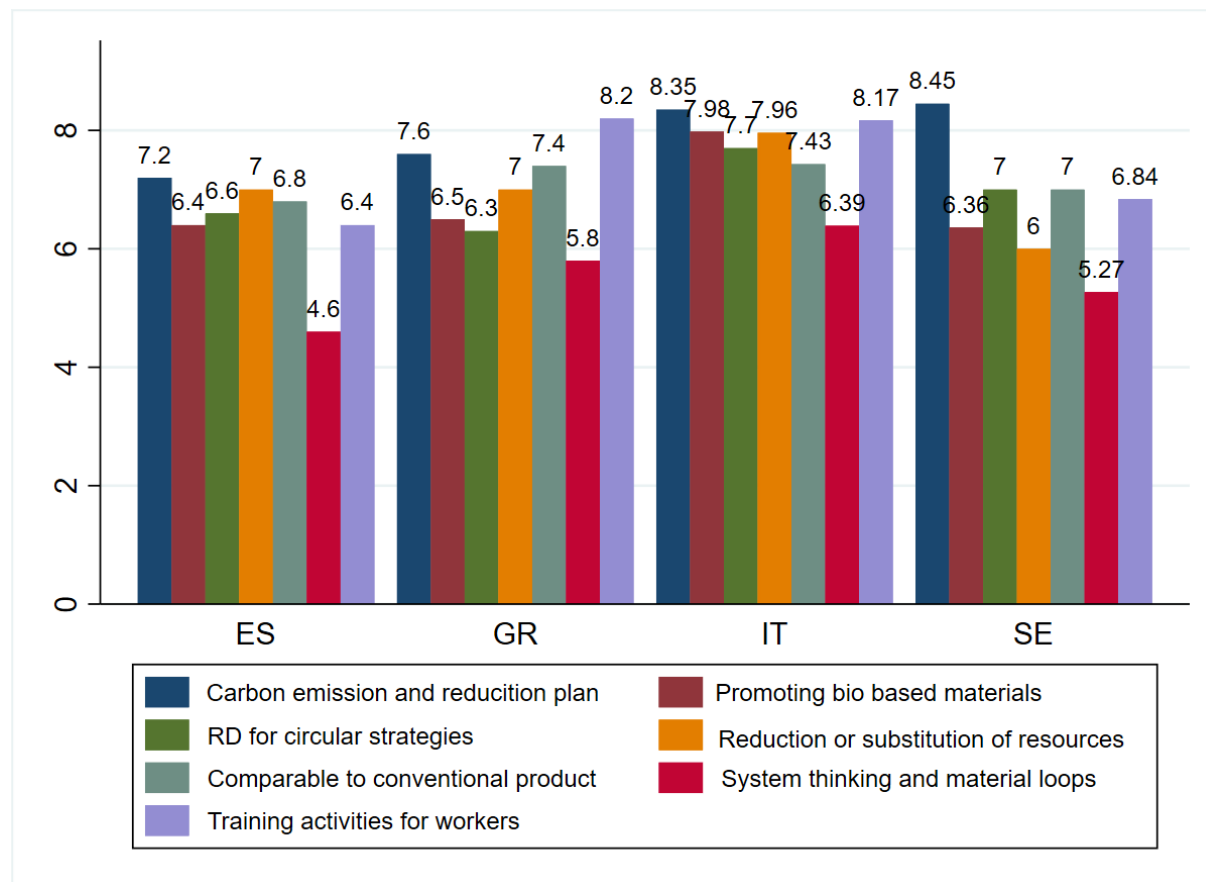


Figure 4. Importance of requirements for consumers – Round 1

Analysing the cross-ranking of requirements, consumers among all 4 countries have expressed a preference for Requirement n.1. To the survey question “Please rate on a scale from 1 (not at all) to 10 (a great deal) how much you think it is important to include the following requirement in the existing certification schemes”, the option ranked on top for all the 4 countries has been ***“The company measures its carbon emissions and has established a reduction plan”***.

On the contrary, the ranking from the industrial perspective differs across countries: Requirement n.1 has been ranked as first across Spanish and Greek industries, while in Italy, the best-ranked requirement has been Requirement n.3 “The company allocates resources to research and develop circular economy strategies within its value chain”, and for Sweden Requirement n.2 “The company promotes the use of materials with a bio-based origin”. This divergence across countries may be reasonably attributed to the low number of observations, and especially in this context, it is essential to observe whether such differences remain or shrink in the second round of the survey.

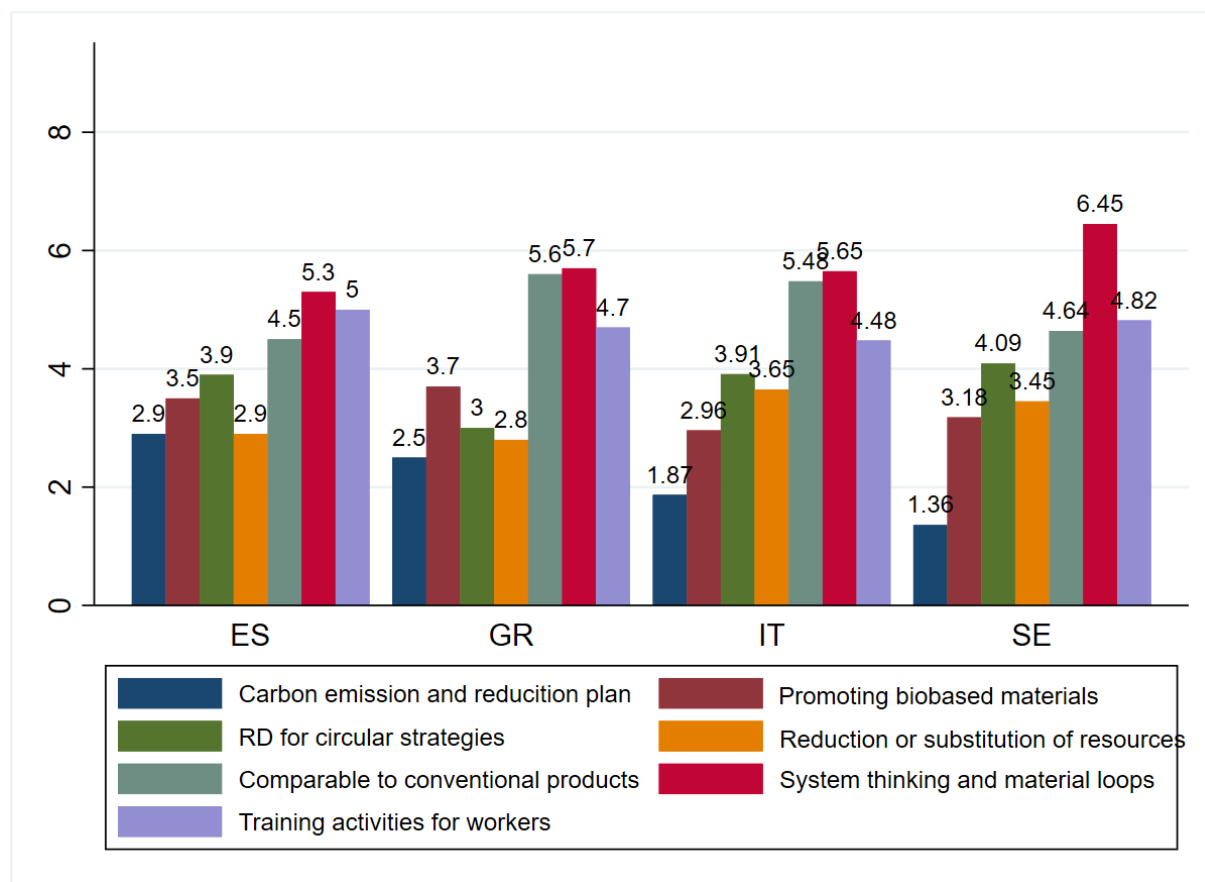


Figure 5. Importance of requirements for industries – Round 1

Summing up the first round, by combining the preferences of consumers and industries, for all the case studies, the first round of the Delphi survey led to the following result:

Table 2. First-round Delphi survey results

| Country     | Most important requirement for Consumers | The most important requirement for industries |
|-------------|------------------------------------------|-----------------------------------------------|
| Italy (IT)  | 1                                        | 3                                             |
| Spain (ES)  | 1                                        | 1                                             |
| Sweden (SE) | 1                                        | 2                                             |
| Greece (GR) | 7                                        | 1                                             |

Despite the relatively scarce consensus among industries, the requirement which came out as the most relevant to be included in the actual certification schemes seems to be Requirement n.1: "The company measures its carbon emissions and has established a reduction plan".

Given the relevance of such requirements, we further analysed the main perceived drivers and barriers towards their potential implementation in the current certification schemes.

We therefore asked participants to rate on a scale from 1 (not at all) to 5 (a great deal), the importance of the following 7 barriers related to the adoption of the new requirements:

1. Presents high implementation costs
2. Adds complexity to existing processes and management systems
3. Involves ongoing costs to maintain compliance with the specific requirement
4. Compliance with the requirement may lead to an increased price for consumers
5. Consumers may not easily recognize the benefits in terms of health, safety, and ethics generated by compliance with the specific requirement
6. Adds to the administrative burden of compliance/Requires extensive documentation
7. Challenges in ensuring compliance along the whole supply chain

A ranking of the importance attributed to each barrier is shown in Figure 6, which includes the average of responses of both consumers and industries.

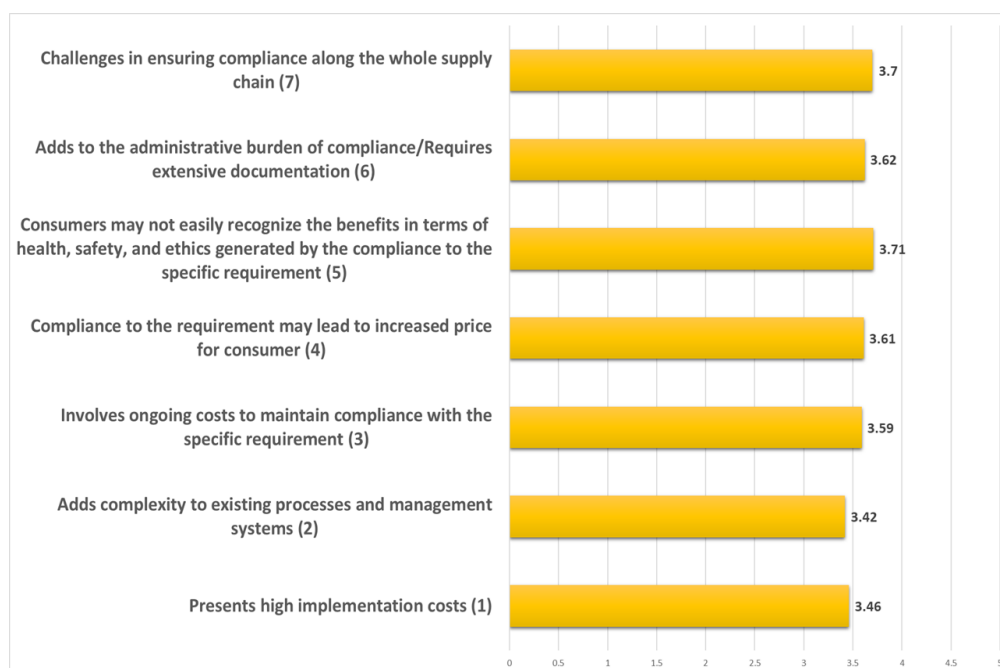


Figure 6. Importance of barriers by consumers and industries. Each bar represents a specific barrier, and x-axis measures the average value.

According to the responses of consumers and industries, the most relevant barriers to including this requirement are:

1. Consumers may not easily recognize the benefits in terms of health, safety, and ethics generated by compliance with the specific requirement (3.71)

2. Challenges in ensuring compliance along the whole supply chain (3.70)
3. Adds to the administrative burden of compliance/Requires extensive documentation (3.62).

Finally, we also asked participants to ***rate, on a scale from 1 (completely disagree) to 5 (totally agree), how much they agree on a list of drivers related to the potential inclusion of the certification schemes of Requirement n.1, among the following:***

1. Boosts corporate public image (reputation) and brand value
2. Provides a competitive advantage over companies that are not compliant with this specific requirement
3. Attracts investment from capital providers (investors) with a higher commitment to sustainability
4. Improves the quality and the safety of products offered, ensuring consumer protection.
5. Promotes responsible innovation and new products and processes development
6. Promotes more efficient use of resources
7. Leads to long-term cost savings for the industry and, hence, has the potential to reduce prices for consumers

According to consumers and industries responses, as it is visible from Figure 7, the most important drivers are related to the inclusion of such requirements, which could:

1. Boosts corporate public image (reputation) and brand value (4.22)
2. Attracts investment from capital providers (investors) with a higher commitment to sustainability (4.13)
3. Promotes more efficient use of resources (4.03)



Figure 7. Importance of drivers for including Requirement n.1. Each bar represents a specific driver, and the x-axis measures the average value.

The whole questionnaire we administered for the Delphi Survey is in Annex I.

### 3.3 Results presentation in the virtual workshop: validation of first round results

On November 27<sup>th</sup> 2024, the BIORECER II Annual Multistakeholder meeting took place, involving, in the online event, a total of 78 participants from 18 countries. Participants, besides the BioReCer community, were either stakeholders already registered in the BRSP platform or potential stakeholders interested in the topics that we advertise through different channels (e.g., posts on social media). Figure 8 and Figure 9 provide a detailed overview of the characteristics of the participants. Regarding their origin, the majority of the attendees were from Southern Europe. Regarding the categories they belong to, we reach a good share of all categories, meaning Bio-industry, Certification Body, Consumer association, and Institution.

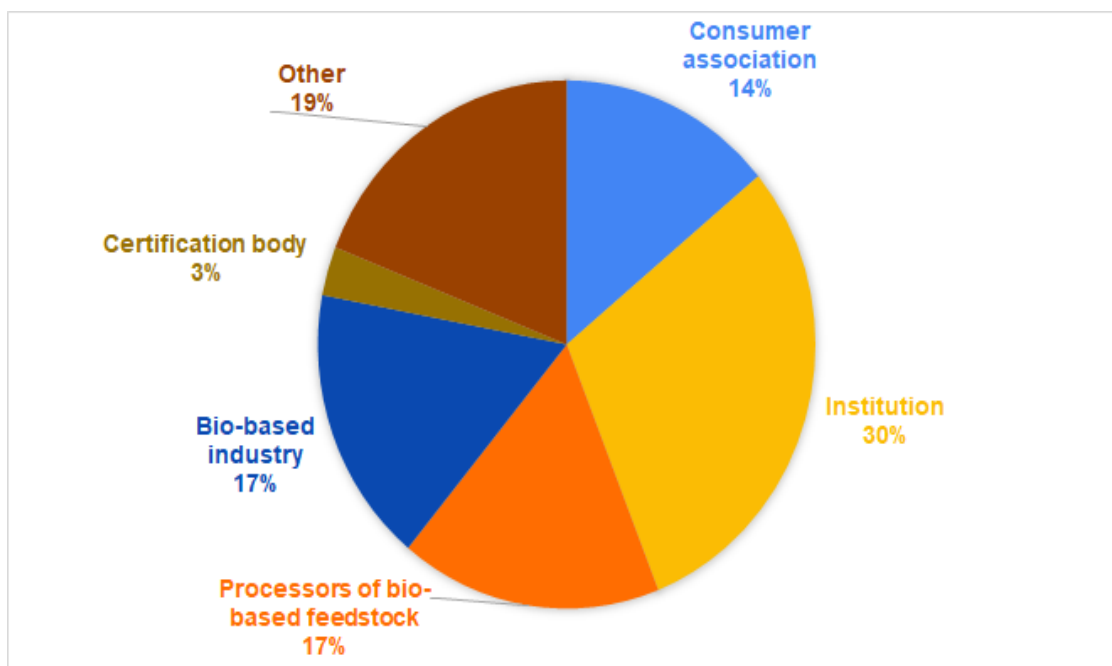


Figure 8. Contribution of stakeholders for each category

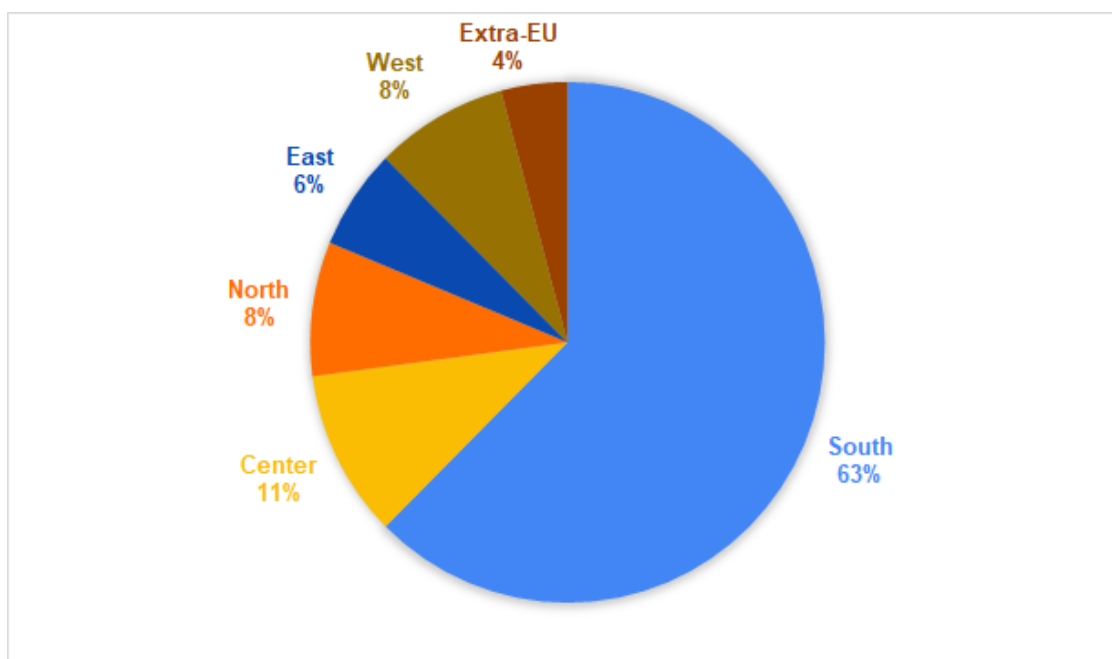


Figure 9. Contribution of stakeholders for the country of origin

We validate the results from the first round of the Delphi survey by asking all the attendees to rank, from the most to the least important, the requirements to be included in the certification schemes.<sup>7</sup> The requirements were the same as those used in the survey: 1.

<sup>7</sup> Notice that, due to the time constraint and to avoid loss of attention, we avoid to ask stakeholders opinions about drivers and barriers and we solely focus on the main goal of the survey (i.e., requirement selection).

The company measures its carbon emissions and has established a reduction plan; 2. The company promotes the use of materials with a bio-based origin; 3. The company allocates resources to research and develop circular economy strategies within its value chain; 4. The company achieves goals of reduction or substitution of resources; 5. The company can demonstrate that its products have comparable characteristics and quality to its conventional counterpart; 6. The company has defined strategies to promote a systems thinking of processes and the analysis of material loops; 7. The company has programmed training activities for workers in order to tackle the specifics of circular technologies and/or strategies.

The main results of the poll are summarized in Figure 10. As emerged, the first requirement has been ranked as the most important by 50% of the respondents. This result is in line with the consumers' preference as grasped with the Delphi survey.

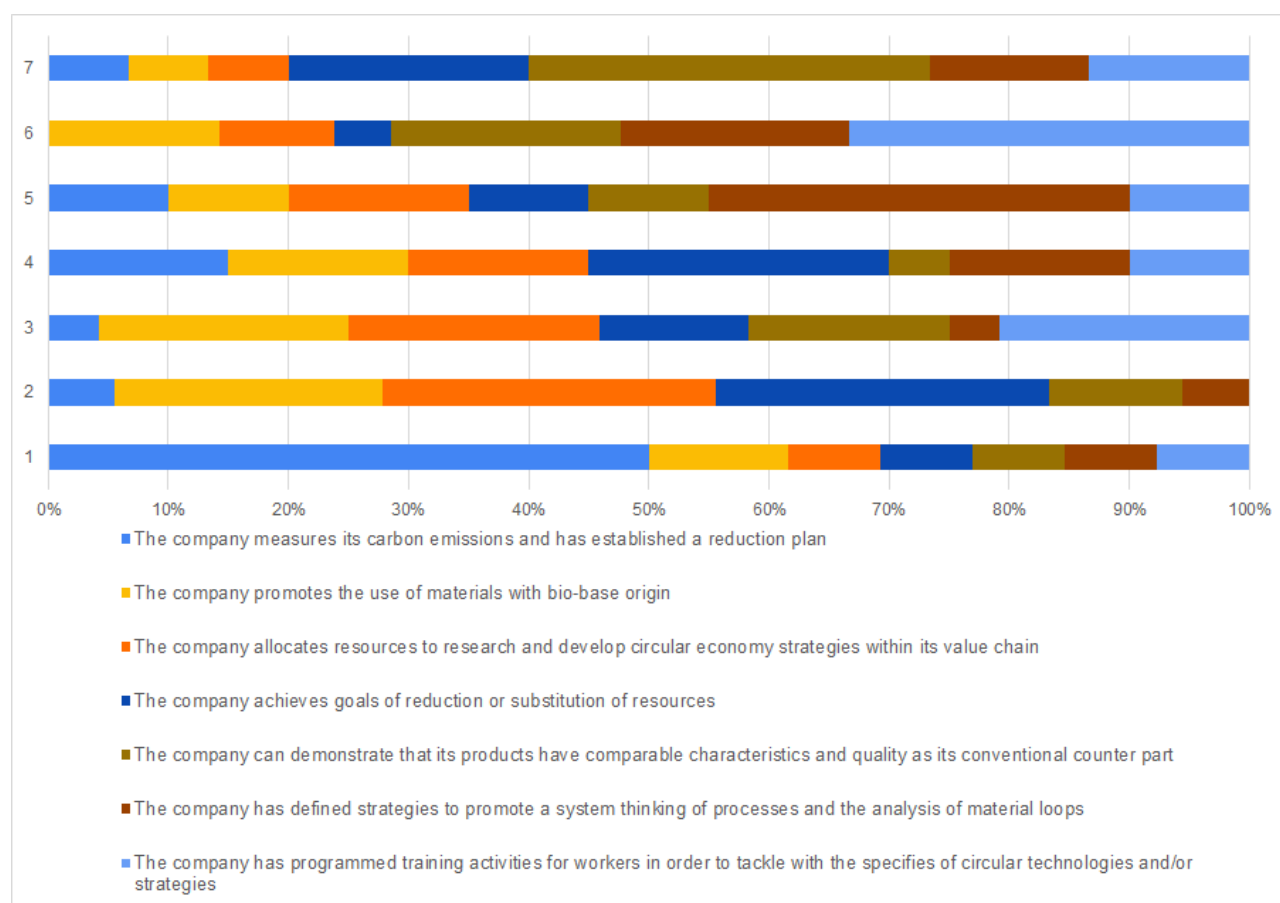


Figure 10. Validation of Delphi survey first-round results

### 3.4 Second round: results

We replicated the structure of the analysis of the 1<sup>st</sup> round by sending out the survey to the same participants, from both industries and consumers, in the four countries. Accordingly, we analysed the importance of including the new requirements in the current certification schemes, and the results led to a consensus among both consumers and industries.

In fact, starting from consumers, it is visible from Figure 11 that most of them expressed a larger level of importance for Requirement n. 1 “The company measures its carbon emissions and has established a reduction plan” in all the considered countries (Italy: 9.2; Spain: 8.7; Greece: 8.7; Sweden: 8.1).

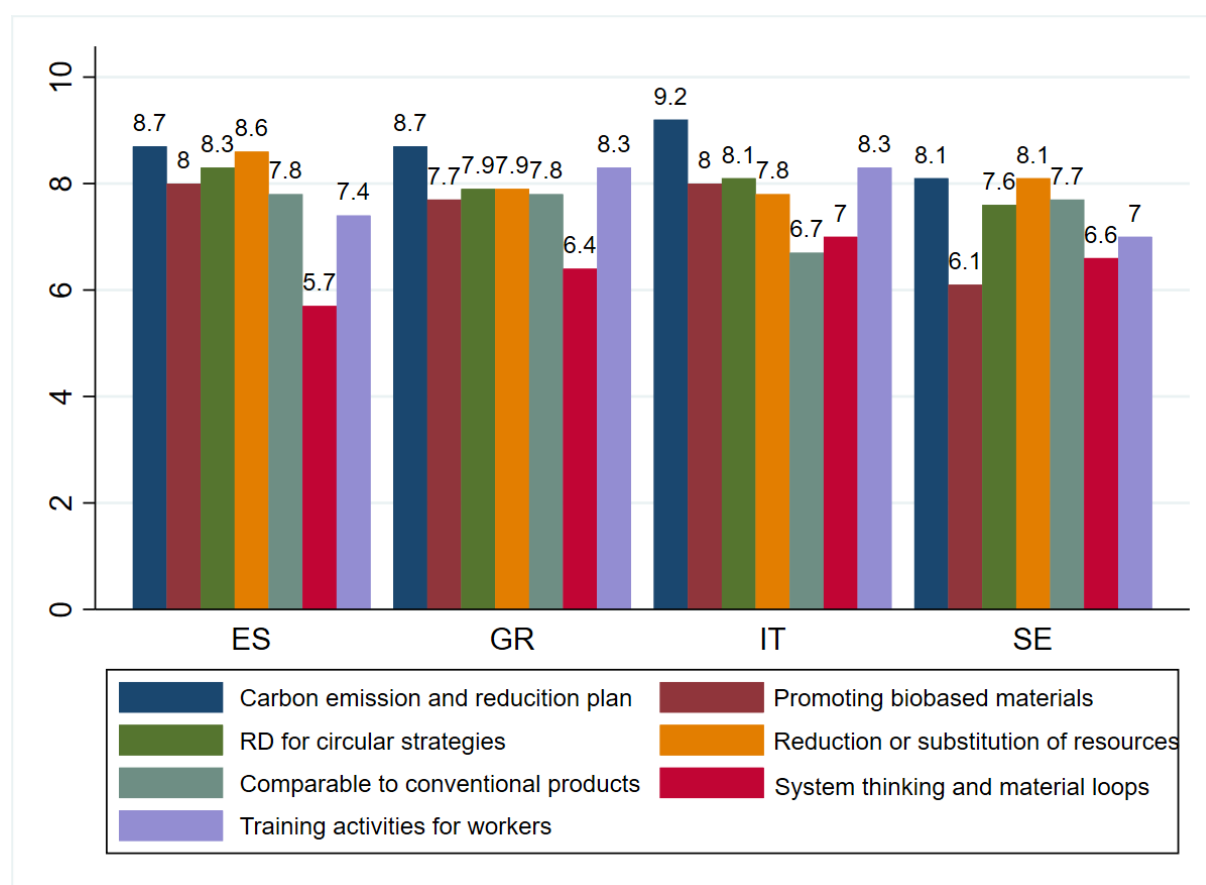


Figure 11. Consumers' average importance of requirement by country – 2<sup>nd</sup> round

Consistently, consumers from all countries ranked Requirement n.1 as the most relevant, also in the cross-comparison across requirements, as it is visible from Figure 12.

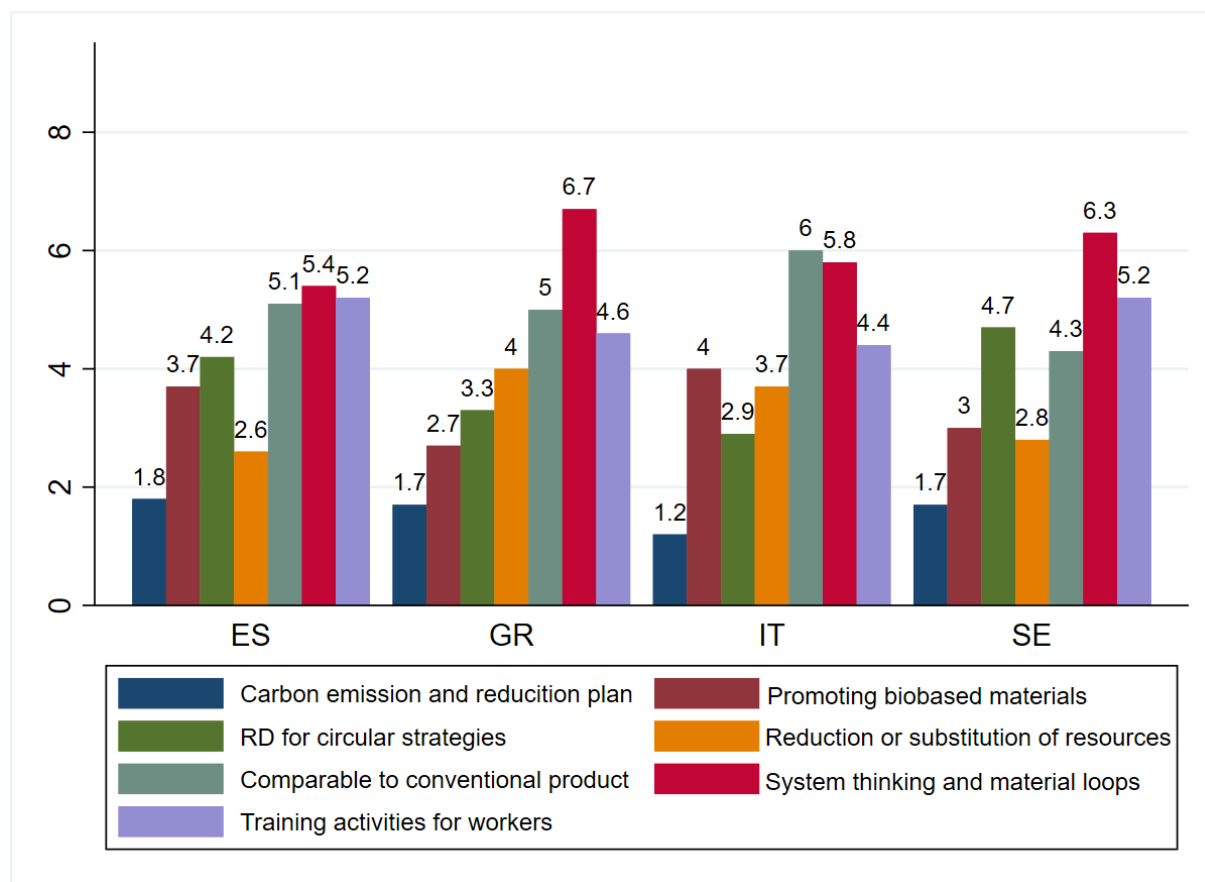


Figure 12. Consumers' ranking of requirements by country – second round

As regards industries, unlike the 1<sup>st</sup> round, there has been a large consensus on the most important requirement to be included. Also in this case, in line with consumers' results, participants representing industries have attributed to Requirement n.1 "The company measures its carbon emissions and has established a reduction plan" The highest values (Italy: 9.5; Spain: 9.5; Greece: 9.25; Sweden: 9.25), as it is visible from Figure 13 below.

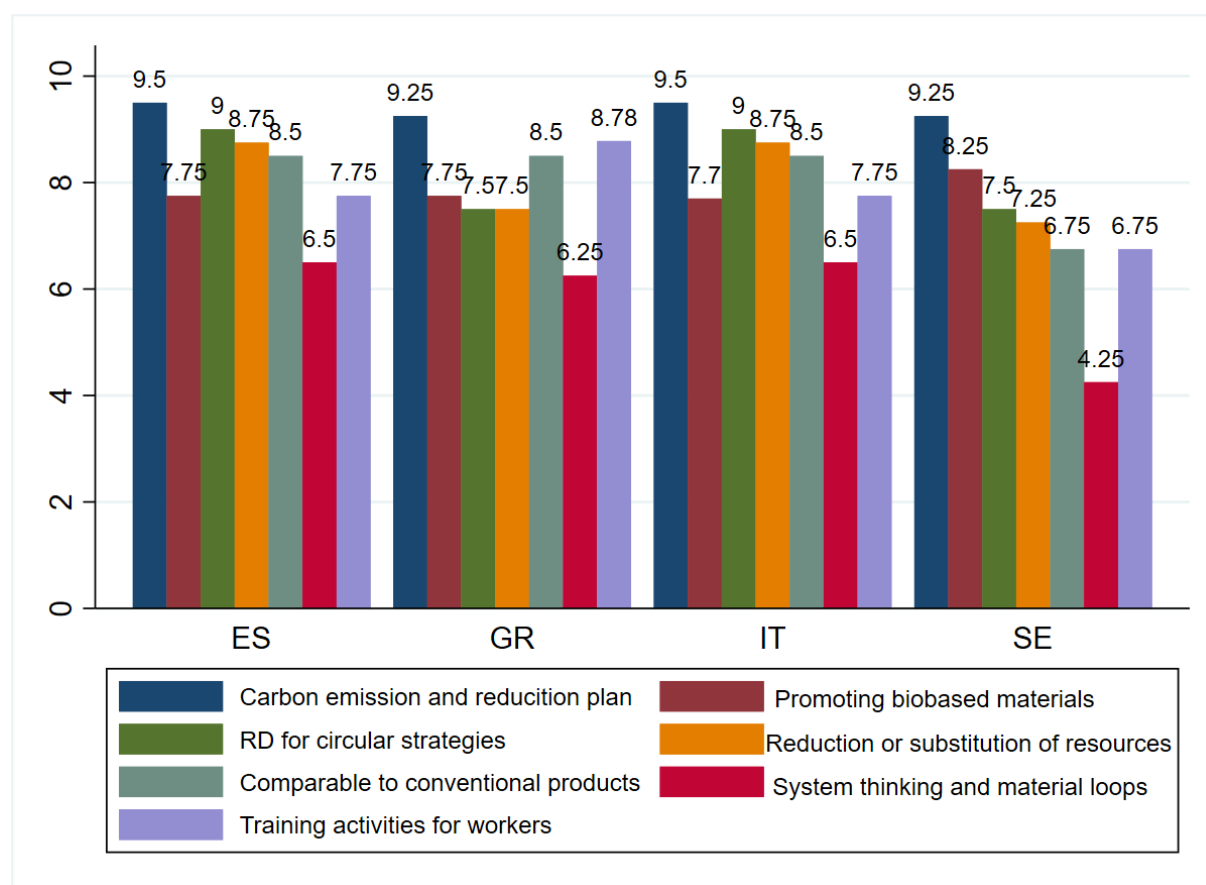


Figure 13. Industries' average importance of requirement by country – second round

All in all, the cross-comparison of requirements confirms the relative importance attributed to Requirement n.1 also among industries, as visible from Figure 14

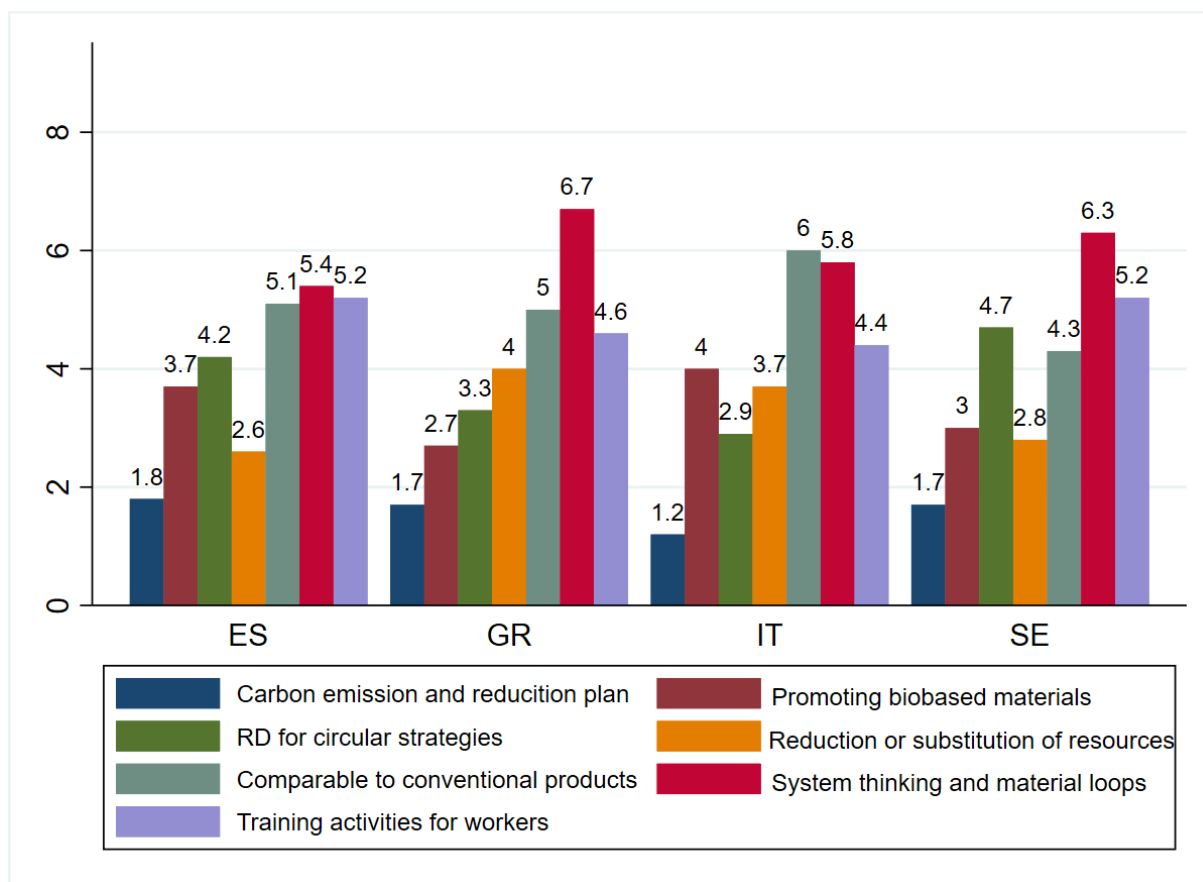


Figure 14. Industries' ranking of requirements by country – second round

Summing up, in the second round, by combining the preferences of consumers and industries for all the case studies, the Delphi survey led to a consensus for the inclusion of Requirement n.1 "The company measures its carbon emissions and has established a reduction plan", as visible from the following table.

Table 3 Second-round Delphi survey results

| Country | Most important requirement for Consumers | Most important requirement for industries |
|---------|------------------------------------------|-------------------------------------------|
| Italy   | 1                                        | 1                                         |
| Spain   | 1                                        | 1                                         |
| Sweden  | 1                                        | 1                                         |
| Greece  | 1                                        | 1                                         |

### 3.5 Synthesis of the results

The Delphi survey, conducted in two rounds with stakeholders representing industries and consumers from Italy, Spain, Sweden, and Greece, provided interesting insights into the priorities for improving the existing certification schemes. Based on both rounds, a clear picture emerged regarding the most important requirements to be included in the certification schemes.

In the first round, consumer preferences revealed a strong alignment across the four countries. In fact, in Italy, Spain, Greece and Sweden, the consumers expressed as top priority in the cross-ranking of requirements the Requirement n.1: "The company measures its carbon emissions and has established a reduction plan". This requirement received high scores, reflecting the perceived relevance on the demand side in addressing pressing environmental concerns.

On the industry side, preferences were more diverse in the first round. While Requirement n. 1 was ranked highest by industries in Spain and Greece, Italian industries prioritized Requirement n. 3 "The company allocates resources to research and develop circular economy strategies within its value chain", while in Sweden, the top choice was Requirement n. 2: "The company promotes the use of materials with bio-based origin". These variations suggested that industrial priorities were influenced by local market dynamics and sector-specific challenges.

Despite these initial differences, Requirement n.1 stood out as the most widely supported requirement when combining consumer and industry perspectives across countries. In analyzing the drivers and barriers for all the proposed requirements, on a scale from 1 to 10, the most relevant barriers participants highlighted refer to the difficulty for consumers to recognize the direct benefits of compliance (e.g., in terms of health, safety, and ethics) with a value of 3.71, as well as the challenges of ensuring compliance along complex supply chains (3.70) and the increased administrative burden (3.62). Conversely, the main drivers for adopting Requirement n. 1 included its potential to enhance corporate reputation (4.22), attract investment from sustainability-focused stakeholders (4.13), and promote more efficient resource use (4.03).

In the second round of the survey, a stronger consensus emerged across all groups and countries. Both consumers and industries unequivocally identified Requirement n. 1 as the most important requirement to include in certification schemes. For consumers, the scores for this requirement were consistently high, ranging from 8.1 in Sweden to 9.2 in Italy. Similarly, industries expressed unanimous support, with scores between 9.25 and 9.5 across the four countries. This marked a notable shift from the first round, where industry preferences had been more fragmented.

Ultimately, the analysis carried out through the Delphi survey was useful to identify the need for both the demand and the supply side represented by consumers and industries, respectively. The results highlight the importance of including the requirement “The company measures its carbon emissions and has established a reduction plan” signalling how stakeholders needs are also in line with the Green Deal main goal, i.e., the carbon emission reduction by 2030.

## 4 Analytic Hierarchy Process analysis

A further step to identify the requirements that need to be integrated in the certification schemes, we assess experts' opinion on the basis of the identified requirements. The aim of this analysis is to compare whether industries and consumers opinions are consistent with experts in the field opinions.

To assess experts' opinions, we deploy the AHP method that easily allows us to obtain a priority scale on a list of alternatives on the basis of criteria pairwise comparisons (see, for instance, Saaty, 2008). One of the critical points in structuring the AHP analysis is the criteria identification. Since it involves a selection or a ranking of possible alternatives, criteria need to be defined based on the alternatives. In our analysis, we defined seven alternatives and seven criteria.

This analysis required two main steps: i) identify the pool of experts and ii) define criteria and alternatives to be submitted for experts' evaluation. For the former aspect, see Section 4.1 for more details. For the latter point, see Section 4.2. Once we identified the pool of experts, UNITELMA reached out to them by sending the Excel file to compile. We had a response rate close to 80%. The overall results are presented in Section 4.3.

### 4.1 Definition of the pool of experts

The first and one of the most important steps to set up the AHP was the expert pool identification. Experts are identified based on their knowledge, experience, and credibility in the relevant field. In our study, experts are called to express their opinion about what entities should do to improve some aspects related to both sustainability and circularity.

The selection of experts was based on some relevant characteristics such as relevant domain knowledge (either academic background or practical experience) and recognition in the field (publications, awards, professional status). We identified a group of experts composed by:

- BioReCer Case Study leaders: given their experience in the field of circularity, sustainability and their familiarity with certification schemes;
- members of the academic community: we selected recognized experts whose research interests focus on the bioeconomy and circular economy;
- industry representatives that are experts in the field of bioeconomy and circular economy.

We got a total of 7 answers, and their answers are analysed in Section 4.3.

## 4.2 Criteria selection

This assessment may be considered as a validation of the results collected from the Delphi survey. In the AHP analysis, the decision is broken down into a hierarchical structure considering criteria and alternatives. In our validation exercise, we consider as the alternatives the list of requirements that stakeholders previously evaluated. The criteria to select the most valuable alternative were defined as the set of drivers we proposed in the Delphi survey (see Section 3.2). Recall that the AHP criteria are initially weighted based on a series of pairwise comparisons and, then, the alternatives scored relative to each other. This weighting and scoring process leads to the generation of a total score for each alternative, by which they are ranked.

As explained in Section 3.2, the criteria listed in Table 4 were selected according to the literature (see, for instance, Van Schoubroeck et al., 2019; Lindfors, 2021) and to specific suggestions from project's partners and CSs leaders. Table 4 lists the list of criteria.

Table 4. List of AHP criteria

| Criteria | Type                   | Example                                                                                                       |
|----------|------------------------|---------------------------------------------------------------------------------------------------------------|
| C1       | Reputation             | Boosts corporate public image (reputation) and brand value                                                    |
| C2       | Competitive advantage  | Provides a competitive advantage over companies who are not compliant with this specific requirement          |
| C3       | Investment             | Attracts investment from capital providers (investors) with a higher commitment to sustainability             |
| C4       | Safety and quality     | Improves the quality and the safety of products offered, ensuring consumer protection                         |
| C5       | Responsible innovation | Promotes responsible innovation and new products and processes development                                    |
| C6       | Efficiency             | Promotes more efficient use of resources                                                                      |
| C7       | Saving                 | Leads to long-term cost savings for the industry and, hence, has the potential to reduce prices for consumers |

Following the standard procedure, we asked participants to evaluate criteria according to their relative importance on a 9-level scale as reported in Table 5, indicating the Numerical Rating (NR). This means that they had to assess through a pairwise comparison whether, and to what extent, one criterion is more (or less) relevant than another.

Table 5. Numerical rating of criteria

| Numerical rating | Verbal judgements of preferences |
|------------------|----------------------------------|
| 1                | Equally preferred                |
| 2                | Equally to moderately            |
| 3                | Moderately preferred             |
| 4                | Moderately to strongly           |
| 5                | Strongly preferred               |
| 6                | Strongly to very strongly        |
| 7                | Very strongly preferred          |
| 8                | Very strongly to extremely       |
| 9                | Extremely preferred              |

An example of the sheets that participants filled is reported in Figure 15.

|       | C1 | C2      | C3      | C4      | C5      | C6      | C7      |  |  |
|-------|----|---------|---------|---------|---------|---------|---------|--|--|
| C1    | 1  | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! |  |  |
| C2    |    | 1       | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! |  |  |
| C3    |    |         | 1       | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! |  |  |
| C4    |    |         |         | 1       | #DIV/0! | #DIV/0! | #DIV/0! |  |  |
| C5    |    |         |         |         | 1       | #DIV/0! | #DIV/0! |  |  |
| C6    |    |         |         |         |         | 1       | #DIV/0! |  |  |
| C7    |    |         |         |         |         |         | 1       |  |  |
| Total | 1  | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! |  |  |

|       | C1   | C2      | C3      | C4      | C5      | C6      | C7      | Total   | Average |
|-------|------|---------|---------|---------|---------|---------|---------|---------|---------|
| C1    | 1.00 | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! |
| C2    | 0.00 | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! |
| C3    | 0.00 | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! |
| C4    | 0.00 | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! |
| C5    | 0.00 | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! |
| C6    | 0.00 | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! |
| C7    | 0.00 | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! |
| Total | 1.00 | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! | #DIV/0! |

|  | Amax    | CI      | CR      |
|--|---------|---------|---------|
|  | #DIV/0! | #DIV/0! | #DIV/0! |

| CRITERIA                                                                                                                       |
|--------------------------------------------------------------------------------------------------------------------------------|
| C1 Reputation: Boosts corporate public image (reputation) and brand value                                                      |
| C2 Competitive Advantage: Provides a competitive advantage over companies who are not compliant with this specific requirement |
| C3 Investment: Attracts investment from capital providers (investors) with a higher commitment to sustainability               |
| C4 Safety and quality: Improves the quality and the safety of products offered, ensuring consumer protection.                  |
| C5 Responsible innovation: Promotes responsible innovation and new products and processes development                          |
| C6 Efficiency: Promotes more efficient use of resources                                                                        |
| C7 Savings: Leads to long-term cost savings for the industry and, hence, has the potential to reduce prices for consumers      |

**INSTRUCTION**

You solely need to fill the yellow cells with numbers. Put a number between 1 and 9 according to whether you believe criteria in the row are more relevant than the criteria in the column. On the contrary, if you believe that criteria in the columns are more relevant than those in the rows, write the number corresponding to 1/NR.

For example: if you believe that C4 is "strongly preferred" to C3, you will write the value 5 in the cell E5. If, on the contrary, you evaluate that C3 is "strongly preferred" to C4, you report the value 0,20 (= 1/5) in the cell E5.

Recall to check that CR is less or (at least) equal to 0.1

Figure 15. Sheet filled by participants – Example 1

By looking at Figure 15, we asked participants to fill the cells highlighted in yellow with numbers from 1 to 9. If, in participants' opinion, the criteria reported in the row are less relevant than those in the column, they had to write the number corresponding to 1/NR. As an example: if they believed that C4 was "strongly preferred" to C3, they would write the value 5 in the cell E5. If, on the contrary, they would evaluate that C3 was "strongly preferred" to C4, they had to report the value 0,20 (= 1/5) in the cell E5.

We also pointed out that in filling in the cells for weighting criteria, participants had to be "consistent" with the evaluations that they assigned to the different criteria. Indeed, a value (consistency ratio) that measures such consistency was included in the sheet. In fact, this value, called "CR", was computed at the bottom of the sheet "weight" and highlighted in green. We also stressed that this value had to be less or (at least) equal to 0,1.

Once participants provided their judgments for criteria, they had to express, on the same scale from 1 (minimum value) to 9 (maximum value) reported in Table 5, how important is each criterion for any alternative proposed. The list of alternatives (requirements) is reported in Table 6.

Table 6. List of alternative requirements

| Alternatives | Type          | Example                                                                                                                                 |
|--------------|---------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| <b>A1</b>    | Requirement 1 | The company measures its carbon emissions and has established a reduction plan.                                                         |
| <b>A2</b>    | Requirement 2 | The company promotes the use of materials with bio-based origin.                                                                        |
| <b>A3</b>    | Requirement 3 | The company allocates resources to research and develop circular economy strategies within its value chain.                             |
| <b>A4</b>    | Requirement 4 | The company achieves goals of reduction or substitution of resources.                                                                   |
| <b>A5</b>    | Requirement 5 | The company can demonstrate that its products have comparable characteristics and quality as its conventional counter part.             |
| <b>A6</b>    | Requirement 6 | The company has defined strategies to promote a system thinking of processes and the analysis of material loops.                        |
| <b>A7</b>    | Requirement 7 | The company has programmed training activities for workers in order to tackle the specifics of circular technologies and/or strategies. |

Also, in this case we asked them to fill the cells highlighted in yellow (see example in Figure 16).

|    | A1 | A2 | A3 | A4 | A5 | A6 | A7 |
|----|----|----|----|----|----|----|----|
| C1 | 3  | 4  | 3  | 4  | 5  | 3  | 3  |
| C2 | 7  | 7  | 7  | 7  | 8  | 6  | 5  |
| C3 | 7  | 7  | 7  | 8  | 5  | 6  | 5  |
| C4 | 3  | 8  | 8  | 6  | 6  | 3  | 3  |
| C5 | 7  | 7  | 8  | 8  | 7  | 5  | 5  |
| C6 | 8  | 7  | 7  | 8  | 5  | 5  | 3  |
| C7 | 3  | 3  | 3  | 5  | 6  | 6  | 5  |

**INSTRUCTION**  
Fill in only yellow cells. In this case you are asked to express, on a scale from 1 (minimum value) to 9 (maximum value) how much important is each criterion for any alternative proposed.

| CRITERIA |                        |  |  |  |  |  |  |
|----------|------------------------|--|--|--|--|--|--|
| C1       | Reputation             |  |  |  |  |  |  |
| C2       | Comparative Advantage  |  |  |  |  |  |  |
| C3       | Investment             |  |  |  |  |  |  |
| C4       | Safety and quality     |  |  |  |  |  |  |
| C5       | Responsible innovation |  |  |  |  |  |  |
| C6       | Efficiency             |  |  |  |  |  |  |
| C7       | Savings                |  |  |  |  |  |  |

| ALTERNATIVES - CS4 |                                                                                                                                                            |  |  |  |  |  |  |
|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|--|--|--|
| A1                 | Requirement 1: The company measures its carbon emissions and has established a reduction plan                                                              |  |  |  |  |  |  |
| A2                 | Requirement 2: The company promotes the use of materials with bio-base origin                                                                              |  |  |  |  |  |  |
| A3                 | Requirement 3: The company allocates resources to research and develop circular economy strategies within its value chain                                  |  |  |  |  |  |  |
| A4                 | Requirement 4: The company achieves goals of reduction or substitution of resources                                                                        |  |  |  |  |  |  |
| A5                 | Requirement 5: The company can demonstrate that its products have comparable characteristics and quality as its conventional counter part                  |  |  |  |  |  |  |
| A6                 | Requirement 6: The company has defined strategies to promote a system thinking of processes and the analysis of material loops                             |  |  |  |  |  |  |
| A7                 | Requirement 7: The company has programmed training activities for workers in order to tackle with the specifics of circular technologies and/or strategies |  |  |  |  |  |  |

Figure 16. Sheet filled by participants – Example 2

Based on the evaluation of both criteria and alternatives, we were able to identify the most important requirement based on experts' view.

### 4.3 Main results

In order to obtain results from the AHP analysis, we had to aggregate individual responses. Several studies provided a guide to aggregate individual judgements for group decision-making (i.e., Bahurmoz, 2006). Once participants have filled in pairwise judgments of both criteria and alternatives, data have been aggregated in order to obtain the highest ranked alternative for each of the case studies. In order to aggregate individual preferences, given the homogeneous hierarchy of stakeholders' expertise within each case study, we computed the arithmetic mean of the final outcomes. As a sensitivity check, we replicated the AHP analysis by applying the geometric mean, as proposed by Bahurmoz (2006), and the results remained overall consistent.

Table 7 reports the aggregated alternatives' weights with respect to criteria across all the involved respondents.

Table 7. Alternatives' weights with respect to criteria

|           | A1  | A2  | A3  | A4  | A5  | A6  | A7  | Priorities |
|-----------|-----|-----|-----|-----|-----|-----|-----|------------|
| <b>C1</b> | 6.5 | 4.8 | 4.7 | 5.2 | 6.2 | 3.7 | 4.0 | 0.06       |
| <b>C2</b> | 6.7 | 5.5 | 6.0 | 6.0 | 7.3 | 4.5 | 4.5 | 0.11       |
| <b>C3</b> | 6.8 | 6.0 | 6.7 | 6.0 | 5.8 | 5.0 | 4.3 | 0.11       |
| <b>C4</b> | 4.5 | 5.5 | 5.8 | 5.2 | 7.2 | 4.3 | 5.2 | 0.20       |
| <b>C5</b> | 7.0 | 6.2 | 7.5 | 6.7 | 5.7 | 5.8 | 5.3 | 0.20       |
| <b>C6</b> | 6.5 | 5.0 | 6.0 | 7.3 | 4.8 | 6.3 | 5.5 | 0.19       |
| <b>C7</b> | 5.5 | 4.5 | 5.8 | 6.7 | 4.7 | 6.3 | 5.8 | 0.13       |

We then weighted the pairwise criteria-alternatives judgement for the respective level of priority. Once obtained information from the weighted criteria-alternatives matrix, we computed the ranking of alternatives for each case study, by computing the geometric mean across criteria. Finally, we were able to select the highest ranked alternative by looking at the largest eigenvalue of their comparison matrix.

As it is visible from the Figure 17, which shows the final ranking of alternatives, results confirm also in this case that the most important alternative is related to the Requirement n.1 (A1): "The company measures its carbon emissions and has established a reduction plan". Therefore, the experts' assessment of importance of such requirements, based on their respective list of drivers, seem to be consistent with the results obtained from the previously described Delphi survey, aligning with both consumers and industries preferences.

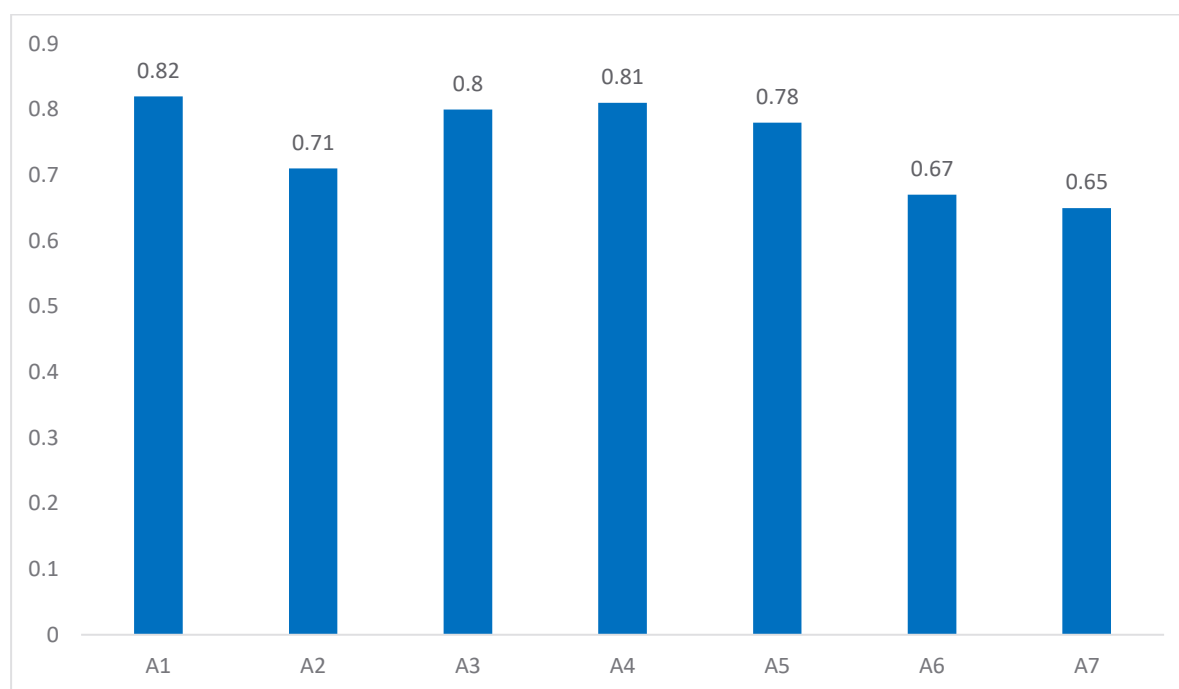


Figure 17. Ranking of alternatives. Each bar represents an alternative and the y-axis measures the average values.

A1: "The company measures its carbon emissions and has established a reduction plan"; A2: "The company promotes the use of materials with bio-based origin"; A3: "The company allocates resources to research and develop circular economy strategies within its value chain"; A4: "The company achieves goals of reduction or substitution of resources"; A5: "The company can demonstrate that its products have comparable characteristics and quality as its conventional counterpart"; A6: "The company has defined strategies to promote a system thinking of processes and the analysis of material loops"; A7: "The company has programmed training activities for workers in order to tackle with the specifics of circular technologies and/or strategies"

Although this result reinforces the previous evidence, it is important to note that, with respect to the A1, there is a slight difference in the evaluations of A4 and A3, which ranked respectively as second and third preferred alternatives (0.81 and 0.80).

This evidence shows that experts attach almost the same importance to the requirements A4 "The company achieves goals of reduction or substitution of resources" and A3 "The company allocates resources to research and develop circular economy strategies within its value chain", being very close to the Requirement 1.

## 5 Experiment

### 5.1 Introduction

The additional activity we performed to identify the most important requirement that should be integrated into the existing certification scheme is the experiment. Experiments are widely used in economics to assess how no observable factors could influence individual decision-making. The mechanism is quite easy: the variable of interest is identified and the choices from a control group are compared with those of the “experimental” group. The main advantage of running an experiment is to analyze the effect of a specific variable in a controlled environment (see Davis and Holt, 2021, for more details). Let us make an example to clarify. Suppose you want to assess the role of including a new (still not existing) label on a specific product to verify if this label has an impact on the number of products sold. You may identify the control group that makes their choice considering a product without a label and an “experimental” group in which subjects make their choices considering the product with the label. If the experimental group's average purchase is higher than the one of the control group, adding a label does have a (positive) effect.

Experiments can be conducted in different contexts and the main distinction is between laboratory and field experiments. In the former context, participants need to go to a laboratory to take part in the experiment and in the majority of cases the pool is composed of (university) students. Regarding the latter context, following Morone et al., (2021), field experiments can be classified into three main categories: artefactual field experiments (i.e., similar conventional laboratory experiments but with a subject pool composed by non-students), framed field experiments (i.e., as the artefactual field experiments but with a real context) and natural field experiments (i.e., similar to framed field experiments but conducted in a real environment where subjects are unaware that they are participating in an experiment). Artefactual field experiments preserve the same characteristics of lab experiments, incorporating significant elements of the context under investigation. Indeed, they are carried out in such a way that participants' behavior can be successfully studied and analyzed even though they are aware that they are participating in an experiment. There is a bunch of paper deploying artefactual field experiment to investigate important environmental problems (see, as an example, Torres-Guevara and Schlüter, 2016; Voors et al., 2011) and elicit consumers' willingness to pay (WTP) for sustainable products. Finally, a more recent literature deployed the so-called online experiment in which participants are recruited and took part in the experiment thanks to online platforms.

To reach a wide audience, we run an artefactual online field experiment in which participants were recruited through the Prolific<sup>8</sup> platform, and they also receive monetary compensation for their participation.<sup>9</sup>

## 5.2 Sample identification

The aim of this experiment is to assess the effectiveness of Sustainable Certification Schemes on consumers' decisions. To reach this goal, we selected a wide sample of people out of our list of stakeholders. Also, according to the Grant Agreement's objectives, we selected a subject pool of consumers belonging to the four countries object of BioReCer CSs, namely: Italy, Spain, Greece, and Sweden.

We recruited a total of 400 participants, 100 for each country, who took part in the proposed artefactual online field experiment. In order to recruit such participants, it has employed the Prolific platform, selecting a subject pool composed of the working age population (18-65 years old) for each of the four case studies. The experiment took place in March 2025. Participants received a show-up fee of 3.00€ to complete the questionnaire.

## 5.3 Experimental design

In particular, to assess the effect of certification schemes on consumers' purchase intentions and, hence, their effectiveness in enhancing bioproduct products' market potential, we have structured an experiment following the structure proposed by Brach et al. (2018) and assuming that certification schemes will reduce the consumers' perceived risk related to bioproduct products and that a lower perceived risk will translate in higher willingness to buy this kind of product (see Figure 18). Perceived Risk refers to a consumer's subjective evaluation of the degree of risk related to an event, such as a purchase of a good. Following Brach et al. (2018) and the references therein, we are aware that consumers associate higher perceived risk with nonconventional products. The main reason, especially when talking about green products, is the difficulty in verifying some attributes both before and after purchasing a specific product. This difficulty in observing green attributes could have a negative impact on consumers' PI. We assume that certifications may work as an assurance that a product has specific characteristics. Based on this assumption, Sustainable Certification Schemes may reduce consumers' perceived risks and, in turn, increase their willingness to buy a product.

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<sup>8</sup> <https://www.prolific.com/>

<sup>9</sup> Notice that this is a standard procedure in experimental economics: to get a valid result, you need to compensate participants for their effort.

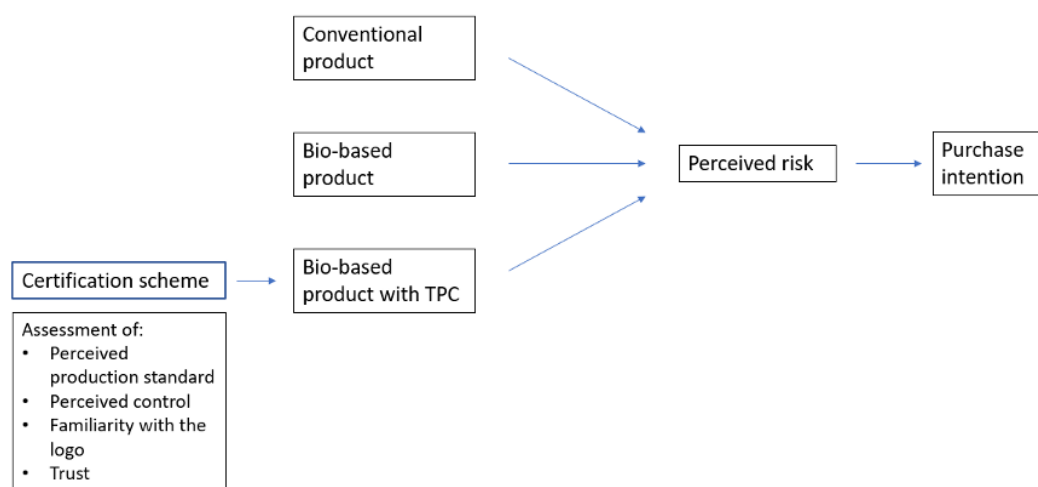


Figure 18. Design of the experiment

Our experiment aimed to elicit consumers' PI on three different products: shampoo, cosmetics and fertilizer. These products were selected in accordance with the CSs leaders and based on the potential use of the byproducts for each CS. In particular:

- Shampoo for CS1 (Spain)
- Fertilizer for CS2 and CS3 (Italy and Greece)
- Cosmetic cream (e.g., face cream) for CS4 (Sweden)

The participant's purchase intention was measured by eliciting their willingness to pay for such products and by asking them specific questions about the probability of buying a specific good. Following Schmidt and Bijmolt (2020), WTP can be elicited in both real and hypothetical scenarios: the only difference is the real or artefactual link to the goods to be purchased. Since not all the goods produced with specific byproducts are currently in the market, we elicit the WPT in a hypothetical scenario. We asked respondents to declare the price they are willing to pay for each of the above-mentioned products, considering the following alternatives:

- the conventional product (i.e., produced with chemicals);
- the bioproduct (i.e., produced by recycling organic or industrial waste materials);
- certified bioproduct (i.e., bioproduct with a certificate).

To assess whether there is a difference across different certification schemes in shaping consumers' PI, we select two certification schemes, namely ISCC PLUS and RSB. The choices was based the comparison across different certification schemes carried out in the framework of WP2 (See Deliverable D2.2), and the main reason why we selected these certificates relies on: i) the selected schemes cover sectors related to BioReCer CSs (i.e., Fishery, Forestry, Agriculture and Urban residues); ii) the two certification schemes cover

production, manufacturing and consumption value chains; iii) both labels are not well-known by consumers and this avoid the potential bias due to the perceived trust.

To sum up, since the experiment has been structured as between subject design so that each participant took part solely in one study (i.e., each participant evaluated only one certification scheme, related to one single product, depending on their country of residence), our experiment considers the following treatments:

Table 8. Groups of participants

|                 |                       | Certification Scheme                 |                                      |
|-----------------|-----------------------|--------------------------------------|--------------------------------------|
|                 |                       | ISCC PLUS                            | RSB                                  |
| <b>Products</b> | <b>Shampoo</b>        | Study 1<br>50 participants<br>Spain  | Study 2<br>50 participants<br>Spain  |
|                 | <b>Cosmetic cream</b> | Study 3<br>50 participants<br>Sweden | Study 4<br>50 participants<br>Sweden |
|                 | <b>Fertilizer (1)</b> | Study 5<br>50 participants<br>Italy  | Study 6<br>50 participants<br>Italy  |
|                 | <b>Fertilizer (2)</b> | Study 7<br>50 participants<br>Greece | Study 8<br>50 participants<br>Greece |

The proposed questionnaire has been structured into two main parts: questions on certifications and questions on the products.

The first part of the experiment is to grasp consumers' perception of the proposed certification scheme. Participants received structured information (a description of the scheme, its key requirements regarding sustainability and traceability, and examples of control measures used to ensure compliance) about the assigned certification scheme. The objective is to provide participants with a sufficient understanding of the certification scheme to enable informed evaluation. An example for participants in the ISCC PLUS treatment is shown in Figure 19.

**ISCC PLUS** is a voluntary certification scheme designed to validate sustainability characteristics of alternative feedstocks such as waste and residues, renewable energy-derived feedstock, but also sustainably grown agricultural raw materials and forest biomass.

Each producer interested in getting a certification scheme needs to fulfill some obligations that are called requirements.

We provide you a list of some of the **requirements** that need to be fulfilled to get ISCC PLUS certifications:

- The company has proposed strategies to protect water, soil and air quality and prevent negative impacts.
- The company shall have evaluations about the state of the biodiversity within the area and a plan to maintain and improve biodiversity.
- The company characterizes the introduced genetically modified species.
- The company ensures gender equality.
- The company applies the waste hierarchy to reduce and valorised its waste.
- The company has an energy efficiency plan in place.
- The company identifies and quantifies of the use of chemicals and hazardous substances.
- The company has established measures to track the disposal of by-products and waste.



**This logo on the product signals that the company meets all the requirements and** that it proved evidence of compliance with the requirements by sending all the documents to the Certification Body.

Figure 19. Information provided to participants for ISCC PLUS

After providing this information, based on the contribution of Janssen and Hamm (2011), we asked some questions to assess: *i*) perceived (strict) production standard, *ii*) perceived (strict) control, *iii*) familiarity with the logo, *iv*) trust toward the certification scheme.

The second step consisted of evaluating consumers' perceptions about three products (shampoo, cosmetic, fertilizer) in the above-mentioned variations (i.e., conventional product, bioproduct without certification, certified bioproduct).

An example of such a section is reported in Figure 20, which includes the example for the shampoo:

Imagine you are about to buy a shampoo and you can choose among the following alternatives:

- **Conventional** shampoo (i.e., produced with chemicals).
- **Bioproduct** (i.e., produced by recycling organic or industrial waste materials).
- **Bioproduct with certificate** (as the previous option with the RSB certificate).

A summary is shown in the following image:



Assume that the price of 1 liter of conventional shampoo is 10€.



Please indicate for each of the alternatives, how much you are willing to pay for 1 liter of shampoo (insert your answer in numbers).

Bioproduct Shampoo

Bioproduct with RSB certificate Shampoo

Imagine you are about to buy a shampoo and you can choose among the following alternatives:

- **Conventional** shampoo (i.e., produced with chemicals).
- **Bioproduct** (i.e., produced by recycling organic or industrial waste materials).
- **Bioproduct with certificate** (as the previous option with the ISCC PLUS certificate).

A summary is shown in the following image:



Assume that the price of 1 liter of conventional shampoo is 10€.



Please indicate for each of the alternatives, how much you are willing to pay for 1 liter of shampoo (insert your answer in numbers).

Bioproduct Shampoo

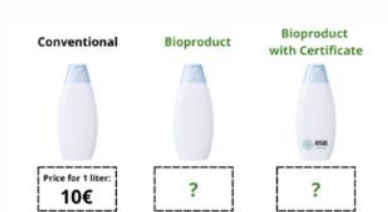
Bioproduct with ISCC PLUS certificate Shampoo

Figure 20. Information provided to participants for ISCC PLUS (left) and RSB certificate (right)

We replicated such sections for each group of consumers, depending on the products (Shampoo, Fertilizer, Cosmetic cream) and certification (ISCC PLUS, RSB). Since the prices of such products may be different, we proposed different reference prices for the conventional product, as reported in Figure 21 below, namely: 1 litre of shampoo 10€<sup>10</sup>; 1 litre of fertilizer 15€; 100 ml of cosmetic cream 10€.

<sup>10</sup> We deploy the conventional symbol € to indicate Euro.

Assume that the price of 1 liter of conventional shampoo is 10€.



Assume that the price of 1 liter of conventional shampoo is 10€.



Assume that the price of 1 liter of fertilizer is 15€.



Assume that the price of 1 liter of fertilizer is 15€.



Assume that the price of 100 ml of conventional cosmetic cream (purifying scrub, face cream) is 10€.



Assume that the price of 100 ml of conventional cosmetic cream (purifying scrub, face cream) is 10€.



Figure 21. Reference prices for the three products

We also assessed their perceived risk with the following question: "How much do you agree with the following statement on a scale from 1 (strongly disagree) to 7 (strongly agree)?"

Table 9. Questions to assess participants' perceived risks

|                                                                                                                             | conventional | bioproduct | bioproduct with certificate |
|-----------------------------------------------------------------------------------------------------------------------------|--------------|------------|-----------------------------|
| There is a chance that there will be something wrong with this product and will not provide the level of benefit I expected |              |            |                             |
| The production of this product causes direct or indirect damage to the environment (e.g. water pollution)                   |              |            |                             |
| The use of this product causes direct or indirect effect on my health (e.g. allergic reaction)                              |              |            |                             |

Finally, we asked for some general information such as socio-demographic factors, prior familiarity with bioproduct products, and general sustainability concerns. The experiment

has been conducted in English, selecting participants from the Prolific platform who declared to be fluent in such language.

## 5.4 Main results

This section presents the results of the analysis conducted across three products: cosmetic cream, fertilizer, and shampoo. For each product, participants evaluated three variants: a conventional version (baseline), a bioproduct product without certification, and a certified bioproduct product. Two certification schemes were tested: ISCC PLUS and RSB. Recall that the main aim of the experiment was to assess whether certification schemes have an impact on consumers' purchase intention measured through both their willingness to pay and by the declared probability to buy a specific good. Furthermore, since we consider two different certificates, the results also allow for a cross-comparison of the efficacy of other certifications.

Table 10 reports the descriptive statistics of the willingness to pay for all the proposed versions of the bioproducts, for both ISCC PLUS and RSB certificate.

Table 10. Descriptive statistics of WTP

| Variable                      | Mean  | Std. Dev. | Min | Max | Obs |
|-------------------------------|-------|-----------|-----|-----|-----|
| <i>Cosmetic – ISCC PLUS</i>   |       |           |     |     |     |
| WTP bio                       | 12.17 | 6.266     | 5   | 50  | 50  |
| WTP bio cert                  | 15.12 | 9.192     | 7.5 | 60  | 50  |
| <i>Cosmetic – RSB</i>         |       |           |     |     |     |
| WTP bio                       | 11.58 | 3.990     | 4   | 30  | 50  |
| WTP bio cert                  | 14.66 | 7.531     | 6   | 60  | 50  |
| <i>Fertilizer – ISCC PLUS</i> |       |           |     |     |     |
| WTP bio                       | 17.07 | 7.137     | 7   | 80  | 100 |
| WTP bio cert                  | 19.83 | 7.085     | 10  | 70  | 100 |
| <i>Fertilizer – RSB</i>       |       |           |     |     |     |
| WTP bio                       | 16.87 | 3.602     | 6   | 30  | 100 |
| WTP bio cert                  | 19.47 | 5.687     | 7   | 50  | 100 |
| <i>Shampoo – ISCC PLUS</i>    |       |           |     |     |     |
| WTP bio                       | 11.13 | 2.573     | 5   | 20  | 50  |
| WTP bio cert                  | 12.75 | 3.844     | 5   | 30  | 50  |
| <i>Shampoo – RSB</i>          |       |           |     |     |     |
| WTP bio                       | 11.55 | 1.882     | 3   | 15  | 50  |
| WTP bio cert                  | 13.32 | 3.079     | 5   | 25  | 50  |

As it is clearly visible across all product categories and certification schemes, participants reported on average higher WTP for bioproducts relative to conventional benchmarks. This indicates the presence of a green premium (Biswas and Roy, 2016; Carus et al., 2014), whereby consumers attribute additional value to products derived from sustainable or alternative feedstocks.

Analyzing data related to the cosmetic cream, participants in the ISCC PLUS group reported a mean WTP of €12.17 for the bioproduct, compared to the €10 reference price of the conventional product. In the RSB group, WTP was slightly lower but still above the conventional (€11.58). As regards the fertilizer, the average WTP for the bioproduct was €17.07 in the ISCC PLUS group and €16.87 in the RSB group, both exceeding the conventional reference price of €15. The same pattern is visible for the shampoo, since bioproducts were valued at €11.13 (ISCC PLUS) and €11.55 (RSB), relative to the conventional price of €10.

Another key result is that the presence of certification signalled by the logo resulted in a further increase in WTP across all product categories and both certification schemes. This effect, referred to as the certified green premium (Morone et al., 2021), highlights the role of third-party verification in enhancing product credibility and perceived sustainability.

In fact, the certified bioproduct variant of the cosmetic cream shows higher average WTPs: €15.12 (ISCC PLUS) and €14.66 (RSB), compared to €12.17 and €11.58 for the uncertified bioproduct versions. The same is true for the fertilizer, since WTP increased to €19.83 in the ISCC PLUS group and €19.47 in the RSB group, from respective base values of €17.07 and €16.87. Also for the shampoo, participants in the ISCC PLUS group reported an average WTP of €12.75 for the certified bioproduct version, while the RSB group showed a similar value at €13.32.

These results are visually confirmed by the corresponding boxplots (Figure 22), where the WTP distributions for bioproduct products (blue boxes) consistently lie above the red horizontal reference lines representing the price of conventional products, and the larger WTPs are also evident in the orange boxplots, which display higher medians and broader upper quartiles compared to their uncertified counterparts.

While the presence of certification seems to be associated with a higher average WTP, the results show no substantial difference in consumer perception between ISCC PLUS and RSB. Across all three product categories, the magnitude of the certified green premium was comparable between the two certification schemes, and this is clearly visible from the box plots in Figure 22, Figure 23 and Figure 24.

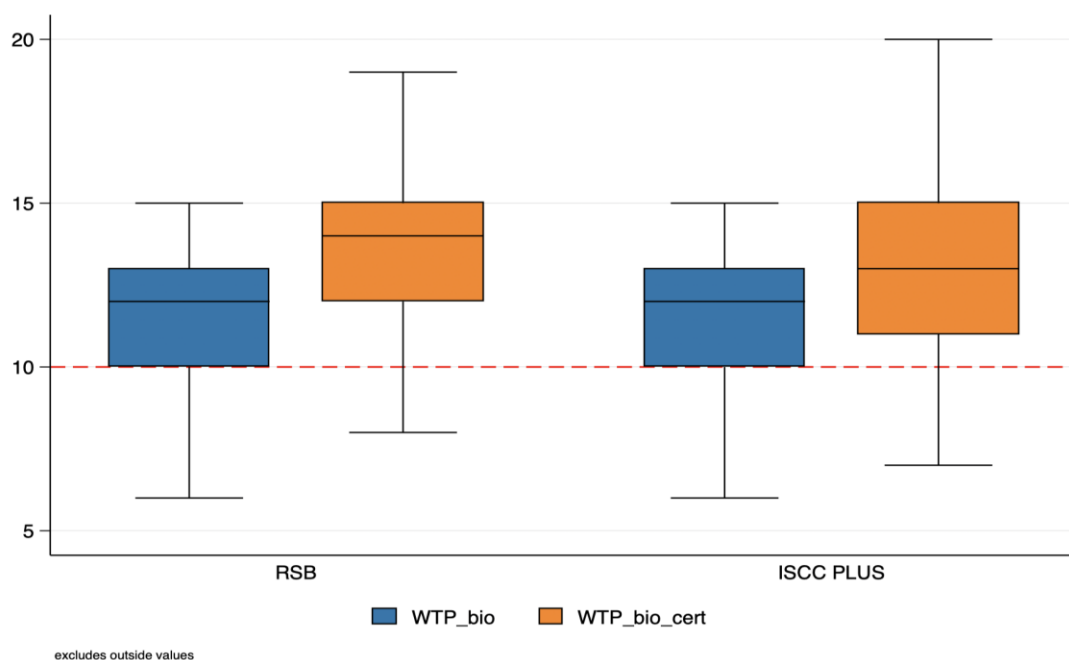


Figure 22. WTP for cosmetic bioproduct (blue box) and bioproduct with certificate (orange box) across RSB and ISCC PLUS certificates, respectively on the left and on the right. The red line represents the reference price of the conventional product.

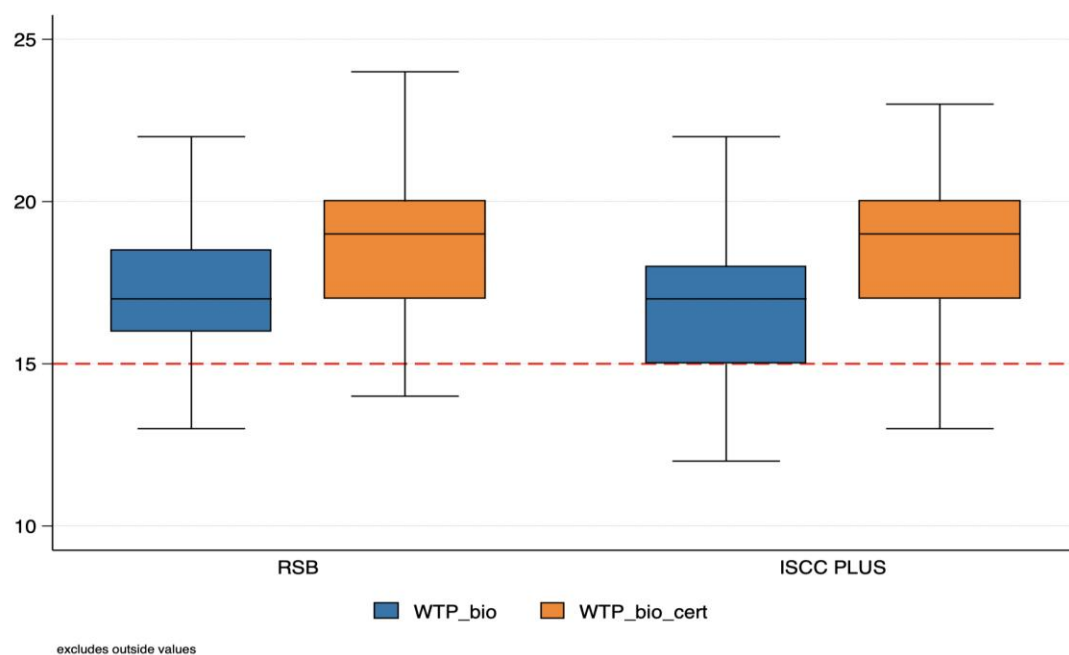


Figure 23. WTP for fertilizer bioproduct (blue box) and bioproduct with certificate (orange box) across RSB and ISCC certificates, respectively on the left and on the right. The red line represents the reference price of the conventional product.

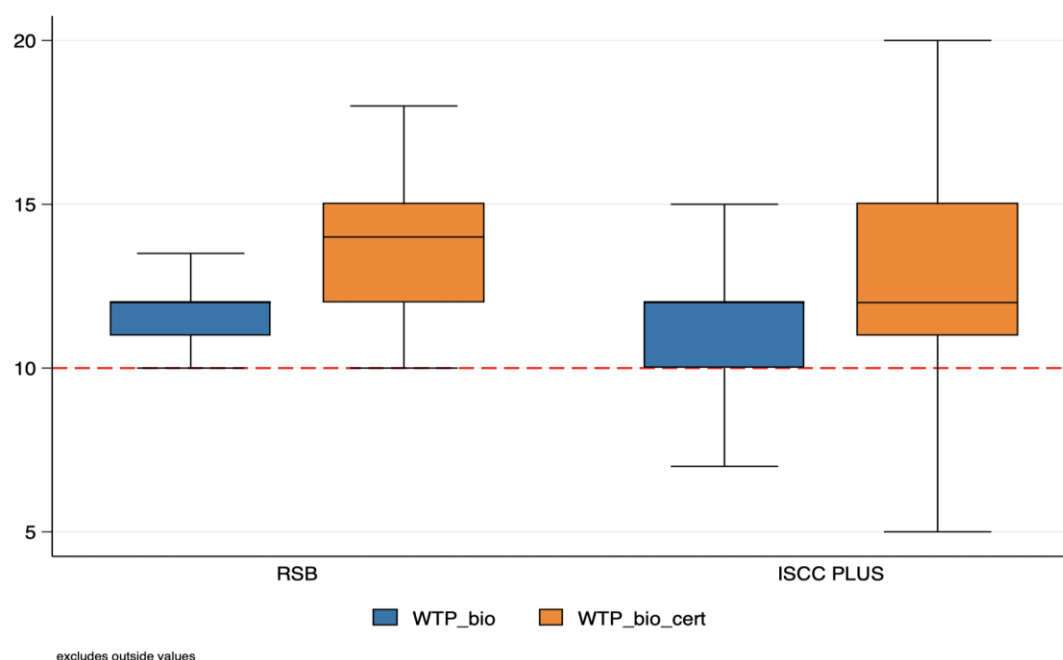


Figure 24. WTP for shampoo bioproduct (blue box) and bioproduct with certificate (orange box) across RSB and ISCC certificates, respectively on the left and on the right. The red line represents the reference price of the conventional product.

Despite the importance of analyzing the WTP, it is also essential to investigate the consumers' PI for each alternative product. The PI variable was measured by the respondent's answer to the question "On a scale from 1 to 100%, the probability I would consider buying the product is". Each respondent evaluated both the bioproduct version without certification and the certified bioproduct version, with certification provided by either ISCC PLUS or RSB, depending on the treatment group in which they were involved.

In the case of fertilizer, as visible from Figure 25, participants showed moderately strong PI for the bioproduct version, which increased further when certification was introduced. For the ISCC PLUS group, the average PI rose from 65.19% for the uncertified bioproduct fertilizer to 74.29% for the certified version. A similar pattern was observed in the RSB group, with average PI increasing from 67.47% to 75.69%. These results suggest that the presence of a sustainability certification positively influences consumers' behavioural intentions, enhancing the perceived reliability and desirability of the product.

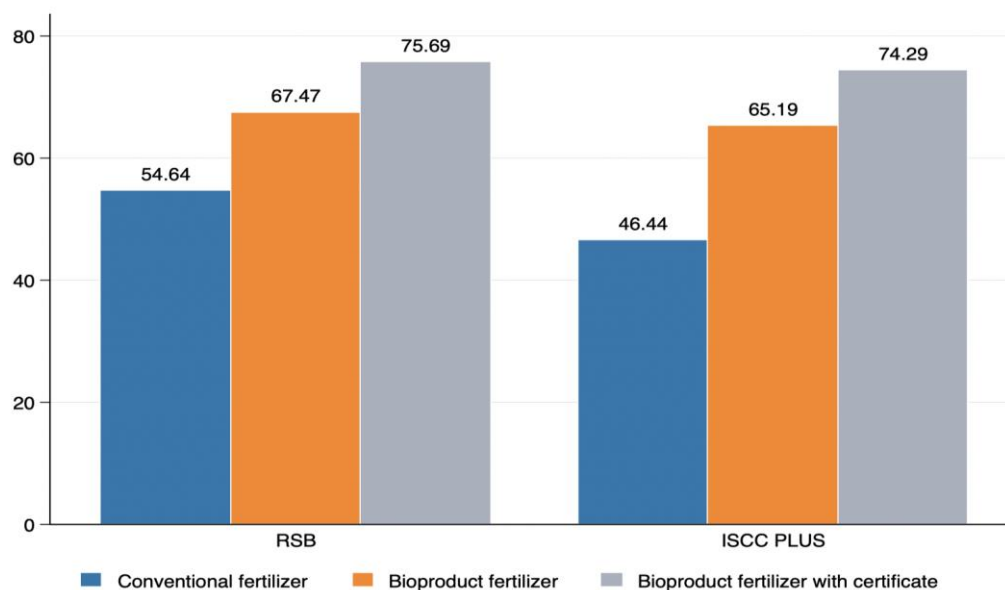


Figure 25. Purchase intention for the fertilizer. Over each bar, average values are reported.

For cosmetic cream, the average PI values also showed an upward trend when certification was added, although the effect size was somewhat smaller compared to fertilizer. In the ISCC PLUS group, as shown in Figure 26, the mean PI increased from 60.82 for the bioproduct product to 70.06 when certified, while in the RSB group, the increase was from 63.44 to 72.24. This indicates that although certification still plays a role in reinforcing PI, the degree of influence may vary depending on the product category and the perceived relevance of certification to that type of good.

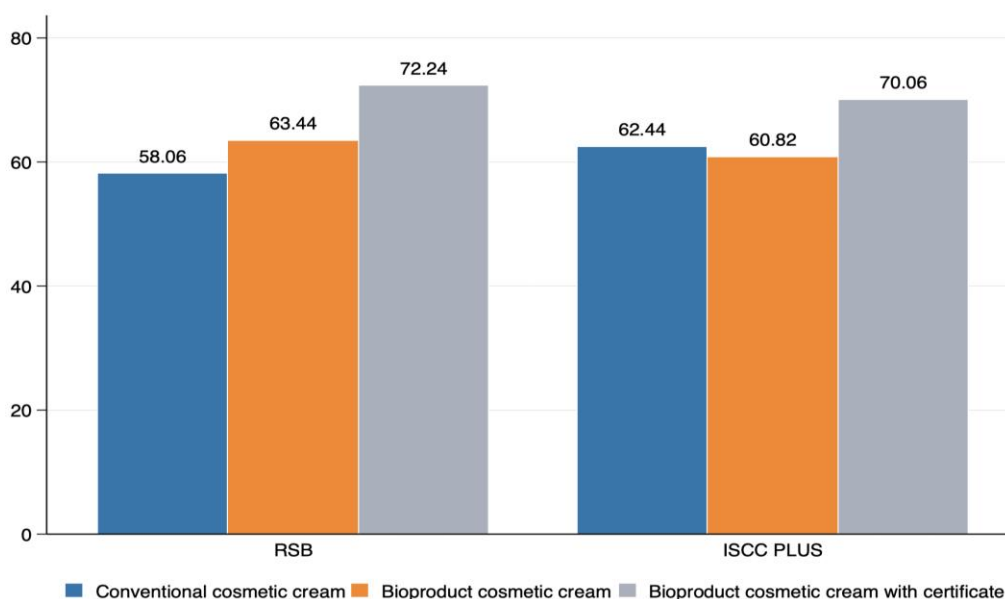


Figure 26. Purchase intention for the cosmetic cream. Over each bar, average values are reported.

Shampoo registered the highest PI scores among all three products, with both certification groups showing values well above the midpoint of the scale. As emerged in Figure 27, in the ISCC PLUS group, the mean PI increased from 54.18 for the bioproduct shampoo to 62.92 for the certified version. In the RSB group, the respective values were 64.59 and 71.57. These high scores suggest that consumers are particularly receptive to sustainable innovations in personal care products, likely due to their frequent usage and lower perceived risk, which may make consumers more willing to experiment with certified bioproduct alternatives.

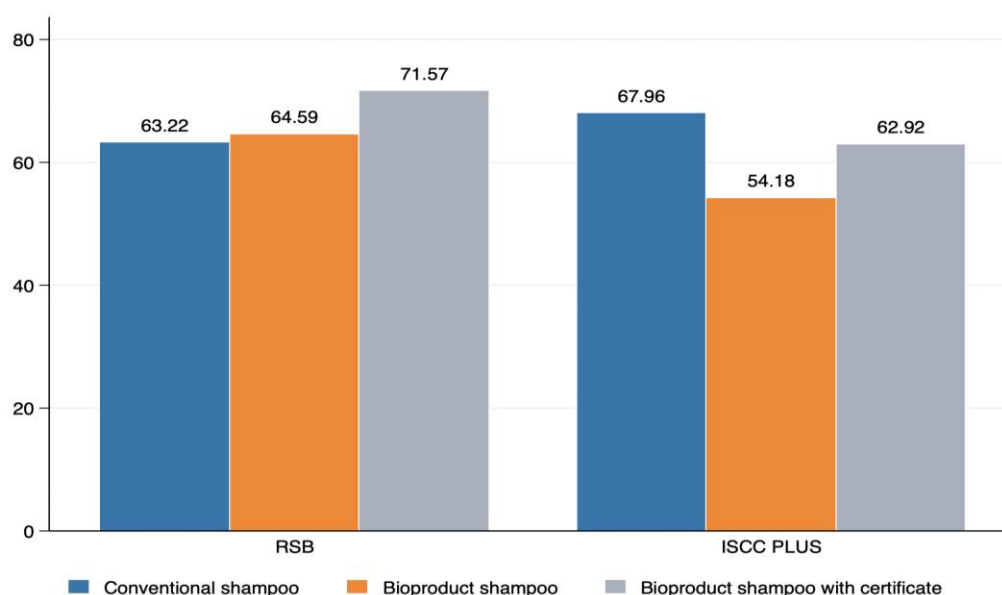


Figure 27. Purchase intention for the shampoo. Over each bar, average values are reported.

Overall, the data confirm that purchase intention toward bioproduct products is generally positive across all product types and that third-party certification enhances this intention in a consistent and meaningful way. Furthermore, no substantial differences emerged between ISCC PLUS and RSB, suggesting that both certification schemes are similarly effective in reinforcing consumer trust and driving behavioural intent. Notably, shampoo elicited the strongest PI, which may reflect higher consumer openness to sustainability features in everyday personal care products compared to categories such as fertilizer or cosmetics. These findings are consistent with those obtained in the previous WTP analysis and also in the literature (see Morone et al., 2021) that highlights different consumers' attitudes and purchase intentions regarding personal care frequently used products. This reinforces the conclusion that certification not only increases the monetary value attributed to sustainable products but also strengthens consumers' stated likelihood of purchasing them. It is worth noting that, as the data were collected across various countries, the observed heterogeneity in WTP may also reflect divergent pro-environmental attitudes between the different geographical contexts. Indeed, in some countries, people place more

weight on environmentally related aspects, and this could imply a different evaluation of these attributes when buying a product. Despite these insightful findings, the results should be interpreted with caution regarding their generalizability, given the specific nature of the sample and the potential influence of unobserved heterogeneity across the different countries.

Finally, to further explore the role of certification in shaping consumer attitudes, we analyzed perceived risk along three key dimensions: performance risk, health risk, and environmental risk. Each was measured using a 7-point Likert scale (1 strongly agree; 7 strongly disagree) in response to the following statements:

- “There is a chance that there will be something wrong with this product and it will not provide the level of benefit I expected” (performance risk);
- “The use of the product causes direct or indirect effects on my health (e.g., allergic reaction)” (health risk);
- “The production of this product causes direct or indirect damage to the environment (e.g., water pollution)” (environmental risk).

Participants evaluated all three product types—conventional, bioproduct, and certified bioproduct—across these risk dimensions. Across all three risk categories, the results show that certified bioproduct products are consistently associated with lower levels of perceived risk when compared to both conventional products and uncertified bioproduct alternatives. Results are reported in Figure 28, Figure 29 and Figure 30.

In terms of performance risk (Figure 28), participants expressed greater concerns toward conventional and uncertified bioproduct products, with the lowest perceived risk observed for the certified bioproduct alternatives. This suggests that certification serves as a signal of product reliability, helping to reassure consumers that sustainability does not come at the cost of effectiveness.

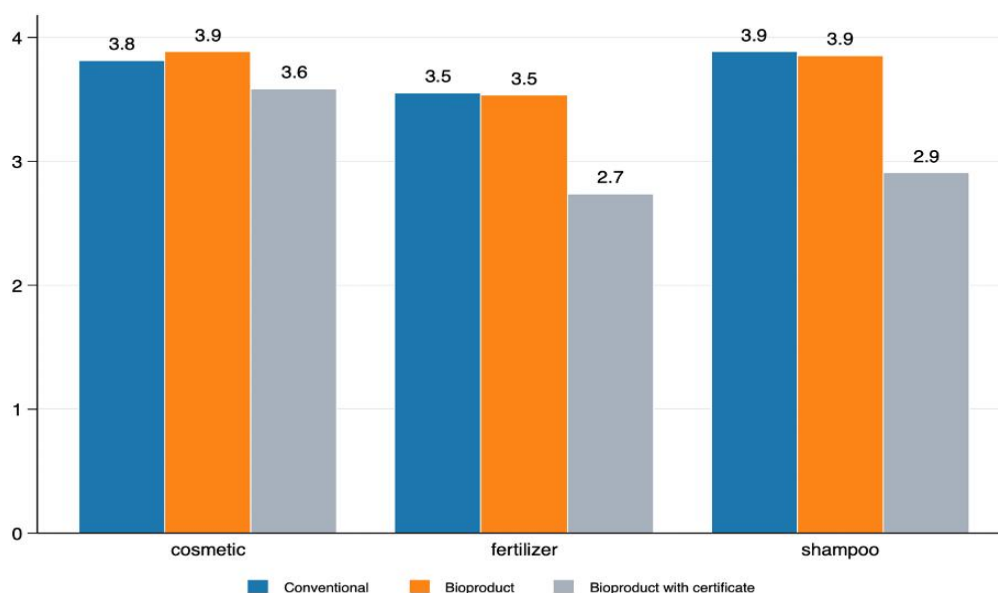


Figure 28. Performance risk.

Average values are reported on the individual evaluation on a value scale ranging from 1 (strongly agree) to 7 (strongly disagree)

A similar trend emerged for health risk (Figure 29), where certified bioproduct products were perceived as safer to use. The reduction in health-related concerns indicates that certification may also convey an implicit guarantee of quality control and safety standards, particularly important in product categories like cosmetics and personal care.

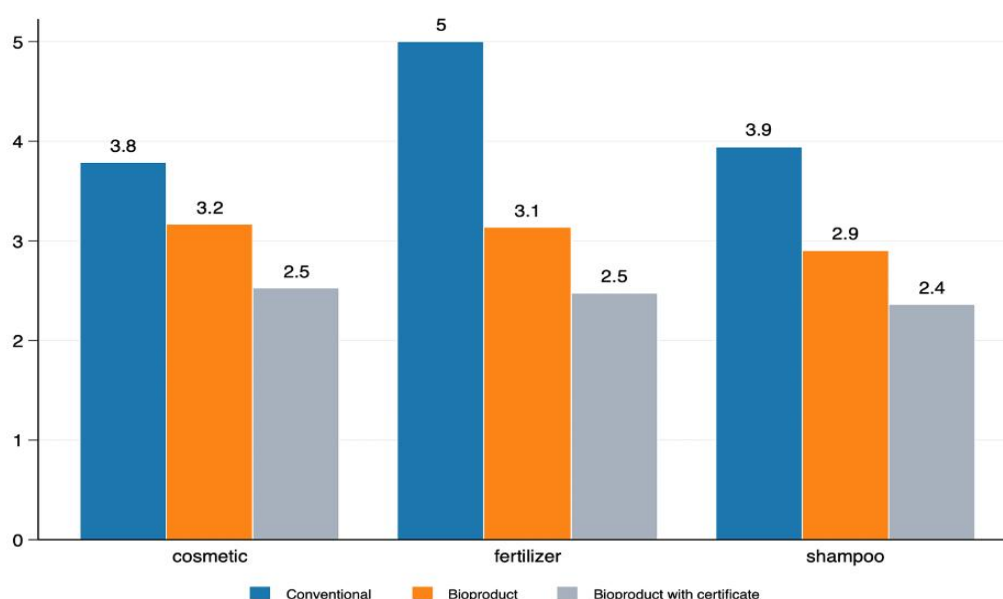


Figure 29. Health risk

Average values are reported on the individual evaluation on a value scale ranging from 1 (strongly agree) to 7 (strongly disagree)

For environmental risk (Figure 30), certification again played a clear mitigating role. Certified products were consistently seen as causing less environmental harm, even compared to bioproduct products without certification. This result reinforces the role of certification as a trusted signal of environmental responsibility, lending credibility to claims about the sustainability of production processes and materials.

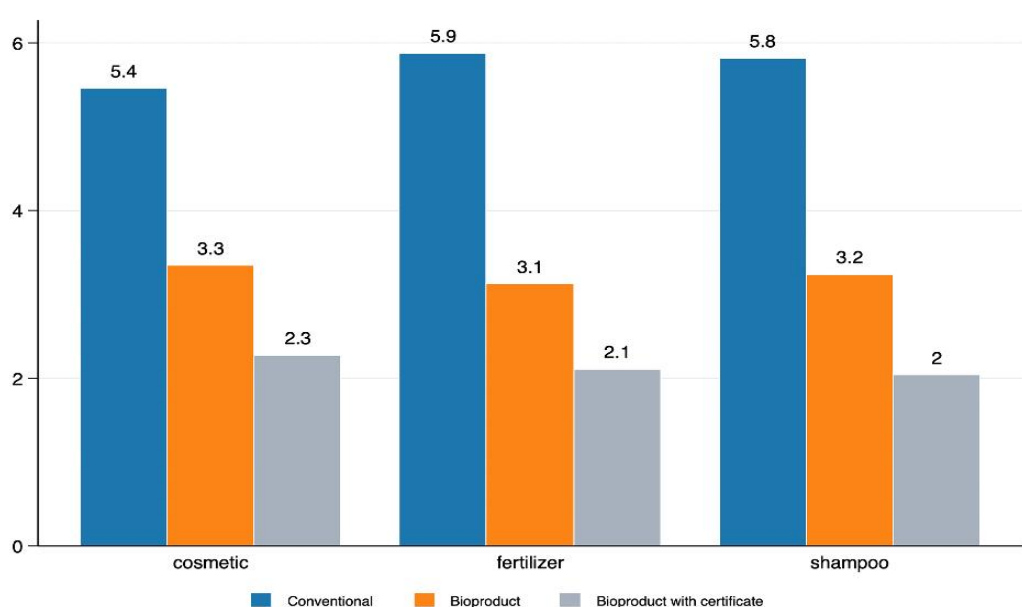


Figure 30. Environmental risk

Average values are reported on the individual evaluation on a value scale ranging from 1 (strongly agree) to 7 (strongly disagree)

Overall, this evidence supports the fact that certifications not only influence economic preferences (as seen in the WTP and PI analyses) but also help reduce cognitive barriers to adoption by mitigating concerns related to product performance, personal health, and environmental impact.

## 6 Conclusion

This report offers a comprehensive description of the socio-economic analysis aimed at supporting the adaptation of existing certification schemes in alignment with stakeholders' needs and expectations. By combining qualitative and quantitative methodologies (i.e., Delphi survey, Analytic Hierarchy Process (AHP), and an artefactual field experiment) the study successfully involved a wide set of relevant stakeholders, including consumers, industries, and experts in the bioeconomy and sustainability sectors. All the details of the analysis were discussed in depth in several meetings either regular WP meetings or bilateral meetings with key partners (e.g., USC, MCS, ACN).

Despite the set of stakeholders, the countries they belong to and the methodology deployed, a clear and consistent preference for a specific requirement emerged, named "The company measures its carbon emissions and has established a reduction plan." This requirement not only represents consumers and industry needs but it is also in line with the European Green Deal's target of achieving significant carbon emissions reductions by 2030. Its relevance was further validated through the AHP analysis conducted with experts.

The experimental evidence collected considering a wide sample of 400 consumers across 4 European countries showed the importance of certification especially for bioproducts. Moreover, the experiment demonstrated that certification schemes positively influence consumer behaviour, since they increase consumers' trust in bioproducts and mitigate perceived risks related to performance, health, and environmental impact. These results reinforce the strategic role that certification schemes can play in promoting sustainability and enhancing market acceptance for innovative bioproducts.

The findings of this analysis will be instrumental in guiding the integration of the BioReCer impact and traceability assessment framework into existing certification schemes. They also offer practical insights for future research, particularly on how certification can shape consumer acceptance and, as a consequence, foster sustainable innovation.

The main barriers we faced to getting the results rely on two major aspects. The first one relies on the difficulty, for some of the involved stakeholders, to understand some aspects of our analysis. Indeed, we needed to postpone the launch of the Delphi Survey and explained the mechanism during a meeting. The second issue refers to the field experiment. Even though the artefactual online field experiment had the same validity as other types of field experiments, collecting data through a framed field experiment in which subjects could also have the real product would have reduced the potential bias related to the hypothetical choice.

We may conclude that all the activities listed in Task 3 have been successfully completed. In the next months we will try to further increase the number of stakeholders engaged in

the BioReCer project especially through the BRSP. This deliverable D4.2 was written by UNITELMA with the support of all the project's partners. The results collected and presented in the current document are useful to understand the stakeholders' relevance for the BioReCer project and to assess their needs in terms of certification schemes.

## 7 List of abbreviations

|      |                                                     |
|------|-----------------------------------------------------|
| AHP  | Analytic Hierarchy Process                          |
| BRIE | Bioresources Innovation Ecosystem                   |
| BRSP | BioResources Stakeholders Platform                  |
| CS   | Case Study                                          |
| ES   | Spain                                               |
| ISCC | International Sustainability & Carbon Certification |
| IT   | Italy                                               |
| LL   | Living Lab                                          |
| MCS  | Meo Carbon Solutions GmbH                           |
| MFA  | Material Flow Analysis                              |
| PI   | Purchase Intention                                  |
| RSB  | Roundtable on Sustainable Biomaterials              |
| SW   | Sweden                                              |
| TM   | Targeted metrics                                    |
| T&T  | Tracking and traceability                           |
| USC  | Universidad de Santiago de Compostela               |
| WTP  | Willingness to Pay                                  |
| WP   | Work Package                                        |

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## 9 Annex A – Delphi survey Questionnaire

### Welcome to the Delphi survey - Round 1

BioReCer (Biological Resources Certifications Schemes) aims at assessing and complementing current certification schemes for biological resources according to the new EU sustainability goals to enhance bioproduct circular systems.

This will be achieved by including new criteria that align with EU taxonomy and EU corporate due diligence regulations into guidelines for certifying biological resources' sustainability, origin, tracking and traceability (T&T), and by ensuring applicability at EU and global scale. This project is based on the ongoing dialogue with stakeholders to grasp their needs and consider them in the whole process.

To this extent, the current survey aims to collect feedback about new requirements that can be adopted to improve and adapt the certification schemes.

We will ask you to read carefully the following sentences before providing an answer: your opinion matters!

The actual certification schemes provide a framework to verify that production processes minimize environmental impacts, such as habitat destruction and biodiversity loss. However, improving the actual certification schemes for sustainable practices in bioproduct industries is crucial for effectively ensuring the protection of ecosystems.

Please rate on a scale from 1 (not at all) to 10 (a great deal) how much you think it is important to include the following requirement in the existing certification schemes, regarding the company's development strategies of mitigation and adapting to climate change:

1 2 3 4 5 6 6 7 8 9 10

Requirement 1: **"The company measures its carbon emissions and has established a reduction plan" ( )**



Please rate on a scale from 1 (completely disagree) to 5 (totally agree) how much you agree on the following barriers related to the potential inclusion in the certification schemes of the

**Requirement 1 "The company measures its carbon emissions and has established a reduction plan"**

|                                                                                                                                                    |   |   |   |   |   |
|----------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---|---|---|
| Presents high implementation costs (1)                                                                                                             | ★ | ★ | ★ | ★ | ★ |
| Adds complexity to existing processes and management systems (2)                                                                                   | ★ | ★ | ★ | ★ | ★ |
| Involves ongoing costs to maintain compliance with the specific requirement (3)                                                                    | ★ | ★ | ★ | ★ | ★ |
| Compliance to the requirement may lead to increased price for consumer (4)                                                                         | ★ | ★ | ★ | ★ | ★ |
| Consumers may not easily recognize the benefits in terms of health, safety, and ethics generated by the compliance to the specific requirement (5) | ★ | ★ | ★ | ★ | ★ |
| Adds to the administrative burden of compliance/Requires extensive documentation (6)                                                               | ★ | ★ | ★ | ★ | ★ |
| Challenges in ensuring compliance along the whole supply chain (7)                                                                                 | ★ | ★ | ★ | ★ | ★ |

Please rate on a scale from 1 (completely disagree) to 5 (totally agree) how much you agree on the following pros/benefits related to the potential inclusion in the certification schemes of Requirement 1 **"The company measures its carbon emissions and has established a reduction plan"**

|                                                                                                          |   |   |   |   |   |
|----------------------------------------------------------------------------------------------------------|---|---|---|---|---|
| Boosts corporate public image (reputation) and brand value (1)                                           | ★ | ★ | ★ | ★ | ★ |
| Provides a competitive advantage over companies who are not compliant with this specific requirement (2) | ★ | ★ | ★ | ★ | ★ |
| Attracts investment from capital providers (investors) with a higher commitment to sustainability (3)    | ★ | ★ | ★ | ★ | ★ |
| Improves the quality and the safety of products offered, ensuring consumer protection. (4)               | ★ | ★ | ★ | ★ | ★ |

|                                                                                                                   |   |   |   |   |   |
|-------------------------------------------------------------------------------------------------------------------|---|---|---|---|---|
| Promotes responsible innovation and new products and processes development (5)                                    | ★ | ★ | ★ | ★ | ★ |
| Promotes more efficient use of resources (6)                                                                      | ★ | ★ | ★ | ★ | ★ |
| Leads to long-term cost savings for the industry and, hence, has the potential to reduce prices for consumers (7) | ★ | ★ | ★ | ★ | ★ |

Sustainability has to be evaluated not only from the environmental, but also from the socio-economic pillar. The actual certification schemes provide a framework to verify that production processes are in line with socio-economic sustainability. However, improving the actual certification schemes for sustainable practices in bioproduct industries is crucial for effectively ensuring socio-economic sustainability.

Please rate on a scale from 1 (not at all) to 10 (a great deal) how much you think it is important to include the following requirement in the existing certification schemes, regarding the company's activities to ensure of the quality and traceability of its products

|                                                                                     |                                                                                      |   |   |   |   |   |   |   |   |   |    |
|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|---|---|---|---|---|---|---|---|---|----|
|                                                                                     | 1                                                                                    | 2 | 3 | 4 | 5 | 6 | 6 | 7 | 8 | 9 | 10 |
| Requirement 2: "The company promotes the use of materials with bio-based origin" () |  |   |   |   |   |   |   |   |   |   |    |

Please rate on a scale from 1 (completely disagree) to 5 (totally agree) how much you agree on the following barriers related to the potential inclusion in the certification schemes of the Requirement 2 "The company promotes the use of materials with **bio-based origin**"

|                                                                                                                                                       |                                                                                     |                                                                                     |                                                                                     |                                                                                       |                                                                                       |
|-------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Presents high implementation costs<br>(1)                                                                                                             |    |    |    |    |    |
| Adds complexity to existing processes and management systems<br>(2)                                                                                   |    |    |    |    |    |
| Involves ongoing costs to maintain compliance with the specific requirement (3)                                                                       |    |    |    |    |    |
| Compliance to the requirement may lead to increased price for consumer (4)                                                                            |   |   |   |   |   |
| Consumers may not easily recognize the benefits in terms of health, safety, and ethics generated by the compliance to the specific requirement<br>(5) |  |  |  |  |  |
| Adds to the administrative burden of compliance/Requires extensive documentation (6)                                                                  |  |  |  |  |  |
| Challenges in ensuring compliance along the whole supply chain (7)                                                                                    |  |  |  |  |  |

Please rate on a scale from 1 (completely disagree) to 5 (totally agree) how much you agree on the following pros/benefits related to the potential inclusion in the certification schemes of the Requirement 2 "**The company promotes the use of materials with bio-based origin**"

|                                                                                                          |   |   |   |   |   |
|----------------------------------------------------------------------------------------------------------|---|---|---|---|---|
| Boosts corporate public image (reputation) and brand value (1)                                           | ★ | ★ | ★ | ★ | ★ |
| Provides a competitive advantage over companies who are not compliant with this specific requirement (2) | ★ | ★ | ★ | ★ | ★ |
| Attracts investment from capital providers (investors) with a higher commitment to sustainability (3)    | ★ | ★ | ★ | ★ | ★ |
| Improves the quality and the safety of products offered, ensuring consumer protection. (4)               | ★ | ★ | ★ | ★ | ★ |
| Promotes responsible innovation and new products and processes development (5)                           | ★ | ★ | ★ | ★ | ★ |
| Promotes more efficient use of resources (6)                                                             | ★ | ★ | ★ | ★ | ★ |

Leads to long-term cost savings for the industry and, hence, has the potential to reduce prices for consumers  
(7)



The actual certification schemes provide a framework to verify that production processes respect the circular economy principles. However, improving the actual certification schemes can be useful to ensure circularity under the economic pillar effectively.

Please rate on a scale from 1 (not at all) to 10 (a great deal) how much you think it is important to include the following requirement in the existing certification schemes, regarding the company's activities to promote innovation and procurement to create value

1 2 3 4 5 6 6 7 8 9 10

Requirement 3: **"The company allocates resources to research and develop circular economy strategies within its value chain" ( )**



Please rate on a scale from 1 (completely disagree) to 5 (totally agree) how much you agree on the following barriers related to the potential inclusion in the certification schemes of the Requirement 3 **"The company allocates resources to research and develop circular economy strategies within its value chain"**

|                                                                                                                                                       |                                                                                     |                                                                                     |                                                                                     |                                                                                       |                                                                                       |
|-------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Presents high implementation costs<br>(1)                                                                                                             |    |    |    |    |    |
| Adds complexity to existing processes and management systems<br>(2)                                                                                   |    |    |    |    |    |
| Involves ongoing costs to maintain compliance with the specific requirement (3)                                                                       |    |    |    |    |    |
| Compliance to the requirement may lead to increased price for consumer (4)                                                                            |  |  |  |  |  |
| Consumers may not easily recognize the benefits in terms of health, safety, and ethics generated by the compliance to the specific requirement<br>(5) |  |  |  |  |  |
| Adds to the administrative burden of compliance/Requires extensive documentation (6)                                                                  |  |  |  |  |  |
| Challenges in ensuring compliance along the whole supply chain (7)                                                                                    |  |  |  |  |  |

Please rate on a scale from 1 (completely disagree) to 5 (totally agree) how much you agree on the following pros/benefits related to the potential inclusion in the certification schemes of the Requirement 3 **"The company allocates resources to research and develop circular economy strategies within its value chain"**

|                                                                                                          |   |   |   |   |   |
|----------------------------------------------------------------------------------------------------------|---|---|---|---|---|
| Boosts corporate public image (reputation) and brand value (1)                                           | ★ | ★ | ★ | ★ | ★ |
| Provides a competitive advantage over companies who are not compliant with this specific requirement (2) | ★ | ★ | ★ | ★ | ★ |
| Attracts investment from capital providers (investors) with a higher commitment to sustainability (3)    | ★ | ★ | ★ | ★ | ★ |
| Improves the quality and the safety of products offered, ensuring consumer protection. (4)               | ★ | ★ | ★ | ★ | ★ |
| Promotes responsible innovation and new products and processes development (5)                           | ★ | ★ | ★ | ★ | ★ |
| Promotes more efficient use of resources (6)                                                             | ★ | ★ | ★ | ★ | ★ |

Leads to long-term cost savings for the industry and, hence, has the potential to reduce prices for consumers  
(7)



The actual certification schemes provide a framework to verify that production processes respect the environment, in light of circular economy principles. However, improving the actual certification schemes can be useful to ensure circularity under the environmental pillar effectively.

Please rate on a scale from 1 (not at all) to 10 (a great deal) how much you think it is important to include the following requirement in the existing certification schemes, regarding the company's activities to promote the substitution of virgin materials by secondary raw materials

1 2 3 4 5 6 6 7 8 9 10

Requirement 4: "The company achieves goals of reduction or substitution of resources" ()



Please rate on a scale from 1 (completely disagree) to 5 (totally agree) how much you agree on the following barriers related to the potential inclusion in the certification schemes of the Requirement 4 **"The company achieves goals of reduction or substitution of resources"**

|                                                                                                                                                       |                                                                                     |                                                                                     |                                                                                     |                                                                                       |                                                                                       |
|-------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Presents high implementation costs<br>(1)                                                                                                             |    |    |    |    |    |
| Adds complexity to existing processes and management systems<br>(2)                                                                                   |    |    |    |    |    |
| Involves ongoing costs to maintain compliance with the specific requirement (3)                                                                       |    |    |    |    |    |
| Compliance to the requirement may lead to increased price for consumer (4)                                                                            |   |   |   |   |   |
| Consumers may not easily recognize the benefits in terms of health, safety, and ethics generated by the compliance to the specific requirement<br>(5) |  |  |  |  |  |
| Adds to the administrative burden of compliance/Requires extensive documentation (6)                                                                  |  |  |  |  |  |
| Challenges in ensuring compliance along the whole supply chain (7)                                                                                    |  |  |  |  |  |

Please rate on a scale from 1 (completely disagree) to 5 (totally agree) how much you agree on the following pros/benefits related to the potential inclusion in the certification schemes of the Requirement 4 "**The company achieves goals of reduction or substitution of resources**"

|                                                                                                          |   |   |   |   |   |
|----------------------------------------------------------------------------------------------------------|---|---|---|---|---|
| Boosts corporate public image (reputation) and brand value (1)                                           | ★ | ★ | ★ | ★ | ★ |
| Provides a competitive advantage over companies who are not compliant with this specific requirement (2) | ★ | ★ | ★ | ★ | ★ |
| Attracts investment from capital providers (investors) with a higher commitment to sustainability (3)    | ★ | ★ | ★ | ★ | ★ |
| Improves the quality and the safety of products offered, ensuring consumer protection. (4)               | ★ | ★ | ★ | ★ | ★ |
| Promotes responsible innovation and new products and processes development (5)                           | ★ | ★ | ★ | ★ | ★ |
| Promotes more efficient use of resources (6)                                                             | ★ | ★ | ★ | ★ | ★ |

Leads to long-term cost savings for the industry and, hence, has the potential to reduce prices for consumers  
(7)



The actual certification schemes provide a framework to verify that production processes respect the environment, in light of circular economy principles. However, improving the actual certification schemes can be useful to ensure circularity under the environmental pillar effectively.

Please rate on a scale from 1 (not at all) to 10 (a great deal) how much you think it is important to include the following requirement in the existing certification schemes, regarding the company's activities to design and manufacture products and assets taking into account circular economy strategies

1 2 3 4 5 6 6 7 8 9 10

Requirement 5: **"The company can demonstrate that its products have comparable characteristics and quality as its conventional counter part" ( )**



Please rate on a scale from 1 (completely disagree) to 5 (totally agree) how much you agree on the following barriers related to the potential inclusion in the certification schemes of the Requirement 5 **"The company can demonstrate that its products have comparable characteristics and quality as its conventional counterpart"**

|                                                                                                                                                       |                                                                                     |                                                                                     |                                                                                     |                                                                                       |                                                                                       |
|-------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Presents high implementation costs<br>(1)                                                                                                             |    |    |    |    |    |
| Adds complexity to existing processes and management systems<br>(2)                                                                                   |    |    |    |    |    |
| Involves ongoing costs to maintain compliance with the specific requirement (3)                                                                       |    |    |    |    |    |
| Compliance to the requirement may lead to increased price for consumer (4)                                                                            |  |  |  |  |  |
| Consumers may not easily recognize the benefits in terms of health, safety, and ethics generated by the compliance to the specific requirement<br>(5) |  |  |  |  |  |
| Adds to the administrative burden of compliance/Requires extensive documentation (6)                                                                  |  |  |  |  |  |
| Challenges in ensuring compliance along the whole supply chain (7)                                                                                    |  |  |  |  |  |

Please rate on a scale from 1 (completely disagree) to 5 (totally agree) how much you agree on the following pros/benefits related to the potential inclusion in the certification schemes of the Requirement 5 **"The company can demonstrate that its products have comparable characteristics and quality as its conventional counterpart"**

|                                                                                                          |   |   |   |   |   |
|----------------------------------------------------------------------------------------------------------|---|---|---|---|---|
| Boosts corporate public image (reputation) and brand value (1)                                           | ★ | ★ | ★ | ★ | ★ |
| Provides a competitive advantage over companies who are not compliant with this specific requirement (2) | ★ | ★ | ★ | ★ | ★ |
| Attracts investment from capital providers (investors) with a higher commitment to sustainability (3)    | ★ | ★ | ★ | ★ | ★ |
| Improves the quality and the safety of products offered, ensuring consumer protection. (4)               | ★ | ★ | ★ | ★ | ★ |
| Promotes responsible innovation and new products and processes development (5)                           | ★ | ★ | ★ | ★ | ★ |
| Promotes more efficient use of resources (6)                                                             | ★ | ★ | ★ | ★ | ★ |

Leads to long-term cost savings for the industry and, hence, has the potential to reduce prices for consumers  
(7)



The actual certification schemes provide a framework to verify that production processes respect the environment, in light of circular economy principles. However, improving the actual certification schemes can be useful to ensure circularity under the environmental pillar effectively.

Please rate on a scale from 1 (not at all) to 10 (a great deal) how much you think it is important to include the following requirement in the existing certification schemes, regarding the company's activities to strategically promote the creation of added value

1 2 3 4 5 6 6 7 8 9 10

Requirement 6: **"The company has defined strategies to promote a system thinking of processes and the analysis of material loops"** ()



Please rate on a scale from 1 (completely disagree) to 5 (totally agree) how much you agree on the following barriers related to the potential inclusion in the certification schemes of the Requirement 6 **"The company has defined strategies to promote a system thinking of processes and the analysis of material loops"**

|                                                                                                                                                       |                                                                                     |                                                                                     |                                                                                     |                                                                                       |                                                                                       |
|-------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Presents high implementation costs<br>(1)                                                                                                             |    |    |    |    |    |
| Adds complexity to existing processes and management systems<br>(2)                                                                                   |    |    |    |    |    |
| Involves ongoing costs to maintain compliance with the specific requirement (3)                                                                       |    |    |    |    |    |
| Compliance to the requirement may lead to increased price for consumer (4)                                                                            |  |  |  |  |  |
| Consumers may not easily recognize the benefits in terms of health, safety, and ethics generated by the compliance to the specific requirement<br>(5) |  |  |  |  |  |
| Adds to the administrative burden of compliance/Requires extensive documentation (6)                                                                  |  |  |  |  |  |
| Challenges in ensuring compliance along the whole supply chain (7)                                                                                    |  |  |  |  |  |

The actual certification schemes provide a framework to verify that production processes respect the environment, in light of circular economy principles. However, improving the actual certification schemes can be useful to ensure circularity under the environmental pillar effectively.

Please rate on a scale from 1 (completely disagree) to 5 (totally agree) how much you agree on the following pros/benefits related to the potential inclusion in the certification schemes of the Requirement 6 **"The company has defined strategies to promote a system thinking of processes and the analysis of material loops"**

|                                                                                                          |   |   |   |   |   |
|----------------------------------------------------------------------------------------------------------|---|---|---|---|---|
| Boosts corporate public image (reputation) and brand value (1)                                           | ★ | ★ | ★ | ★ | ★ |
| Provides a competitive advantage over companies who are not compliant with this specific requirement (2) | ★ | ★ | ★ | ★ | ★ |
| Attracts investment from capital providers (investors) with a higher commitment to sustainability (3)    | ★ | ★ | ★ | ★ | ★ |
| Improves the quality and the safety of products offered, ensuring consumer protection. (4)               | ★ | ★ | ★ | ★ | ★ |
| Promotes responsible innovation and new products and processes development (5)                           | ★ | ★ | ★ | ★ | ★ |
| Promotes more efficient use of resources (6)                                                             | ★ | ★ | ★ | ★ | ★ |

Leads to long-term cost savings for the industry and, hence, has the potential to reduce prices for consumers  
(7)



The actual certification schemes provide a framework to verify that production processes respect the social aspects (i.e., respecting workers' rights, etc.), in light of circular economy principles. However, improving the actual certification schemes can be useful to ensure circularity under the social pillar effectively.

Please rate on a scale from 1 (not at all) to 10 (a great deal) how much you think it is important to include the following requirement in the existing certification schemes, regarding the company's activities of communication and education programmes

1 2 3 4 5 6 6 7 8 9 10

Requirement 7: **"The company has programmed training activities for workers in order to tackle with the specifics of circular technologies and/or strategies" ( )**



Please rate on a scale from 1 (completely disagree) to 5 (totally agree) how much you agree on the following barriers related to the potential inclusion in the certification schemes of the Requirement 7 **"The company has programmed training activities for workers in order to tackle with the specifics of circular technologies and/or strategies"**

|                                                                                                                                                       |                                                                                     |                                                                                     |                                                                                     |                                                                                       |                                                                                       |
|-------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Presents high implementation costs<br>(1)                                                                                                             |    |    |    |    |    |
| Adds complexity to existing processes and management systems<br>(2)                                                                                   |    |    |    |    |    |
| Involves ongoing costs to maintain compliance with the specific requirement (3)                                                                       |    |    |    |    |    |
| Compliance to the requirement may lead to increased price for consumer (4)                                                                            |  |  |  |  |  |
| Consumers may not easily recognize the benefits in terms of health, safety, and ethics generated by the compliance to the specific requirement<br>(5) |  |  |  |  |  |
| Adds to the administrative burden of compliance/Requires extensive documentation (6)                                                                  |  |  |  |  |  |
| Challenges in ensuring compliance along the whole supply chain (7)                                                                                    |  |  |  |  |  |

Please rate on a scale from 1 (completely disagree) to 5 (totally agree) how much you agree on the following pros/benefits related to the potential inclusion in the certification schemes of the Requirement 7 **"The company has programmed training activities for workers in order to tackle with the specifics of circular technologies and/or strategies"**

|                                                                                                          |   |   |   |   |   |
|----------------------------------------------------------------------------------------------------------|---|---|---|---|---|
| Boosts corporate public image (reputation) and brand value (1)                                           | ★ | ★ | ★ | ★ | ★ |
| Provides a competitive advantage over companies who are not compliant with this specific requirement (2) | ★ | ★ | ★ | ★ | ★ |
| Attracts investment from capital providers (investors) with a higher commitment to sustainability (3)    | ★ | ★ | ★ | ★ | ★ |
| Improves the quality and the safety of products offered, ensuring consumer protection. (4)               | ★ | ★ | ★ | ★ | ★ |
| Promotes responsible innovation and new products and processes development (5)                           | ★ | ★ | ★ | ★ | ★ |
| Promotes more efficient use of resources (6)                                                             | ★ | ★ | ★ | ★ | ★ |

Leads to long-term cost savings for the industry and, hence, has the potential to reduce prices for consumers  
(7)



Please rank the following requirements to be included in the certification schemes from the most to the least important:

\_\_\_\_\_ The company measures its carbon emissions and has established a reduction plan (1)

\_\_\_\_\_ The company promotes the use of materials with bio-base origin (2)

\_\_\_\_\_ The company allocates resources to research and develop circular economy strategies within its value chain (3)

\_\_\_\_\_ The company achieves goals of reduction or substitution of resources (4)

\_\_\_\_\_ The company can demonstrate that its products have comparable characteristics and quality as its conventional counter part (5)

\_\_\_\_\_ The company has defined strategies to promote a system thinking of processes and the analysis of material loops (6)

\_\_\_\_\_ The company has programmed training activities for workers in order to tackle with the specifics of circular technologies and/or strategies (7)

Please indicate your country:

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Please indicate your sector:

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Are you a consumer/industry?

- ☐ Consumer (1)
- ☐ Industry (2)
- 

Please indicate which case study you are mainly interested in:

- ☐ CS1: fishery sector (1)
- ☐ CS2: urban waste (2)
- ☐ CS3: agriculture (3)
- ☐ CS4: forestry (4)
- 

Did you take part in other activities in the framework of the Biorecer program (e.g. focus group, workshop)?

- ☐ Yes (1)
- ☐ No (2)