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Lead Beneficiary

Blue Synergy SL

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Executive Summary

Deliverable D8.4 - Report on Consumer Awareness & Social Acceptance of the SECRETed project presents a comprehensive analysis of the project's efforts to raise consumer awareness and assess social acceptance of bio-based innovations. The report is structured around two interrelated pillars: consumer awareness and social acceptance, both of which are essential for the successful integration of sustainable biotechnologies into society.

The consumer awareness strategy employed a multi-channel approach, combining online outreach—via social media, newsletters, articles, and a dedicated website section—with on-site engagement through workshops held in Italy and Spain. These activities targeted a wide range of stakeholders, including students, researchers, policymakers, and industry representatives. The goal was to inform, educate, and involve the public in the project's mission, while also gathering feedback to refine communication strategies.

The social acceptance component of the report is based on a dual-methodology assessment: a quantitative survey of 182 participants across Belgium, Spain, and the Netherlands, and qualitative interviews with 20 experts from academia and industry. The findings reveal a generally positive perception of bio-based products, particularly among younger and more educated demographics. However, challenges remain, including cost sensitivity, limited awareness among older populations, and the need for clearer communication and regulatory support.

The report concludes that while acceptance of bio-based innovations is growing, further efforts are needed to move from passive acceptance to active identification and support. SECRETed's approach offers a replicable model for future sustainability-focused projects, emphasizing the importance of aligning scientific innovation with societal values and readiness.

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1. Introduction

The transition toward a sustainable, bio-based economy is not solely a technological or scientific endeavor—it is a societal one. As the European Union intensifies its efforts to reduce environmental impact and foster circular economic models, public awareness and social acceptance of innovative solutions become critical enablers of change. The SECRETed project—Sustainable Exploitation of bio-based Compounds Revealed and Engineered from naTural sources—has been at the forefront of this transformation, developing novel biotechnological solutions derived from marine and extremophilic microorganisms. These include biosurfactants and siderophores, which hold the potential to replace petrochemical-based compounds in industries such as pharmaceuticals, cosmetics, and agriculture. However, the success of such innovations depends not only on their scientific merit but also on how they are perceived, understood, and embraced by society.

Deliverable D8.4, the “Report on Consumer Awareness and Social Acceptance,” presents a comprehensive overview of the strategies, activities, and findings related to the SECRETed project’s outreach and engagement efforts. It is structured around two core pillars: consumer awareness and social acceptance. These dimensions are interlinked, as raising awareness is a prerequisite for fostering acceptance, and both are essential for ensuring the long-term viability and societal integration of bio-based innovations.

The consumer awareness component of the report details a multi-channel strategy designed to inform and engage diverse audiences. This includes online initiatives such as social media campaigns, newsletters, and a dedicated website section, as well as on-site activities like workshops held in Italy and Spain. These efforts targeted a broad spectrum of stakeholders—from university students and researchers to policymakers and industry representatives—ensuring that the project’s message reached both specialized and general audiences. The content was tailored to highlight the environmental, economic, and societal benefits of SECRETed’s work, while also encouraging dialogue and participation.

Complementing these outreach activities, the social acceptance assessment provides a deeper understanding of public and stakeholder perceptions regarding bio-based compounds. Through a combination of surveys and expert interviews, the assessment explores attitudes toward sustainability, trust in innovation, and willingness to adopt new products. The findings reveal a generally positive outlook, with high levels of awareness and interest in sustainable alternatives. However, they also underscore the need for continued

education, transparent communication, and policy support to overcome barriers such as cost sensitivity and regulatory uncertainty.

This deliverable not only documents the progress made in engaging the public and stakeholders but also offers strategic insights for future initiatives. It highlights the importance of aligning scientific innovation with societal values and expectations, and it reinforces the role of communication, collaboration, and inclusivity in driving systemic change. As Europe moves toward a greener, more resilient future, the lessons from SECRETed's consumer awareness and social acceptance efforts will serve as a valuable blueprint for similar projects aiming to bridge the gap between laboratory breakthroughs and real-world impact.

2. Consumer Awareness

The consumer awareness activities are divided in two main categories – Online and On-Site. This division was intended to serve the purpose of reaching different kinds of audiences where they are, and having a multi-channel strategy that will help spread the achievements and solutions of SECRETed. Among the audiences reached with this effort were university students, researchers, policymakers and industry representatives (from Pharma, Cosmetics, among others). The consumer awareness activities are key tools to raise awareness among people not only interested in the project, but also the public, whether they follow these topics or not.

2.1. Objectives

The consumer awareness activities are conducted with the objective of raising awareness among the different SECRETed stakeholders and the public about the importance and transcendence of the project's goals for the transition to a more sustainable industry in Europe. The mission is to let people know how SECRETed's solutions contribute to the progression of sustainable research, and to the improvement of industrial processes through the development of novel biotech products.

More specifically, the consumer awareness activities aim at:

- Transmitting key information about the ways in which the project supports and promotes sustainability.
- Communicate stakeholders and the public about the importance of the work SECRETed consortium is doing for the future of Biotechnology.
- Gathering information about the public and the stakeholders point of view and opinions on the work SECRETed is doing and the perspectives for sustainability research in the EU.

2.2. Methodology

For the consumer awareness, a different approach was employed for each of the parts contained in the task. Regarding the online activities, Social Media posts and News/Articles were created based on relevant information from the project, useful information related to the topics of the projects, and outputs such as Social Awareness Interviews and Surveys. Both of these activities were released on a monthly basis, thus the information used was generally up to date and new. The Social Awareness Newsletters were created based on the same

information as the Social Media posts and News, but collected over time and by the final year of the project; on average, each of the four newsletters were released every three months. And the Consumer Awareness Website section was projected as a hub of information for the public in general with which they could understand in a more simple way the project, its development and its impact; in this sense, the information was collected from multiple sources inside and outside of the project, with the objective of creating a complete source of truth that would guide the reader through the vision of SECRETed, its potential positive consequences for society and the ways to get in touch or participate in the project. On the other hand, regarding the on-site activities, for each of the three social awareness workshops, a type of stakeholder or interested party was selected, so the content of the events could be adapted to reach different audiences and, thus, expand the message of the project. The workshops were conducted in three different sites: Verona (Italy), Madrid (Spain) and Seville (Spain), selected because of opportunities to reach ample audiences were detected. Finally, the workshops were organized in a bidirectional way, starting with quick conferences on the project's solutions and goals, and following with a space for questions and conversations between the attendees and SECRETed's representatives at the event.

2.3. Consumer Awareness Online

The consumer awareness online strategy includes posting Social Awareness pieces of information on SECRETed's social media channels, for the public to gain access to valuable resources to understand and replicate the efforts being made regarding bio-based solutions; it also includes News and Articles posted to SECRETed's website, for more in-depth information; a Social Awareness Newsletter with four editions, posted to both the social media channels and the website, and available to download, so that the public may read in a lighter format all the developments and information about the Social Awareness activities; and a Consumer Awareness Website Section on the project's website, which aims at creating a sort of library where the public has access to information, definitions, resources, and where they can also find ways to get in touch with the project.

2.3.1. Social Media Posts

The social media posts for the Consumer Acceptance and Social Awareness task were posted to all project's channels for several months of the project. Across all platforms, more than 180 publications were made with content specifically made to raise awareness among consumers and the public, and to create sensitivity to the topics that fall into the scope of the SECRETed Project. The following are the collective metrics of all publications made in the project's social media channels for this task:

Metric	LinkedIn	Facebook	Twitter (X)
Impresions	17157	2251	1410
Clicks	712	1073	188
Likes	506	149	67
Comments	6	21	29
Reposts	35	3	11

Table 1. Social Media Metrics of Social Awareness Publications

On the other hand, all posts addressed different kinds of activities, content and Project aspects, all pertinent of the social acceptance and consumer Awareness goals. Here are some images of the posts shared:

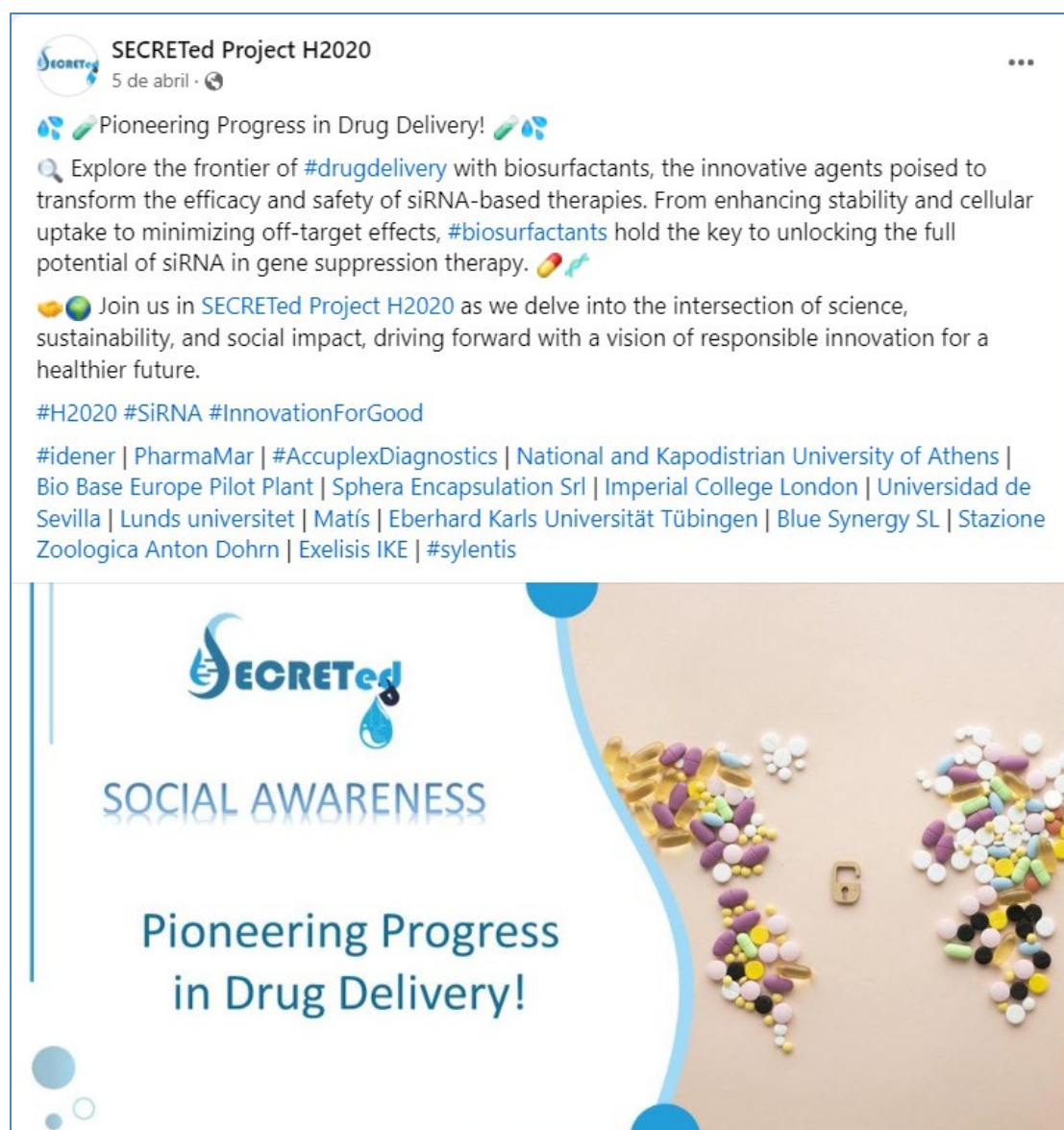


Figure 1. Example of a Social Media post 1.



Figure 2. Example of Social Media post 2.



Figure 3. Example of Social Media post 3.



Figure 4. Example of Social Media post 4.

The topics of the social media posts for the task were varied and, among other, included:

- Invitation and Completion of Social Acceptance and Consumer Awareness Activities, such as the workshops.
- Information about different topics covered by the Project, such as Bioinformatics, Biosurfactants, or siRNA.
- The task digital output and other type of information pieces, such as the Social Awareness Newsletters, articles and infographics.
- The Social Awareness Interviews with experts in Biotechnology.
- The invitation to participate and the results of the Social Awareness Survey.

Overall, the social media activity for the Consumer Awareness On-line part of the task was constant and succesful, being recognized by the channels users through different kinds of interactions that were able to be measured. The importance of these actions lie in changing the perspective the public has about the work being done in SECRETed and the consequences of its outcomes for the future of European society. By introducing the public and audience of the Project to the societal and economic benefits of projects like SECRETed, the consortium has effectively supported the transition towards a more sustainable, clean and responsable industry and society.

2.3.2. News and Articles

SECRETed's Consumer Awareness News and Articles were the second part of the strategy to reach new audiences and the project's stakeholders. This content was created to be distributed through the project's website and social media channels, and it was based on the SECRETed's topics, developments and solutions, related topics of interest that might shed light on the project's activities, and other types of project outputs, such as the Social Awareness Interviews made with the participation of multiple researchers and industry representatives. These posts gained 281 views on the website collectively since they were started to be posted.

Below is the summary and link to each of the publications:

Unlocking Sustainable Solutions: Insights from Dr. Marcel Jaspars' Interview – December 14th, 2023

Dr. Marcel Jaspars, a distinguished professor of chemistry at the University of Aberdeen, shared his insights on the transformative potential of the SECRETed Project. With a career spanning 28 years in marine biodiscovery and biotechnology, Dr. Jaspars emphasized the importance of sustainable solutions derived from marine resources. He stated, "Our work aims to unlock the vast potential of marine biodiversity to develop innovative and sustainable products."

The interview delves into the project's goals, challenges, and the future of marine biotechnology. For more details, [keep reading the full article](#).

SECRETed Consumer Awareness Workshop – January 25th, 2024.

The SECRETed Consumer Awareness Workshop, hosted by Blue Synergy, concluded with insightful discussions on the importance of consumer awareness in marine biotechnology. The workshop featured presentations from IDENER, LUND University, and the University of Seville, highlighting the benefits and applications of biosurfactants and siderophores. EXELISIS provided an overview of the exploitation potential, while Sphera Encapsulation, Bio Base Europe Pilot Plant, PharmaMar, and Imperial College London discussed the applications of research findings in various industries. The event wrapped up with engaging sessions on consumer perceptions and collaboration schemes. For more details, [keep reading the full article](#).

In-Depth Discussion with Dr Oksman-Caldentey: Pioneering Sustainable Solutions in Biotechnology – February 14th, 2024.

In a recent interview, Dr. Kirsi-Marja Oksman-Caldentey, Senior Advisor at VTT Technical Research Centre of Finland, shared her extensive experience in pioneering sustainable solutions in biotechnology. With over 24 years in the research field, Dr. Oksman-Caldentey discussed the innovative approaches and challenges faced in developing eco-friendly products from marine and extremophilic microorganisms. She emphasized, "Interdisciplinary collaboration is key to unlocking the full potential of sustainable biotechnology." The interview highlights the importance of collaboration and the potential impact of these sustainable solutions on various industries. For a deeper understanding of Dr. Oksman-Caldentey's insights and the future of biotechnology, [keep reading the full article](#).

Unveiling the Transformative Potential of Marine-Based Compounds – February 23rd, 2024.

During the first Social Awareness Workshop, held in Verona, Italy, the SECRETed project explored the transformative potential of marine-based compounds and their significant impact on sustainability. Key topics included the development of novel hybrid molecules through the combination of biosynthetic genes from marine and extremophilic microorganisms, and the use of machine learning algorithms to identify genetic mechanisms for biosynthesis. The workshop also explored the applications of these compounds in various industries, such as pharmaceuticals, cosmetics, and agrochemicals, emphasizing their sustainable and eco-friendly properties. For a deeper dive into these discussions, [keep reading the full article](#).

Unleashing the Potential of siRNA: Revolutionizing Gene Therapy – March 20th, 2024

The article explores the groundbreaking advancements in small interfering RNA (siRNA) technology and its transformative impact on gene therapy. Key topics include the precise targeting of disease-causing genes, the mechanisms of siRNA in degrading messenger RNA (mRNA), and the innovative applications in biomedical research and medicine. The article also discusses the challenges and future prospects of siRNA-based therapies in treating various genetic disorders. For a deeper dive into this thematic approach, [keep reading the full article](#).

Winds of Change in Biosurfactant Production Bring Exciting Prospects for the Industry – May 24th, 2024.

The article explores the rapid advancements in biosurfactant production and their transformative impact on various sectors. Key topics include the shift from traditional surfactants to eco-friendly biosurfactants, the role of renewable biomass in production, and the benefits of biosurfactants in reducing environmental impact. The article also delves into the innovative methods being developed to enhance biosurfactant yield and efficiency, such as genetic engineering and optimized fermentation processes. Additionally, it highlights the importance of industry collaboration and innovation in driving these changes, with various stakeholders working together to overcome challenges and harness the full potential of biosurfactants. For a deeper dive into these discussions, [keep reading the full article](#).

Insightful Conversations: What Dr. Dorit Avni thinks about the future of bio-compounds, research and the transition to a more sustainable industry – June 21st, 2024.

Dr. Dorit Avni, Head of the Sphingolipids, Phytochemicals, and Immune Modulation Lab at MIGAL, shared her vision for the future of bio-compounds research and the transition to a more sustainable industry. She highlighted the innovative approaches being developed under the European program HORIZON2020, particularly the Algae4IBD project. Dr. Avni emphasized, "Our goal is to harness the potential of natural bio-compounds to create sustainable and effective solutions for various health challenges." The discussion also covered the importance of interdisciplinary collaboration and the potential impact of these advancements on global sustainability efforts. For a deeper understanding of Dr. Avni's insights and the future of bio-compounds research, [keep reading the full article](#).

Embracing Biobased Compounds: A Pathway to Sustainable Industry and Society – July 29th, 2024.

The article explores the global shift towards sustainability and the innovative adoption of biobased compounds. Key topics include the benefits of

transitioning to biobased compounds, such as reducing environmental impact and promoting eco-friendly practices. The article also highlights the role of interdisciplinary collaboration and the importance of industry partnerships in driving these changes. Bradley Haltli from CRODA shares insights into the transformative movement, emphasizing the potential of biobased compounds to revolutionize various sectors. For a deeper dive into these discussions, [keep reading the full article](#).

The Future of Bio-based Economy: The Search for a Better Regulatory Framework for Bio-based Materials in Europe – September 6th, 2024.

The article discusses the critical need for improved regulations to support the growth of the bio-based economy. Key topics include the benefits of bio-based products, such as reducing CO2 emissions and promoting circularity, and the challenges posed by regulatory complexities. The article highlights the European Commission's efforts to develop a comprehensive policy framework to enhance the competitiveness of bio-based products. It emphasizes, "A practical and beneficial regulation is becoming necessary" to ensure the success of the bio-based economy. For a deeper dive into these discussions, [keep reading the full article](#).

The future of bio-based products and the role of government, industry and academia in it: a conversation with Dr Amy Switzer – September 19th, 2024.

Dr. Amy Switzer, a molecular microbiologist and bio-plastics innovator, shared her vision for the future of bio-based materials. She discussed the advancements in microbial engineering and strain development, particularly her work at Biome Bioplastics on creating monomers for bio-plastics using microbial fermentation. Dr. Switzer emphasized, "A lot of it actually could be cheaper, when you get to larger scales," highlighting the economic viability of bio-based materials. The interview also covered the importance of proper life-cycle assessments and the need for better dissemination of information to ensure that bio-based products are truly environmentally beneficial. For a deeper understanding of Dr. Switzer's insights and the future of bio-based materials, [keep reading the full article](#).

Insightful Conversations: Dr. Andrew Mearns-Spragg View on the Biotech Landscape and the Transition to a More Sustainable Industry – October 15th, 2024.

Dr. Andrew Mearns-Spragg, a marine biotechnology entrepreneur and Chief Scientific Officer at Jellagen, shared his perspective on the biotech landscape and the transition to a more sustainable industry. He discussed the innovative work being done at Jellagen, particularly in developing collagen from jellyfish, and the broader implications for sustainability in biotechnology. Dr. Mearns-Spragg emphasized, "it's about making things that are not only better for the

environment but also competitive in the marketplace”. The interview also covered the challenges and opportunities in the field, highlighting the importance of interdisciplinary collaboration and innovation. For a deeper understanding of Dr. Mearns-Spragg's insights and the future of sustainable biotechnology, [keep reading the full article](#).

Insightful Conversations: The Promise and Challenges of Bio-Based, with Biotechnology Expert Nikola Milić – November 13th, 2024.

Nikola Milić, a biologist specializing in microbiology, mycology, and natural products chemistry, shared his insights on the promise and challenges of bio-based compounds. He emphasized the sustainability of these compounds, stating, “if we, for example, compare them to their petrochemical counterparts, biosurfactants are safer for workers, for consumers”. The discussion covered the advantages of bio-based compounds, such as reduced toxicity and economic opportunities, as well as the challenges like high production costs and supply chain reliability. For a deeper understanding of Milić's insights and the future of bio-based compounds, [keep reading the full article](#).

Insightful conversations: an insider's view of the bio-based product landscape, with Marine Biotech Expert, Dr. Charles Bavington – November 26th, 2024.

Dr. Charles Bavington, a seasoned biochemist and marine biotechnology expert, shared his insights on the bio-based product landscape. He discussed the development of bio-based compounds derived from marine resources, emphasizing their sustainability and unique chemical compositions. Dr. Bavington noted, “even now, something like 50% of all drugs are naturally inspired, some of them with marine origin.” The interview also covered the challenges of cost-competitiveness and validation standards in the industry. For a deeper understanding of Dr. Bavington's perspective and the future of bio-based products, [keep reading the full article](#).

Insightful conversations: Stefano Donadio Explores the Potential and the Hurdles of Developing Bio-Based Compounds – December 12th, 2024.

Dr. Stefano Donadio, CEO of NAICONS and a seasoned expert in natural products, shared his insights on the potential and hurdles of developing bio-based compounds. He discussed the sustainable methods that replace traditional chemical-based approaches and the significant advancements in bio-based production processes. The interview also covered the challenges faced in scaling up these innovations, such as regulatory hurdles, the need for industry collaboration and the market pressure; regarding the later, Dr. Donadio emphasized: “you cannot just say, replace your chemical process with a biological one. You have to say, I can provide you all the information to replace your chemical process with a biological one that I've tested, and it works”. For

a deeper understanding of Dr. Donadio's perspective and the future of bio-based compounds, [keep reading the full article](#).

Insightful conversations: Challenges and Opportunities for a Greener Agriculture with Gabino Sánchez – December 27th, 2024.

Dr. Gabino Sánchez-Pérez, a biochemist and Business Development Director at Hudson River Biotechnology, shared his insights on the challenges and opportunities for a greener agriculture. He discussed the development of bio-based compounds, particularly in the agricultural sector, and the potential for these innovations to reduce environmental impact and enhance sustainability. Dr. Sánchez-Pérez emphasized, "The integration of biotechnology in agriculture is crucial for achieving a more sustainable future." The interview also covered the importance of industry collaboration and the need for supportive regulatory frameworks. For more details on Dr. Sánchez-Pérez's perspective and the future of sustainable agriculture, [keep reading the full article](#).

Insightful Conversations: A SECRETed insider view on the challenges of bio-based Compounds with Igor De las Heras – January 28th, 2025.

Dr. Igor de las Heras, a chemical engineer and expert in bio-based compounds, shared his insights on the challenges and opportunities within the bio-based industry. He discussed the significant advancements in biofuels, biosurfactants, and specialty chemicals, highlighting the increasing market share of biofuels as a success story. Dr. De las Heras emphasized, "The bio-based industry is at a pivotal point where innovation and sustainability must go hand in hand to drive future growth." The interview also covered the hurdles faced in scaling bio-based innovations, such as production costs and regulatory challenges. For a deeper understanding of Dr. De las Heras' perspective and the future of bio-based compounds, [keep reading the full article](#).

Insightful conversations: Dr. Paul Christakopoulos deep dives into the opportunities and challenges for bio-based solutions – February 25th, 2025.

Dr. Paul Christakopoulos, chaired professor at the Biochemical Process Engineering Group at Luleå University of Technology in Sweden, shared his insights on the opportunities and challenges for bio-based solutions. He discussed the advantages of bio-based compounds, such as their sustainability and potential to reduce environmental harm, and highlighted the importance of designing environmentally friendly processes. Additionally, he pointed out that by raising awareness about the benefits and potential of bio-based compounds, stakeholders can drive more informed decision-making and support for eco-friendly innovations: "Information is very important, not only at the academic level but also for the general public for fostering a broader understanding and acceptance of sustainable practices". The interview also covered the economic

challenges and societal acceptance issues that need to be addressed for mainstream adoption. For more details, [keep reading the full article](#).

Insightful conversations: Dr. Erik Malta Contributes to the debate about the benefits and limitations of developing biobased products. – March 21st, 2025.

Dr. Erik Jan Malta, Chief Scientific Officer at the Aquaculture Technological Center (CTAQUA) in Andalusia, Spain, shared his insights on the benefits and limitations of developing bio-based products. Dr. Malta discussed the challenges, including economic feasibility and production variability, emphasizing the need for greater investment and industrial interest. He noted, "To stimulate industries, I think it's still required that there are subsidies for public and private sector collaborations." The interview covered the importance of policy support and industry collaboration in overcoming these hurdles. For a deeper understanding of Dr. Malta's perspective, [keep reading the full article](#).

Insightful Conversations: Insights from Aránzazu Pagán on the Development of Bio-Based Products. – April 14th, 2025.

As Europe advances towards a sustainable, circular economy, Aránzazu Pagán, a Research and Development Technician at CETENMA, highlights the promise and challenges of bio-based products. Her work focuses on biorefineries and genetically enhanced microbial strains to improve yields and reduce environmental impact. Despite the early-stage nature of many bio-based processes, their potential to reduce waste and comply with new regulations is significant. However, economic feasibility, legislative support, and a talent gap remain hurdles. Pagán emphasizes, "You can't bring a product to market because the law doesn't even recognize its possibility yet," underscoring the need for policy incentives and public education to bridge these gaps. [Keep Reading the full article](#).

Insightful Conversations: Biotechnology from the Standpoint of a Renowned Research Institute, with Dr. Rosa Doménech – May 16th, 2025.

Dr. Doménech highlights how biotechnology can reduce environmental harm by replacing toxic chemicals with bio-based compounds in industries like agriculture and cosmetics. Dr. Doménech also explains how biological processes are more expensive and less reproducible in early stages compared to synthetic ones, posing a challenge especially for small companies. Additionally, moving from lab-scale to industrial-scale production requires significant investment and technical adaptation. Dr. Doménech stresses the need for government incentives, regulatory frameworks, and public education to support the adoption of bio-based products. She advocates for partnerships between companies, universities, and research centers, and emphasizes the role of consumer awareness and certifications. [Keep reading the full article](#).

Insightful conversations: Seaweed, sustainability, and the bioeconomy, an interview with Dr. David Mackie – May 22nd, 2025.

Dr. David Mackie, co-founder of Marine Biopolymers Ltd, delves into the transformative potential of seaweed within the bioeconomy. He emphasizes seaweed's versatility, highlighting its applications in sustainable product development, such as biodegradable packaging and bioactive compounds for pharmaceuticals. Dr. Mackie also discusses the environmental benefits of seaweed cultivation, including carbon sequestration and ecosystem restoration. However, he points out challenges like regulatory hurdles and the need for public acceptance. The conversation underscores the importance of interdisciplinary collaboration and innovation in harnessing seaweed's full potential for a sustainable future. [Keep Reading the full article.](#)

Insightful conversations: Turning waste into worth, an interview with Dr. Katerina Kousoulaki on the Future of Bio-Based Innovation – May 26th, 2025.

In her interview with SECRETed, Dr. Katerina Kousoulaki, a senior researcher at NOFIMA in Norway, discusses the transformative potential of bio-based innovation in promoting sustainability. Dr. Kousoulaki highlights challenges in this field, including regulatory barriers, processing costs, and market readiness, noting that current legal frameworks often restrict the use of certain biomass in food and feed production. Consumer acceptance is growing, particularly for products that are nutritious and have a neutral taste, with successful examples like fish collagen supplements demonstrating the viability of circular, health-promoting products derived from waste materials. [Keep reading the full article.](#)

2.3.3. Newsletter

Four Social Awareness newsletters were published every three months during the last year of the project. The documents were a compilation of the advances of the project in a language that is understandable by the public, as well as informative/educative capsules of related topics. Below are the summaries of all four editions of the newsletter.

First Social Awareness Newsletter – Published on: 31st July, 2024



Figure 5. Images of the first Social Awareness Newsletter.

The first Social Awareness newsletter discusses several topics from the Project development in this area, such as the first social awareness workshop held in Verona, Italy, which focused on the project's goals and the effects of marine-based chemicals on society. In this event, feedback from attendees, coordinators, and partners played a crucial role in refining and reevaluating the project's dissemination strategies. The newsletter also includes an interview with Dr. Dorit Avni, who discussed her views on the importance of bio-compounds and the transition to a sustainable industry. Additionally, it covers socio-economic news from the industry, such as the increasing investments in biosurfactants and the celebration of World Environment and Ocean Days. The newsletter also provides updates on the project's social media activities, highlighting their efforts to raise social awareness through various platforms. It explains what bio-based compounds are, their uses, and their importance in promoting sustainability. The newsletter concludes with a partner commentary, information on how to get in touch with SECRETed, and contact information.

Second Social Awareness Newsletter – Published on: October 31st, 2024



Figure 6. Images of the second Social Awareness Newsletter.

The second edition of the newsletter continues to provide updates on SECRETed and its societal impact. It begins by reiterating the project's aim: to develop novel molecules with tailored properties by combining biosynthetic genes of amphiphilic compounds (biosurfactants and siderophores) from marine and extremophilic microorganisms, targeting industries like agrochemical, pharmaceutical, cosmetic, and chemical.

The newsletter features an interview with Dr. Amy Switzer, discussing the future of bio-based products and the roles of government, industry, and academia in advancing environmentally friendly plastics. A second key highlight is the report on SECRETed's second Social Awareness Workshop at Farmaforum in Madrid, focusing on harnessing biosurfactants with model-assisted development. The workshop covered topics such as the project's vision, the potential of marine biotech, green chemistry in pharma, and innovations in drug delivery systems.

Additionally, the newsletter includes broader industry news, emphasizing the benefits of bio-based products and the need for better regulatory frameworks in Europe. An interview with Dr. Andrew Mearns-Spragg discusses the transition to more sustainable sources in various sectors. On the other hand, also included are updates on SECRETed's social media presence highlight the

project's efforts to disseminate information and raise awareness about sustainable solutions and environmental protection.

Finally, the newsletter shares results from the Social Awareness survey which aims at measuring public knowledge and attitudes towards the industry's shift from fossil-based to bio-based ingredients; and it also provides a definition of Bioeconomy. The newsletter concludes with information on how to get in touch with the SECRETed project and its consortium partners.

Third Social Awareness Newsletter – Published on: January 31st, 2025



Figure 7. Images of the third Social Awareness Newsletter.

The third edition of the newsletter continues to focus on SECRETed's efforts to promote social awareness regarding bio-based compounds and their role in sustainability and circularity.

A key theme is the importance of raising awareness about bio-based compounds as a cornerstone of a green/blue future. The newsletter highlights SECRETed's commitment to promoting sustainability and circularity by developing bio-based compounds to transform the production of everyday products, currently derived from petroleum, contributing to a cleaner industry.

The newsletter features interviews with experts, including Gabino Sánchez-Pérez, discussing the need for greener practices in the agricultural industry and the challenges in transitioning away from harmful pesticides. Further interviews with Dr. Charles Bavington and Nikola Milić explore the landscape of bio-based

products, their benefits, challenges, and potential for a sustainable future. Updates on sustainability assessments within the SECRETed project are also provided, detailing the evaluation of raw materials and data analysis.

The newsletter includes results from SECRETed's Social Awareness Survey, revealing insights into public perception of the industry's transition towards more sustainable products and processes. For example, it presents data on consumer inclination towards sustainably sourced food, providing context for the survey results. Additionally, an informational section on bioinformatics explains its definition, its role in the SECRETed project, and its societal impact, emphasizing its importance in scientific discoveries and various industries.

Additionally, the newsletter also highlights social media activities, showcasing the project's efforts to disseminate information on various topics related to bio-based innovation and sustainability. Finally, the newsletter concludes with information on how to get in touch with the SECRETed project and access additional resources

Fourth Social Awareness Newsletter – Published on: April 30th, 2025



Figure 8. Images of the fourth Social Awareness Newsletter.

The fourth and last Social Awareness Newsletter includes the project's efforts to raise social awareness about the importance of bio-based compounds for a sustainable and circular economy.

The newsletter highlights the following the importance of social Awareness by emphasizing the need to raise awareness about bio-based, novel compounds

in the pursuit of sustainability; the third Social Awareness Workshop, which details the third and final Social Awareness Workshop held in Seville, Spain, which focused on "Unlocking the potential of Marine Biotechnology"; the Social Awareness Interviews, which include interviews with experts like Aránzazu Pagán, discussing the development of bio-based products and the challenges and opportunities in transitioning to a sustainable, circular economy; a SECRETed Glossary, with terms such as siderophores and biosurfactants, which are key compounds in the Project; and the Social Media activities regarding Social Awareness, with the objective of engaging the public and sharing information about the project's goals and impact. Overall, the newsletter communicates the project's mission, activities, and the importance of fostering a broader understanding of bio-based solutions for a sustainable future.

2.3.4. Website Section

The Social Awareness section of SECRETed.eu has been designed to be the gateway to understanding the impact and potential of bio-based innovations and, in particular, how SECRETed, as a Project, is delivering new solutions that will help achieve the goal of using biotechnology to shape a more sustainable world. Here are the four subsections of the Social Awareness tab in the website:

- **A Sustainable Future:** to learn how cutting-edge research, such as SECRETed's, is reducing pollution, tackling waste, and protecting biodiversity, paving the way for greener alternatives to everyday products.
- **A Thriving Industry:** To explore how bio-based solutions are transforming the industry, from improving energy efficiency to opening new markets and driving EU economic growth.
- **Get Involved:** To find out how make part of the transition and get in touch with SECRETed. Plus, access to valuable downloadable resources to help the reaser spread awareness and take action.
- **Glossary & Useful Links:** This section provides clear definitions of key terms and links to trusted resources for deeper learning.

Below are some of the topics discussed in each subsection:

A Sustainable Future

- Environmental benefits- Development of biosurfactants
- Environmental benefits- Sustainable siderophore production
- Environmental benefits- Promotion of a circular economy
- Environmental benefits- Reduction of greenhouse gas emissions

Community benefits

- Giving communities and target industries a sense of purpose
- Creating synergies among stakeholders and industry actors
- Empowering communities to demand sustainable solutions
- Creating jobs in target industries

Second Subsection: A Thriving Industry

- Economic development
- Innovation
 - Genomic and metabolic engineering
 - Fermentation technology
 - Downstream processing and purification
 - Analytical and characterization tools
 - Application development
 - Machine Learning as the backbone of the project
 - Circular economy principles
- How does SECRETed raise awareness in the industry

Third Subsection: Get Involved

- Attend our next public events
- Downloadable content
- Receive SECRETed's social awareness newsletter
- Send topic-related content or get in touch
- Sign up to SECRETed's newsletters

Fourth Subsection: Glossary & Useful Links

- Glossary
 - Marine Biotechnology
 - Surfactants
 - Biosurfactants
 - Siderophores
 - Microbial Fermentation
 - Environmental Sustainability
 - Circular Economy
 - Biotechnology Innovation
 - Machine Learning
 - Algorithm
 - Extremophilic Microorganisms
 - Biodegradable and non-biodegradable
 - Greenhouse Gas Emissions

- Useful links

2.4. Consumer Awareness On-site

The SECRETed Consumer Awareness workshops were a series of organized event aimed at raising awareness across various stakeholder groups about the project's goals and the impact of marine-based, biobased compounds. These workshops served as a crucial tool for disseminating information and engaging with diverse audiences.

The topics discussed during these events included: the project's main goals; the effects of marine-based chemicals on society; the project's vision and recent developments; the future of Green Chemistry in Pharma; and raising awareness about research, innovation, and sustainability among university students.

Among the attendees for the three workshops were Project coordinators, partners from SECRETed, industry representatives from Pharma, Cosmetic, and Nutraceutical sectors, and biomedicine students. The workshop facilitated discussions and debate among the participants; created opportunities for Networking; provided insights into the project's work, methodology and results; and fostered academic development and interest in biotech careers.

These workshops were instrumental in SECRETed's mission to raise awareness and engage different stakeholder groups, ensuring a broad understanding of the project's innovative solutions. The following are the summaries of each workshop's development and results:

2.4.1. Workshop 1

The workshop, which took place at Hotel Leon d'Oro, in Verona, Italy, offered a forum for in-depth talks about the SECRETed project, with particular emphasis on consumer awareness, main goals, and the possible effects of marine-based chemicals on society.

On January 24, 2024, SECRETed held its first Social Awareness Workshop, a space in which collaboration played a pivotal role. Attendees, coordinators, and partners engaged in a dialogue, offering perspectives that would shape the trajectory of future events. Sessions on biosurfactants and siderophores provided a deep dive into the science behind the marine origin compounds being developed at SECRETed. Expert-led discussions elucidated their applications in diverse industries, from agrochemicals to cosmetics, emphasizing their transformative potential.



Figure 9. Picture from the first Social Awareness workshop 1.



Figure 10. Picture from the first Social Awareness Workshop 2.

The debate was greatly influenced by input from partners, coordinators, and workshop participants. Although participants voiced worries about content redundancy, they liked the project's deep insights. There were insightful recommendations on how to vary presentation styles and guarantee lively participation. To raise awareness of the initiative, coordinators and partners stressed the necessity for creative distribution techniques. The group determined that the goal was to look beyond standard distribution channels and investigate alternatives that appeal to a wide range of audiences.

SECRETed's first Social Awareness Workshop served as a catalyst for refining and reevaluating the dissemination strategies of the SECRETed project. Throughout the event, relevant feedback was gathered from participants, partners, and coordinators, providing valuable insights into the effectiveness of our current approaches. This input will be instrumental in shaping future workshops, ensuring a more effective and inclusive approach to engaging with a diverse audience. These strategies are crucial for increasing public awareness and fostering widespread interest in the innovative discoveries emerging from the realm of marine-based chemicals as our research progresses.

2.4.2. Workshop 2

The second Social Awareness Workshop of SECRETed project took place on September 26th, 2024, at Farmaforum, one of the biggest fairs for Pharma, Cosmetic, Nutraceutical and other related industries. The workshop was hosted by Blue Synergy and Idener.ai, with the collaboration of Fundación para el Conocimiento Madri+d and Enterprise Europe Network Spain, who helped secure the space for the workshop at Farmaforum. This event was organized with the objective of raising awareness on the important topics and developments of the project, as well as connecting with industry representatives that wanted to have a better idea of what the project was doing.



Figure 11. Manuel Salvador, from Idener.ai, during the second Social Awareness Workshop.



Figure 12. Sebastián Ospina, from Blue Synergy, during the second Social Awareness Workshop.

Titled “From Concept to Scale-Up: Harnessing Biosurfactants with Model-Assisted Development” and presented by Idener’s Manuel Salvador and Blue Synergy’s Sebastián Ospina, the workshop gave the attendees a glimpse into the SECRETed Project’s vision and goals, as well as its most recent developments; an introduction to the potential of marine biotech in relation to the biosurfactants and siderophores integrated management platform; the future of Green Chemistry in Pharma and how harnessing biosurfactants may contribute to a sustainable drug development; and an overview of encapsulation innovations, with the objective of creating more sustainable Drug Delivery Systems. Thus, the workshop had a variety of interesting topics for researchers and decision-makers in the Pharma, Cosmetic and Nutraceutical industries

The SECRETed second social awareness workshop at Farmaforum Madrid allowed the project to showcase its goals and vision, as well as its key findings and future prospects to an audience of specialized researchers and representatives from industries such as Pharma, Cosmetic and Nutraceutical. Additionally, the presence of SECRETed at Farmaforum also allowed for networking activities with interested parties from the mentioned industries. Overall, the outcome of the second social awareness workshop is positive, as it served the purpose of delivering the message and updates of the project to a broader audience.

2.4.3. Workshop 3

On February 24th, 2025, SECRETed H2020 conducted the third and final Social Awareness Workshop in Seville, Spain; titled “Unlocking the potential of Marine Biotechnology”, the event allowed the students of biomedicine of the University

of Sevilla to get to know the project, understand some of the science behind it and get a glimpse at a real-life application case.



Figure 13. Picture from the third Social Awareness Workshop 1.



Figure 14. Picture from the third Social Awareness Workshop 2.

With the objective of raising awareness about the benefits of Research and Innovation, and Sustainability, the workshop welcomed students that may potentially consider a career in these areas as a professional future. The students had the opportunity to listen to short conferences on the main topics and issues of the project and how the partners are addressing them.

The first part of the conference was led by Blue Synergy's sustainability engineer, Sebastián Ospina Corral, with an overview and main details of the project. Afterward the conferences focused on two main topics: first, the microbiology and genetics behind SECRETed, led by Dr. Montserrat Argandoña and PhD candidate Tania Antón from Universidad de Sevilla; and second, a case study on siRNA encapsulation with biosurfactants led by Sebastián Ospina.

After the conferences finished, the students used the remaining time to ask questions, a valuable exchange that will contribute to their academic development and to the goals of the social awareness workshop initiative of SECRETed. The outcome of this workshop is very positive because, with the participation of almost 50 students and their active participation, the project fulfills its goal of raising awareness among the public and completes the task with the satisfaction of making a positive impact in the future generation of Biotech researchers.

3. Social Acceptance

The conduction of a Social Acceptance Assessment (SAA) regarding the work of the SECRETed project creates an opportunity to not only present to key stakeholders' important information about the benefits of the project's topics and solutions, but also to measure to which extent SECRETed complies with the expectations and fits with the social needs of the public and potential consumers. To that end, this assessment is divided into two sections, corresponding with the two approaches previously established: surveys and interviews. While interviews will give this assessment expert opinions on the potential benefits of the project's topics, the survey part will provide it with insights from potential consumers on how they view the solutions that SECRETed is proposing.

For the purpose of the Social Acceptance Assessment, the methodology that is presented in this document has been tailored to address the needs and opinions of stakeholders from different industries (namely: pharmaceutical, agricultural, nutraceutical and cosmetic) and academia, and of the public. Each part of the Assessment (Interviews and Surveys) will have their own methodological approaches. Afterward, the results of each of those activities will be analyzed and discussed and, at the end, those results will be integrated into the final Social Acceptance Assessment, derived from findings in both the interviews and the surveys. As a result from this exercise, a comprehensive analysis will be made where the level of social acceptance will be assessed, and mitigation alternatives for potential social risks will be formulated in case of need. With the focus on the importance of SECRETed's work on biobased compounds for society and sustainability goals, this assessment will highlight the role of social acceptance into the core of biotechnological research and development. The purpose of conducting this assessment is to ensure the social dimension is contemplated when fulfilling the project's goal of contributing to environmental and economic sustainability through innovation in marine bio-compounds, as well as fostering a positive social perception of SECRETed as a whole.

Finally, the social acceptance assessment of the SECRETed project will lay the basis for an understanding of how these types of projects could influence society and consumers and could be the starting point for related social acceptance studies in other European Union funded research projects. Along with the consumer awareness activities, the Social Acceptance Assessment reveals that the consequences that SECRETed may have in the European Society are front and center, and that the social aspect has been a core task along the development of the project.

3.1. Social Acceptance Assessment General Objective

The Social Acceptance Assessment objective is to gain an in-depth knowledge of how SECRETed's public and potential consumers view the project's general topics and solutions, and to propose mitigation alternatives in case there's a negative outcome.

3.2. Social Acceptance Assessment Specific Objectives

- To gather citizen and stakeholder perceptions of SECRETed's general topics and what their impact on society and consumer trends might be.
- To assess the potential social acceptance levels of SECRETed's general topics and solutions.
- To determine the project's potential benefits for stakeholders, society and consumers; as well as the possible barriers, drivers for social acceptance, and willingness to adopt these new products.
- To showcase and discuss the results of this assessment and present it to SECRETed's consortium for their evaluation and feedback.

3.3. Social Acceptance Survey

3.3.1. Theoretical Framework

After a careful review of available literature on methods for conducting social acceptance surveys, a tailored methodology has been created to meet the goals and needs of this subtask. Particularly, this tailored methodology relies on the work done on the matter by Peñaloza *et al* in "Social and market acceptance of photovoltaic panels and heat pumps in Europe: A literature review and survey"; Robert Boutilier and Ian Thomson in "modelling and measuring the social license to operate: fruits of a dialogue between theory and practice"; and Munjur Moula in "Public acceptance of biofuels in the transport sector in Finland".

Boutilier and Thompson study the 'Social License to Operate', a critical concept for gauging community acceptance of industrial projects like mining. The SLO model and measurement approach evolved through iterative theoretical and practical engagements, involving stakeholder surveys and factor analyses to establish a robust framework for assessing the social acceptability of corporate operations. Nonetheless, this concept could be extrapolated and adapted the needs of the present of this study by utilizing the categories for the assessment of community acceptance that could be crucial for understanding the social acceptance of a project like SECRETed. These categories, graphically represented in an arrowhead (see fig. 1) are: withheld/withdrawn, which implies restricted access to essential resources, indicating high [social] risk;

acceptance, which is the most common level where the [project] has minimal issues in [implementation]; approval, which requires credibility and signifies a higher degree of stakeholder trust; and psychological identification, which represents the highest level of acceptance where the community and stakeholders identify with the project, implying very low [social] risk (Boutilier & Thomson, 2011).

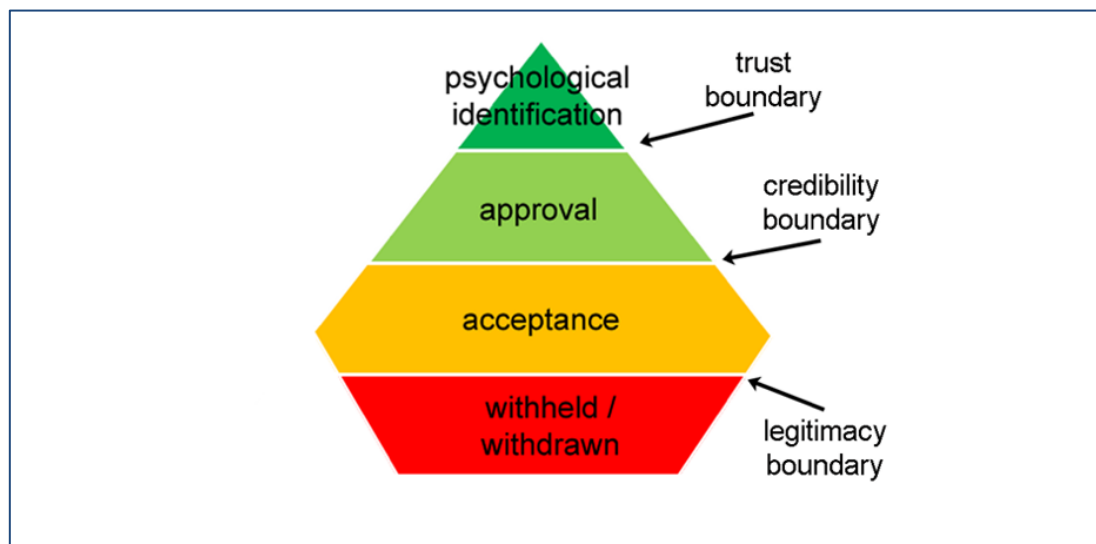


Figure 15. The “arrowhead” model of the SLO proposed by Thomson & Boutilier (2011).

On the other hand, Peñaloza *et al* propose a conceptual framework that will define the way the surveys are conducted and the point of view from where the responses are going to be analyzed. According to their work, the first step is to create a set of three questions that need to be answered under the umbrella of selected [social] factors. Thus, this first step serves as a compass for the rest of the study. After that, the authors propose the creation of a ‘respondent profile’ where demographic data, including gender, age, income, education, nationality, employment status, household size or environmental profile are collected. For this study, only some of those categories will be collected, as they are previously identified to be relevant for the survey. As a third step, this study will use the social acceptance evaluation design proposed by the authors in which the respondents are surveyed on their attitudes toward the social factors previously identified using both close ended questions and 5-point Likert Scale (Peñaloza *et al*, 2022).

Finally, the methodology, including the sample and data collection, scope, the questionnaire design, distribution and protocol, and the data analysis guidelines were adapted from the methodology proposed by Moula, Nyári & Bartel (2017).

3.3.2. Methodology

Sample and Data Collection

Adapting the proposal for sample and data collection method from Moula, Nyári and Bartel (2017) for this study, more than one hundred people were reached to participate in the survey. The respondents were recruited randomly, and they belong to different age groups, genders and countries. They are part of the public and are not associated to any industry in particular. These characteristics have been chosen specifically to understand the acceptance of biobased compounds, SECRETed's solutions, in society. The participants were requested to submit their agreement with the EU's GDPR, and those who did not agree weren't able to fill the questionnaire. Additionally, the geographical boundaries correspond with the countries in which there are partners of the SECRETed project; in this case, the surveys were completed by people in Belgium, The Netherlands and Spain. The surveys were completed during the second semester of 2024.

Scope

The scope of the social acceptance surveys was determined by three factors, or main topics, that answer the following questions: How do respondents perceive the effort the industry in general is doing towards sustainable processes? Are respondents aware of the use of unsustainable compounds by different industries? Will respondents welcome a reduction in petrochemicals in their day-to-day products?

The factors, which correspond to the questions formulated and included in the survey questionnaire, are:

- 1. Industry transition to sustainable sources:** Seeks to know the respondent's level of understanding of the need for creating cleaner and more sustainable standards for industrial processes in general.
- 2. Awareness of origin of product ingredients:** Intends to clarify if respondents are conscious of the usage of petrochemical or other unsustainable compounds as industrial ingredients of their products.
- 3. Market acceptance:** Aims at discovering if a progressive replacement of unsustainable compounds for bio compounds in day-to-day products would be welcomed by the public.

Questionnaire, protocol and distribution

The questionnaire for this study was designed to respond to the above-mentioned factors, that are represented in 6 questions. Nevertheless, the questionnaire is, divided into two parts: first, a demographic set of four questions that aims at gathering background information about the respondents such as age, educational level, gender and nationality, to make sure to collect information from a variety of people and then be able to cross that information with the other responses, so trends and positions can be identified; and,

second, the set of six questions related to the three social factors identified, with the purpose of revealing the positions, beliefs and attitudes towards the project's core topics and solutions.

A protocol¹ for answering the questionnaire was also designed. The protocol included: first, a welcome message to SECRETed's social acceptance survey, with a brief description of SECRETed's philosophy, goals and activities; second, a GDPR information box, with a question at the intended for the participant to accept or not the data treatment policy²; third, the participant was shown the demographic questions; and fourth, the participant was shown the six core questions related to the factor previously defined.

For the questionnaire distribution and data collection, a Market Research Company was selected. This company was in charge of identifying and selecting candidates that meet the criteria that SECRETed has established for the survey respondents. The selected company was SurveyMonkey. The distribution was made online, and the results were obtained in a short span of time. The SurveyMonkey survey complies with GDPR, as the company states it: "SurveyMonkey made changes before Europe's General Data Protection Regulation (GDPR) became law on May 25, 2018. Even before GDPR came into effect, we maintained company practices that were very respectful of our users' privacy and all the relevant privacy laws. However, we've still used our GDPR preparations as an opportunity to ensure that we do even better for our customers"³.

Data Analysis

According to Moula, Nyári and Bartel (2017) the data is to be analyzed quantitatively by summarizing responses and calculating percentage choices for each question. Then trends within responses will be identified, providing insight into public acceptance and patterns regarding SECRETed's solutions. Correlations will be examined between various questions to understand beliefs and positions related these topics. This study will aim at providing a clear picture of where the public stands regarding the project, understanding factors influencing social acceptance and identifying potential areas of improvement for social acceptance of SECRETed's solutions.

The analysis of the responses will be made with scale described by Boutilier and Thomson (2011) for Social License to Operate, which will be adapted to a Social Acceptance Assessment for the purpose of this study. A qualitative

¹ To see the protocol and the questionnaire, please see Annex 1.

² If the participant answered no to the Data Treatment question, they were disqualified from the survey.

³ For more information on Survey Monkey's data & privacy policies, please refer to: <https://www.surveymonkey.com/curiosity/surveymonkey-committed-to-gdpr-compliance/>

assessment of the responses to the survey will be made with the objective of determining the level in which the respondents may be placed in the following scale:

1. **Reluctance:** The lowest level, where acceptance may not be assured.
2. **Acceptance:** The most common level where the project has minimal issues.
3. **Approval:** Requires credibility and signifies a higher degree public trust.
4. **Identification:** Represents the highest level of acceptance.

The level of acceptance will be represented with the adapted arrowhead model for social acceptance, as shown below. This will help to graphically represent the results to the readers.

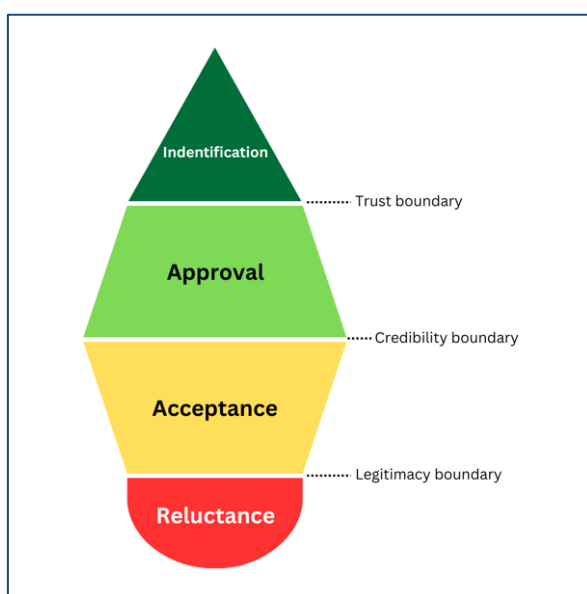


Figure 16. Arrowhead Model for Social Acceptance Assessment (adapted from Boutilier and Thomson, 2011).

3.3.3. Results

Demographics

The Social Awareness Survey received a total of 182 answers from participants. These participants were male and female (with one declining to specify), and their age ranged from 18 to 80, as can be seen in the following chart:

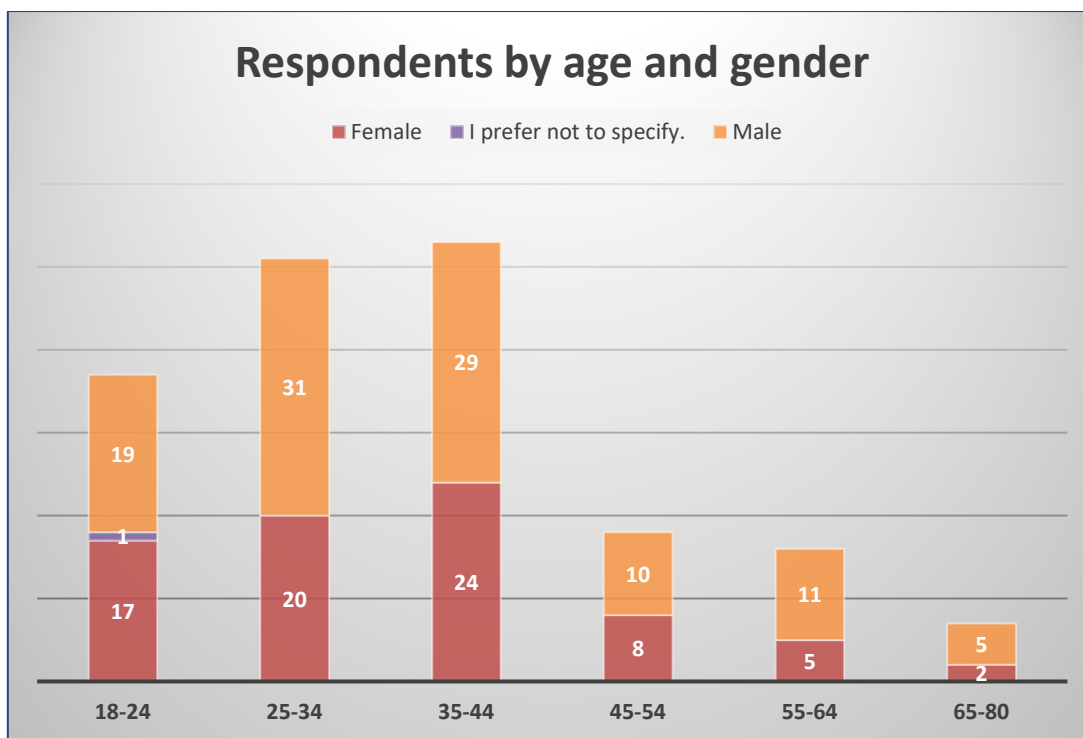


Figure 17. Social Awareness Survey – Respondents by age and gender.

The majority of respondents were males, with the bulk of them aged 25 to 44 at the time of the survey. For the females, the majority were comprised in the age groups 25-34 and 35-44. There were also a good number of young (18-24) respondents, both male and female. The older groups (54 to 80) represent the minority of the participants.

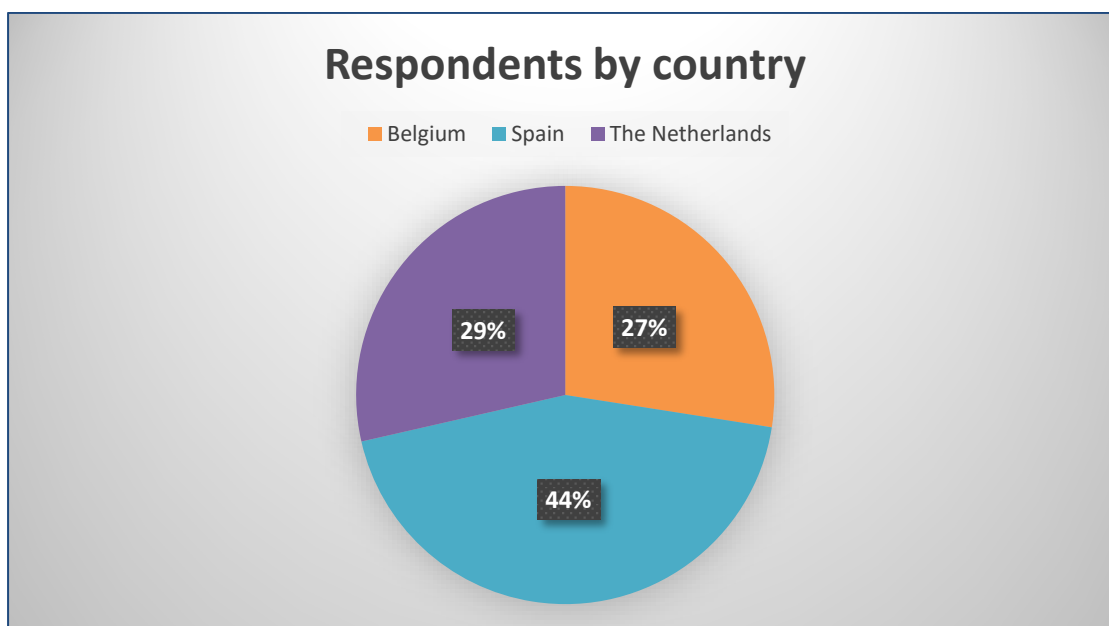


Figure 18. Respondents by country. N= 182.

The participants for the survey were mainly located in Spain with 44% of them being residents of this country, while participants from Belgium and the Netherlands make up 27 and 29% respectively.

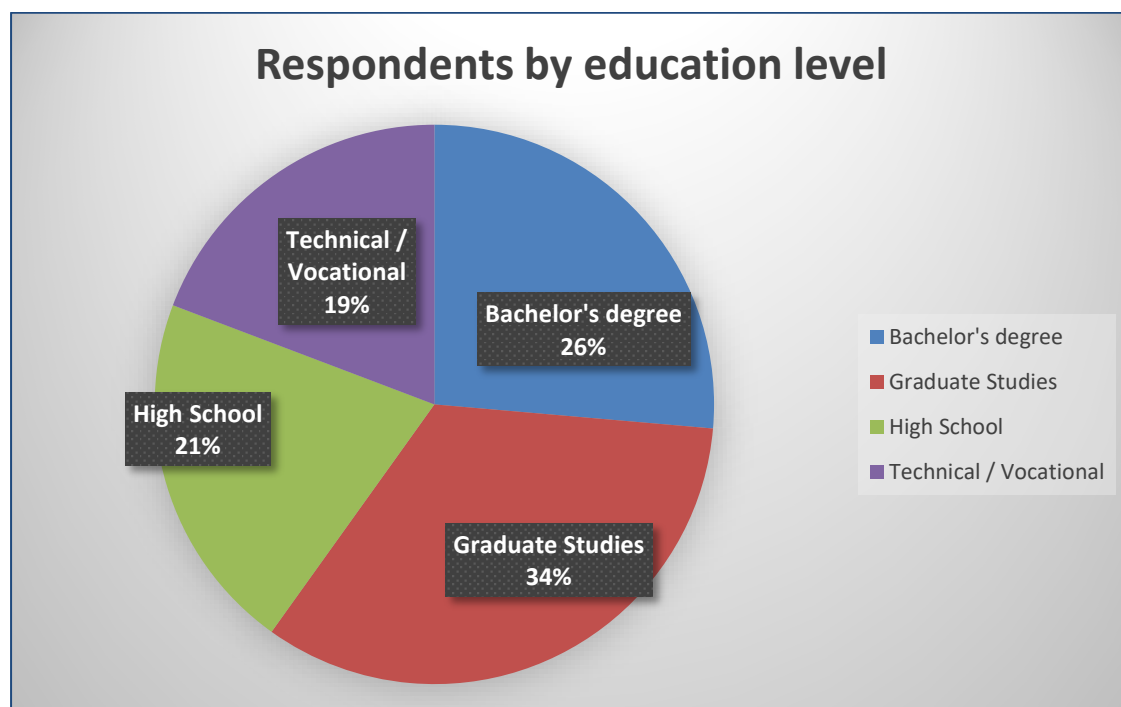


Figure 19. Respondents by education level. N= 182.

The question about education level brought interesting results as all the answer were more or less distributed proportionally, without exaggerated differences between the categories. That said, Graduate studies dominated the results with 3 in 10 respondents, while Technical/Vocational studies were the least chosen option. Additionally, it can be pointed out that university studies make up for 60% of the participants.

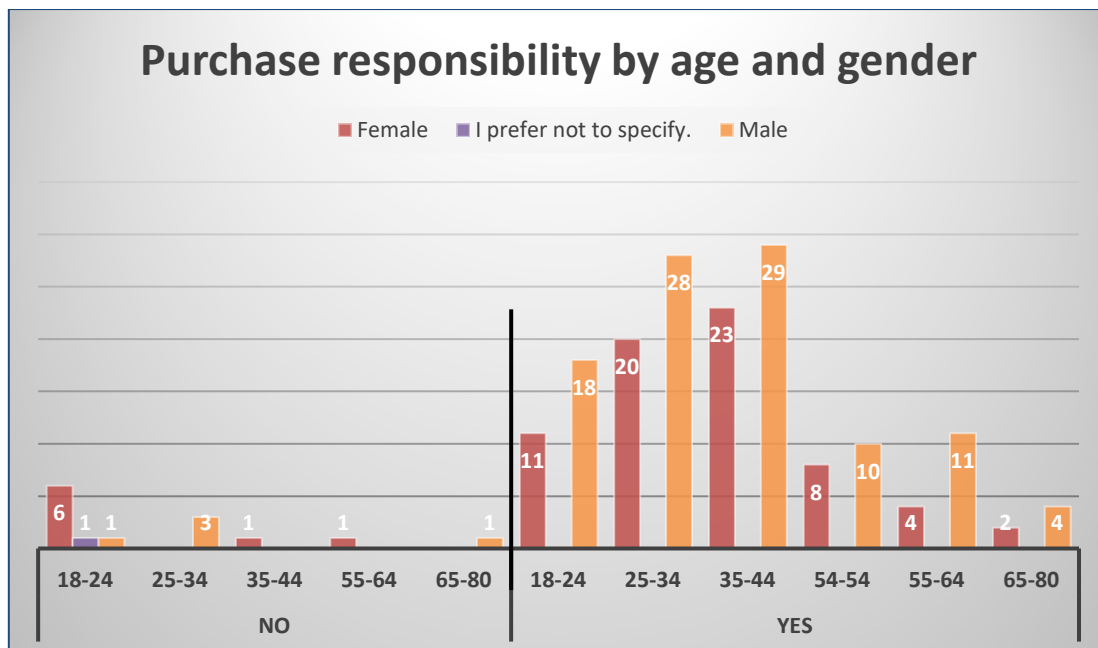


Figure 20. Purchase responsibility by Age and Gender. N= 182.

When designing the survey, one of the objectives was to know if the person answering it was in charge of buying goods for their household. This was important as the survey's goal is to track the awareness level of a transition from fossil-based to bio-based ingredients that might end up in common, day-to-day products for every household; therefore, a habit of buying products and awareness about what is being bought were crucial for this study.

The answers to this question have been separated by the two options (Yes, No) but have also been crossed with the data on gender and age, to have a broader view. For the “No” options, very few of the respondents chose it, being the segment 18-24 the one with the most answers and, predominantly, among women. On the other hand, the “Yes” option was chosen by the majority, with the highest rates going to men between 25 and 44 years old; and subsequently to women of the same age groups.

Industry transition to sustainable sources

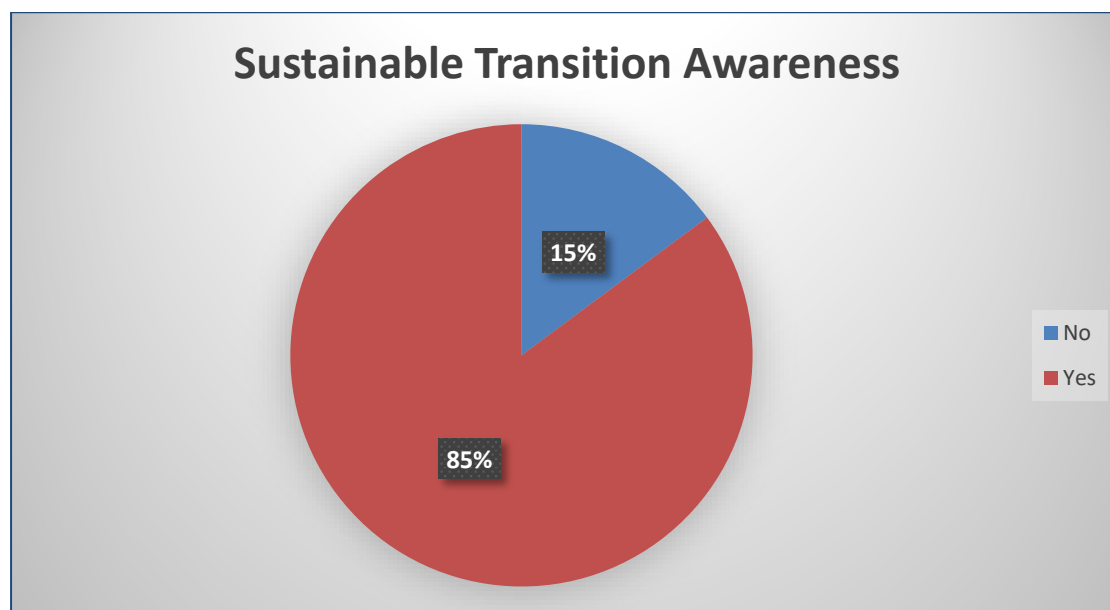


Figure 21. Sustainable transition awareness. N= 182.

The first question in the “Industry transition to sustainable sources” factor was about awareness about a “sustainable transition”, in other words: the participants were questioned about their knowledge of an industry-level replacement of the sources and ingredients of products, from fossil-based to bio-based sources and ingredients. The majority of participants answered that they were aware of this transition, with an 85% of the responses; while only 15% said they weren’t aware or have never heard of it before.

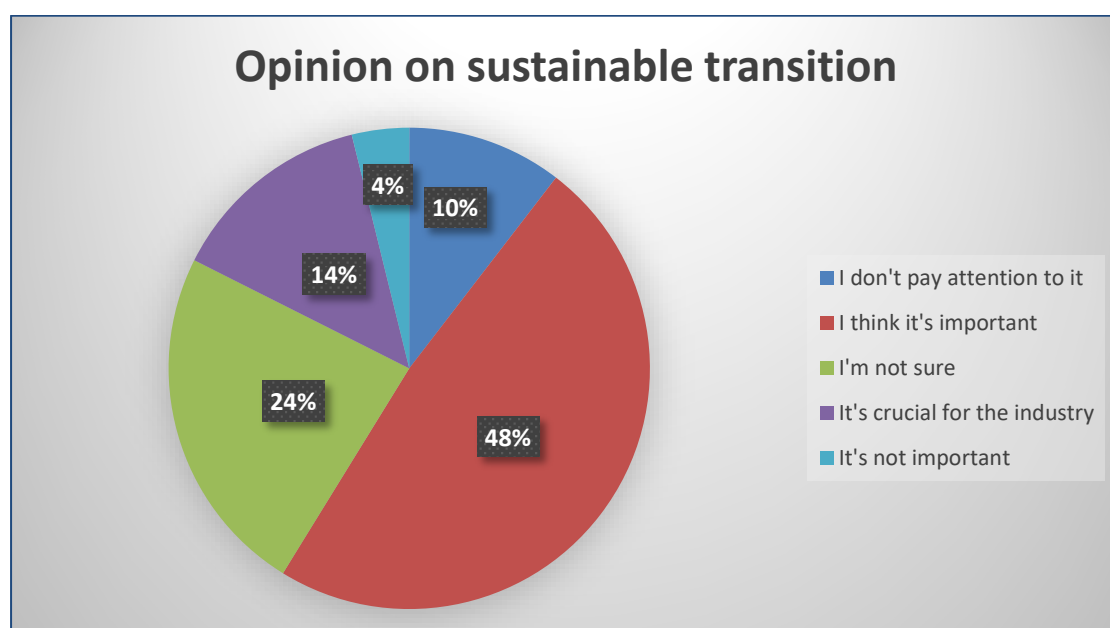


Figure 22. Opinion on sustainable transition. N= 182.

The participants were also asked about their opinion of the industry transition to ‘greener’ resources and products. The majority of them replied that it is important (48%); the second biggest group said they were not sure about their opinion on the matter (24%); 14% of the participants said that this transition is crucial for the industry; a fraction stated that they don’t pay attention to such topic (10%) and only 4% expressed that, in their opinion, it was not important.}

Awareness of origin of product ingredients

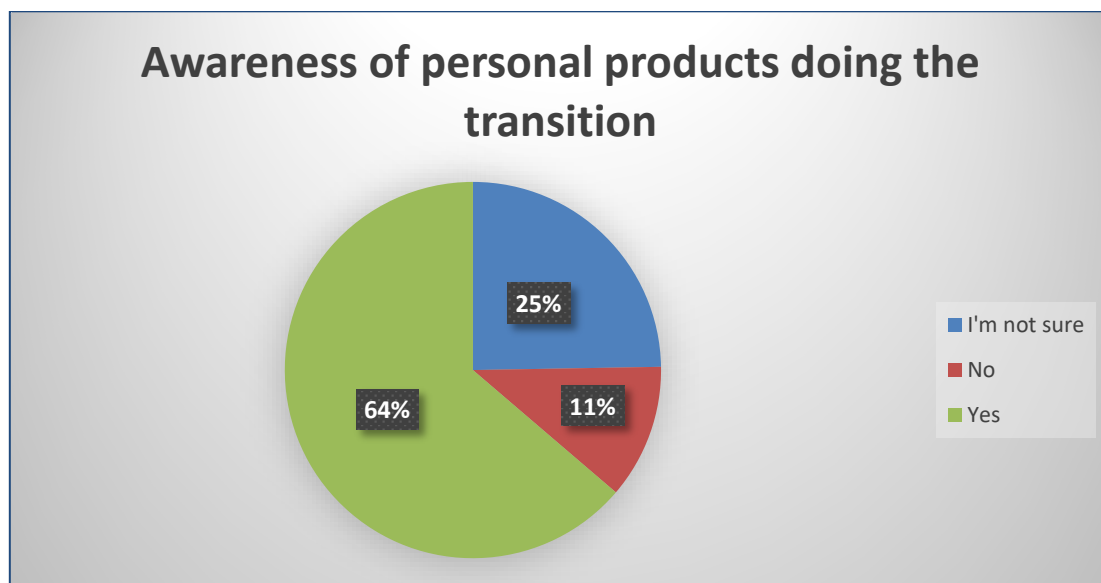


Figure 23. Awareness of personal products doing transition. N= 182.

For the next block of questions, the factor was “awareness of the origin of products ingredients”, and the first question was “Do you know if products that you use in a day-to-day basis are changing their ingredients to be more sustainable or environmentally friendly?”. Six and a half out of ten people answered that they are aware of the type of ingredients in their products; two and half out of ten participants weren’t sure about it; while 1 in 10 people replied that they were not aware of the ingredients in their products.

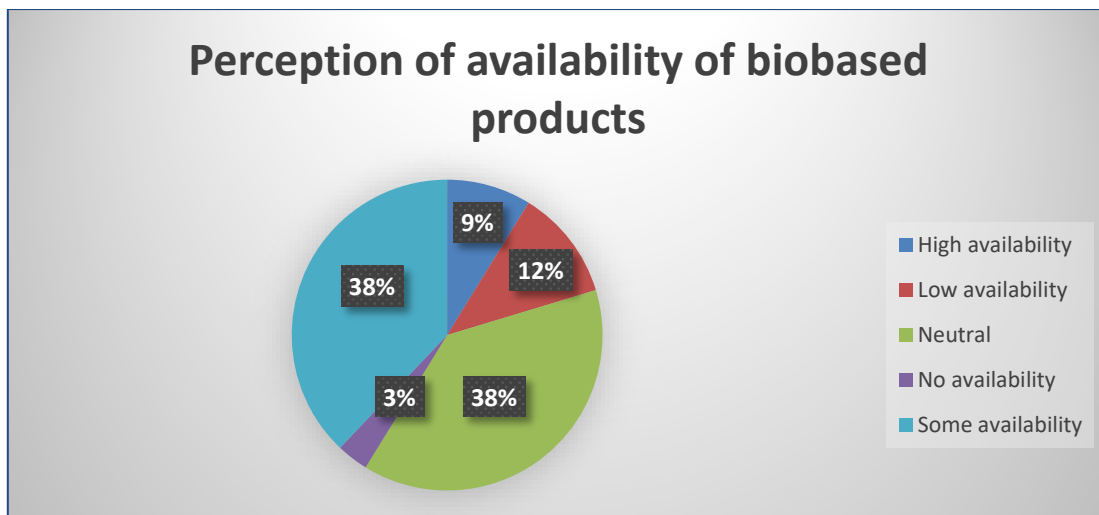


Figure 24. Perception of availability of biobased products. N= 182.

As for the next question, “How do you perceive the availability of products that use biobased ingredients in the pharmaceutical, food and cosmetic industries currently?”, the answers were split and there is no clear trend: 38% answered that they perceived some availability of these products whenever they went shopping; another 38% answered that the availability was neutral (neither high nor low); 9% said that there was high availability; 12% said there was low availability; and only 3% answered that the products were not available.

Market acceptance

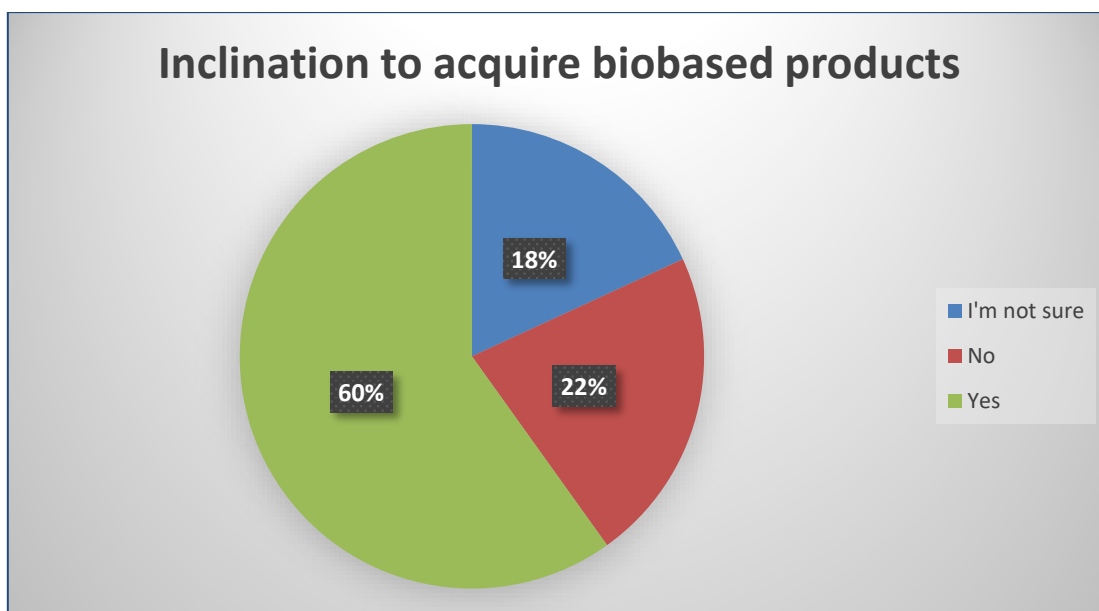


Figure 25. Inclination to acquire biobased products. N= 182.

The third factor, market acceptance, had two questions as well. The first question aimed at discovering if the participants were inclined to acquire products with biobased ingredients, to what the majority answered yes (60%);

the minority answered that they were not sure (18%); and 2 out of 10 participants answered that they were not inclined to acquire said products.

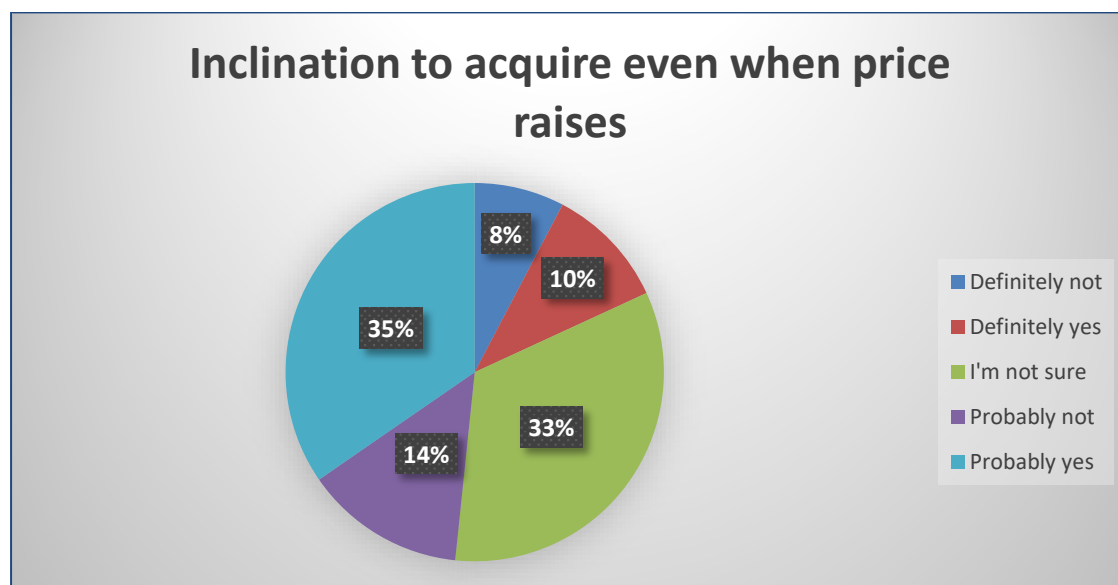


Figure 26. Inclination to acquire even when price raises. N= 182.

Finally, the last question was “Currently, commonly used cosmetic products utilize petrochemical compounds in their formulation. If these were progressively changed to biobased compounds, would you be willing to acquire them, even if it would imply a 5-10% raise in the cost?”, this was designed to test their willingness to acquire the products. The answers were varied, with no clear indication of a trend, but the majority (35%) said that they would probably buy them; 33% said they were not sure if they would buy them; 14% said they would probably not buy them; 10% expressed that they would definitely buy them; and only 8% said that they definitely would not buy them.

3.3.4. Discussion

The results indicate that the majority of people is indeed aware of a sustainable transition happening right now in the industry and reflect the desire of a segment to pursue options that accommodate their needs in terms of sustainability. In fact, and just as an example, in a country like The Netherlands, people are actively engaging in strategies to acquire more sustainable, bio-based products over traditional ones, as the statistics about “Green Friday”⁴ awareness show: in just over a year, the Dutch increased their awareness on such an initiative by 5 points, going from 21% in 2022 to 26% in 2023 (Motivation, 2023). Numbers like these show that there is a niche, and even a platform, for the biobased industry efforts and that people (at least in Europe) are paying attention to new developments in this area.

⁴ Green Friday is an anti-Black Friday initiative created to spread awareness on the negative impact of over-consumption and excessive shopping habits on climate (Tighe, 2024).

Regarding the first question, figure 7 shows 8.5 out of 10 participants declare that they know the transition is underway. This means that a majority of people regularly check the ingredients of their products, are informed about the steps being taken to ensure sustainability or receive other type of external stimulus that makes them aware of what the industry is doing in this regard. If the results are contrasted with the age of the participants, it's possible to see that the younger generations are generally more aware of the transition than the older ones:

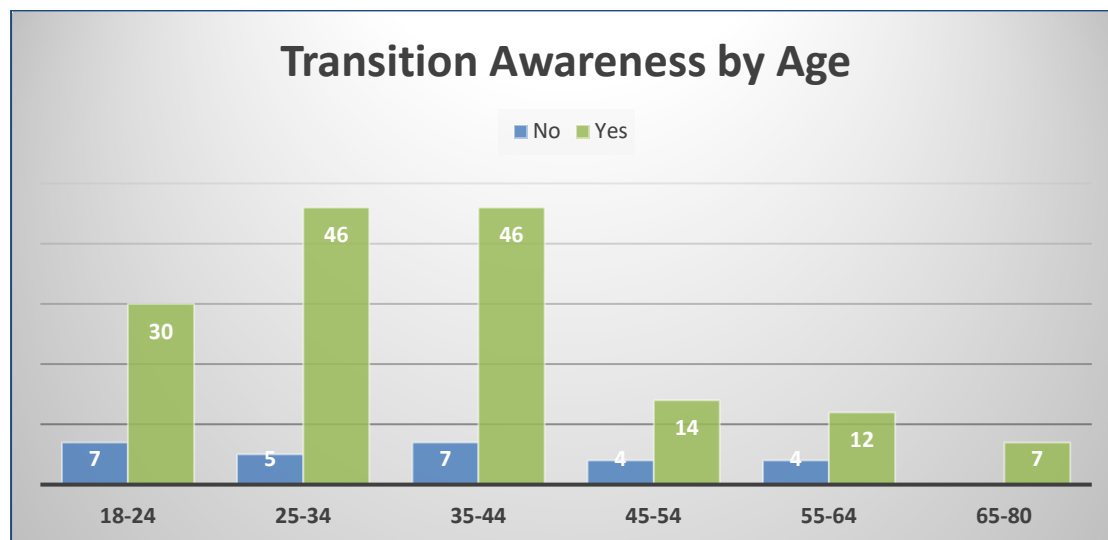


Figure 27. Transition Awareness by Age. N= 182.

In any case, these numbers represent an opportunity to reach the older generations and let them know about the importance of the sustainable transition and how they can search for products that include sustainable ingredients. On the other hand, if the results are crossed with the gender of the participants, male, females and unspecified express that they know about the transition, although proportionally, the number of females that are not aware could be higher than the number of men, according to the results.

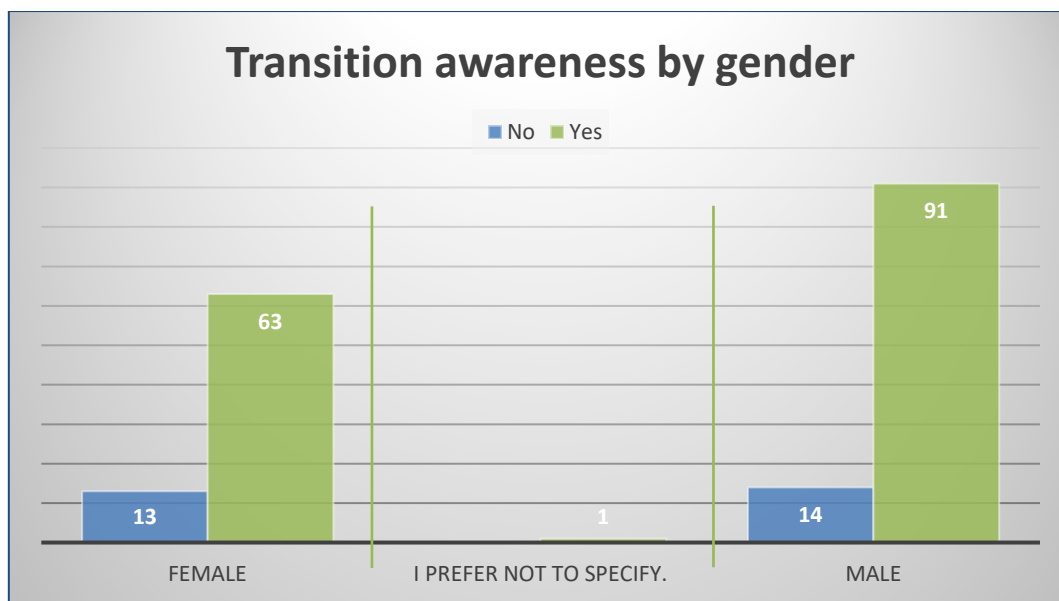


Figure 28. Transition Awareness by Gender. N=182.

When it comes to the opinion on the sustainable transition, more than a half of the participants had a positive opinion, answering that they think is important or crucial for the industry, which means that the efforts being made to introduce sustainable processes and products is well received among the people. There were also some participants that weren't sure about this transition and did not have a clear opinion. This represents an opportunity to sway some of them to a positive opinion, by increasing awareness on what it means to invest in research and development of biobased solutions and why that it is important. On the other hand, if the answers are distributed by the countries of the participants, the trend remains the same both with the exception of the Netherlands, as it can be seen in the following graphic:

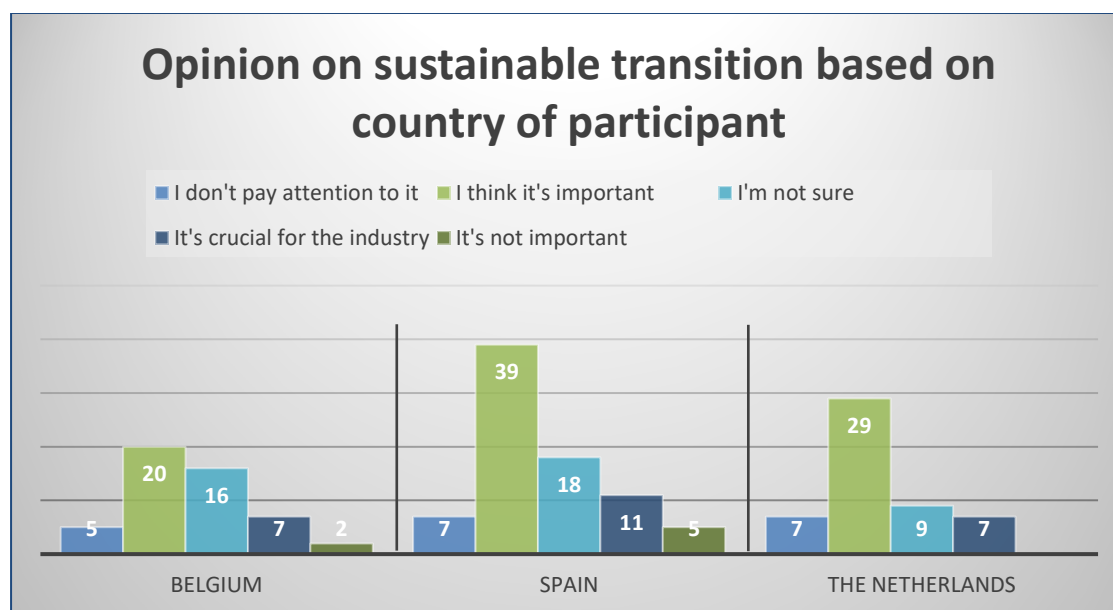


Figure 29. Opinion on sustainable transition based on country of participant. N= 182.

When it comes to a positive, negative or neutral opinion on the sustainable transition based on level of education, the participants with university degrees were generally more favorable to it, while the participants with high school and technical or vocational education were less inclined to have a positive opinion. Either way, the general trend is positive among all educational levels.

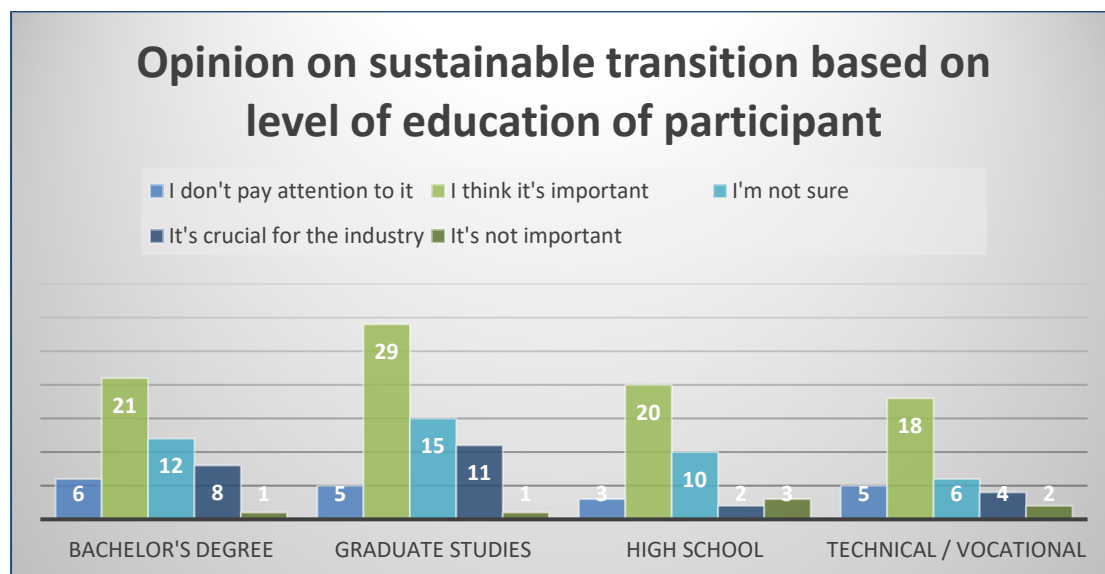


Figure 30. Opinion on Sustainable transition based on level of education of participant. N= 182.

For the question about awareness of sustainable ingredients in personal, day-to-day products, the majority of participants (64%) answered that they are aware of the sustainable ingredients/products that are used in what they buy. It's a clear trend that is being backed by what the European Union is doing through its Bioeconomy Strategy, which as of 2022, reported that "An increasing number of national and regional bioeconomy strategies promote cross-sectoral cooperation and sustainability principles, and invest in bioeconomy innovation" and "Mobilisation of private investments and research and innovations in food and other bio-based industries are increasing and show promising developments. Europe has a strong position in the global market for bio-based chemicals and materials" (European Commission, 2023). But to put it in perspective, a comparison between those participants who expressed that they are in charge of buying the groceries at home and those that are not in charge, related to the sustainable ingredients in what they are buying or consuming; the trend of being aware that there are sustainable ingredients in their products is present in both groups of participants. This is significant because it implies that even if they're not actively buying the products for their households, they are aware that these include sustainable components. On the other hand, the following graphic might also suggest an inclination to acquire sustainable products (this will be discussed more in detail below).



Figure 31. Awareness of sustainable ingredients in personal products - people in charge of groceries vs people not in charge of groceries. N= 182.

Additionally, the majority of participants expressed that they perceive from some to high availability of these products on their day-to-day shopping, which might indicate a recognition of patterns associated with sustainable ingredients. When it comes to the participants who are in charge of buying the groceries at home and the ones who are not, the trend is still visible, with no availability being the minority response, as can be seen in the following graphic:

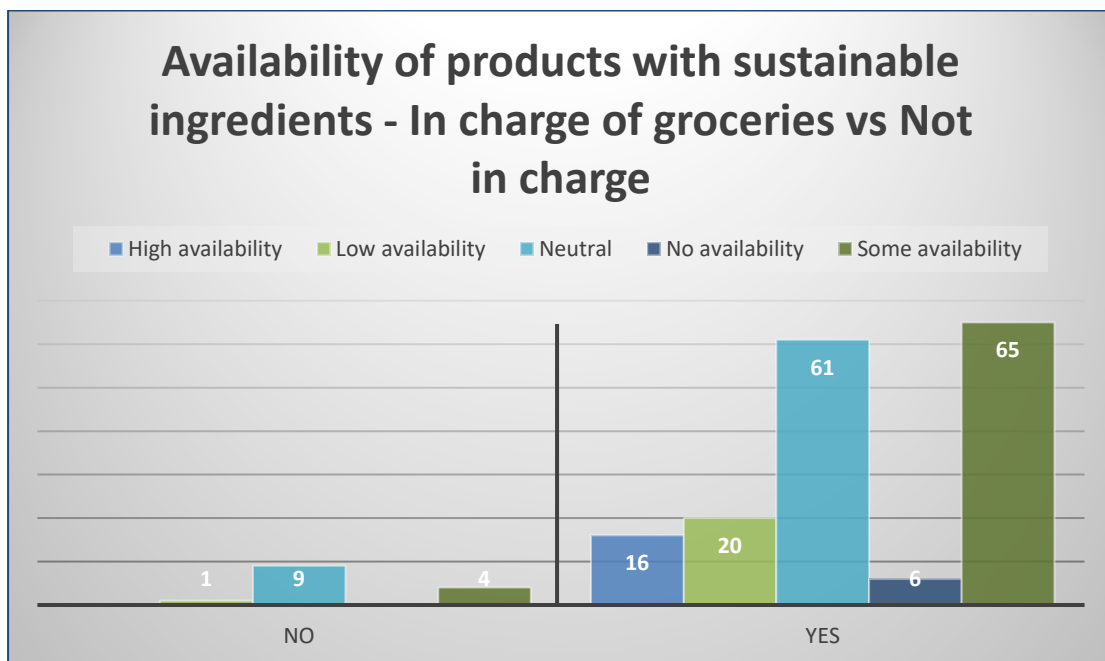


Figure 32. Availability of products with sustainable ingredients - In charge of groceries vs Not in charge. N= 182.

Finally, when it comes to market acceptance, along with the previous answers, the majority of participants (6 out of 10) were open to acquire products that contained biobased ingredients or that are more sustainable, although a considerable portion (22%) said no. To look into the possible variants of this matter, here are the graphics that cross those responses with age and gender of the participants:

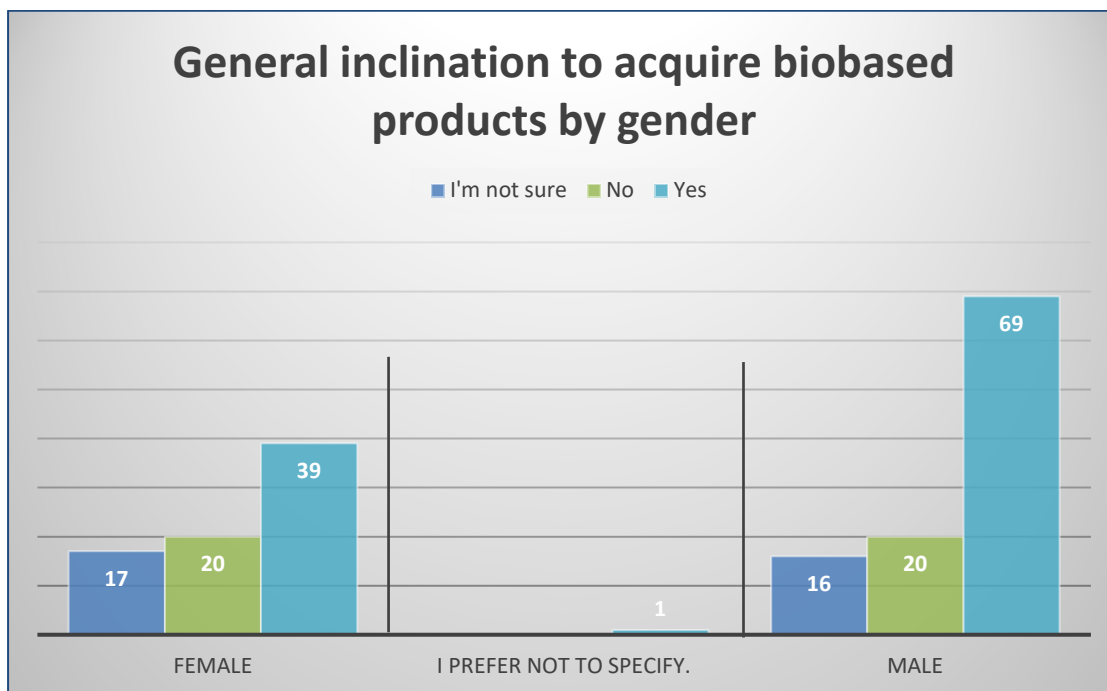


Figure 33. General inclination to acquire biobased products by gender. N= 182.

When the answers are contrasted with the gender of the participants, the trend is held: the majority of people, including non-specified, state that they are inclined to buy biobased products; a significant part says that they are not; and some of them say they are not sure. Although, this time, the shares of the participants that are opposed to the idea of acquiring biobased products is slightly bigger than that of those who are neutral to it. This might mean that the gender of the buyer does not strongly correlate with the intention of buying biobased products.

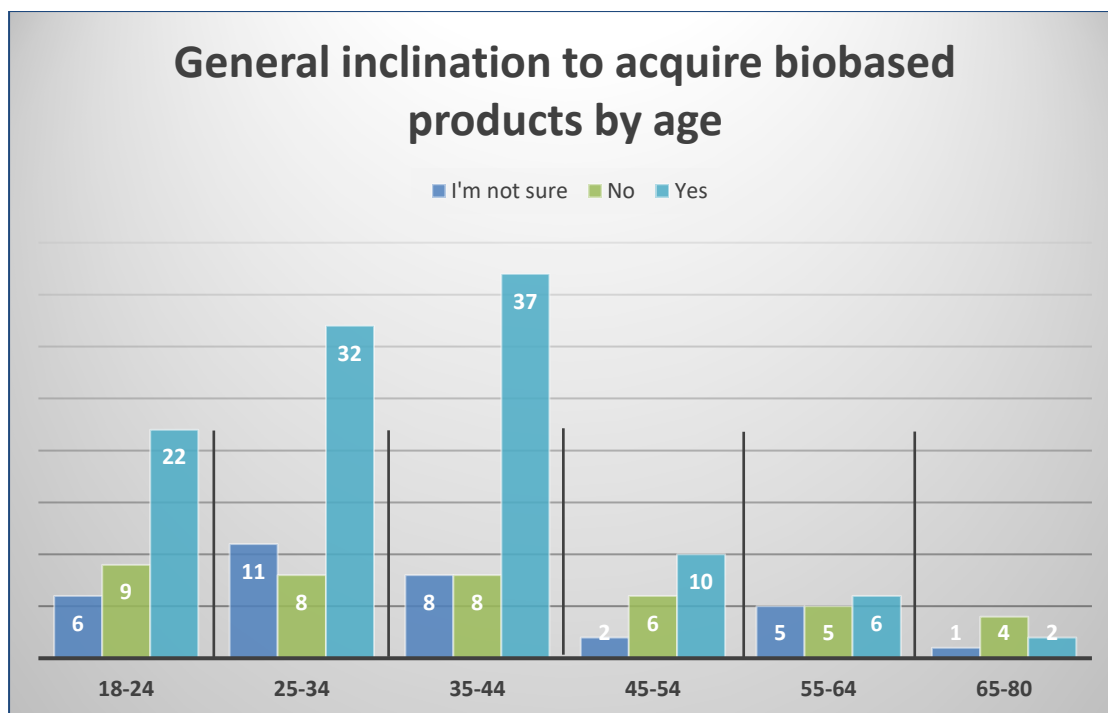


Figure 34. General inclination to acquire biobased products by age. N= 182.

On the other hand, the age of the participants clearly show that the younger generations are more inclined to buying biobased products than the older ones. It even shows that the majority of the people in the age group 65-80 are against, and in the age group 55-64 are basically tied. This would imply that a greater effort must be made in the older groups of consumers, with the objective of showing them the benefits of the biobased economy and bringing them closer to the cause by raising awareness on the importance of encouraging sustainability in the industry.

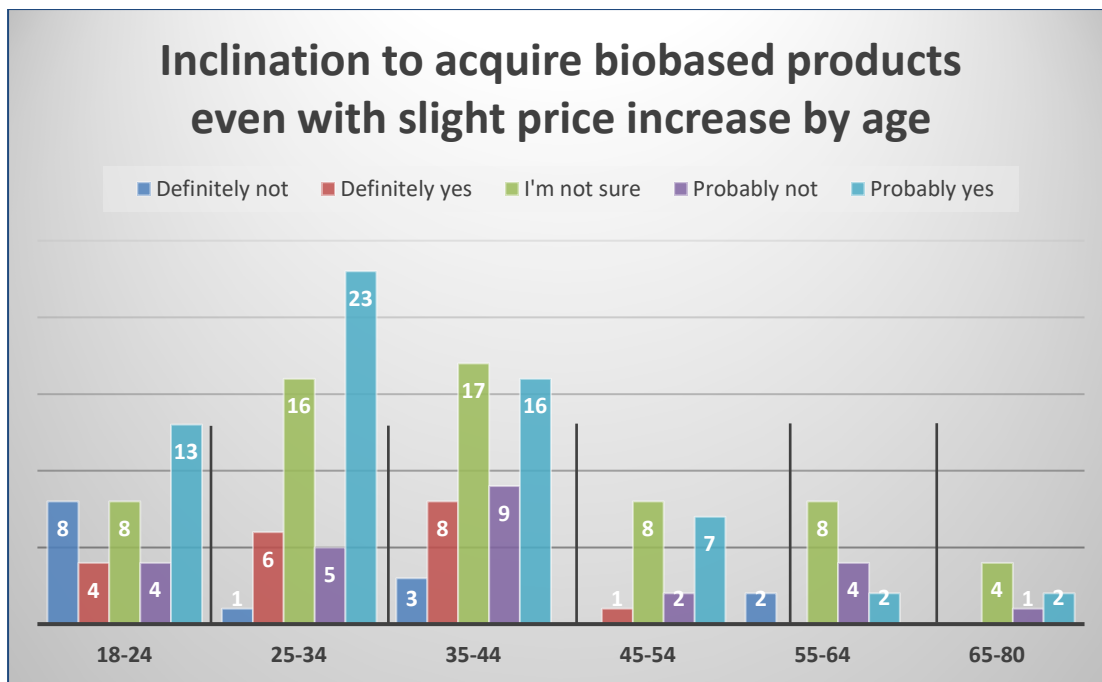


Figure 35. Inclination to acquire biobased products even with slight price increase by age.
N= 182.

However, when filtered by age, the same result as the previous question appears, signaling the older generations may not be that open to acquiring biobased products with an increase of the price. Then these results might support the premise of investing in social awareness for those age groups as an opportunity to gain a new public and increase the acceptance of biobased products.

Finally, the last question, which was about inclination to acquire biobased products vs conventional products even if the price increases slightly, draw mixed responses but showed that 4.5 out of ten people would be inclined to buy the products; 2.2 out of ten people would not buy them; and 3.3 out of ten people are not sure about buying them if it means an increase in the price. This result might be considered normal especially when the prospective buyer doesn't know the product or is not used to buying solely on the base of the origin of the ingredients; but this result might also reflect a somewhat favorable opinion towards bio-based products among the European population.

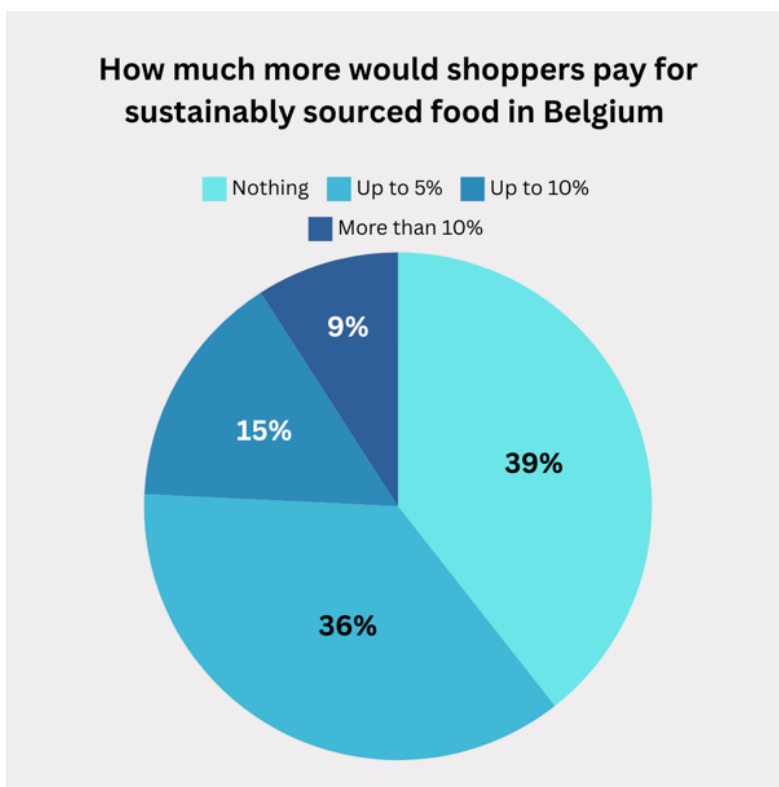


Figure 36. How much more shoppers would pay for sustainably sourced food in Belgium as of August 2021. Source: Statista.

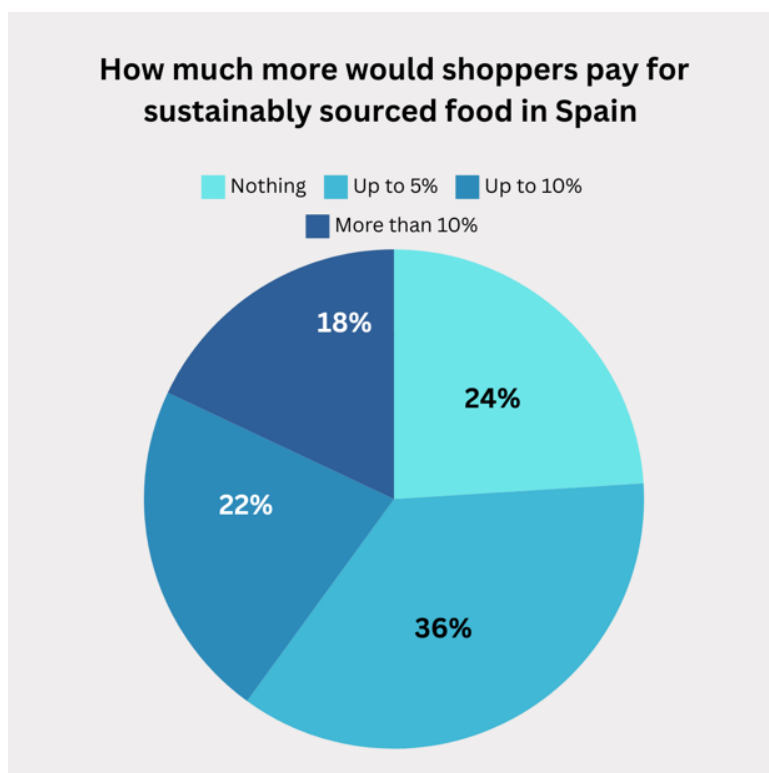


Figure 37. How much more shoppers would pay for sustainably sourced food in Spain as of August 2021. Source: Statista.

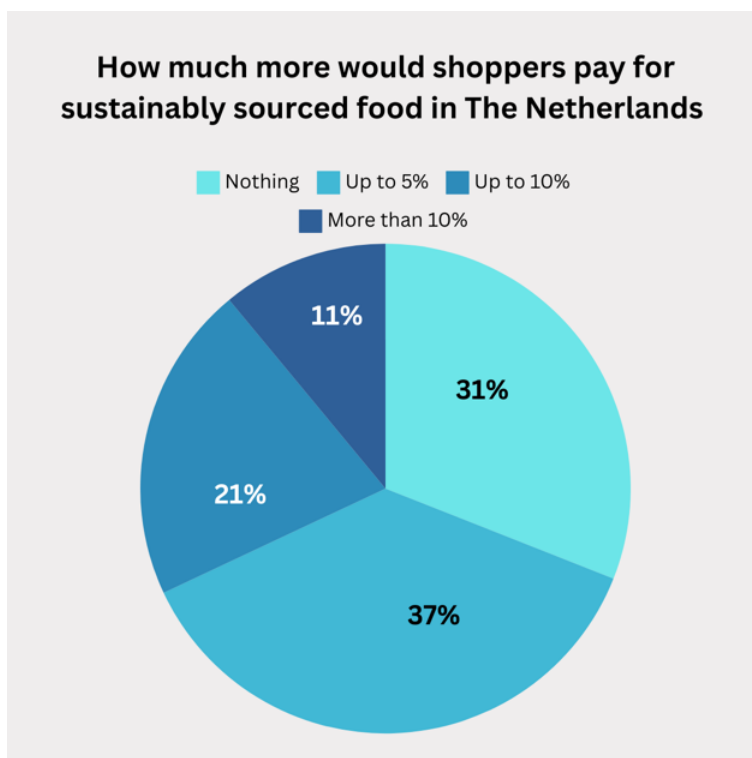


Figure 38. How much more shoppers would pay for sustainably sourced food in the Netherlands as of August 2021. Source: Statista.

According to a series of studies made by Deloitte in 2021, in the three countries of reference for SECRETed's Social Awareness Survey, the amount of people that is willing to pay extra for sustainably sourced products or ingredients represents the majority of the population. For example, almost 7 out of 10 people in The Netherlands would be willing to pay from 5% to more than 10% more for a sustainably sourced product, while only a third of them would not be willing to pay anything additional (Deloitte, 2021). In the case of Belgium, 6 out of 10 people would be willing to acquire sustainably sourced products even if they had to pay the additional percentages expressed above, while 4 out of 10 said they wouldn't pay anything else for the same product (Deloitte, 2021). And in Spain, the proportion of people willing to pay more for sustainably sourced products is significantly higher with 76% saying they would, while only 24% saying they wouldn't.

3.3.5. Survey Conclusions

The social awareness survey results reflect the state of transition that people generally perceive in an industry that is increasingly walking towards more sustainable resources and ingredients for its processes. Some of the broad conclusions are:

- The participants are aware of a sustainable transition happening in the industry and want to pursue options that accommodate their needs in terms of sustainability.

- Older generations are generally less inclined to recognize the sustainable transition, but the numbers represent an opportunity to let them know about its importance and how they can welcome more sustainable and biobased products.
- The majority of participants think it is important or crucial to implement sustainable products in the industry.
- Both, participants who expressed that they are in charge of buying the groceries at home and those that are not in charge expressed their awareness about bio-based products in their shopping list.
- The majority of participants are inclined to acquire bio-based products even if that entails a slight increase in the price, in line with the trends in terms of sustainable shopping in the three countries of reference.

Finally, when analysing the responses, it is possible to see that there is an inherent acceptance of the fact that the industry in general is transitioning towards more sustainable resources and processes, including bio-based compounds. However, there are still many people saying that they are not sure or neutral about aspects of this transition, such as the presence of bio-based ingredients in their products, the availability of more “bio” products and their inclination to acquire these products. Therefore, and even though the trend is positive, it is possible to say that there isn’t still an approval, much less an identification, from the public with the pillars of the sustainable transition. Although they might perceive the efforts as legitimate, they haven’t still crossed the credibility boundary, thus resulting in a mere acceptance of the transition and the biobased economy.

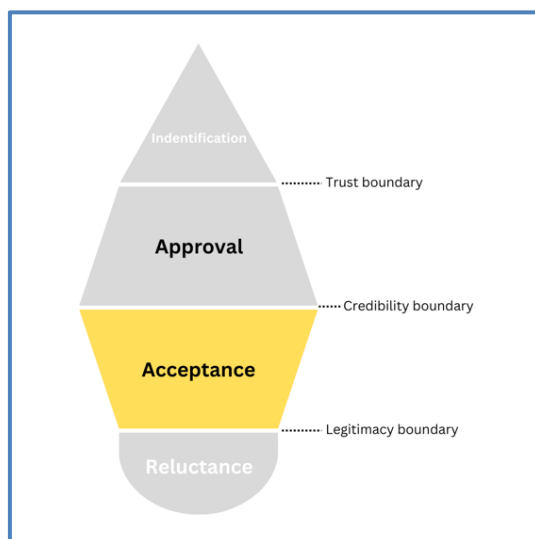


Figure 39. Final Arrowhead Model for SECRETed Social Acceptance Assessment (adapted from Boutilier and Thomson, 2011).

3.3.6. Recommendations based on the survey

Based on the results, discussion and conclusions of the Social Awareness Survey, a set of recommendations for SECRETed's or any topic-related project's current or future social awareness and acceptance endeavors are suggested:

- **Enhance public awareness campaigns:** Increase efforts to educate the public about the benefits of bio-based compounds, emphasizing their sustainability and environmental impact. Use clear, relatable messaging to reach diverse demographics.
- **Target older generations:** Develop specific outreach programs aimed at older age groups, who may be less aware or supportive of the transition to bio-based products. Highlight the long-term benefits for future generations and the planet.
- **Leverage positive perceptions:** Capitalize on the generally positive perception of sustainable transitions by showcasing successful case studies and testimonials from early adopters of bio-based products.
- **Address price sensitivity:** Clearly communicate the value proposition of bio-based products, even if they come at a slightly higher cost. Highlight the long-term savings and health benefits associated with sustainable products.
- **Transparency in ingredient sourcing:** Provide detailed information about the sourcing and production processes of bio-based compounds. Transparency can build trust and credibility among consumers.
- **Highlight regulatory compliance:** Emphasize that bio-based products comply with strict regulatory standards, ensuring their safety and efficacy. This can alleviate concerns about the quality and reliability of new products.

3.4. Social Acceptance Interviews

3.4.1. Theoretical Framework

The transition toward a bioeconomy, where biobased products replace fossil-based alternatives, hinges not only on technological feasibility but also on consumer acceptance. Social acceptance in this context refers to the degree to which consumers are willing to integrate biobased products into their daily lives, influenced by perceptions of sustainability, trust, and value. For this assessment, the social acceptance is projected, due to the nature of the SECRETed Project, and understood as the future willingness to adopt biobased products, particularly the ones related to the industrial and market evolution of the outcomes of the Project.

In this sense, a qualitative methodology, particularly through in-depth interviews with experts in the biotechnology field, was the well-suited alternative to explore the nuanced and context-dependent nature of possible future social perceptions around this topic. The semi-structured interview is the primary data collection method, allowing participants to articulate their thoughts on the context and future of biobased product research, development and social acceptance while enabling the researcher to probe deeper into emerging themes. As Miles, Huberman, and Saldaña (2014) emphasize, qualitative research is particularly effective for “understanding the meaning people have constructed, that is, how they make sense of their world and the experiences they have in the world”. This approach is essential for unpacking the complex interplay between the industry role, the consumer values, the environmental concerns, and product choice.

The Social Awareness Interviews of the SECRETed Project were developed following three interrelated dimensions, that became the guiding aspects for the study of the participant’s opinions:

#	Principle	Description
1	Perceived Environmental Benefit	Beliefs about the ecological advantages of biobased products.
2	Trust in Innovation and Producers	The extent to which the claims made by producers and the safety and efficacy of biobased alternatives could be trusted
3	Perceived Value and Usability	How the cost, quality, and practical utility of biobased products compared to conventional ones would be evaluated by society.

Table 2. Social Awareness Interviews - Dimensions / Principles.

These dimensions are informed by Zeithaml’s (1988) model of consumer perceptions, which links price, quality, and value in shaping consumer behavior. In the context of biobased products, these perceptions are further influenced by ethical and environmental considerations, making qualitative inquiry particularly valuable. For this part of the assessment, the dimensions are the guiding aspects for the discussions with the experts, seeking to examine a potential reception of the biobased products developed by SECRETed, by extrapolating the opinions on the current and future state of the biotechnology industry in Europe.

This theoretical framework provides a robust foundation for exploring the social acceptance of biobased products through qualitative methods. By focusing on consumer perceptions and values, the study aims to generate insights that can inform policy, marketing strategies, and product development in the bioeconomy sector.

3.4.2. Methodology

The methodology followed by the Social Acceptance Interviews was focused on the conduction of expert interviews as the first step. The experts in question came from different types of industries and profesional backgrounds, and were chosen after recommendations from top professionals related to SECRETed were made. There were a total of 20 semi-estructured interviews, and they were conducted over the course of the last year of the proyect. The interviews generally lasted between 20 and 30 minutes, and were guided with the following general questionnaire:

#	Questions
1	Could you tell me if there are any ways in which the different kinds of industries could avoid using harmful chemicals in their production processes?
2	Do you know what biobased compounds, such as siderophores and biosurfactants, are?
3	And, in your opinion, what are the benefits and limitations of using these biobased compounds in industrial processes?
4	How could the industry in general be encouraged to use more bio compounds for sustainability purposes?
5	And how could the use of more bio compounds be tied to circular economy principles for industrial processes?
6	Have you, your company or your organization ever used bio compounds, or conducted research about it, or engaged in related activities?
7	And how do you think the industries that use these processes could promote awareness among consumers or end-users?
8	How do you think these new bio compounds (like biosurfactants and siderophores) will influence regulation or policymakers?
9	Among our possible clients for SECRETed solutions, there are industries like Pharma, Food and Cosmetic. What do you think is the role of groups of interest, like clusters or associations, in the adoption of the bio compounds or other sustainable products in the industry in general?
10	Do you know any success cases where there was a replacement of synthetic materials by bio compounds in their value chains or production processes?
11	What do you think could be the impact of Bio compounds production on the environment?
#	Optional Questions
1	What do you think is the impact for the marine environment if the industry transitions to biosurfactants and siderophores, or other sustainable chemicals derived from marine sources?
2	What do you think are the clearest environmental risks derived from using chemicals, like surfactants, when producing something at industry level?

Table 3. Social Awareness Interviews - Questionnaire.

Data Analysis

The resulting data will be analyzed using thematic analysis, following the coding strategies outlined by Miles, Huberman, and Saldaña (2014), which allow for the identification of patterns and themes across narratives, and additionally incorporating the dimensions established above. This method supports the iterative development of theory grounded in empirical data.

3.4.3. Results

The 20 Social Awareness Interviews yielded multiple trends and aligning opinions from the participants, which may not result strange due to the relatively homogeneous pool of participants. The interviewees were researchers and representatives from various industries and career paths, as shown below:

#	Participant	Country	Position / Institution
1	Dr. Marcel Jaspars	UK	Chemistry professor at the University of Aberdeen
2	Dr. Kirsi-Marja Oksman-Caldentey	Finland	Senior Advisor at VTT Technical Research Centre of Finland.
3	Dr. Dorit Avni	Israel	Coordinator of the Algae4IBD project under HORIZON2020 and head of a research lab at MIGAL in Israel.
4	Bradley Halti	Canada	R&D Manager at Croda Canada.
5	Dr. Amy Switzer	UK	Molecular microbiologist at Biome Bioplastics.
6	Dr. Andrew Mearns-Spragg	UK	Marine biotechnology entrepreneur and CSO of Jellagen.
7	Nicola Milić	Greece	Microbiologist and PhD candidate at the University of Athens.
8	Dr. Charlie Bavington	UK	Marine biochemist and entrepreneur.
9	Dr. Stefano Donadio	Italy	CEO of NAICONS and veteran in natural product research.
10	Dr. Gabino Sánchez-Pérez	The Netherlands	Business Development Director at Hudson River Biotechnology.
11	Dr. Igor De las Heras	Spain	Chemical engineer and researcher at Idener.ai
12	Dr. Paul Christakopoulos	Sweden	Professor at Luleå University of Technology.
13	Dr. Erik Malta	Spain	Chief Scientific Officer at CTAQUA.
14	Dr. Loïc de Carvalho	UK	Head of R&D at Biomara.
15	Aranzazu Pagán	Spain	R&D technician at CETENMA (Technological Center for Energy and the Environment).
16	Dr. David Mackie	UK	Co-founder of Marine Biopolymers Limited (MBL).
17	Dr. Rosa Doménech	Spain	Head of the biotechnology area at ITENE.
18	Dr. Katerina Kousoulaki	Norway	Senior researcher at NOFIMA.
19	Dr. Francesca Patrignani	Italy	Proffesor at University of Bologna.
20	Patricio Cano	Spain	Sustainability Engineer at Blue Synergy SL.

Table 4. Social Awareness Interviews - Participants.

The topics ranged from the benefits and challenges of developing bioproducts, consumer education and policy issues, to give some examples. Below is a summary of the conversations, distributed by patterns and themes in the opinions:

Biotechnology research and development brings enormous benefits

In the opinion of the experts, the benefits of Biotechnology research and development are great and groundbreaking. For instance, Dr. Marcel Jaspars emphasizes the urgent need for eco-friendly alternatives to harmful marine anti-fouling agents, because they could bring innovations such as biodegradable biocides and biosurfactants; Dr. Dorit Avni sees the potential of algae in reducing environmental pollutants and methane emissions, while also serving as a future protein source; Bradley Haltli highlights the environmental and performance benefits of biosurfactants and other natural compounds, and how this could drive-up consumer demand, circular economy principles, and public-private collaboration for sustainable innovation; Nikola Milic thinks that the reduced toxicity and economic potential of bio-based compounds, particularly in replacing fossil-derived chemicals, is reason enough to invest in it; Dr. Charles Bavington notes the potential to replace harmful synthetic chemicals and meet growing consumer demand for sustainable products, while underscoring the unique chemical diversity of marine organisms and the sustainability advantages of seaweed cultivation, which requires no land, freshwater, or fertilizers; Dr. Paul Christakoupoulos points out that bio-based compounds could offer real-world applications, especially in replacing harmful synthetic surfactants; Dr. Erik Malta explained how seaweed cultivated in wastewater can be repurposed for various applications, from agriculture to cosmetics, contributing to greener, circular production systems; Dr. Loic De Carvalho emphasizes the importance of replacing synthetic ingredients with natural, sustainable alternatives, particularly in industries like nutraceuticals and food; Dr. Aranzazu Pagán discusses the potential of genetically modified strains used to convert agri-food and textile waste into high-value compounds like lysine; Dr. David Mackie sees bioproducts offering serious societal benefits such as improved health for multiple societies; Dr. Rosa Doménech says that the long-term impact of biotech projects include reducing industrial environmental footprints, promoting circular economy principles, and shifting societal mindsets toward sustainability; Dr. Katerina Kousoulaki explains the promise of bio-based innovation in food systems, emphasizing the importance of utilizing marine side streams like fish waste to produce sustainable and nutritious products; Dr. Francesca Patrignani highlights environmental sustainability through reduced reliance on petrochemicals, the valorization of organic-rich waste, and the potential for cross-sector innovation; and Dr. Patricio Cano highlights several benefits of working with biocompounds, including lower energy requirements (especially in warmer regions like

southern Spain), environmental advantages, and technical precision due to the selectivity of microorganisms.

In this sense, all participants were able to point out the benefits of the work that projects like SECRETed, and Biotechnology Institutions do, related to the pursuit of a sustainable industry.

Biotech development faces critical challenges

On the other hand, all participants were also able to point out the challenges, complexities and obstacles that the work with biocompounds and biotechnology Development face. For example, Dr. Jaspars thinks that challenges remain mainly in the scaling-up of biobased production; Dr. Haltli acknowledges challenges such as cost, scalability, and regulatory hurdles; Dr. Amy Switzer explains the public misunderstanding of terms like “biodegradable” and “compostable,” and highlights the need for better labeling and life cycle assessments; Nikola Milic sees higher production costs and raw material availability as clear struggles for biotechnology; Dr. Stefano Donadio emphasizes that while industries are interested in replacing harmful chemicals with biological processes, barriers such as cost, time, regulatory complexity, and patent uncertainties often hinder adoption; Dr. Sánchez explains that, in the case of farmers, they are eager to adopt less harmful alternatives to pesticides, but regulatory delays and high costs diminish progress; Dr. Igor De las Heras thinks that industrial biotechnology may be very complex, especially when working with microorganisms; Dr. Paul Christakoupoulos notes that high production costs remain a major barrier to widespread adoption of biobased solutions; Dr. Malta labels inconsistent supply and high costs as a significant economic and logistical barrier; Dr. de Carvalho highlights the challenges faced by startups, including high costs, limited access to scale-up facilities, and the need to prove commercial viability early on; Dr. Pagán emphasizes the importance of aligning industrial processes with environmental goals, noting that while there is growing interest from companies in bio-based solutions, challenges remain—particularly in scaling up, regulatory delays, and the need for highly skilled personnel; Dr. Mackie notes that while bio-based materials like alginate are promising, they cannot currently compete with the massive scale of petrochemical-based plastics, for example; Dr. Kousoulaki also points out critical barriers such as market immaturity and flawed environmental assessment models that fail to credit circular practices; Dr. Patrignani backs the regulatory uncertainty claim and the need for clearer frameworks for new bio-based products, to help the industry scale up from lab to industrial production; and, finally, Dr. Patricio Cano alludes to a lack of specialized knowledge among professionals, confusion between biotechnology and biomedicine, and regulatory hurdles—especially concerning genetically modified organisms.

Multisectoral Collaboration is key for the future

Dr. Jaspars, Dr. Switzer and Nikola Milic advocate for stronger collaboration between academia, industry, and policymakers, to align innovation with policy and infrastructure, drive adoption of sustainable technologies and influence regulations through structured reports and foresight initiatives. Additionally, they agree that cross-sector collaboration, education, and standardized labeling are key to accelerate innovation and promote market integration. Dr. Malta emphasizes the importance of public-private collaboration, upscaling, and efficient logistics to attract industry investment and Dr. De Carvalho explained how these are key for future commercialization efforts. In line with this, Aranzazu Pagán and Dr. Doménech see industry associations and clusters as vital in supporting SMEs (Small and Medium Enterprises) and guiding them toward sustainable practices, as well as connecting stakeholders, promoting best practices, influencing policy, and building trust in sustainable products. On the other hand, Dr. Patrignani also underscores the need for greater involvement of consumer groups to support dissemination, acceptance, and exploitation of project results. Finally, Dr. Mackie and Dr. Cano explain how these efforts underscore the importance of multidisciplinary collaboration in fostering innovation and influencing policy.

Policy landscape: an uphill ride

Regarding the policy landscape, Dr. Kirsi-Marja Oksman-Caldentey explains the role of initiatives like SECRETed in influencing legislation and promoting circular economy practices; while Dr. Avni believes that projects like Algae4IBD and SECRETed can influence legislation and public awareness, ultimately driving a more sustainable and health-conscious future.

On his side, Dr. Andrew Mearns-Spragg advocates for tax incentives, better labeling, and integration into circular economy models to encourage industry adoption. Dr. Gabino Sánchez advocates for fast-tracking green technology initiatives, improving regulatory support, and creating business models that make innovation viable for smaller companies, Sánchez also highlights the need for government subsidies, consumer awareness, and collaborative ecosystems to be improved through regulations.

Dr. Igor De las Heras points out the cautious nature of large enterprises towards biotechnology as a barrier, but believes bio-based industries will grow significantly in the medium-term; something of which Dr. Christakopoulos is also confident about, but explains that policy support, public awareness, and cross-sector collaboration are necessary to drive that kind of change.

On the other side, Dr. Malta argues that policy can both support and hinder progress, but sees slow improvement in circularity, driven by regulation and environmentally conscious industry players. On this matter, Dr. Pagán underscores the role of European research funding and policy in driving innovation, and warns that legislation often lags behind technological development. Dr. Mackie agrees with Dr. Pagán on the fact that regulation often lags behind innovation, but believes the bioeconomy will expand significantly in the coming decades, driven by necessity and creative research into alternative raw materials like banana leaves and cellulose-based systems.

On her side, Dr. Doménech underscores the critical role of government policies, funding, and consumer awareness in supporting the adoption of bio-based technologies, especially for small companies. She notes that policy and innovation often evolve in tandem, with regulations both driving and responding to technological development. Siding with Dr. Doménech, Dr. Patrignani sees projects like SECRETed, RELIEF and EXPLORA as proof-of-concept initiatives that can help expand regulatory frameworks and drive sustainable innovation across sectors.

Finally, Dr. Patricio Cano emphasizes the importance of legislation in driving industry change, noting that most companies only adopt safer, more sustainable practices when required by law. However, he also acknowledges that some companies act proactively due to market demand or corporate responsibility.

Communication is gold for Biotech Initiatives

For Dr. Dorit Avni transparent communication, stakeholder engagement, and real-world case studies help bridge the gap between scientific innovation and industry adoption; something that Dr. Donadio also highlights by saying that the importance of communication—between academia, industry, policymakers, and the public—is essential for driving awareness and adoption. Dr. Donadio stresses that policy should account for the full life cycle of products, and that success stories, like NAICONS' development of a production process for a new antibiotic, must be shared widely to inspire broader change. On his side, Dr. De las Heras He says that there is an imperant need for industry awareness, strong communication strategies, and long-term impact to drive adoption of biobased research and Development solutions. In this sense, Dr. Christakopoulos advocates for better communication to dispel misconceptions about bio-based products, and Dr. Cano agrees with this by saying that public perception remains a barrier, with many people misunderstanding or fearing bio-based processes despite their long-standing use in food production (e.g., wine, yogurt). However, Dr. Malta explains that while public awareness remains limited due to the mostly B2B nature of the work made by projects like

SECRETed, he sees growing interest from companies and values the role of associations and clusters in spreading the word on innovation.

Consumer Education and Open Access

Consumer education, successful case studies, and collaborative research to overcome challenges like cost and scalability, are key for Dr. Oksman-Caldentey, while Dr. Haltli sees great value in initiatives like SECRETed, for their potential to provide open-access databases that can accelerate discovery and reduce duplication of effort in the bioeconomy. Dr. Switzer also points out the importance of consumer education, and argues that projects like SECRETed are vital for bridging academic research with industrial application and global sustainability goals, creating knowledge that needs to be passed on to consumers and industry partners. On the other hand, Dr. Aranzazu Pagán highlights the importance of education, both in universities and through public outreach, to prepare future professionals and raise societal awareness about the importance of the solutions developed by the Biotech industry.

The market landscape for Biotech

For Dr. Andrew Mearns-Spragg, the importance of using bio-based compounds in high-value markets like cosmetics and medicine, where innovation and sustainability can offer competitive advantages, should be very attractive to investors. On the other side, Dr. de Carvalho advocates for more public education, stakeholder engagement, and policy support to foster acceptance and adoption of bio-based innovations, noting that while luxury markets are more receptive to these types of products, a diversified strategy that includes both high-value and affordable offerings could offer interesting returns on a global scale. Additionally, Dr. Francesca Patrignani spoke about importance of involving regulatory bodies early in the process to accelerate market uptake: challenges like standardizing raw material quality and ensuring year-round availability of inputs like fish waste, among other, need to be overcome.

Success Cases that prove the point

The participants also gave some success cases in which the biotechnology initiatives have encountered an environment to thrive in, with the help of other companies and institutions, and the public. For instance, Dr. Mearns-Spragg said that his company, Jellagen, exemplifies this approach by sustainably harvesting jellyfish to produce novel collagen for medical applications, showcasing how marine biotechnology can drive both innovation and environmental responsibility; Nikola Milic explains how microbial vanillin and algal carotenoids illustrate successful transitions to bio-based alternatives; Dr. Sánchez pointed to the successful case of Almería, Spain, where innovation,

policy, and industry aligned to transform a desert into a sustainable agricultural hub, which implies that if the technology exists, systemic change and political will are essential to make green solutions scalable and impactful; Dr. De las Heras spoke about biofuels, biosurfactants, and bio-pigments, all of which demonstrate the potential of biotechnology, provided that feasibility, regulation, and public acceptance are addressed; Dr. Christakopoulos gave successful examples like enzyme use in detergents and CO₂ capture technologies, which demonstrate the potential of bio-based innovations to make a tangible environmental impact; and Dr. Doménech cited success stories in cosmetics, agriculture, and food—such as biopesticides, biofertilizers, and plant-based meat alternatives—as examples of bio-based innovation making tangible progress.

Final thoughts

Finally, as Dr. Bavington stated, marine biotechnology initiatives such as SECRETed could become a key player in the transition to a greener economy, provided that innovation is matched with investment and policy support. In this regard, Dr. De las Heras, emphasized the importance of research, bioinformatics, and life cycle analysis in identifying and developing environmentally friendly bio-compounds. In a second stage, as Dr. Donadio explained, presenting companies with fully developed, tested biological alternatives and fostering risk-sharing partnerships between biotech firms and industry will be a natural second step to make the link with the industry. Additionally, as Dr. Kousoulaki said, these types of projects must make a continuous effort of advocating for stronger regulatory support, economic incentives, and consumer education, and envision a future where high-value bio-based products reduce reliance on resource-intensive practices, thus aligning profitability with sustainability.

3.4.4. Interviews conclusions

In conclusion, the Social Awareness Interviews conducted for the SECRETed Project provide valuable insights into the future social acceptance of biobased products. Experts emphasized the environmental and economic benefits of biotechnology while acknowledging the challenges of scalability, cost, and regulation. The interviews underscored the importance of trust, perceived value, and environmental awareness in shaping public attitudes. Collaboration across sectors, effective communication, and supportive policy frameworks emerged as key drivers for the successful integration of biobased innovations. These findings offer strategic direction for advancing sustainable solutions in the bioeconomy and highlight the relevance of consumer-centered research in guiding future developments.

3.5. Final insights of the Social Acceptance Assessment

The Social Acceptance Assessment of the SECRETed Project offers a comprehensive exploration of societal attitudes toward the use of biobased compounds in industrial applications. By combining qualitative interviews with biotechnology experts and quantitative surveys with the general public, the study captures both projected and present-day perceptions of biobased solutions. The dual methodology enables a multidimensional view, illustrating how knowledge, trust, environmental awareness, and cost sensitivity shape consumer and stakeholder perspectives on transitioning away from petrochemical ingredients.

From the surveys, several trends emerged. Most respondents (85%) were aware of a broader industry transition toward sustainability, reflecting growing environmental consciousness, especially among younger demographics. However, awareness does not always equate to strong support. While 60% were inclined to purchase products with biobased ingredients, willingness dropped when a price increase was introduced—only 45% said they would likely pay 5–10% more. This hesitance suggests that although sustainability matters to many, economic considerations remain a strong determining factor in purchasing decisions, especially among older participants.

The expert interviews added valuable depth, revealing strong consensus on the environmental and industrial benefits of biobased innovation. Interviewees highlighted significant progress in areas such as marine bio-compounds and waste valorization, noting potential to reduce toxicity, lower energy use, and replace harmful chemicals. Nevertheless, they also emphasized persistent challenges including cost-efficiency, production scalability, and regulatory hurdles. The industry's ability to move from lab-scale innovation to mainstream industrial adoption hinges on stronger regulatory support and clearer communication with consumers and policymakers alike.

Importantly, both data sources converge around the critical role of education and communication. Experts consistently advocated for increased consumer awareness, transparent labeling, and storytelling that connects the science behind biobased compounds with tangible benefits. The public's mixed understanding of ingredient origins and sustainability goals, as reflected in the survey, reinforces this call. Projects like SECRETed need to invest not just in innovation but in public engagement that simplifies complex scientific concepts without diminishing their impact.

Another key insight relates to social segmentation. Younger respondents and those with university-level education were consistently more informed and open to bio-based products. Meanwhile, older generations and individuals with

technical or vocational education were less receptive. This gap points to a need for targeted outreach strategies that address diverse knowledge levels and concerns—whether through community programs, public service campaigns, or collaboration with trusted institutions.

Overall, the Social Acceptance Assessment highlights that the transition to bio-based compounds is viewed positively, but public support remains at the “acceptance” level rather than full “approval” or “identification,” using Boutilier and Thomson’s adapted Social License to Operate model. Moving forward, SECRETed and similar initiatives must foster trust, ensure affordability, and communicate clearly to bridge this gap. By aligning innovation with social readiness, the project is well-positioned to contribute meaningfully to Europe’s bioeconomy transition.

4. Conclusions

The SECRETed project has demonstrated that scientific innovation and societal engagement must go hand in hand to ensure the successful adoption of sustainable, bio-based solutions. Through a comprehensive strategy that combined digital outreach, in-person engagement, and rigorous social research, this deliverable has provided a clear picture of how consumer awareness and social acceptance can be cultivated and measured in the context of biotechnology.

The consumer awareness activities—spanning social media, newsletters, articles, and workshops—have proven effective in reaching diverse audiences and communicating the value of SECRETed's work by highlighting its benefits for society. These efforts not only informed the public about the project's goals and achievements but also fostered a sense of inclusion and participation in the broader sustainability transition.

Simultaneously, the social acceptance assessment revealed a generally positive perception of bio-based innovations, particularly among younger and more educated demographics. However, it also highlighted key challenges, including cost sensitivity, limited awareness among older populations, and the need for clearer communication about the benefits and safety of bio-based products. These insights underscore the importance of continued investment in public education, stakeholder dialogue, and transparent communication.

Ultimately, this report affirms that awareness and acceptance are not static outcomes but dynamic processes that evolve alongside technological progress and societal values. SECRETed's approach offers a replicable model for future projects seeking to align innovation with public interest. By placing people at the center of the bioeconomy transition, the project has laid the groundwork for a more informed, engaged, and supportive society—one that is ready to embrace the sustainable solutions of tomorrow.

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