ShapingBio

The bioeconomy of the future

D1.1 Methodology and stakeholder needs report

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List of Abbreviations

Abbreviation	Full name
Fraunhofer ISI	Fraunhofer Institute for Systems and Innovation Research
ART	Agriculture Research Troubsko, Ltd
BBEPP	Bio Base Europe Pilot Plant
APRE	Agency for the Promotion of the European Research
TTG	Tech Tour Global
TTE	Tech Tour Europe
SUBNET	SUBMARINER Network
FBCD	Food & Bio Cluster Denmark
FAO	Food and Agriculture Organisation
EU	European Union
EC	European Commission
UN	United Nations
DG	Directorate General
CBE-JU	Circular Bio-based Europe Joint Undertaking
BBI-JU	Bio-based Industries Joint Undertaking
SCAR	Standing Committee on Agricultural Research
NACE	Nomenclature générale des Activités économiques dans les Communautés Européennes (Statistical classification of economic activities in the European Community)

Executive Summary

The ShapingBio project aims to support and accelerate bioeconomy innovation and the deployment of new knowledge in the EU and its member states. The project seeks to provide evidence-based information, guidelines and recommendations for better policy alignment and stakeholder actions to realize the cross-sectoral potential of the bioeconomy and to reduce the fragmentation across bio-based sectors, the food system and policies across regions, domains and governance levels.

To achieve these objectives, ShapingBio employs several qualitative and quantitative methods and a co-creation approach within a multi-actor context. The approach ensures the robustness and relevance of the project's findings, allowing for a comprehensive understanding of the bioeconomy landscape and its various stakeholder groups. This approach also enables the project to identify potential areas for further investigation and improvement, ultimately contributing to the successful transition to a circular bioeconomy. Data collection methods utilized in ShapingBio, and further explained in this Deliverable, include interviews, surveys, and policy document analysis.

In order to provide information and advisory tailored to stakeholder needs, the project conducted a stakeholder needs assessment with interviews and an online survey. The Interviews were conducted with key stakeholders from various sectors, such as industry, academia, policy-making, and civil society, to gain in-depth insights into their perspectives, needs, and concerns regarding the bioeconomy. These semi-structured interviews allowed for the exploration of diverse viewpoints and facilitated a deeper understanding of the complex dynamics within the bioeconomy sector and to collect directly ideas for in-depth assessment.

To complement the interview approach, surveys were administered to a wider audience to gather quantitative data on stakeholders' information needs, perceptions, and expectations. In addition, secondary data and information such as policy documents were analyzed to provide a deeper understanding of the bioeconomy landscape and its various stakeholder groups. This methodological approach enables the project to identify key areas of concern and opportunity, ultimately guiding the development of effective strategies and tools to support the successful transition to a sustainable, circular bioeconomy.

The insights from interviews, surveys, and policy document analysis cover critical areas such as governance and policy, R&D and technology transfer, cross-sectoral collaboration, financing, and communication channels and formats. Understanding the perspectives and challenges faced by stakeholders is crucial for designing effective initiatives and ensuring the long-term success of the bioeconomy. The stakeholder assessment confirms that these topics are of crucial relevance for the acceleration of the bioeconomy and for each topic a number of challenges and advise was identified. In the upcoming tasks ShapingBio will consider these identified aspects for the fine-tuning of research questions and implementation activities. Moreover, Effective communication channels and formats were identified as vital tools for raising awareness, sharing information, and fostering dialogue among stakeholders. Stakeholders expressed that a range of formats and channels are relevant for their needs; ShapingBio will utilize a mix of methods to reach them, such as public forums, matchmaking events, social media platforms, and more.

By incorporating the insights gained from this research, ShapingBio can better address stakeholders' concerns and design initiatives that resonate with different stakeholder groups. This will help the project to achieve its goals of fostering cross-sectoral collaboration, identifying best practices and success factors, and developing tailored tools and strategies for the sustainable development of the bioeconomy. In doing so, ShapingBio can contribute to informed decision-making, facilitate innovation, and promote the long-term success of the bioeconomy.

1 Introduction

1.1 Aims of ShapingBio

The bioeconomy is an important sector for the EU and its member states, as it offers significant economic, social and environmental benefits. The bioeconomy covers a wide range of activities, including agriculture, forestry, fisheries, food and drink production, bio-based industries (making e.g. bio-chemicals, bioplastics, bio-pesticides, biomaterials and bio-surfactants), and side-stream and waste management. The cross-sectoral nature of the bioeconomy, however, makes it difficult to effectively align policies and promote innovation.

ShapingBio aims to support and accelerate bioeconomy innovation and the deployment of new knowledge in the EU and its member states. It aims to provide evidence-based information, guidelines and recommendations for better policy alignment and stakeholder actions to realize the cross-sectoral potential of the bioeconomy and to reduce the fragmentation across bio-based sectors, the food system and policies across regions, domains and governance levels.

To achieve these goals, the project will undertake a comprehensive mapping and analysis of initiatives, structures, policy instruments, and key gaps across the four EU macro-regions (Central and Eastern Europe, Baltic Sea Region, Western Europe and Southern Europe) and different sectors related to policy and governance, applied R&D & technology transfer, collaboration, and financing. The project findings will be extensively discussed and checked with stakeholders from different groups, levels and regions to develop promising recommendations for shaping the future of bioeconomy in the EU.

1.2 Approach of ShapingBio

In order to address the issues (gaps, coordination aspects, etc.) consistently in the project through mapping, analysis, implementation and communication, we defined four key topics that will be consistently handled and specified throughout the project, through use of existing literature and studies and the profound experiences of the project consortium:

- **Policy and governance**, including policy strategies, instruments and structures at different vertical (across EU, national, regional, and local level levels) and horizontal (across sectors, policy, domains, political boundaries) policy levels, and linkages of the bioeconomy to other relevant policy domains;
- **Applied R&D and effective technology transfer** including the interaction of relevant stakeholders (research, industry and policy for different important activities, e.g. scaling up).
- **Collaboration** across all stakeholders, in particular cross-sectoral and cross-country collaboration
- **Financing**, including the interplay of the (public and private) financial institutions community, research and industry at various stages of bioeconomy innovation developments and value chains.
- To ensure a consistent approach between and across the topics, the following activities will be performed:
- Analysis of the topics specified according to the stakeholder needs, which are directly assessed;
- Mapping of topic in each macro-region;
- Analysis for each topic;
- Knowledge transfer, matchmaking, dissemination activities and recommendations.

This approach is visualised in the following graphic by indicating the involvement of stakeholders in orange and the key topics in blue.

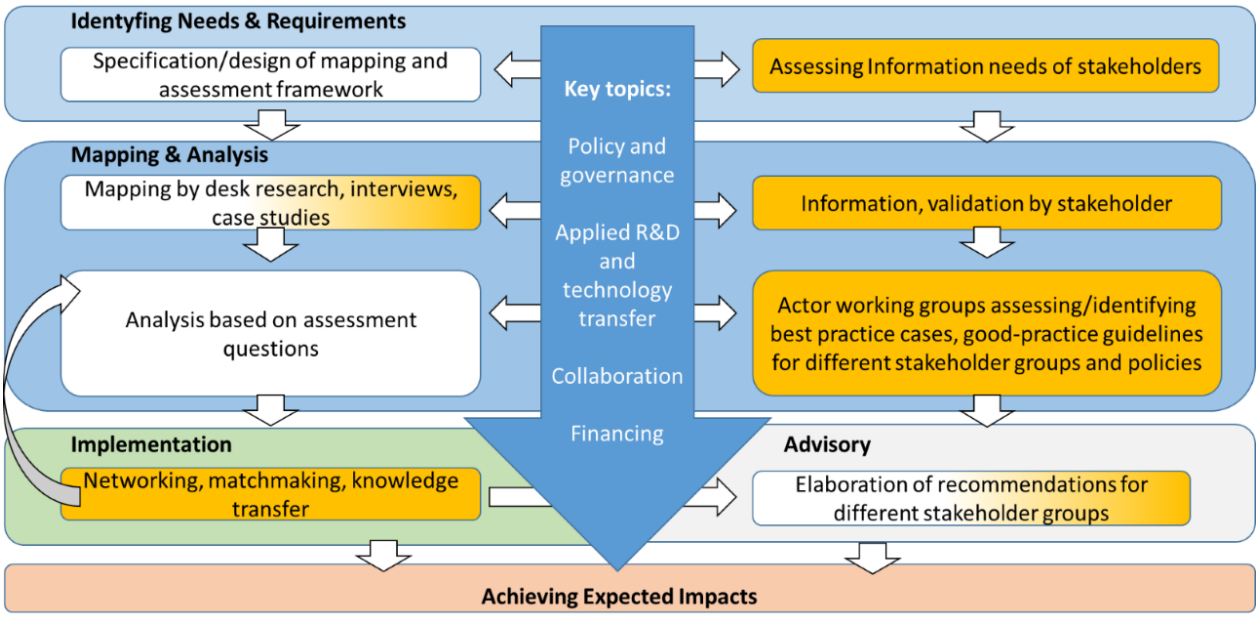

Figure 1. Overall approach of ShapingBio.

For these different activities:

- A clear scope has to be specified, which is consistently implemented and addresses the actual needs of stakeholders. The scope specification has to cover the diverse themes, activities and geographical levels.
- A sound methodological mix is implemented according to goals of the different activities.

1.3 Aim and structure of the deliverable

This Deliverable comprises two parts that are based on the first two tasks of ShapingBio:

- Specification of the scope and the planned methodological approach,
- Empirical assessment of stakeholder needs, based on interview and an online survey.

Please note that these two parts are quite distinctive. The first addresses the methodological approach of significant parts of the whole project. It contains those elements that are relevant for several tasks of the project and focuses mainly on the first two Work Packages (WP1: Specification of methodological approach and mapping: WP2: analysis of mapped information and involvement of stakeholders). The full methodology approach will be elaborated in D 1.4 at a later stage of the project. In addition, for certain activities (e.g. the mapping) a detailed guideline will be developed as part of the task itself.
The second part of this deliverable presents the specified methodology and results for the identification of the status-quo and stakeholder needs. Based on this, we analyse the implications for the focus and approach in ShapingBio.
In the following, we present in the first part the scope of the project (section 2) and then provide an overview of the most relevant methods for ShapingBio. The second part begins in section 4 and describes the approach to collect information needs of stakeholders. Then in section 5 we present the results of the interviews and online survey first separately and then discuss them together in terms of the implications of the assessed stakeholder needs for ShapingBio. We finish in section 6 with conclusions.

2 Scope of ShapingBio

2.1 Definition of bioeconomy and food systems

There is no uniform understanding of the bioeconomy; it differs between stakeholder groups, countries, etc. The BioMonitor project identified 26 different definitions of the bioeconomy, which highlight different aspects of the concept, e.g. the use of biomass, the use of biological resources and methods, sustainability, economy. The European Commission defines the bioeconomy as following:

"The bioeconomy covers all sectors and systems that rely on biological resources (animals, plants, micro-organisms and derived biomass, including organic waste), their functions and principles. It includes and interlinks: land and marine ecosystems and the services they provide; all primary production sectors that use and produce biological resources (agriculture, forestry, fisheries and aquaculture); and all economic and industrial sectors that use biological resources and processes to produce food, feed, bio-based products, energy and services" (European Commission, 2018, p. 4).

Hence, the bioeconomy covers the use of biological resources from different origins as well as many different sectors, including food. However, food is not only treated as a sub-sector of the bioeconomy in political, industrial and societal activities and discussions but it is a very important field of interest in its own right. Here, the notion of food system has become very relevant in discussions around the bioeconomy. The UN Food and Agricultural Organization (FAO) describes food systems as "Food systems encompass the entire range of actors and their interlinked value-adding activities involved in the production, aggregation, processing, distribution, consumption and disposal of food products that originate from agriculture, forestry or fisheries, and parts of the broader economic, societal and natural environments in which they are embedded. The food system is composed of sub-systems (e.g. farming system, waste management system, input supply system, etc.) and interacts with other key systems (e.g. energy system, trade system, health system, etc.)." (FAO 2018, p.1).

Hence, while the notions of the bioeconomy and food systems are clearly interlinked they are used rather independently and there is no single understanding regarding their relationship. Examples of where they are interlinked include Trigo et al. (2023) and OECD (2018) who describe the bioeconomy as a driver for the food system. For ShapingBio, we aim to cover food and the other uses such as feed, material and energy and include it under the term of bioeconomy. As the next section points out, we partially take a sectoral view, where we differentiate between bio-based sectors, which are usually meant as those sectors that do not include food on the one side and food systems on the other hand.

2.2 Sectoral scope

As outlined above, the bioeconomy encompasses many different sectors. In order to be able to analyse sectoral specifics as well as cross-sectoral issues we use two delineations. On a broader level, we take up the production as well as the use of biological resources and divide each in two further groups. For production, we distinguish between agriculture and forestry on the one hand and aquatic biomass on the other hand. This differentiation is needed to address the scope of ShapingBio, which explicitly aims to include and highlight the relevance of the blue bioeconomy on the production side. On the user side, the differentiation between food and bio-based sectors has already been explained above. This approach results in the four sectors shown below.

Especially for the group of bio-based sectors, a further disaggregation is needed to enable some more detailed analysis. This is because these sectors are very heterogonous regarding their activities, framework conditions, feedstock intensity, relevant bio-based innovations, etc. Therefore, the right side of table below indicates further sector groups, related to official NACE[1] codes. This classification helps to ensure that the respective target coverage of sectors for the different tasks are addressed and assessed.

Table 1 Cassification of the Bioeconomy in ShapingBio

Main thematic fields	Sector on NACE 2-Level	
Agriculture + Forestry	1	Agriculture (A01)
	2	Forestry (A02)
„Blue“ Bioeconomy	3	Fishing and Aquaculture (A03)
Bio-based sectors (including materials, energy)	4	Textiles (C13-15)
	5	Pulp & Paper & Printing (C17+C18)
	6	Chemicals, Pharma & Plastics (C20-C22)
	7	Wood, including furniture (C16+C31)
	8	Waste and water management (E36+38)
	9	Bioenergy + Biofuels (no own NACE code)
	10	Others (e.g. construction, financing, trade)
Food and Feed sectors	11	Food, Feed and Beverages (C10+C11)

Source: Fraunhofer ISI.

2.3 Geographical Scope

In order to map and assess the very heterogonous regions and sectors in the bioeconomy, we differentiate between macro-regions. Those regions often share common potentials and fields of activities (e.g. use of similar biogenic resources and/or strengths in certain application sectors). Moreover, in some macro-regions relevant activities to coordinate and enhance activities in the bioeconomy already exist, such as the BioEast Initiative or the EU Strategy for the Baltic Sea Region This focus on macro-regions enables us to specify key geographical issues of the bioeconomy.

This differentiation is in particular relevant for the mapping activities in the later stages of the project, when topic wise issues across EU become very relevant. In the mapping, we will collect possible country-specific information but where gaps arise, we will focus either on the macro-region in general or on certain countries in the macro-region. This will be specified in the macro-regional mapping (deliverable 1.3).

Table 2 Macro-regions and characteristics.

Macro-Region (+ Countries)	Key Strategies / Initiatives	Main sectors of activity
Central and Eastern Europe (BG, HR, CZ, HU, PL, RO, SL, SK, AL, SE)	Initiative number of strategic documents, action plans, vision document form BIOEAST initiative; the BIOEASTsUP2 H2020 project is approved	Production sectors: Agriculture, forestry, Fresh Water Based Bioeconomy fishery (in Baltic countries and Croatia). User sectors: bioenergy (in some countries), fragmented activities in other bio-based using sectors.

Macro-Region (+ Countries)	Key Strategies / Initiatives	Main sectors of activity
Baltic Sea Region (EE, LV, LT, DK, FI, SE, NO – EFTA country)	EU Strategy for the Baltic Sea Region, Nordic Bioeconomy Strategy, Baltic Blue Growth Strategy, HELCOM Baltic Sea Action Plan, SUBMARINER Action Plan 2021+	Production sectors: Blue bioeconomy (fish, seaweed, aquaculture, fisheries, algae, etc.); Forestry. User sectors: food, cosmetics, pharmaceuticals, fine chemicals, bio-fertilisers, bioenergy and biomaterials for blue bioeconomy; pulp & paper, chemicals, construction with wood.
Western Europe (BE, FR, DE, LU, NL, IRL, AT)	Strong national & regional level policies, Atlantic Action Plan (DG MARE)	Production sectors: Agriculture, forestry, bio-waste/ Residues, industrial side streams. User sectors: Most of the application sectors of bio-based products.
Southern Europe (CY, GR, IT, MT, PT, ES)	West-Med Initiative (DG MARE)	Production sectors: Agriculture, fishery/aquaculture. User sectors: Food, pharmaceuticals, fine chemicals, bioenergy and biomaterials.

3 Methodological Overview

ShapingBio aims to address key research questions and objectives related to the European bioeconomy landscape. The project seeks to understand the technological dynamics, regional differences, policy landscape, and good practices in the bioeconomy sector, with the ultimate goal of informing effective policy recommendations and strategies. To achieve these objectives, ShapingBio has adopted a comprehensive methodological approach that combines multiple research methods and tools, including desk research, patent and indicator analysis, case and in-depth studies, interviews, workshops, and surveys. Moreover, ShapingBio employs patent/indicator analysis, case studies and in-depth studies to ensure a comprehensive understanding of the European bioeconomy landscape.

The multi-actor approach, which forms the foundation of the project, is designed to ensure the inclusion of diverse perspectives and knowledge, and foster effective collaboration among stakeholders. Key stakeholders are identified and their roles and responsibilities are described, highlighting the importance of engaging with various actors in the bioeconomy ecosystem. Furthermore, the co-creation process is discussed, emphasizing its role in promoting knowledge exchange, consensus-building, and the development of shared solutions.

The advisory board's role and composition are also discussed, underscoring its strategic importance in guiding the project and providing expert input. The board comprises members with diverse expertise and backgrounds, across different geographic domains, ensuring a well-rounded perspective on the challenges and opportunities within the European bioeconomy.

ShapingBio's methodological approach is designed to address key research questions and objectives related to the European bioeconomy landscape by combining patent/indicator analysis, case and in-depth studies, and multi-actor and co-creation processes. This comprehensive approach enables the project to generate a thorough understanding of the bioeconomy sector, which in turn informs the development of effective policy recommendations and strategies tailored to the specific needs and opportunities of the European bioeconomy. This section presents a detailed overview of each method and tool, explaining their purpose, context, and relevance to the project's objectives. The guidelines for conducting desk research, interviews, workshops, and surveys are provided, offering clear and step-wise instructions to ensure the quality and rigor of data collection and analysis.

3.1 Multi-actor approach

The multi-actor approach (MAA) is a collaborative methodology utilized in Horizon Europe projects to address complex societal challenges by engaging diverse stakeholders in the research and innovation process (Feo et al. 2022). This approach emphasizes the importance of integrating stakeholder perspectives, knowledge, and experiences to develop tailored, end-user-specific solutions that are both relevant and effective. MAA fosters cross-sector collaboration, knowledge sharing, and social inclusion across various domains, sectors, and governance levels (Cronin et al. 2022).

In the context of ShapingBio, the multi-actor approach was chosen for the following reasons:

- Enhancing collaboration: By engaging diverse stakeholders from academia, industry, the public sector, and civil society, MAA facilitates collaboration and knowledge sharing, ensuring a comprehensive understanding of the bioeconomy sector's challenges and opportunities.
- Ensuring relevance: MAA helps in developing well-founded, end-user-specific solutions by incorporating the perspectives and knowledge of various stakeholder groups. This ensures that the project's recommendations and outputs are relevant to the intended audience.
- Fostering social inclusion: MAA promotes social inclusion by actively involving marginalized groups and fostering the exchange of ideas, experiences, and knowledge among various actors.

This helps in developing socially inclusive innovation processes and outcomes that meet the needs of diverse publics.

- Facilitating knowledge transfer: As MAA becomes more common in research and development projects across Europe, there is a considerable potential for knowledge transfer between different projects. This can help in developing innovative solutions by learning from the experiences and good practices of other projects.

These reasons highlight the value of the successful application of the multi-actor approach in research and innovation projects across diverse sectors. By adopting this approach, ShapingBio can leverage the strengths of various stakeholders to develop evidence-based guidelines and recommendations that contribute to the growth and development of the bioeconomy sector.

- The principles of the multi-actor approach (MAA) are based on promoting collaboration, stakeholder engagement, and knowledge sharing to address complex societal challenges. Here are the key principles (Feo et al. 2022):
- Inclusiveness: Engage a diverse range of stakeholders, including academia, industry, public sector, and civil society, ensuring representation from different sectors, regions, and governance levels.
- Active participation: Encourage active involvement of stakeholders in all stages of the project, from problem identification to the development of solutions and dissemination of results.
- Shared decision-making: Promote a collaborative environment where stakeholders share decision-making power, fostering a sense of ownership and responsibility among all participants.
- Knowledge exchange: Facilitate the exchange of knowledge, experiences, and good practices among stakeholders, fostering innovation and learning.
- Adaptability: Be flexible and responsive to stakeholder needs and context-specific requirements, adjusting the approach and methods as needed.
- Evaluation and reflection: Continuously assess and reflect on the multi-actor approach's effectiveness, incorporating lessons learned and adjusting the process accordingly.

To ensure the successful application of the multi-actor approach in ShapingBio, a clear plan has been developed based on the following steps (Feo et al. 2022; Cronin et al. 2022):

1. Stakeholder identification and analysis: Begin by identifying key stakeholders and analyzing their roles, interests, and potential influence on the project. This analysis will help tailor engagement strategies and ensure balanced representation across stakeholder groups.
2. Stakeholder engagement plan: Develop a stakeholder engagement plan, outlining strategies for involving stakeholders in various stages of the project, from research and development to dissemination and evaluation.
3. Co-creation and collaborative activities: Organize workshops, focus groups, and other participatory activities that bring stakeholders together to co-create solutions, share knowledge, and develop a shared understanding of the challenges and opportunities in the bioeconomy sector.
4. Capacity building and networking: Provide capacity-building and networking opportunities for stakeholders to enhance their understanding of the project's goals, methodologies, and expected outcomes.

5. Monitoring and evaluation: Regularly evaluate the progress and impact of stakeholder engagement together with the Advisory Board members, and adjust the strategies and methods accordingly.
6. Dissemination and knowledge transfer: Develop a dissemination and knowledge transfer plan to ensure that the project's results and recommendations reach the appropriate target audiences.

By following these steps and adhering to the principles of the multi-actor approach, ShapingBio can effectively engage diverse stakeholders in the research and innovation process, leading to the development of evidence-based guidelines and recommendations that contribute to the growth and development of the bioeconomy sector.

3.2 Co-creation process

Co-creation is a collaborative approach that brings together stakeholders from diverse backgrounds and sectors to jointly develop innovative solutions, policies, or products (Stier and Smit 2021). In the ShapingBio project, the co-creation process is designed to ensure that the project's objectives are achieved through the active participation of all relevant stakeholders. This section outlines the objectives, steps, principles, and examples of the co-creation process in ShapingBio.

The primary objectives of the co-creation process in ShapingBio are to foster effective collaboration and knowledge exchange among stakeholders, develop evidence-based and practical recommendations for policy alignment and stakeholder actions, ensure that the project's outcomes are responsive to the needs and expectations of stakeholders, and enhance the legitimacy and acceptance of the project's outcomes by involving a diverse range of actors.

The co-creation process in ShapingBio involves several key steps, including the identification of stakeholders using the multi-actor approach, the establishment of effective communication channels, engaging stakeholders in defining the challenges and opportunities related to the bioeconomy and food systems, working collaboratively with stakeholders to identify, develop, and refine innovative solutions, recommendations, and actions, involving stakeholders in testing the feasibility and effectiveness of proposed solutions and incorporating their feedback to improve the outcomes, collaborating with stakeholders to disseminate the project's results and support their implementation in practice, and engaging stakeholders in monitoring and evaluating the impact and effectiveness of the co-creation process and its outcomes (Stier and Smit 2021; Ruoslahti 2020).

Examples of how the co-creation process have been implemented within ShapingBio include that for each of the four main topics (see section 1) we will organize three meetings with multi-stakeholder groups working on identifying good practice cases, good-practice guidelines for different stakeholder groups and input for the recommendations. Various workshops are planned for several work packages, both in-person and online, to gather the insights and feedback of stakeholders on the project's outcomes and recommendations.

The principles of the co-creation process in ShapingBio emphasize inclusiveness, transparency, flexibility, mutual learning, and shared ownership (Stier and Smit 2021). To ensure the successful application of the co-creation process in ShapingBio, all workshops will be designed carefully and according to these principles to ensure active participation and commitment of all relevant stakeholders. Moreover, the workshops and events will be evaluated based on feedback received from the participants.

To achieve its research objectives and develop informed recommendations, the ShapingBio project will try to engage in discussions with various stakeholders to refine its research methods, including interviews, workshops, surveys, case studies, and indicator analysis. By incorporating diverse perspectives and expertise, the project can tailor its research methods to the European bioeconomy landscape's needs and

challenges. This co-creative approach will ensure a robust research design and contribute to the project's success, ultimately shaping effective bioeconomy policies and strategies across the European Union.

3.3 Group of stakeholders

In the ShapingBio project, a diverse range of stakeholders is involved, representing various sectors, regions, and governance levels. This multi-actor approach ensures that a wide range of perspectives, knowledge, and experiences are taken into account, ultimately leading to more effective and inclusive outcomes, and ultimately greater chance that the developed solutions will be brought into practice/policy. The key stakeholders involved in ShapingBio can be classified into four main groups and 14 sub-groups, each with distinct roles and responsibilities in supporting the development of the bioeconomy.

Group 1: Academia

1. Universities: Provide research expertise, contribute to the development of practice-based knowledge, and support educational and capacity-building activities related to the bioeconomy.
2. Research institutes: Offer specialized research and technical expertise, collaborate on interdisciplinary research projects, and support innovation in the bioeconomy sector.
3. Business & innovation support centers: Facilitate connections between academia, industry, and other stakeholders, provide support for the commercialization of research outcomes, and foster innovation in the bioeconomy sector.

Group 2: Industry

4. Primary producers and suppliers of biomass: Contribute to the sustainable production of biomass, provide insights into the practical aspects of bioeconomy development, and support the implementation of innovative practices and technologies.
5. Bio-based and food industries: Develop and implement innovative bio-based products and services, contribute to the circular economy, and create employment opportunities in the bioeconomy sector.
6. Technology providers: Offer novel technologies and solutions that enable the development and growth of the bioeconomy, support research and innovation activities, and collaborate with other stakeholders to address technical challenges.
7. Investors: Provide financial support for the development and commercialization of bioeconomy innovations, contribute to risk-sharing mechanisms, and help identify market opportunities.
8. Associations, regional networks and clusters: Foster collaboration and networking among stakeholders, provide support for policy development and advocacy, and facilitate knowledge exchange and dissemination of good practices.

Group 3: Public Sector

9. Policy-makers and regulatory bodies: Develop and implement policies and regulations that support the growth and sustainability of the bioeconomy, facilitate stakeholder engagement, and ensure the alignment of policies across different sectors and governance levels.
10. Funding institutions: Offer financial instruments and funding opportunities to support the development and growth of the bioeconomy, contribute to risk-sharing mechanisms, and help identify market opportunities.
11. Mass media and communication providers: Disseminate information and raise awareness about the bioeconomy, contribute to public engagement and debate, and support the communication and dissemination of project outcomes.

Group 4: Civil Society

12. Consumers: Influence market demand for bio-based products and services, contribute to the adoption of sustainable consumption patterns, and provide feedback on the acceptability and desirability of bioeconomy innovations.
13. Citizens and societal groups: Engage in public debate and decision-making processes related to the bioeconomy, contribute to the identification of societal needs and preferences, and ensure that the bioeconomy addresses local and regional concerns.
14. NGOs: Advocate for sustainable and inclusive bioeconomy development, represent the interests of specific stakeholder groups, and contribute to the monitoring and evaluation of bioeconomy policies and practices.

ShapingBio will ensure balanced representation and active participation from all relevant stakeholder groups in various stages of the project. Depending on the concrete task, this may mean for instance that each of the main groups may be represented (e.g. interviews for the stakeholders' needs). Other activities, e.g. certain workshops may focus on sub-groups of the 14 stakeholder groups. Table 3 presents different groups of stakeholders with further specifications.

Table 3 Groups of stakeholders based on multi-actor approach.

Group	**Stakeholder**		
Academia	1	Universities	Universities, educational centres
	2	Research institutes	Research institutes, applied research centers
	3	Business & innovation support centres	Service providers, match-makers, trainers and mentors, business facilitator
Industry	4	Primary producers and suppliers of biomass	Farmers, foresters, fisheries, primary producers, suppliers of raw materials
	5	Bio-based and food industries	Converting industries, shared pilot facilities
	6	Technology providers	Designer and manufacturer of technology, software and hardware service provider
	7	Investors	Private investors, banks
	8	Associations, regional networks and clusters	Networks, associations, facilitators, multipliers, clusters, consultants
Public Sector	9	Policy-makers, administrative and regulatory bodies	Governmental institutions (e.g., EU commission, national and regional governmental bodies, European Research Executive Agencies)
	10	Funding institutions	Public funding agencies (e.g., EIB, European Circular Bioeconomy Funds (ECBF)

Group	Stakeholder		
	11	Mass media and communication providers	Public media, influencers, awareness raising campains, exhibitions, conferences
Civil Society	12	Consumers	End users of bio-based products
	13	Citizens and societal groups	Citizens, communities
	14	NGOs	NGOs

In ShapingBio, stakeholder engagement is a critical component of our project's success. We have developed a detailed plan for engaging stakeholders throughout various steps and stages of the project. This plan includes identifying key stakeholders, defining their roles and responsibilities, and developing communication strategies to ensure that stakeholders are informed and engaged. By actively involving stakeholders in our project, we aim to promote transparency, build trust, and foster collaboration, ultimately leading to better outcomes for all involved. This plan is continuously evolving and redefined throughout the project and therefore not presented in detail here.

3.4 Advisory Board

The Advisory Board plays a crucial role in ShapingBio, offering expert guidance and insights to ensure the project's success in achieving its objectives. This section provides an overview of the advisory board's roles and responsibilities within ShapingBio and details the composition of the board, highlighting the expertise and backgrounds of its members.

Roles and Responsibilities: The Advisory Board in ShapingBio serves several essential functions, which include:

- Commenting on the progress and results of the project and offering suggestions for improvement. The board members provide their perspectives on the project's interim findings, helping to shape and refine the outcomes.
- Informing the consortium of relevant developments, events, activities, projects, and experts to be involved. The board members leverage their networks and knowledge of the bioeconomy sector to ensure that ShapingBio stays up-to-date with the latest developments and trends.
- Providing strategic advice to the ShapingBio consortium, which includes helping to prioritize research areas and focus the project's resources on the most critical and promising topics.
- Supporting the dissemination activities of ShapingBio by promoting the project's outcomes, participating in events and conferences, and contributing to the development of communication materials, such as reports, articles, and presentations.

Composition of the Advisory Board:
The ShapingBio Advisory Board is composed of 8 to 12 individuals with a strong background in the bioeconomy. The board members represent one or more of the following stakeholder groups:

- Bioeconomy-relevant industries, biomass producers and investors: These members have experience and expertise in various bio-based sectors, such as agriculture, forestry, biotechnology, and renewable energy. They can provide insights into the needs and challenges of industry stakeholders and help the project identify innovative solutions and strategies.

- European initiatives: These members are involved in or have experience with European initiatives related to the bioeconomy. Their insights can help ShapingBio better align its outcomes with existing initiatives, policies, and funding programs at the European level.
- Civil society organizations and NGOs: These members represent the interests of environmental, social, and economic stakeholders in the bioeconomy. Their perspective can help ShapingBio ensure that its recommendations address the concerns of these stakeholders and contribute to sustainable and inclusive development.
- Academia: These members have expertise in research and education related to the bioeconomy. Their knowledge can help ShapingBio identify knowledge gaps, generate new research ideas, and ensure that the project's outcomes are evidence-based and scientifically robust.
- Policy makers from EU, national, or regional levels: These members have experience in developing and implementing policies related to the bioeconomy. They can provide insights into the policy landscape and help ShapingBio develop recommendations that are feasible, effective, and aligned with existing policies and priorities.

ShapingBio management aims to ensure that the project advisory board includes adequate representation from Western, Central and Eastern, Southern, and Northern EU member states, promoting diversity and inclusiveness in the project. This diverse composition helps the ShapingBio project gain a comprehensive understanding of the various challenges, opportunities, and perspectives across the European bioeconomy and enhances the legitimacy and acceptance of the project's outcomes.

3.5 Overview of methods and tools in ShapingBio

The ShapingBio project employs a diverse set of methods and tools to address its research objectives effectively. These methods and tools are chosen based on their suitability and relevance to the specific research questions and contexts within the project.

Desk research is a fundamental method used in ShapingBio to gather existing knowledge and information on the European bioeconomy landscape. It involves the systematic review of literature, policy documents, reports, and other relevant sources. The purpose of desk research is to establish a solid foundation for the project, identify gaps in knowledge, and inform the design and execution of other research methods such as interviews, workshops, and surveys.

Surveys are a quantitative research method employed in ShapingBio to collect data on stakeholder perceptions, experiences, and preferences related to the bioeconomy landscape, policies, and good practices. Surveys are designed and administered using online survey software, ensuring flexibility and accessibility for participants. They play a crucial role in gathering feedback on potential recommendations and strategies to improve the European bioeconomy landscape.

Interviews are an essential qualitative research method used in ShapingBio to gather in-depth insights and perspectives from key stakeholders. These semi-structured interviews allow the project to explore stakeholder experiences, opinions, and preferences related to the bioeconomy. Interviews are conducted with a diverse range of participants, including policy-makers, industry representatives, researchers, and non-governmental organizations, to ensure a comprehensive understanding of the European bioeconomy landscape.

Workshops are interactive and collaborative sessions that bring together stakeholders from different sectors and backgrounds to discuss, debate, and generate ideas related to the bioeconomy. In ShapingBio, workshops serve as a platform for knowledge exchange, co-creation, and consensus-building among participants. They are designed to address specific research questions and objectives, providing valuable insights into stakeholder needs, preferences, and priorities.

To assess and compare the current state-of-play in the European bioeconomy, ShapingBio utilizes indicator analysis. This method involves the examination of existing indicators from the European Commission Knowledge Centre for Bioeconomy and conducting patent research and analysis to measure technological dynamics and specialization across countries. The aim is to assess the capabilities of EU-27 member states in comparison to non-EU countries and identify areas for potential growth and improvement.
ShapingBio conducts case studies and in-depth studies to gain more specific insights into certain aspects of the bioeconomy. These studies allow the project to explore particular topics, good practices, and experiences in greater detail. Case studies are mainly conducted during the mapping stage (WP1) to highlight specific activities, problems, and good practices within macro-regions. In-depth studies are performed during the analysis stage (WP2) to gain insights into various topics, such as policy alignment and stakeholder engagement.
By using this diverse set of methods and tools, ShapingBio ensures a comprehensive and robust approach to addressing its research objectives and providing valuable insights into the European bioeconomy landscape. These methods enable the project to engage with a wide range of stakeholders, gather diverse perspectives, and generate actionable recommendations for the development and implementation of effective bioeconomy policies and strategies. The following sub-sections provide a detailed description of each method and tool used in ShapingBio.

3.5.1 Desk research guideline

The desk research conducted for ShapingBio serves as a critical foundation for the project, providing essential background information and insights to inform subsequent research activities and stakeholder engagement. In this section, we outline the purpose and objectives of the desk research, describe the sources and types of data collected, and provide a clear and step-wise guideline for conducting desk research in ShapingBio.
The primary purpose of the desk research is to create a comprehensive understanding of the bioeconomy landscape, including its policies, good practices, and challenges (Creswell 2014). We have articulated the specific objectives, which serve as a narrative backbone for the research, as follows:

- Exploring existing policy frameworks and initiatives across various sectors and governance levels;
- Identifying knowledge gaps, research priorities, and potential collaboration opportunities;
- Analysing the trends, drivers, and barriers impacting the development of the bioeconomy;
- Laying a solid foundation for ShapingBio's recommendations and strategies.

Sources and Types of Data: During the desk research, a variety of sources and types of data are collected and analyzed to ensure a comprehensive understanding of the bioeconomy landscape. These sources include:

- Academic literature: Research articles, reviews, and reports from academic journals and conferences, providing insights into the latest research and developments in the bioeconomy field.
- Policy documents: Official documents, strategies, and reports from EU, national, and regional authorities, offering insights into the policy frameworks and initiatives relevant to the bioeconomy.
- Industry reports: Publications from industry associations, consultancies, and market research firms, providing data and analysis on bioeconomy-related industries and market trends.

- Media articles: News articles, opinion pieces, and interviews, offering perspectives on current events and developments in the bioeconomy.
- Project outputs: Reports, deliverables, and findings from previous or ongoing projects related to the bioeconomy, providing insights into good practices, lessons learned, and potential synergies.

Guideline for Conducting Desk Research in ShapingBio: The following step-wise guideline provides a clear and structured approach to conducting desk research for the ShapingBio project (Creswell 2014):

1. Define research questions: Begin by clearly defining the research questions or objectives that the desk research is intended to address, ensuring alignment with ShapingBio's overall goals and priorities. For some tasks, the task leaders will develop guidelines to ensure harmonized approach across the whole consortia.
2. Develop a search strategy: Establish a systematic search strategy for identifying relevant sources and data, including the use of keywords, and filters to refine the search results.
3. Establish inclusion/exclusion criteria: Define clear inclusion and exclusion criteria for selecting relevant sources and data, based on factors such as publication date, language, geographical scope, and subject matter.
4. Conduct the search: Perform a comprehensive search of the identified sources, using the search strategy and inclusion/exclusion criteria to identify relevant documents and data for quality control reasons.
5. Review and analyze the data: Thoroughly review the collected data, extracting key insights and findings related to the research questions or objectives. Analyze the data to identify patterns, trends, gaps, and opportunities.
6. Synthesize the findings: Synthesize the findings from the desk research, organizing the data into themes or categories that align with ShapingBio's research questions and objectives. Highlight key insights and implications for the project's recommendations and strategies.

By following these step-wise guidelines, the ShapingBio project team can conduct comprehensive and rigorous desk research that effectively supports the project's objectives and contributes to a robust understanding of the bioeconomy trends and development in the EU.

3.5.2 General Guidelines for Surveys

Surveys are an essential component of the ShapingBio project, providing valuable insights into stakeholder perspectives, experiences, and preferences related to the European bioeconomy landscape. The following sections outline the objectives, target participants, sampling approach/strategies, considerations, and guidelines for conducting surveys within ShapingBio.

The primary objectives and purposes of the surveys conducted within ShapingBio include:

- Collecting data on stakeholder perceptions, experiences, and preferences related to the bioeconomy landscape, policies, and good practices.
- Identifying potential barriers, challenges, and opportunities for the development and implementation of bioeconomy policies and strategies.
- Gathering feedback on potential recommendations and strategies to improve the European bioeconomy landscape.

The target participants for ShapingBio's surveys include a diverse range of stakeholders involved in or affected by the European bioeconomy. These may consist of policy-makers, industry representatives, researchers, non-governmental organizations, and other relevant actors. Step-wise guideline for conducting surveys in ShapingBio are based on Creswell (2014):

1. Define survey objectives: Clearly outline the goals and objectives of the survey, ensuring that they align with the broader research questions and aims of the ShapingBio project.
2. Design the survey: Develop survey questions that address the research objectives, taking care to ensure clarity and relevance. Select an appropriate question format for each question (e.g., multiple-choice, Likert scale, open-ended questions) based on the type of data required.
   Choose a survey platform: Select an appropriate survey tool or platform that offers the necessary features, flexibility, and accessibility for participants.
3. Identify and recruit participants: Utilize the multi-actor approach and various recruitment strategies to identify and engage with potential survey participants, ensuring a diverse range of perspectives is captured.
5. Pilot the survey: Test the survey on a small sample of participants to identify and address any issues related to clarity, usability, or technical problems.
6. Administer the survey: Launch the survey to the target participants, providing clear instructions and information on the survey's purpose, the estimated time for completion, and research ethics and data protection measures.
7. Monitor and manage responses: Regularly monitor survey responses and follow up with non-respondents as needed to encourage participation and increase response rates.
8. Analyze and interpret data: After the survey's completion, analyze the collected data, identifying patterns, trends, and insights relevant to the ShapingBio project's objectives.
9. Share findings and incorporate feedback: Present the survey findings to relevant stakeholders and incorporate their feedback into the project's analyses, recommendations, and strategies.

3.5.3 General guideline for interviews

Interviews play a vital role in the ShapingBio project, providing in-depth insights and perspectives from various stakeholders in the bioeconomy sector. This section outlines the objectives and purpose of the interviews conducted within ShapingBio, describes the target participants and recruitment strategies, and provides a clear and step-wise guideline for conducting interviews in the project.
The primary objectives of the interviews conducted within ShapingBio are to gather qualitative data and insights from a diverse range of stakeholders involved in the bioeconomy. The interviews seek to:

- Understand stakeholders' perspectives, opinions, and experiences regarding the challenges and opportunities in the bioeconomy sector.
- Identify potential synergies, barriers, and opportunities for collaboration and alignment across different sectors, thematic areas and governance levels.
- Inform the development of ShapingBio's recommendations and strategies based on the stakeholders' expert knowledge and experience.

The target participants for the interviews in ShapingBio include stakeholders from various backgrounds, sectors, and levels of governance, such as academia, industry, civil society organizations, and policy makers. The recruitment strategies employed to engage these participants are based on Creswell (2014) and involve:

- Identifying key organizations and individuals with relevant expertise and experience in the bioeconomy sector, through desk research, stakeholder mapping exercises.
- Leveraging existing networks and contacts within the ShapingBio project consortium to establish connections with potential interviewees.
- Where appropriate utilizing snowball sampling, where initial interviewees recommend additional participants who may have valuable insights and perspectives to share.

To ensure a consistent, effective, and ethical approach to conducting interviews, the following step-wise guidelines are provided based on Creswell (2014):

1. Develop an interview questionnaire: Create a semi-structured interview questionnaire that includes open-ended questions designed to elicit in-depth responses from the participants. The questionnaire should align with the project's research questions and objectives, while also allowing for flexibility and adaptation based on the interviewee's expertise and experience.
2. Obtain informed consent: Ensure that all participants provide informed consent before participating in the interview, including a clear explanation of the project's objectives, the interview process, and how their data will be used, stored, and shared. A standardized email template has been developed that should be sent to all the potential interviewees ideally 2 weeks before the interviews are expected to take place. The email includes background, aim of the study and where needed, the request to record the interview
3. Schedule and preparation for the interview: Coordinate with the interviewee to schedule a suitable time and location for the interview (with an on-line option and/or face-to-face option offered), and prepare in advance by reviewing their background, expertise, and any relevant documents or publications. Interviewers will decide whether the questions should be translated into the national language, depending on the background of the interviewee.
4. Conduct the interview: Begin the interview by establishing rapport and reiterating the project's objectives and the purpose of the interview. Use the interview questionnaire as a guide, while also allowing for flexibility and probing to explore topics in more depth.
5. Protocol for the interview: With the interviewee's permission, the interviewer can decide to record the interview to ensure accurate documentation of their responses. If recording is not permitted, the interviewer can request the interviewee's consent to take written notes during the interview. It is important for the interviewer to ensure that they capture all relevant information during the interview, whether through recording or written notes, to ensure accurate documentation of the interviewee's responses in English.
6. Analyze and synthesize the data: Review the interview notes and analyze the data, identifying key themes, patterns, and insights that align with the project's research questions and objectives. Synthesize the findings from multiple interviews to develop a comprehensive understanding of stakeholders' perspectives and experiences.
7. Report and disseminate the findings: Incorporate the findings from the interviews into the project's reports and deliverables, ensuring that the data is presented in a clear, accessible, and anonymized format.

By following this step-wise guideline, the ShapingBio project team can effectively conduct interviews with a diverse range of stakeholders, gathering valuable insights and perspectives.

3.5.4 General guideline for workshops

Workshops are an essential component of the ShapingBio project, fostering collaboration, knowledge exchange, and co-creation among various stakeholders in the bioeconomy sector. This section outlines the objectives and purpose of the workshops conducted within ShapingBio, describes the target participants and recruitment strategies, and provides a clear and step-wise guideline for conducting workshops in the project.

The primary objectives of the workshops conducted within ShapingBio are to facilitate interaction and dialogue among diverse stakeholders, promote the exchange of ideas and experiences, and co-create solutions to the challenges and opportunities in the bioeconomy sector. The workshops aim to:

- Engage stakeholders from different backgrounds in collaborative discussions, fostering a shared understanding of the bioeconomy landscape and its challenges.
- Facilitate the exchange of knowledge, good practices, and experiences among participants, contributing to the development of practical and innovative solutions.
- Encourage stakeholder involvement in the co-creation of the project's recommendations and strategies, promoting a sense of ownership and commitment to their implementation.

The target participants for the workshops in ShapingBio include stakeholders from various sectors, backgrounds, and levels of governance, such as academia, industry, civil society organizations, and policy makers. The recruitment strategies employed to engage these participants are based on Creswell (2014) and involve:

- Identifying relevant organizations and individuals through desk research and stakeholder mapping exercises, ensuring a diverse and representative mix of expertise and perspectives.
- Utilizing the project consortium's existing networks and contacts to invite potential participants and encourage their involvement in the workshops.
- Promoting the workshops through various communication channels, including newsletters, social media, and targeted outreach to specific stakeholder groups.

To ensure successful, effective, and inclusive workshops within ShapingBio, the following step-wise guidelines are provided based on Creswell (2014):

1. Define workshop objectives: Clearly outline the workshop's objectives and desired outcomes, ensuring alignment with the overall goals and priorities of the ShapingBio project.
2. Design the workshop agenda: Develop a structured workshop agenda that incorporates various interactive activities and methods, such as ice-breakers, group discussions, brainstorming sessions, presentations, and case studies. Ensure the agenda is flexible and adaptable to the needs and interests of the participants.
3. Invite and confirm participants: Send out invitations to potential participants, providing clear information about the workshop's objectives, agenda, and logistics. Follow up with confirmations and any additional details, as necessary.
4. Prepare materials and resources: Gather and prepare all necessary materials and resources for the workshop, including presentations, handouts, and any equipment or supplies needed for the activities.
5. Facilitate the workshop: Begin the workshop by setting the context and objectives, and establishing a welcoming and inclusive atmosphere. Actively facilitate the workshop activities, ensuring all participants have the opportunity to contribute and engage in the discussions. Be prepared to adapt the agenda and activities based on the dynamics and emerging themes during the workshop.
6. Document and summarize the outcomes: Capture the key insights, ideas, and recommendations generated during the workshop, either through note-taking, audio recordings, or visual documentation. Summarize the outcomes in a clear and accessible format, highlighting the main themes and findings.
7. Evaluate and follow up: Gather feedback from the participants on the workshop's effectiveness and relevance, using evaluation forms or informal discussions. Follow up with participants after the workshop, sharing the outcomes and any next steps or opportunities for further collaboration.

By following these step-wise guidelines, the ShapingBio project team can effectively conduct workshops that engage a diverse range of stakeholders, foster collaboration and co-creation, and contribute to the development of practical and innovative solutions for the bioeconomy sector.

3.5.5 Patent/indicator analysis

An indicator is a 'measure based on verifiable data that conveys information about more than itself' and indicators are purpose-dependent, meaning that the interpretation given to the data actually depends on the purpose (BIP, 2019). The use of indicators for analyzing the bioeconomy is very helpful to describe and compare the current state-of-play in the European Bioeconomy. Moreover, indicators that are harmonized across countries enable a sound analysis and comparison between the macro-regions and EU member states.

We will mainly use existing indicators from the European Commission Knowledge Centre for Bioeconomy, which provide a large set of indicators in an online library to support EU policy making (Sanchez-Jerez et al., 2023), e.g. in the Bioeconomy country dashboard.3. The JRC has elaborated a sound approach and criteria to elaborate and collect data for indicators with high relevance for various goals of the bioeconomy and that are available in sufficient quality.

ShapingBio will complement these indicators with additional indicators from other sources or our own assessment where needed. This will be in particular the case for innovation indicators, which are currently not (yet) available in the bioeconomy monitoring from the JRC. According to the widely known OECD Oslo Manual (OECD 2018), an innovation indicator is a statistical summary measure of an innovation phenomenon (activity, output, expenditure, etc.) observed in a population or a sample thereof for a specified time or place. We choose patents as a proxy for technological dynamics and competitiveness of countries or regions. Therefore, existing delineations of the bioeconomy by IPC4 codes will be used and extended to cover food systems more broadly (Wackerbauer et al., 2019; Kroll et al., 2022). The aim will be to measure technological dynamics and specialization of the EU-27 member states in comparison to selected non-EU countries (U.S., China, Japan) to assess the capabilities of the different countries. However, patent indicators clearly have their limitations, as some innovations are not patentable (e.g. reconfiguration of existing product technologies or social innovations), some (patentable) market-relevant innovations are not patented, but are protected by other mechanisms (e.g. operational secrecy, speed in development or marketing, etc.). In addition,patent propensity varies across sectors/industries and applications, and over time. Hence, patents should not be considered as the only information source on which to assess innovation capabilities. Discussion of the results of the analysis will consider those stated limitations.

3.5.6 In-depth studies

ShapingBio aims to support bioeconomy innovation by providing evidence-based information and recommendations for better policy alignment and stakeholder actions to realize the cross-sectoral potential of the bioeconomy. In order to generate comprehensive and comparable information across macro-regions and cover topics as thoroughly as possible, in-depth studies and case studies are employed to focus on specific areas of the bioeconomy. This section discusses the importance of in-depth studies in ShapingBio, provides guidelines for case selection and analysis, and outlines key considerations and expected outcomes.

In-depth studies enable researchers to gain deeper insights into specific aspects of the bioeconomy, such as policy instruments and experiences (Tassinari et al., 2021). They serve various purposes in ShapingBio. Firstly, they illustrate complex interactions, providing valuable examples and insights into how different elements of the bioeconomy interact and function together. Secondly, they help identify good practices and challenges by focusing on specific areas, revealing what works well, in what context, and where improvements and adaptations are needed. Lastly, they inform policy recommendations as analyzing particular aspects of the bioeconomy can generate evidence-based policy recommendations for addressing gaps and enhancing cross-sectoral collaboration (Tassinari et al., 2021).

In ShapingBio, cases for in-depth studies are selected and analyzed according to their related work packages (WPs). During the mapping stage (WP1), case studies aim to highlight activities, problems, and good practices in a macro-region, helping to identify interesting subjects for further analysis in later project

stages. The main methods used will be desk research and with some in-depth interviews. There are several examples of cases that warrant in-depth study, including stakeholder involvement in strategy setting, horizontal policy alignment for protein transition, cross-sectoral initiatives for bio-waste utilization, collaborations or initiatives for fresh water management in the BioEast region, existing support with loans guaranteed by public bodies, and functioning technology transfer centers in selected countries.

In the analysis stage (WP2), cases for various topics are carefully selected and analyzed, with the aim of gaining generalizable insights for a certain topic. For instance, for policy alignments there is a need to resolve land use conflicts, resolve biomass use conflicts, valorize biomass waste streams, establish a circular bioeconomy, or increase EU autarky and many more. While it is out of the scope of this project to provide analysis and to propose recommendations for all of these issues, ShapingBio will focus on selected cases and aims to generalize insights for other challenges and constellations.

Some key considerations for in-depth studies include ensuring that selected cases provide insights that are as generalizable and that overall that they cover the needs and challenges of different macro-regions. Expected outcomes of in-depth studies include the identification of good practices and challenges in the bioeconomy, informing policy recommendations and stakeholder actions. Moreover, a deeper understanding of the bioeconomy's complex interactions will support the development of evidence-based policies and strategies.

In-depth studies play a crucial role in ShapingBio, as they enable the project to gain valuable insights into specific aspects of the bioeconomy. By carefully selecting and analyzing cases, ShapingBio can inform policy recommendations, identify good practices and challenges, and enhance cross-sectoral collaboration in the EU bioeconomy.

4 Methodology for collecting information needs of stakeholders

The main objective of this task is to learn about the information needs of the stakeholders, and which type of information formats they favour, in the field of bioeconomy and food system. Information sharing is a fundamental aspect in our society, it allows knowledge flows, innovation and efficiency, and the generation of new ideas. By empowering stakeholders to make the knowledge they have available to others, society as a whole will benefit. Therefore, the current challenges of the bioeconomy have to be assessed, and be subject of further mapping, analysis and information provision. Moreover, adequate communication channels and formats have to be identified.

Both interviews and a survey have been undertaken for this task. The two different methods have been selected with the aim of integrating outcomes of a different nature. Interviews gathered more and deeper information in a one-on-one verbal conversation. In particular, they aimed to get concrete ideas and examples or even material for the further mapping and analysis. The survey, intended to get feedback from the broader community about the status-quo or potential prioritizing of thematic issues and communication in a more efficient way, reducing the effort of those answering the questions. Interviews were carried out with selected experts from different stakeholder groups, sectors, and macro-regions in order to have a broad picture of their needs. In contrast, the survey was disseminated across the macro-regions without targeting any specific expert/stakeholder or sector, but the bioeconomy community as a whole, which may of course include experts. Moreover, with the aim to facilitate information sharing, the survey was anonymous.

The outcome from both the interviews and survey will contribute to feed WP2 (Analysis of mapped information and involvement of stakeholders) that aims at elaborating best practices and guidelines in a co-creation process with multi-actor groups. In other words, the information shared by the experts, and presented in this deliverable, will be better discussed and/or confirmed during the activities of WP2, during which thematic workshops will be organised to discuss ShapingBio investigated topics.

4.1 Creation of database and mapping of the stakeholders

Each partner suggested a number of experts for the interviews, from different stakeholder groups and sectors, in their own country and also in other countries of their macro-region. Macro-regions were divided as follow:

- Central and Eastern Europe (BG, HR, CZ, HU, PL, RO, SL, SK, AL, SE)
- Baltic Sea Region (EE, LV, LT, DK, FI, SE, *NO – EFTA countries*)
- Western Europe (BE, FR, DE, LU, NL, IRL, AT)
- Southern Europe (CY, GR, IT, MT, PT, ES)

The suggested contacts were added in a designated excel file, available on the Fraunhofer Institute SharePoint. A minimum of eight experts per macro-region were selected for the interviews, ensuring knowledge heterogeneity and the lack of severe biases (for example in relation to gender or sector to which they belong).

4.2 Stakeholders engagement to the interviews

Stakeholders were invited to the interview using different approaches, which were more or less formal, according to level of engagement acquired in the past with the inviting institution/person in charge of the interviews (such as previous collaborations or networking opportunities) and according to normal professional approaches within the Member State. Both formal and informal invitations were issued by e-mail. Formal invitations were based on a descriptive project e-mail, stating both ShapingBio and interview

details (see appendix 8.1). If the invited stakeholder agreed to join the interview, the interview was scheduled and the informed consent letter, or link to the letter (to be signed online) was shared. Links to zoom or other online platforms were sent also. Every interview was conducted after having collected the signed informed consent letter (see chapter 4.3. for further information). Interviews took place in January-February 2023.

4.3 Interviews methodology

The structured interview guide was developed by the consortium in a collaborative way, producing a list of open questions aiming at covering the entire spectrum of information needed. Interview questions were uploaded into a web application called “Forms” (developed by Microsoft), as along with the project specifications, and information sheet (see appendix 8.2). The information sheet is a document that fully explains all aspects of the research activity in a clear and concise way, guaranteeing transparency and participants' rights. A total of three forms was created on “Forms”: 1) informed consent sheet (appendix 8.3), 2) general interviewee questions, part A (appendix 8.4); 3), interview demographics and topic questions, part B (appendix 8.4).

The three links to the three forms, were shared among the partners. The online part A and part B of the interview were either filled in real-time while running the interview (sometime even sharing the screen with the interviewee), or completed in a second stage after the interview was completed. In a few occasions, partners recorded the interviews, with interviewees consent, to later transcribe the audio/video interview into written words. All the recorded interviews were deleted after data transcription.

The interviews were carried out through an on-line tool (such as GoToMeeting, Zoom or Teams platforms). If needed, the interviews could have been done also over the phone.

Partners had to perform at least four interviews with experts that have knowledge concerning the state-of-play and needs of the bioeconomy and are expected to be able to articulate the information needs of stakeholders. It was intended to achieve a balanced distribution of interviews across the four macro regions, across the stakeholder groups and across the bioeconomy sectors. However, the interviews had clearly an exploratory nature and it was not intended to achieve a comparison between macro-regions, stakeholder groups etc., as this would have required a minimum number of a certain stakeholder group in a certain macro-region and would have implied a much higher number of interviews. The interviews were partly done in the national language of the interviewee however responses were reported in the online questionnaire in English to facilitate analysis. Interviewers decided whether the questions should be translated into the national language, depending on the background of the interviewee. At the beginning of the interview, the interviewer introduced the project’s aims, activities and expected results. S/he also explained the objective of the interview and the aim of the analysis of all the collected data.

After filling the demographic-related questions, the interviewees had the possibility of selecting the topics they wanted to address. This option was given due to the estimated length of the full interview (about 1.5 hours). The part B interview modules were the following:

- Demographics;
- Policy and governance;
- Applied R&D and technology transfer;
- Collaboration (cross-sectoral);
- Financing;
- Communication channels and formats.

The communication module was the one to be promoted the most, with the aim to invite the interviewees to share their preferred ways to receive and share information, and to participate in future ShapingBio

events. After the submission of parts A and B of the interviews, the partners were required to send an e-mail to thank the experts, and to invite them to register to the ShapingBio database.
All the submitted interviews (part A and part B) and the signed informed consent forms were firstly collected on the online webpage of "Forms", where an application creates automatic excel files, and then on the Fraunhofer SharePoint.
All the submitted interviews (part A and part B) resulted in two excel files, where the reconciliation between part A and B was possible thanks to a unique code assigned to each interviewee. In the first stage of the analysis, the interviewers had to check their submitted material as a quality control step. In the second stage of the analysis, the partners recognized to be topic experts had to conceptualize, interpret and analyse the interview outcomes in their range of expertise (five partners for five topics).

4.4 Survey methodology

Based on the interview questions, a questionnaire was developed and uploaded online (on "Forms") (see appendix 8.5). The survey was conducted online for four weeks. To facilitate the job of the survey respondents, the survey questions were simplified (in comparison to those of the interview), and, in some cases multiple answer options provided. As in the case of the interviews, also the questionnaire provided the option to focus only on a few modules, however the demographic and the communication modules were compulsory. The survey participants were invited first to share their level of satisfaction concerning the four investigated topics (policy and governance, applied research and technology transfer, and collaboration), and, if unsatisfied (answer="no"), they had to share the main reasons for their response. To provide insights, participants were then redirected to the specific module (topic session). In the second stage, responders had to share communication preferences. Since the survey was anonymous, demographic information became fundamental to estimate the degree of heterogeneity of the survey respondents, especially in relation to: 1) macro-region they were referring to when answering the survey questions 2) stakeholder group, category and sector, and 3) gender. The survey was distributed across a wide range of platforms, from social media (LinkedIn, Twitter, and Facebook) to institutional websites, newsletters and mailing lists. All the completed questionnaires were firstly collected on the online webpage of Forms, where an application created an automatic excel file, and then on the Fraunhofer Institute SharePoint.
The survey was disseminated throughout an extensive campaign, using the project website and social media channels, and all the relevant project partners' channels, including newsletters and mailing lists. The survey was kept online for three weeks, and the submissions resulted in one single excel file. In this case, contrary to the analytical methodology of the interviews, and because of the survey nature (primarily based on multiple choice answers), only one partner (APRE) was in charge of the analysis. With the aim to highlight the main outcomes, a summary of the sample profile and of the five modules addressed in the survey (policy and governance; applied R&D and technology transfer; collaboration; financing, etc.) is provided below. As in the case of the interviews, survey questions, divided in topics, are presented in the annex.

5 Information needs for stakeholders – Results and discussion

5.1 Interviews results

Interviewee demographic information
A total of 40 interviews were conducted. Most of the interviewees identified as “man” (22 submissions), seconded by those identified as “woman” (17 submissions). Only one interviewee preferred not to disclose the gender.
The majority of the interviewed occupied senior positions in their organisation, such as CEO, Executive Director, Team leader, and Professor. The stakeholders interviewed were distributed in the macro-regions as follows:

- Central and Eastern Europe: 7 stakeholders
- Baltic Sea Region: 6 stakeholders
- Western Europe: 17 stakeholders
- Southern Europe: 6 stakeholders

Moreover, 3 stakeholders worked in EU multinational organisations, and 1 in a global organisation. Therefore, the Western Europe macro region (in particular Ireland) is highly represented in the interviews.

Regarding the stakeholder groups., "Academia" and "Industry" were equally represented by 16 interviewees each (Figure 2). In contrast, fewer interviews were conducted with public sector (e.g., policy makers; 2 experts) and civil society stakeholders (6 NGOs). It would have been preferable to include more interviewees from these less represented groups. However, several experts from academia and industry gave valuable insights on policy and governance.

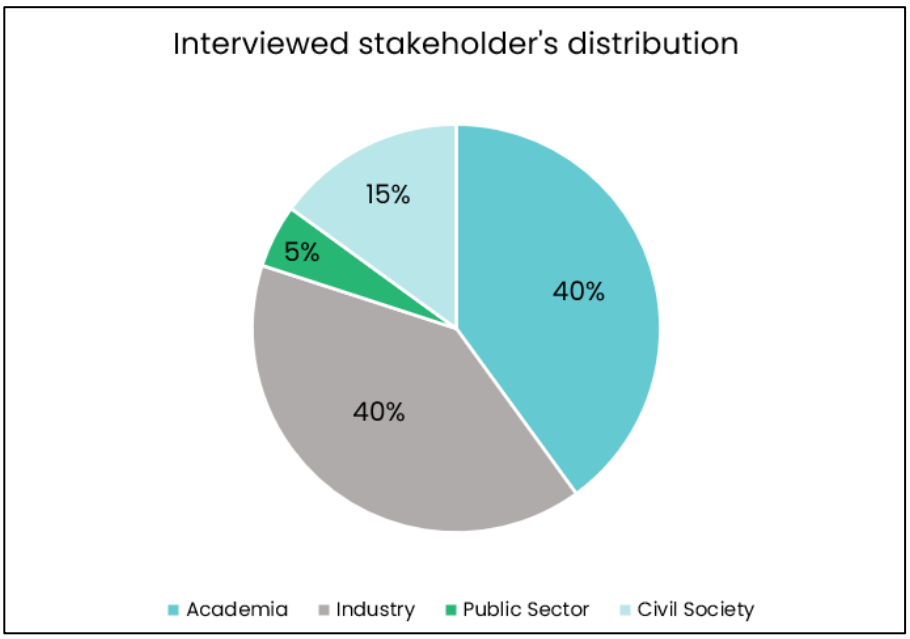

Figure 2. Stakeholder groups representation in the interviews (N=40).

Regarding the sectoral coverage, it has to be stated that some interviewees attributed more than one NACE category to their organization. “Agriculture” was the higher represented sector, followed by “food, feed, and beverages”. The lower represented sector was “wood, including furniture”. The list of sectors is available in the interview form (Appendix 8.4).

Policy and governance

The analysis of this topic was done by Bärbel Hüsing (Fraunhofer ISI).

The starting point for the interviews on policy and governance was that bioeconomy policy is developed and implemented on different governance levels, ranging from the EU, its member states to regions, clusters or sectors. At the same time, it is closely linked with, developed, implemented, and effected by different policy domains (e.g., science, technology and innovation; industry; agriculture/forestry/fisheries; environment). To explore the current state of policy coordination and governance in the EU bioeconomy and identify opportunities for improvement, a series of interviews were conducted with experts and stakeholders from various EU regions. The interviews covered both policy co-ordination across policy domains (= horizontal co-ordination) and across governance levels (= vertical co-ordination). They aimed to assess the importance and current status of policy coordination in the EU bioeconomy, its challenges and opportunities, and the need for improvements. Moreover, interviewees were asked for good practice or suggestions how a better coordination could be achieved.

Out of the 40 interviewees, 28 answered at least one question on policy and governance.

In this section, we summarize the key points and insights from these interviews.

<u>Coordination between bioeconomy policies on EU, national and regional level (vertical coordination)</u>

Interviewees were asked how they see coordination between bioeconomy policies on EU, national and regional levels, and how well it worked according to their experience. The following picture emerged from their answers:

There was no single answer to this question for the EU as a whole or for its member states. Interviewees pointed out that EU member states differ significantly in the extent to which bioeconomy is a political priority, and whether or not a national bioeconomy policy and strategy exists and is implemented. As a logical consequence, also vertical coordination of bioeconomy policies differs accordingly.

In general, most interviewees perceive bioeconomy policy coordination between the EU and member states positively. Moreover, they report that coordination and communication between these governance levels has improved over the past 15 years. The efforts of the European Commission to develop a bioeconomy strategy, to update it and to develop an action plan, are broadly recognized and appreciated. The EC efforts triggered and drove activities in several member states to develop their own national bioeconomy strategies: a "trickle-down effect" from the EU to the level of several member states (e.g., Denmark, Ireland) is reported. The European Bioeconomy Policy Forum, EU Bioeconomy Conferences and Bioeconomy Weeks are mentioned as instruments for policy coordination and awareness raising.

Ongoing efforts are appreciated which aim at supporting and empowering member states which do not (yet) have a dedicated bioeconomy policy and strategy (see also below).

One interviewee characterized the situation of coordination between EU and member states in this way: “*in EU activities in general - and bioeconomy is no exemption - there is always interaction both top down from the European Commission to member states and bottom up in democratic discussion processes. It is normal that each member state has its own interests and the bigger European interest is somehow calling date [stimulating national discussions and "vertical" negotiations (addition by author)]*”.

The coordination between the EU and its member states on the one hand and the international level on the other hand (e.g., FAO, Sustainable Development Goals) is perceived as good.

Although most interviewees perceive bioeconomy policy coordination between the EU and member states positively, they observe a major gap, a weak link or a disconnect between the EU/national level on the one

hand and the regional/local level on the other hand. This means that the regional level has not yet been adequately included in EU and national bioeconomy policy implementation, although the bioeconomy has strong regional and local components. Several interviewees pointed out that bioeconomy could play an important role in regional growth and the diversification of smart specialization of local economies. A need is seen to translate the high-level EU and national strategies to regional or even local activities, and to strengthen regional and local participation.
Some exemptions from this general top-down picture from EU to national and regional levels were given in the interviews:
In Greece and Central and Eastern European countries, there is no national bioeconomy policy or strategy, but relevant activities at regional levels exist. So, no top-down coordination is possible, and a bottom-up pathway, driven by regions, is not supported due to a lack of a political framework for this. For blue bioeconomy, coordination is reported to work well at the EU level and at regional levels. However, a gap is seen at the national level.

Reasons for barriers in vertical policy coordination and suggested solutions
In this section, we focus on reasons and suggested solutions to narrow the gap between EU and national governance levels on the one hand, and regional/local levels on the other hand.
According to interviewees, a major reason for the gap is the lack of knowledge, awareness, and clarity beyond the established "bioeconomy community" relating to what the bioeconomy is and what the relevance of the bioeconomy and bioeconomy policy is. The awareness and understanding of the concept of bioeconomy, the technical terms as well as the related policies, is too low for many regional authorities, regional sectors and industry and primary producers who are not (yet) bioeconomy specialists but need to be actively involved. It does not seem to be clear to them what is different to what they are used to do (e.g., bioenergy), or what distinguishes bioeconomy from related, more well-known concepts (e.g., circular economy, low-carbon, green or blue growth, sustainable agriculture, innovative food production, eco-innovation). Moreover, they often only associate a specific bioeconomy subfield (e.g., bioenergy, biofuels) with the term bioeconomy, but do not grasp the full breadth of the concept. In some regions, a strong focus on certain technologies (e.g., wind and solar energy) may prevent other potential solutions offered by bioeconomy being taken into account.

The following solutions are suggested by interviewees:

- Education, training and consultancy for regional authorities, public administration, sector organizations, industry and primary producers (quadruple helix) relating to what the bioeconomy is, the basic strategies and practical applications. Simplify and adapt the language to the target groups and explain or avoid specific technical terms so that they can understand how the bioeconomy applies to them. Take advantage of the target groups' increased focus on accelerating solutions for utilizing resources more efficiently or in different ways, reducing carbon footprint, etc.
- Especially for the active involvement of industry, clear information and communication is essential in relation to realistic potentials and contributions of the bioeconomy to their business, e.g., which feedstock is available, how scalable it is, to which extent the industry can use it, what the efficiency of biotechnology processes is. Success stories could provide evidence to convince people more easily.
- Regions should be given ownership of the bioeconomy and be empowered to take leadership. A promising approach could be to address a specific challenge (e.g., climate neutrality, increased biodiversity) and adopt a problem-solving perspective. In order to identify a relevant challenge for

a region and potential solutions, a systems approach is recommended. The key actors (e.g., universities, industries, specific target groups (e.g., primary producers and harder to reach stakeholders), local and regional authorities and the public) should be brought together and really work together, building on knowledge in the region. Existing platforms or clusters could be used for this. Good facilitators are required for such a co-creation process. The process must result in actions and change. Therefore, it is essential that regional authorities have the financial means to implement actions e.g., hubs and demonstrators with tangible, workable examples. One example for funding is the Just Transitions Fund; https://ec.europa.eu/regional_policy/funding/just-transition-fund_en).

- Interviewees mentioned a few examples of good practice for bioeconomy in regions:
- the EU-funded project ROBIN – Deploying circular bioeconomies at regional level with a territorial approach (robin-project.eu),
- the Irish projects "Agri Bio Circular Economy" (ABC Economy; https://www.abceconomy.ie/) and CoBioEcon (https://www.cobioecon.com/) which are considered examples for the development of the sustainable regional bioeconomy or to produce an evidence-based, co-designed set of policies for the regional bioeconomy in Ireland, and
- the German model region for sustainable bioeconomy Bioökonomie REVIER (https://www.biooekonomierevier.de).

<u>Coordination of bioeconomy policy on EU or national level</u>

The interview guide only distinguished between vertical coordination between different (geographical) governance levels, and horizontal coordination of bioeconomy policy with other policy domains (horizontal coordination). During the interviews, it became obvious that substantial coordination is also required within bioeconomy policy on any given governance level.

At the EU level and in member states with a dedicated bioeconomy policy, several directorates, ministries or departments are often (or should be) actively involved. This is due to the fact that the bioeconomy is multidisciplinary, cuts across traditional sectors, established policy domains and regulations, and contributes to many different goals. However, these individual directorates, ministries or departments have their own interests and priorities. Interviewees reported that bioeconomy may be high on the agenda of one responsible body, but not on the other. A lack of awareness, communication, co-creation and collaboration can be observed between the different responsible bodies, and even within the same body. Efforts have been taken to improve the situation. Examples are the interministerial working group in Germany, the Bioeconomy Implementation Group (BIG) in Ireland, and the joint efforts of DG RTD, DG Agri, and DG GROW in the Circular Bio-Based Europe Joint Undertaking (CBE JU; https://www.cbe.europa.eu/). However, it remains to be seen how powerful and effective these activities are in overcoming impediments to better coordination.

Specific challenges were reported for the Czech Republic, but seem to apply also to other Central and Eastern European countries without a dedicated bioeconomy policy: Interviewees were of the opinion that currently the government administration does not have a competent background in the bioeconomy. Furthermore, the bioeconomy is not a high political priority. Rather, a traditional sector approach is favored, neglecting the specificities of bioeconomy (e.g., cross-sectoral, multi-stakeholder approach requirement) and its added value (e.g., contribution to national long-term priorities). Activities are underway to improve the situation: The BIOEAST Initiative (https://bioeast.eu/) supports the political level (e.g., via V4 ministry

meetings of the Visegard group[1], high level conferences and state secretaries position papers), the policy level (e.g., through the BIOEAST Board, Secretary General and National Contact Points, BIOEAST Advisory Council) and the experts' level (e.g., within EU-funded projects, such as BIOEASTsUP; https://bioeast.eu/bioeastsup/). However, awareness raising is still weak, incomplete and scattered, according to interviewees' opinions. This is for example illustrated by different national contact points (NCPs) for BIOEAST, Horizon Europe, SCAR, CBE JU (or its predecessor BBI JU), and national programmes. No competent government body has been assigned responsibility for bioeconomy coordination, which is deemed necessary by interviewees. Partial successes have been achieved, e.g., by including bioeconomy as an objective in the RIS3 strategy[2] of the South Bohemia Region.

Alignment between bioeconomy policies and other policy domains (horizontal alignment)

Interviewees are well aware that bioeconomy policy is closely linked with and impacted by policies e.g., in agriculture, forestry, aquatics, feedstock, food, energy, environment, climate change, sustainable financing, nature conservation, water quality, circular economy and many more. On a given governance level, this leads to coordination challenges between the responsible ministries, departments etc. as outlined above.

However, the challenge of horizontal alignment of bioeconomy policies is not uniquely national, but an international and global challenge also. Interviewees characterize the situation of a suboptimal (or even lack of) horizontal alignment between different policy domains as follows:

Policies are too often developed and implemented in silos. Often, one institution takes the lead in developing bioeconomy policy (on EU level e.g., DG RTD), but other policies (e.g., led by DG Agri) also have a major impact on the bioeconomy, but are not within the responsibility and competence of the leading institution. From the perspective of other policies, the bioeconomy seems to be perceived as "too small/in an infant stage" to be taken into account as a relevant policy issue or as providing important contributions to a common goal. Interviewees are of opinion that a holistic picture of the bioeconomy is missing which could provide guidance. Resource and biomass use conflicts by different industries are given as an example which would require such a holistic picture and an alignment of different policy domains: "There are a lot of discussion what feedstock is available. On one hand, we should capture CO_2 in products and materials but on the other hand, due to the energy crisis, the European Commission encourages using biomass for production of biomethane or event to burn biomass for energy. The bioenergy is stimulated by incentives but not the biomaterials. There are many conflicting or even blocking policies where in one area the bio-based are promoted and in another they are blocked. [...] Measuring and monitoring impact of all the policies on bioeconomy is missing. [...] We do not see the future for biobased products because we do not have overview on what feedstock is available. The majority of feedstock is going to bioenergy but there are other renewable sources like solar and wind and we can release huge amounts of biomass for the needs of bio-based industry. [...] The demand for sugar as a food is going down due to low-calorie diets but you need it for fermentation. We need to take these analyses into account and assess the impact of future policies in other domains and to make the biomass available for other bio-based industry areas. The latter is very difficult due to this fragmentation of policies. Coordination with policies for other domains is necessary."

[1] Members of the Visegrad Group (also known as the "Visegrad Four" or "V4") are Czechia, Hungary, Poland and Slovakia. https://www.visegradgroup.eu

[2]RIS3 means "Regional Innovation Strategy for Smart Specialisation". Smart Specialisation strategy (S3) is a place-based innovation policy concept to support regional prioritisation in innovative sectors, fields or technologies through the ‘entrepreneurial discovery process (EDP)’, a bottom-up approach to reveal what a region does best in terms of its scientific and technological endowments. The European Commission introduced the S3 concept in the EU Cohesion Policy 2014-2020 as an ‘ex-ante conditionality’ for European regions to obtain funding for research and innovation from the European Regional Development Fund (ERDF).

Regarding measures and funding, initiatives with similar goals run independently of each other, with no or only few interlinkages. Examples are the smart specialization platform (https://s3platform.jrc.ec.europa.eu/), Horizon Europe, and the European rural development network (https://enrd.ec.europa.eu/). Each of these activities have different policies behind them and different funds. An interviewee is of opinion that a better awareness and alignment in EC units involved in these initiatives could improve the current situation whereby target groups are not aware of the other initiatives and the funding opportunities they offer, or have difficulties in accessing them due to different funding mechanisms. In this way, efficiency and impact are suboptimal, resources are "diluted" and potential synergies not exploited, for e.g., pooling resources or setting up measures which effectively complement each other. On the other hand, the Circular Bio-Based Europe Joint Undertaking (CBE JU) was mentioned as a good practice example of a coherent action by directorates DG RTD, DG AGRI and DG GROW.
Moreover, due to its cross-cutting nature, the bioeconomy is linked to a large number of regulations (i.e., crosses traditional regulatory silos), which were often developed before the term “bioeconomy” was coined. This makes horizontal alignment of regulations very complex, but it is aggravated by a lack of awareness and anticipation of potential lateral consequences of policy actions. Interviewees mentioned several examples of contradicting policies, incentives and regulations due to a lack of horizontal alignment (e.g., various examples hindering the valorization of different side-streams, use of biomass for energy or material purposes, nitrate directive hindering the use of digestate as fertilizer, and implementation of the Maritime Spatial Planning Directive). One interviewee suggested the use of regulatory sandboxes[3] which already exist in other policy domains, such as finance or health, but not yet in bioeconomy. Such regulatory sandboxes in agriculture, primary production, blue economy etc. would make it possible to identify risks in a controlled environment if regulations were changed in one way or the other.

<u>Solutions suggested for improved coordination across different policy domains</u>
Interviewees suggested similar solutions for improved coordination of bioeconomy policy between different governing bodies at the same governance level, as well as alignment of bioeconomy policy with other policy domains:

- To overcome professional, sectoral and ministerial silos, as a first step formal coordination groups between the different responsible bodies should be established. Although it remains to be seen how powerful and effective in coordination and collaboration these groups are in reality, they are a platform for information exchange and dialogue.
- Irrespective of the governance level, interviewees suggested to start from a problem-solving point of view and to take a systems approach for identifying the key actors across ministries, functions, types of actors, sectors, etc. A large diversity of competencies, professions, perspectives and mentalities should work together on the same problem and co-creatively generate different ideas and solutions. Also, a cross-regulatory perspective should be taken. In this way, hindrances and contradicting incentives could be identified. Potential lateral consequences and unintended impacts of policy actions and regulations could be anticipated and, subsequently, addressed.

[3] Regulatory sandboxes enable in a real-life environment the testing of innovative technologies, products, services or approaches, which are not fully compliant with the existing legal and regulatory framework. They are operated for a limited time and in a limited part of a sector or area. The purpose of regulatory sandboxes is to learn about the opportunities and risks that a particular innovation carries and to develop the right regulatory environment to accommodate it. Such sandboxes require instruments that provide legal flexibility, for example in the form of experimentation clauses (i.e. temporary rules allowing experiments to be conducted). Regulatory sandboxes are understood as tools for an innovation-friendly, future-proof and resilient regulatory framework. https://www.bmwk.de/Redaktion/EN/Dossier/regulatory-sandboxes.html, accessed April 16, 2023

Regulatory sandboxes[3] could also be an option. Good facilitators are required for these collaborative processes. It should result in coordinated activities which pool resources, complement each other, avoid contradicting incentives, exploit synergies and thus have higher efficiency and greater impact.

The insights and suggestions for improvement summarized in this section will be considered and further discussed and refined in the ShapingBio project.

Applied research and technology transfer

The analysis of this topic was done by Tanja Meyer (BBEPP).

The starting point for the interviews was that the bioeconomy is a growing sector in Europe that aims to transform renewable resources into innovative products and services, while also contributing to sustainable development goals. However, the efficient transfer of technology from research to the market is crucial for the bioeconomy to reach its full potential. The aim of the interviews was to explore the challenges and opportunities in technology transfer for the bioeconomy, including the need for innovative approaches, barriers to development, and ongoing and proposed actions to improve applied R&D and tech transfer activities. In this section, we summarize the key points and insights from these interviews.

Out of the 40 interviewees, 37 answered at least one question on applied research and technology transfer.

The interviewees discussed the need for innovative approaches to technology transfer for the bioeconomy to take into account the specific requirements of different target groups such as entrepreneurs (including social entrepreneurs), industry, small and medium-sized enterprises, and academia. They suggested that a comparison between different approaches in different regions and countries would be needed to create favorable conditions for collaboration aiming at knowledge transfer. A special focus could be given to the group of open access pilot and multipurpose demonstration infrastructures for bioeconomy. Different open access cooperation models need to be discussed between pilot infrastructure owners and users on how open access works in practice and how they can be supported by favorable ecosystem conditions through local, regional, and national governments.

In terms of whether applied R&D activities for tech transfer have sufficiently developed in Europe, the interviewees had mixed responses. Many interviewees tended towards the negative side of the spectrum, suggesting that applied R&D and tech transfer activities are not sufficiently developed in Europe and that there is greatest room for improvement in terms of efficient transfer to entrepreneurs, local authorities, planning systems, or industry. It seems a consistent opinion that R&D is available and that research about bioeconomy is there, but that it is very "superficial", meaning that not enough proprietary technologies or know-how in the bioeconomy field are exploited. The interviewees pointed out that there is a big difference between European countries and that at the national level there is a totally different approach and results than at the regional level. There is an imbalance between activities and their transfer to different regions. An example for better transfer was identified as Denmark. There are learning effects observed for universities and it is expected that progress will come with open access facilities, which do not yet exist sufficiently.

The interviewees also discussed barriers that lead to insufficient development of applied R&D and tech transfer activities. They suggested that the main barrier has to do with the orientation of the market ("money decides"), significant levels of fragmentation and a lack of synergies between the actors. The challenge is that the bioeconomy is partly still a niche, universities have a huge number of start-ups but only a few in the bioeconomy. Financial considerations, access to specialized laboratories, and the direct link between R&D and tech transfer facilities and access to farmers were also mentioned as barriers. The interviewees

proposed ongoing as well as proposed actions and activities to improve applied R&D and tech transfer activities. These included opening/improving the dialogue between R&D actors and end-users, creating synergies, improving regulatory aspects, IP and licensing rights, and encouraging consumers/end-users to look for bioeconomy solutions and derived products. The need for public funding for scale-up support in biotechnology was also discussed, as well as the need to include environmental, social, or ethical aspects into the system, rather than only the economic component.

The interviewees agreed that open-access pilot/demo plants have a key role in accelerating the deployment of the bioeconomy within the EU. They enable experimentation in scale and in practice and provide a shorter time to implementation/market. Pilot plants are important because they give access to demonstration of feasibility; it is important for all participants in the value chain to know that the technology exists, that it works, and that it is feasible. They are also important for securing the farmers and the industry to make sure that it is credible to produce the product.

Demo and pilot plants are decisive infrastructure for bio-based innovations. It can prove that a process is scalable or it can actually help make the process scalable and get it into industry. Large companies rarely have the need for a pilot facility, but smaller companies, universities, and SMEs find the pilot facility too expensive to build their own. Therefore, having open access pilot plants is very useful. Examples of good collaboration/support of regions/nations for companies' access to pilot plants were provided, including TI, CER, BIORAF, Lisheen, BBEPP, ILVO technology platform, FDL, Genomatica, Algiecel, SATT, ARD. However, there were also examples of poor practices, and feedback on required improvements, such as the need for better channels to inform each other of what is available and overcoming the natural limitations of an open access pilot plant due to size and budget.

Most interviewees agreed that there is a strong need for investment in open access pilot/demo plants, especially on a regional and national level. Pilot plants are being constantly developed, and there is a need for further investment in developing new machines and automation. There may be new needs from local industry and primary producers, so plants need to adjust to new needs, and developments are inevitable.

The perception of the current status of demand and offer in Europe differs among the interviewees. There are not enough pilot plants or offers on a national level where countries are dealing with high demand, but on the other side, there is also not enough supply in terms of funding and financing opportunities are unclear. The interviewees mentioned the growing trend to change to bio-based production with biomass or side streams of waste. Europe is a much more level playing field in the sector than ten years ago. Despite this progress, there are still not enough pilot and demo plants though, and that progress is made too slow. One of the challenges is to demonstrate the value of bioeconomy to the public, and it is also important to have local plants to showcase the bioeconomy to new industries locally.

The offer and demand question is also different in different sectors. For food and agro, there is a lot of capital inflow; in bioplastics, it is much more challenging and requires much more capital. It makes much more sense to facilitate or finance such structures by the EU or other governments as opposed to private funding. The seed stage investors are sector-agnostic, they give small amounts of funding to companies at the early stage and sometimes it takes 10 years to find out that there is no market for their products as there is no business case. What can help is bend of fossil product prices like the price of CO2 emissions - in that way to promote biobased alternative products compared to fossil ones. In the carbon capture market, since there is a price for CO_2 emissions, there are viable business cases and companies start growing very fast. On a regulatory level, creating market penalties and providing subsidies for green alternatives has been proven to help; solar and wind energy are such examples.

The demand for research in the bioeconomy industry is high, not only for technological development but also for documentation, monitoring, and regulation. Large industries are interested in complex processes involving different issues and topics, while SMEs tend to focus on short-term achievements and focused on getting results as cheaply and quickly as possible. There is a need to bridge the gap between academic research at low technology readiness levels (TRLs) and company needs through collaborations and partnerships. Although it is not a common practice, large companies with R&D often engage in public-private partnerships with academia; this is more difficult for SMEs. Acceleration programs exist in different scales and regions, and most interviewees are aware of them. Examples include Accelerate Green, Bioeconomy Venture, and Innovation Fund Denmark.

The engagement of industry in academia through mentoring practices is not yet widespread. Some interviewees suggested a broad campaign to raise the visibility of bioeconomy firms, their industrial bio-based technologies, and products. The link between academia and industry is still often hindered because academia is doing its own research and industry does its own, and industry does not often come to academia to ask for solutions. The human and financial capital resources available to large industry and SMEs is different. It is important to broaden SME involvement to as these have an important role in the innovation ecosystem (e.g. for small scale production, R&D)

Large industries look at for example fermentation, alternatives to current products, waste valorisation, processing of forest-based material, and algae. Industry is interested in making innovation better in terms of including societal issues, particularly because being greener and achieving societal goals can lead to more profitability in the longer term. Large companies are specialized in their field of application, and R&D is mostly well structured in them. However, once in a large company, people are locked in an internal bubble. In contrast, SMEs need to open up and not isolate themselves. There is a structural over-demand/shortage of academic talent, and the scale is different for good collaboration. The SME sector needs more investment, and the R&D work is often too expensive and time consuming for their resources. Industries want to become greener and they are aware of high energy costs and want to save money. It would be valuable to have programmes where academic researchers are stimulated to work on new start-ups, and where industrial mentors are made available. There are already ongoing EU and nationally funded projects addressing many of these deficits.

As part of the interview, a question was asked about the knowledge gap faced by start-ups and SMEs when it comes to scaling up and accelerating their businesses. Most interviewees agreed that a knowledge gap exists in three areas:

- commercialization aspects such as business management, business development, and marketing;
- feasibility of the market when developing new processes or switching to bio-resources for existing products; and
- technical information, including engagement with SMEs regarding various technology options and a lack of clarity from a policy perspective.

To address these gaps, there is a need for broader awareness and education in the bioeconomy, as well as disruptive technologies innovation funds and Public Private Partnerships. There is a huge risk to scale up and it requires a lot of investment. This makes it difficult for companies to scale up, and investors are not eager to invest in the pilot production phase. It is important for start-ups/SMEs to coordinate/know about the whole value chain that their innovation is part of, and all stakeholders should be considered in the broad and complex bioeconomy. For disruptive innovations, it can be hampered by the use of different machinery and the need to establish new supply chains. The industrial process should be considered, and there is in particular a need for drop-in solutions to make it easier for industry to adopt. Some examples – nor restricted

to drop-ins – mentioned include cellular agriculture, biobased switching, and biobased products that have difficulties in terms of stability and downstream management. The threat of substitutes of those products and certain factors influencing the total value chain are underestimated. There is a need to focus more on scaling up and helping start-ups/SMEs with capital investment, sustainability goals, access to markets, exports, marketing, and how to sell their product.
The interviewees were asked about the potential Bioeconomy TechTransfer community, and whether there were any good or bad examples. Most agreed that such a community had not been identified yet, and it was not well developed. The community was often attached to large programs or fragmented local hubs. However, there were some examples of hubs with highly skilled people in different places in Europe, such as BBEPP in Belgium, Biosolution Zealand in Denmark. These hubs could work together to create a value chain from lab scale at universities (TRL 3 to 5) to upscaling (TRL 5 to 6) and full scale (TRL 8).
Regarding advisory services, the interviewees said that these should be implemented to connect people together, but engagement with business is challenging. SMEs and start-ups need senior business supervisors but cannot afford their salary. However, the incentives for policy to set up funding programmes that do so are low, as the value can hardly be put in numbers because it is very informal and contact-based.
All interviewees found Technology Roadmaps useful as they provide a vision and could include the development of research, legislation, and practices. However, a technology roadmap is tricky to do if people don't know what they are looking at. Examples of existing technology roadmaps were the hemp value chain/Czech Hemp Cluster, BioEire study, and the 16 or 17 gateway technologies that deliver innovation expertise to industry. The Mission calls from the European Commission were also mentioned, where the Commission launches targets and aims to reach them by any means necessary or deemed suitable. One idea proposed was for a bio-based mission or bioeconomic mission from the European Commission.

Collaboration
The analysis of this topic was done by Naser Reyhani (Fraunhofer ISI).
The starting point for the interviews was that the bioeconomy is an emerging field that requires cross-sectoral collaboration to achieve its potential. Collaboration along value chains within existing sectors and cross-sectoral collaboration are crucial for the bioeconomy to achieve its ambitions. To explore the current state of collaboration in the EU bioeconomy and identify opportunities for improvement, a series of interviews were conducted with experts and stakeholders from various EU regions. The interviews aimed to assess the importance of (cross-sectoral) collaboration in the EU bioeconomy in their respective regions, the challenges and opportunities they face, and the need for improvements. This section presents a summary of the key insights and themes derived from the interviews. Moreover, options for enhancing the (cross-sectoral) collaboration in the EU bioeconomy are presented which were suggested by the interviewees.
Out of the 40 interviewees, 26 answered at least one question on collaboration.
The analysis of the interview responses revealed a strong consensus among interviewees on the importance of improving collaboration between stakeholders from different sectors in the EU bioeconomy. This enhancement of collaboration is crucial to unlocking the sectors' potential, fostering innovation, and contributing to a sustainable future.
One interviewee emphasized the need for collaboration, stating, "*It is important to bring stakeholders from different sectors together to create a holistic understanding of the bioeconomy and to foster synergies*." Another interviewee underscored that "*cross-sectoral collaboration is key to unlocking the full potential of the bioeconomy*". This sentiment was shared by many other interviewees, who provided detailed accounts of their experiences navigating the complex dynamics of value chains and stakeholder interactions in various sectors.
An interviewee stated that realizing the full potential of a sustainable bioeconomy necessitates investment and systemic changes that cut across different sectors and require multi-sectoral stakeholder collaboration.

The EU Joint Task Force (JTF) was identified as playing a vital role in supporting this collaboration by focusing on waste prevention, reduction, resource efficiency, reuse, repair, and recycling. This, in turn, supports the development of new, sustainable, and high-value products for biobased industries.

Some interviewees provided examples of good collaboration in the bioeconomy, citing initiatives like the Czech Hemp Cluster, Czech Pellet, and CZ Biom. These cases demonstrate that effective collaboration is not only possible but can lead to positive outcomes for the bioeconomy sector, such as increased innovation, resource optimization, and job creation.

Interviewees highlighted areas such as green chemistry, bioplastics, biorefineries, automotive supply and agricultural cooperatives as areas where better coordination and cross-collaboration are needed. The reasons for good or bad collaboration between different sectors are multifaceted, with competition, mistrust, and lack of communication often identified as the main barriers. For instance, one interviewee shared an experience from the Czech Republic, noting that "*the cooperation does not work because of suspicious feelings between actors from different sectors; they more compete than cooperate*." Another interviewee underlined the importance of trust, arguing that "*secrecy, lack of collaboration, and competition between companies*" can impede progress. Building trust among stakeholders is a crucial step toward fostering a collaborative mindset and overcoming the competitive nature that often characterizes the bioeconomy sector. This highlights the importance of fostering a collaborative mindset.

Another interviewee provided valuable insight into the challenges faced by farmers, suggesting that "*cooperatives for farmers and biotech companies organized in regional clusters*" could facilitate collaboration and create a more robust support network for stakeholders. This example demonstrates the potential benefits of collaboration in the bioeconomy sector, particularly for small-scale producers and businesses.

One participant stated, "*Strict rules and regulations within sectors can hamper collaboration along the value chain*." This highlights the need for regulatory frameworks that encourage cooperation and foster a conducive environment for stakeholder collaboration.

To overcome existing barriers and improve collaboration in the EU bioeconomy, participants suggested a range of activities and measures. Building trust and fostering open communication among stakeholders emerged as top priorities. One interviewee emphasized the importance of "*developing win-win situations, ensuring security of investment, and not going over the heads of partners*." This approach recognizes the need for all parties involved to feel a sense of mutual benefit from collaboration.

Government-led or catalyzed initiatives were also seen as of critical importance for enhancing collaboration. One participant proposed "*the creation of a government-led Czech Bioeconomy Task Force*," which could "*boost collaboration in viable and strong bioeconomy value chains*." This task force would play a vital role in identifying opportunities for cooperation, providing strategic guidance, and fostering a collaborative ecosystem.

Furthermore, learning from other countries and sectors was encouraged. One interviewee recommended that stakeholders "*take lessons from the forestry sector in Finland*." By studying successful models and best practices, stakeholders can gain valuable insights into effective collaboration strategies and apply these learnings to their own contexts.

In conclusion, the interviewed stakeholders expressed a strong need for improved collaboration between different sectors in the EU bioeconomy, and for stronger involvement of primary producers, such as farmers (individually and collectively). Addressing the barriers to collaboration, such as competition, mistrust, and lack of communication would be a significant step forward towards unlocking the full potential of the bioeconomy sector.

The analysis of interview responses revealed a strong consensus among interviewees that there is a need to improve collaboration between stakeholders along value chains within existing sectors in the EU bioeconomy. The participants acknowledged that enhancing cooperation within these value chains is vital for unlocking the sector's potential, fostering innovation, and contributing to a sustainable future. One

interviewee mentioned the importance of improved collaboration, stating, "*In all sectors where biotechnology processes/feedstock will improve from such collaboration, it should be an orchestrated collaboration.*"
Several examples of sectors where better coordination and collaboration are needed were identified by interviewees. These included the food sector and sectors involving biotechnology processes. Furthermore, interviewees shared specific examples where better coordination of collaboration is needed, such as carbon footprint policy and collaborations with NGOs.
One interviewed expert noted the challenges in the food value chain, where competition on price often supersedes collaboration: "*I would say in the food chain, the price is still the key element for competition or collaboration, and the money is a strong thing*." One interviewee stated that "*the quality is set by time, and the time where bioeconomy appeared on the market is so short, so just time will tell*." This highlights the need for patience and persistence in fostering a collaborative mindset and overcoming the competitive nature that can hinder progress.
Another interviewee underlined the importance of trust, arguing that "cooperation activities along the value chains, developing supply chains, collaborative principles, and cooperative approaches are essential." Building trust among stakeholders is a crucial step toward fostering a collaborative mindset and overcoming the competitive nature that often characterizes the bioeconomy sector.
To overcome existing barriers and improve collaboration along value chains in the EU bioeconomy, participants suggested a range of activities and measures. Building trust and fostering open communication among stakeholders emerged as top priorities. One interviewee emphasized the importance of "*communicating with research and practice experts - an input for policy makers*."
Government-led initiatives were also seen as of critical importance for enhancing collaboration. One participant proposed "*the creation of the government-led Czech Bioeconomy Task Force*" to "*boost collaboration in viable and strong bioeconomy value chains*." This task force would play a vital role in identifying opportunities for cooperation, providing strategic guidance, and fostering a collaborative ecosystem.
Another interviewee highlighted the need for better communication and understanding of terminologies within the bioeconomy sector. He mentioned that capacity building and knowledge transfer are essential to overcome existing barriers and promote collaboration. In addition, he pointed out that actions in the bioeconomy sector need to be justified based on economic return, which sometimes leads to a lack of appreciation or understanding of what goes on within the value chains.
Furthermore, learning from other countries and sectors was encouraged. One interviewee recommended that stakeholders "*learn from countries where collaboration works well, such as Finland's forestry sector*." By studying successful models and best practices, stakeholders can gain valuable insights into effective collaboration strategies and apply these learnings to their own contexts.
In conclusion, the main findings highlight the need for improved collaboration among stakeholders within the EU bioeconomy to unlock its full potential. The primary barriers to effective collaboration include competition, mistrust, and lack of communication. Interviewed stakeholders suggested several options how collaboration within existing value chains and between sectors could be improved. Based on the analysis of responses from stakeholders, the following actionable options can be proposed to improve collaboration, overcome barriers, and capitalize on opportunities in the bioeconomy sector:

- Foster trust and open communication: Encourage transparency and open dialogue among stakeholders in the bioeconomy sector to build trust and promote collaboration. Organize regular meetings, workshops, and networking events to facilitate the exchange of ideas, knowledge, and best practices.
- Establish government-led initiatives: Support the creation of government-led task forces and programs aimed at fostering collaboration in the bioeconomy sector. These initiatives should

provide strategic guidance, identify opportunities for cooperation, and promote a collaborative ecosystem.

- Promote cross-sector partnerships: Encourage partnerships between stakeholders such as academia, industry, government, and NGOs from different sectors within the bioeconomy. These collaborations can lead to new insights, innovative solutions, and resource optimization.
- Learn from successful models: Study successful models of collaboration in other countries and sectors and apply these learnings. Identify good practices that can be adapted to local contexts and shared among stakeholders to facilitate improved collaboration.
- Support capacity building and training: Invest in capacity building and training programs for stakeholders in the bioeconomy sector, and especially those stakeholder groups that are not specialists in the bioeconomy, but whose active involvement is essential. Enhance their understanding of the value and benefits of collaboration and equip them with the skills needed to participate effectively in collaborative projects.
- Develop and implement supportive policies: Advocate for the development and implementation of policies that support collaboration between sectors and along value chains. Ensure that regulations and incentives are aligned with the goals of fostering this cooperation.

These insights and suggestions for improvement will be considered and further discussed and refined in the ShapingBio project.

Financing

The analysis of this topic was done by Milena Garthley (TTG) and Youssef Sabbah (TTE).

Access to finance is of vital importance for the bioeconomy across Europe. Interviews were conducted with the aim of better understanding the facilitators and hindrances in obtaining finance by various stakeholders, and to identify best practice that illustrates or exemplifies the process of obtaining finance in bioeconomy from various European regions. In this section, the key points and insights from these interviews are summarized.

21 of the 40 interviewees answered at least one question on financing.

Recipients of bioeconomy financing in Europe obtain funding from various sources, including EU investment instruments (public), private and corporate capital, or a combination of the three. The most significant sectors for technology development and investment, as perceived by interviewees, are agriculture and food, the blue economy, biofuels, and to a lesser extent, biopharma, textiles, and waste utilization. The interviewees often mentioned that bioeconomy is not well understood by both entrepreneurs and investors as this is a comparatively new concept. From this perspective, the adequacy of financing sources for bioeconomy companies at EU, macro/regional or national level is being considered predominantly inadequate. There are several areas referring to bioeconomy financing where the stakeholders recommend improvement:

<u>Awareness</u>

There is lack of awareness or in some cases a lack of consensus regarding what the bioeconomy is, lack of information regarding the financial sources available for the bioeconomy, and a lack of knowledge on where to find adequate information. There are only few hubs that encompass the often fragmented information that is specific for bioeconomy like industry statistics, analyses, trends, sources of financing, services for bioeconomy stakeholders, etc. Some of the respondents expressed the need for dialogue between the

stakeholders – companies, financiers, public funding bodies, clusters, and other players providing services – to prepare companies for an investment round.
The interviewed experts pinpoint often overlooked or underused sources of information regarding bioeconomy financing, while at the same time they underline the lack of "all-in-one" information hubs where investors, companies, accelerators and other stakeholders can find reliable or validated information from the entire bioeconomy domain.

Strategic framework
The interviewees mention the Green Deal most often when it comes to the strategic framework most relevant to bioeconomy. The Green Deal provides guidance for responsible investors to align with EU priorities. It provides understanding on future regulatory trends, and future segments within the sectors that will be promoted. Because the bioeconomy encompasses many policy sectors, the interviewees perceive the transposition to regional and national strategies for bioeconomy financing as difficult and very fragmented. Some interviewed experts find that the public spending for bioeconomy is fragmented and differs in levels for specific bioeconomy sub-sectors. The interviewees consider it important that the action plans and economic incentives, if any, at regional and local level are well designed and operationalised with the regional and local specificities in mind, such as most developed bioeconomy sector in the region, consider new prospective bioeconomy technologies and domains, and that they are well communicated. It is still a challenge to communicate, in a comprehensible way, the complex policy landscape that is relevant to the bioeconomy in order to have a better understanding not only of the sector but also about the opportunities emerging as a result, and of more aligned financing instruments.

Regulatory framework
The interviewees perceive the regulatory framework relevant to bioeconomy financing as lacking long-term vision and difficult to navigate. An analytical tool that enables investors to identify promising business opportunities, based on the regulatory incentives or restraints established, would be valuable. At a more operational level, Europe is not the easiest region to invest in because of regulatory issues. Food regulatory issues are given as an example. The European Food Safety Authority (EFSA; https://www.efsa.europa.eu/) follows the precautionary principle and sets high standards. According to interviewees, it is a very hard, long process to get a new product approved, if it is approved at all. There are examples where companies develop a new product in Europe but then go to the USA or Asia because "placing on the market" is easier there. This may restrain investors as they are very careful about investing in companies whose products are under regulatory provisions that may limit market returns.

Accessibility of finance and investment opportunities
Even though there are various public and private financing sources, obtaining them is not easy, according to the interviewees' experience. This is especially relevant for the EU public funding where the applicants need to go through a lengthy and laborious process to apply, get approval, manage and administer the financing schemes. The interviewed experts acknowledge a trade off in allocating time and effort running a business vs. building a consortium, writing a proposal, finding a project leader, coordinating a group of stakeholders, participating in regular meetings, filling in reports, etc.
The interviewees find the effort of combining public and/or private investment instruments large and complex; they are also very aware of the significant potential risks. They acknowledge the availability of financing, and at the same time they indicate that the bioeconomy is under-financed and not an easy sector to invest in. The private investment funds would like to see thousands of opportunities every year to identify the investment opportunities as "enough". Currently in bioeconomy, the respondents' estimate is perhaps of a hundred of such opportunities per year – an order of magnitude less than "enough". In general, the

investors see a small number of really attractive investment opportunities, even allowing for the small number available.
The capital intensity is also a factor, here referring to the amount of capital (money, equipment, buildings, etc.) required to produce goods or services in bioeconomy, as a measure of how much capital investment is needed per unit of output. Bioeconomy is often considered capital-intensive because it requires expensive machinery, equipment, and infrastructure to produce goods. Capital intensity is an important consideration for businesses and investors in bioeconomy as it can impact the profitability and financial sustainability of a company. A high capital intensity bioeconomy enterprise may require a significant upfront investment, which can increase the risk for investors and require longer payback periods. Understanding the capital intensity of the bioeconomy can help businesses and investors make informed decisions about where to allocate their resources and investment, which may also be a deterrent. And finally, most of the products produced are close to commodities or are even commodities; such products should be produced at a very large scale or very low price to be able to compete with alternatives. This is very difficult for small companies to do.
Despite attempts to create large financing structures, they have had limited success. For companies requiring €100 million to scale up their technology, finding the right financing may be impossible. Such companies may be operating at a high TRL level (5 to 9) where significant investments are necessary to scale up the technology to the commercial stage. However, the financing structures available may not be adequate to support such a level of investment, leading to difficulties in securing the necessary funding. The technology may be too risky or too expensive to attract the required financing. These challenges highlight the difficulties that start-ups (TRL level 1-4) and scale-ups (TRL level 5-9) face in securing the necessary funding to scale up their technology, particularly at higher TRL levels where significant investments are required.
Respondents are careful at recommending the creation of financing structures because the risk can be too high for the amount of invested capital. One of the solutions may be to search for very capital- and cost-efficient technologies at relatively low scale. Big corporates in bioeconomy say the same thing – they will not invest hundreds of millions in first-of-the-kind new plants. There should be more effort in research and development side to find those technologies and solutions that can get to reasonable cost/price at a reasonable scale, not €100 million.
The interviewees also provide another perspective – they acknowledge the availability of good financing sources for basic research for early stages TRL 3-4 in the EU. But when it comes to growth funding for TRL level 5 and higher, interviewees are of opinion that the USA financial system succeeds much better. This boils down to the groundwork being done in Europe and financing of the successes taking place elsewhere. Financing sources are adequate for companies in certain stages of venture development but are not connected along the stages and are not sufficient to assure an accurate funding mix at later stages.
A venture leasing programme on financial sources and instruments to finance capex-intensive scale-ups would be welcome for more mature companies. Grants may provide some funding but may not be sufficient to cover all the costs associated with building or expanding an industrial plant or refinery. Venture and equity capital, on the other hand, may not be suitable for financing such projects because they often require a high return on investment in a relatively short time frame, which may not be feasible for large-scale projects with longer timelines. Therefore, a venture leasing programme that provides financial sources and instruments to finance capex-intensive scale-ups could be a more suitable option for more mature companies looking to expand or build industrial plants or refineries. The pilot plants and shared pilots should be used more extensively also for technology validation.

<u>Programmes to prepare the companies for financing</u>
The interviewees perceive that the strength in the EU lies in "*financial instruments in ideation and early stage – good accelerators, early VC funds, established grants scheme for R&D*", etc. The interviewees in

general agree that there is a need for more and better investment opportunities, and initiatives to build awareness and provide support for companies that operate in the bioeconomy. This is perceived to require a cumulative effort on behalf of the companies themselves, the public and private actors such as accelerators, incubators, development agencies, matchmaking fora. The interviewed experts elaborate that the facilitation of investor relations and networking is something that should be encouraged more strongly to develop activities with investors and to attract them, to internationalise the start-ups and prepare them for investors. To develop and internationalise start-ups and prepare them for investors, it is perceived as requiring a cumulative effort from various entities, including the companies themselves, as well as public and private actors such as accelerators, incubators, development agencies, and matchmaking fora. The interviewed experts suggest that the facilitation of investor relations and networking should be encouraged more strongly among these actors to foster connections with investors and develop activities with them. This is particularly useful for venture capital funds, which often operate at the EU or global level. Therefore, stronger collaboration among these entities and the encouragement of connections between investors are essential for the success of start-ups seeking investment opportunities.
The interviewees also mention that, at the ideation stage, R&D trials and product development progress is very important but it is also important to develop business soft skills and qualifications to succeed in future commercialisation of the innovation. This lack of such commercialisation skills is perceived as a bottleneck when it comes to scaling-up innovation.
Clusters, by their mandate of understanding technology and the business landscape, could play a more pronounced role at sector level. They could enhance their members' knowledge and skills in SME operations, engagement with R&D projects or investors, commercial relationships, negotiating. But they are more focused on their company members. With other stakeholders (e.g., accelerators, innovation hubs), investors face a challenge of a lack of critical mass of other investors to share views on trends, discuss opportunities or elaborate on concrete company assessment, despite having access to deal-flow exchange with other stakeholders such as accelerators and innovation hubs. Tech Tour was identified as a best practice example. Tech Tour bridges this gap by facilitating both worlds and providing a platform for investors to engage with other investors, exchange ideas, and assess potential investment opportunities together. Relations with start-ups, who pitch at the events, and relations with other investors, who participate in the investment raising process, provide also space and platforms to facilitate ongoing contact to leverage the expertise of other companies.
To sum up, we conclude that the interviewees' perception about adequacy of financing sources relative to the needs of bioeconomy at the EU or country level, or in a specific field of expertise, is mixed. They propose similar solutions for improvement, such as the way the financing means are streamlined or how the financing process is organised. Financing for R&D and for start-ups is seen to be sufficient but it is less adequate for scaling-up companies. It also depends on the awareness of the existing/available investment opportunities by both companies and investors. Some of the interviewees underline the need to allocate enough funding for specific emerging technologies or sub-sectors that need special attention and need development such as waste valorisation and by-product innovation from the agricultural sector. There is a common understanding that the funding instruments and financing sources, their availability, accessibility and management in the EU significantly lag behind the investments in the USA.

Communication channels and formats

The analysis of this topic was run by Francesca Santaniello (APRE).
Good communication can also reduce misunderstandings, and increase the possibility of developing strong relationships and collaborations, which tat appears to be one of the key pillars for developing the bioeconomy. To better understand stakeholders' needs and preferences concerning communication, specific questions were asked about their communications practices and preferences.
Out of the 40 interviewees, 38 answered at least one question of this module.

Here below is a summary of the main outcomes:

Preferred documents and information source

The majority of the stakeholders interviewed shared their preference for institutional and official sources of information. The reason for this is related to the level of trustworthiness and availability of such instruments, and also relates to the possibility of accessing information in different languages. However, some stakeholders expressed interest in a larger spectrum of options, including social media channels, being a source of news and events rather than less engaging information, such as procedures, scientific updates, and patents. The word "*official*" was without any doubt one of the most frequent words mentioned during the interviews. Official websites, official newsletters, official summaries and fact sheets from institutions and research centres, and official documents shared for example by the European Commission, FAO (Food and Agriculture Organisation), or UN (United Nations) were the most frequently recommended. Scientific publications followed the same line, with the remark that access to certain data is not always possible due to access restrictions. Because of the "*overwhelming amount of information shared on the web*", some stakeholders expressed their interest in receiving customized information, for example in the form of newsletters focusing on very specific topics. A minority of stakeholders identified themselves as "*old fashioned*", and therefore more interested in social events (like exhibitions and physical workshops) as sources of information. Anyway, web-based information sharing was the first choice of the majority of the stakeholders. A final comment resulting from the interviews refers to lack of an EU bioeconomy platform aiming at managing, organising, filtering and sharing information about the bioeconomy and food sectors.

Preferred information formats

Most of the stakeholders shared their interest in receiving information in a "*short and concise*" way, pointing at e-mails and newsletters as favourite information sharing formats/tools. Some stakeholders declared that they preferred video and infographic formats, being "*very useful to get an idea of the topic quickly (a topic that can be better investigated in a second moment, when time allows)*". A few shared interest in face-to-face meeting and seminars, appreciating the possibility to ask questions.

Most of the comments refers to the interest in engaging in co-creation events/seminars. In this context, stakeholders suggested the use of online platforms such as "Slak" and "Lucidchart" to receive information, and share and develop topic ideas. Webinars, podcasts, and digital story-telling were also mentioned.

Some stakeholder wished to see more summaries and policy briefs. recommendations.

Needed information

Stakeholders clearly expressed the need to learn about bioeconomy success stories (case studies, projects, initiatives, and accelerators), with the aim to inspire people, and raise interest in bioeconomy investments. They propose sharing information and advice through real-world examples from practice, examples illustrating practices, innovations, discoveries, and tools, which could be applied in other systems, in the frame of international cooperation and collaboration. Moreover, stakeholders shared the need to shape/establish a system of feedback, aiming at collecting experiences and re-using them in a constructive way, both in the case of successful or non-successful stories. This could benefit bioeconomy by increasing efficiency and effectiveness based on knowledge.

Preferred events typology

Stakeholders showed a strong bias between physical and virtual events, where physical events were the most preferred, being "*the best way to leverage a relationship*". This outcome contradicts how the majority of the stakeholders would like to receive information, which was virtually, on the web. Despite expressing valid reasons to attend virtual events (such as lower or no-cost), stakeholders seemed to be more interested in events such as expositions, conferences, and thematic meetups. Stakeholders highlighted that "*the*

foundations for collaborations is more likely to be created during a physical meeting rather than a virtual one, due to the possible of establishing trust". Moreover, the stakeholders unanimously expressed their interest in engaging in ShapingBio activities aiming at networking and knowledge dissemination.

Co-creation workshops

The majority of the stakeholders was well aware of the concept of co-creation workshops, and only a few interviewees were unaware of their existence/meaning. The general view is that co-creation workshops can function as a democratization tool, where equal space can be given to creativity regardless of the sector to which participants belong. It was pointed out that industrialists and researchers are often the main actors for idea development, while other categories of stakeholders (such as landowners) are often underrepresented. As in other environments, diversity (intended as the integration of diverse approaches, disciplines, and experiences) is a fundamental aspect in co-creation processes, and this should be incentivised according to the interviewees. Another outcome pointed at the effectiveness of co-creation events, when they have a very specific aim, for example the creation of a new material, tool, or solution to a tangible problem.

To conclude, with the aim to improve communication and networking opportunities, the interviewees shared the following suggestions:

- Establish an official and centralized platform for information sharing.
- Make information accessible and easy to understand, possibly tailored to the specific stakeholder groups.
- Share success stories, at regional, national and international level, and establish a system of feedbacks.
- Promote co-creation events and physical meetings, being a good opportunity for networking and for the establishment of long-lasting and trustworthy collaborations.

5.2 Survey results

Survey participants demographic information

A total of 145 surveys was submitted (sample profile information were compulsory). Most of the participants identified as "man" (79 submissions), seconded by those identified as "woman" (61 submissions). Five participants preferred not to disclose their gender.

The interviewed were distributed in the macro regions as follow:

- Central and Eastern Europe: 13 submissions
- Baltic Sea Region: 26 submissions
- Western Europe: 60 submissions
- Southern Europe: 42 submissions

In addition, one survey was submitted from an EU multinational organisation, one from a global organisation, one from Switzerland, and one from Brazil. Due to the low occurrence, and relevant contributions, these submissions were integrated into the study. The distribution of the survey responders is in favour of academia and industry, while public sector and civil society are underrepresented (Figure 3).

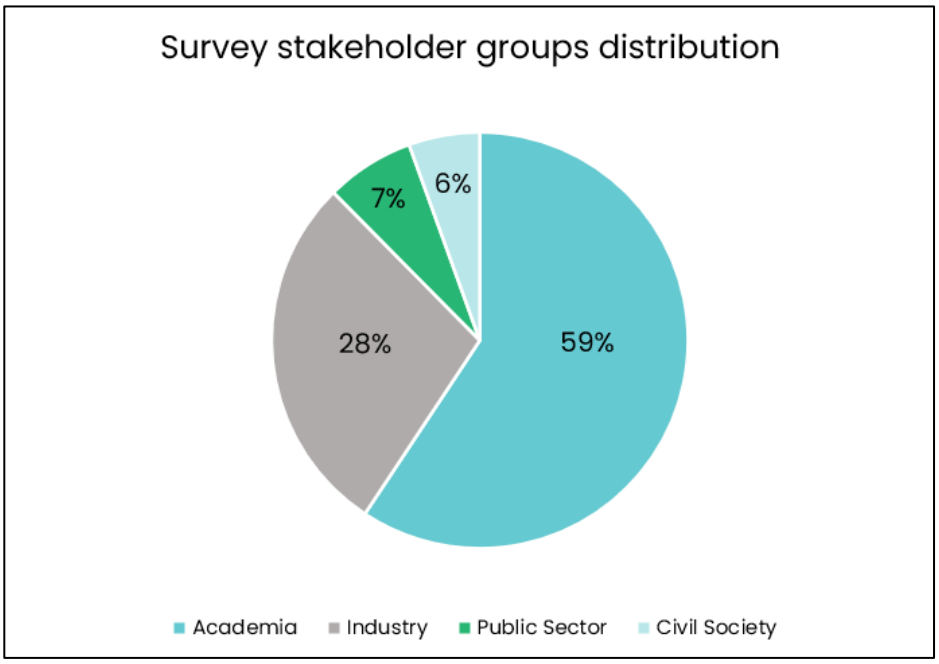

Figure 3. Stakeholder group representation in the survey. N=145.

Topic modules

Survey participants were firstly invited to answer four main questions (see below table 4), and, if needed, meaning they were not satisfied with the current situation in the EU bioeconomy regarding a specific area of interest, they were directed to specific modules where they were presented with more detailed questions on the module. Before submitting the survey, responders had to answer questions about communication channels and formats. Here below is an overview of the responders' perceptions across the four main topics of ShapingBio (Table 4).

Table 4 Overview of the level of satisfaction of survey responders in relation to four investigated topics. Values represent the number of collected answers.

Survey main outcome				
	Policy & governance	Applied research & technology transfer	Collaboration	Financing
Responders answer	Are bioeconomy policies on EU, national and regional level well-coordinated with one another?	Is applied R&D and technology transfer sufficiently well developed in the EU to allow deployment of bioeconomy innovations?	Does collaboration between different sectors and along new value chains work sufficiently well in the EU bioeconomy?	Are sources of financing adequate to the needs of bioeconomy in the EU/your Country/your field of expertise?
Yes	3%	8%	10%	11%
To some extent	48%	59%	49%	41%

Survey main outcome				
	Policy & governance	Applied research & technology transfer	Collaboration	Financing
Responders answer	Are bioeconomy policies on EU, national and regional level well-coordinated with one another?	Is applied R&D and technology transfer sufficiently well developed in the EU to allow deployment of bioeconomy innovations?	Does collaboration between different sectors and along new value chains work sufficiently well in the EU bioeconomy?	Are sources of financing adequate to the needs of bioeconomy in the EU/your Country/your field of expertise?
No - Tell us more, go to Topic …	33%	26%	31%	35%
Don't know/Not relevant to me	15%	7%	11%	13%
Total number of responders	155	155	144	144

As visible in table 4, the general level of satisfaction (the sum of the answers "yes" and "to some extent"), is rather high. However, this answer has to be interpreted with caution as it was indicated in the survey answer possibilities (see Annex 8.5) that answering "no" led the respondent to detailed questions for the topics. Hence, respondent fatigue may have been a factor. Anyway, about one third of the responders were not satisfied with the state of the art of bioeconomy in EU regarding the different topics and answered additional questions. To better interpret the results, it is important to know that in some occasions the responders had the possibility to select multiple answers.

Policy and governance

The main outcome from the responders keen to share insights about their dissatisfaction is that bioeconomy policies on EU, national and regional level are not well coordinated with one another, or only to a small extent. No one answered that they are well coordinated.

Responders see a need for coordination improvement at any level (between EU and national, EU and sub-national, national and sub-national, and cross-border as well). Responses to the coordination question "Where do you see the need to improve bioeconomy policy coordination?" are presented below (the values are calculated based on the total number of responders that answered the question, n=47; multiple answer choice was offered):

- 72% selected "Between EU policies and national member state policies";
- 51% selected "Between EU and subnational policies (e.g., regions, provinces, clusters)";
- 38% selected "Between national and subnational policies";
- 32% selected "Cross-border national policies";
- 2% selected "Other" (suggesting at "global level").

When asked if the bioeconomy and food systems policies are sufficiently well aligned with other policy domains (such as environment, climate, agriculture or innovation), no one answered "yes". The majority of the responders pointed at the existence of alignment only to a small extent, followed by those responders that perceived the alignment as not sufficient. Answering the question: "From your experience, which challenges would require better alignment of different policy domains (e.g. environment, climate,

agriculture, education, and innovation) on EU or national level?", the most frequently mentioned answers are listed below (the values are calculated based on the total number of responders that answered the question, n=47, multiple answer choice was offered):

- 77% selected: "Establishment of circular bioeconomy";
- 57% selected: "Achievement of climate change mitigation goals";
- 53% selected: "Valorisation of biomass waste";
- 51% selected: "Resolution of biomass use conflicts";
- 40% selected: "Promotion/establishment of a qualified bioeconomy workforce";
- 38% selected: "International competitiveness of the EU/member states".

More sustainable agricultural practices for biomass provisioning, protein transition (referring to substitutes for animal proteins in food and feed), and resolving land use conflicts were also mentioned. A minority selected the option to increase EU autarky. Other suggestions shared in the section dedicated to further comments included opening spaces for social exchanges and increasing transparency while sharing information.

When asked which activities should be intensified to overcome existing barriers in bioeconomy policy, consultation/dialogue with stakeholder groups, coordination of different strategies and action plans, and formal exchange fora were the options selected most frequently (see figure 4 for further details). Some responders added a few extra options. Among them were a quantitative systems level measurement at what contribution the bioeconomy can make; Responsible Research, Innovation & Implementation; bridging rural and regional development instruments (e.g. European Regional Development Fund); and the suggestion to include potential future stakeholders due to paradigm shifts.

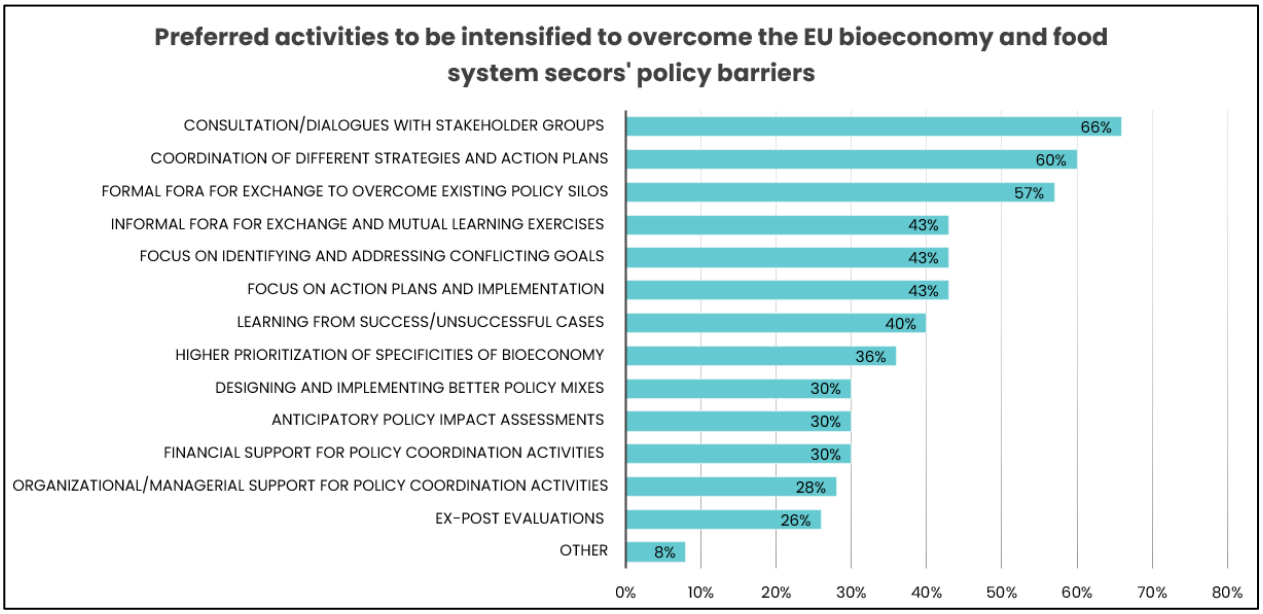

Figure 4. Responders preferred activities to be intensified to overcome bioeconomy and food system policy barriers. Multiple answers were permitted. (% of responders to the questions, n=47).

Applied research and technology transfer

Responders were keen to provide insights about their experience in applied research and technology transfer.

Answering the question: "Where do you see the major challenges in applied research and technology transfer in the bioeconomy in the EU?", they recognised the following main challenges (the values are calculated based on the total number of responders that answered the question, n=37; multiple answer choice was offered):

- 68% selected: "Fragmentation of support actors, both institutional and associative players, each developing its own structures and lacking synergies";
- 57% selected: "Poor support infrastructure";
- 54% selected: "Scale-up of small and medium enterprises";
- 46% selected: "Slow uptake of R&D findings";
- 43% selected: "Poor exchange of knowledge";
- 35% selected: "Mismatch of R&D topics between academia and industry".

Some responders added a note, sharing an interest in 1) increasing the efforts dedicated to training of bioeconomy-related technicians, 2) increasing R&D activities, 3) increasing the "technological solutions", considering sustainability principles.

While asking the question: "Which 'support' infrastructures should be improved in applied R&D and technology transfer in the bioeconomy in the EU to gain maximum impact in deployment of bioeconomy?", responders pointed firstly to the following infrastructures (the values are calculated based on the total number of responders that answered the question, n=37; multiple answer choice was offered):

- 62% selected: "Sharing open access pilot facilities";
- 60% selected: "Promoting start-ups and small and medium enterprises";
- 54% selected: "Research and development, research and innovation, and investment and advisory projects";
- 54% selected: "Promoting regional networks";
- 45% selected: "Promoting knowledge and technology transfer";
- 38% selected: "Promoting flagships, public and private partnerships".

Matchmaking events, consultancy and accelerator programmes, and exhibitions and conferences, were also mentioned, but less frequently.

While asking the question: "From your experience, in which innovation areas would R&D activities of academia and research institutes need a better alignment with industry needs or market requirements?", responders recognized a few business opportunities that could benefit from a better alignment. The most frequently mentioned were (the values are calculated based on the total number of responders that answered the question, n=37; multiple answer choice was offered):

- 70% selected: "Biomass valorisation";
- 51% selected: "Biofertilizers/biopesticides";
- 49% selected: "Alternative proteins";
- 49% selected: "Biomaterials";
- 43% selected: "Personalised nutrition".

Biosurfactants, cosmetics, specialty carbohydrates, and colorants were also mentioned but less frequently.

Responder were also asked to share where they see a need for improvement in scale-up of processes and products. The need to improve collaboration with shared open facilities was the most frequently selected

option, followed by the need to improve collaboration between small and medium scale enterprises and big industries, and the need to improve the offering of funding programmes to sustain existing infrastructure (e.g., shared pilot facilities). Responders also selected those activities that, in their experience, should be intensified to improve R&D and knowledge and technology transfer in the EU bioeconomy. Accessibility of shared pilot facilities had the highest score (for further details, see the figure below, figure 5).

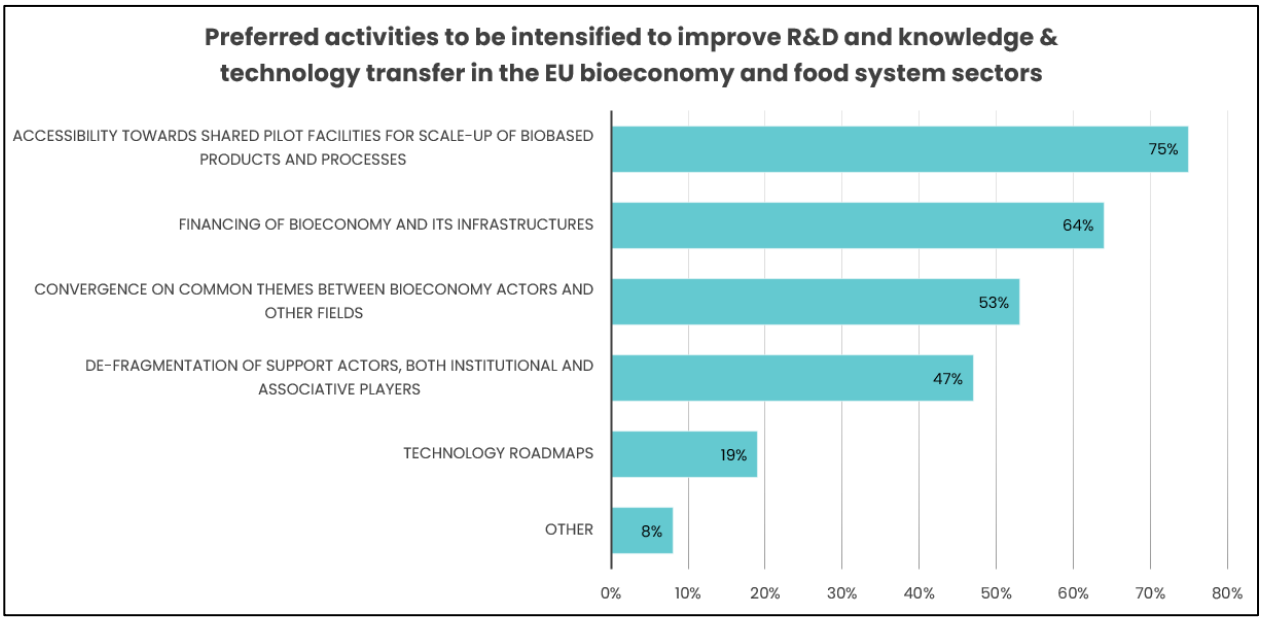

Figure 5. Responders preferred activities to be intensified to improve R&D and knowledge and technology transfer in the EU bioeconomy and food system sectors. (% of responders to the questions, n=36).

Collaboration

The main result from the responders is that collaboration between all the bioeconomy sectors and the bio-based industry (therefore, cross-sectoral collaboration) is needed. Additional comments pointed to the need to establish/improve collaborations throughout the entire value chain. The responders identified also the barriers that hinder cross-sectoral collaboration in the EU bioeconomy (Figure 6).

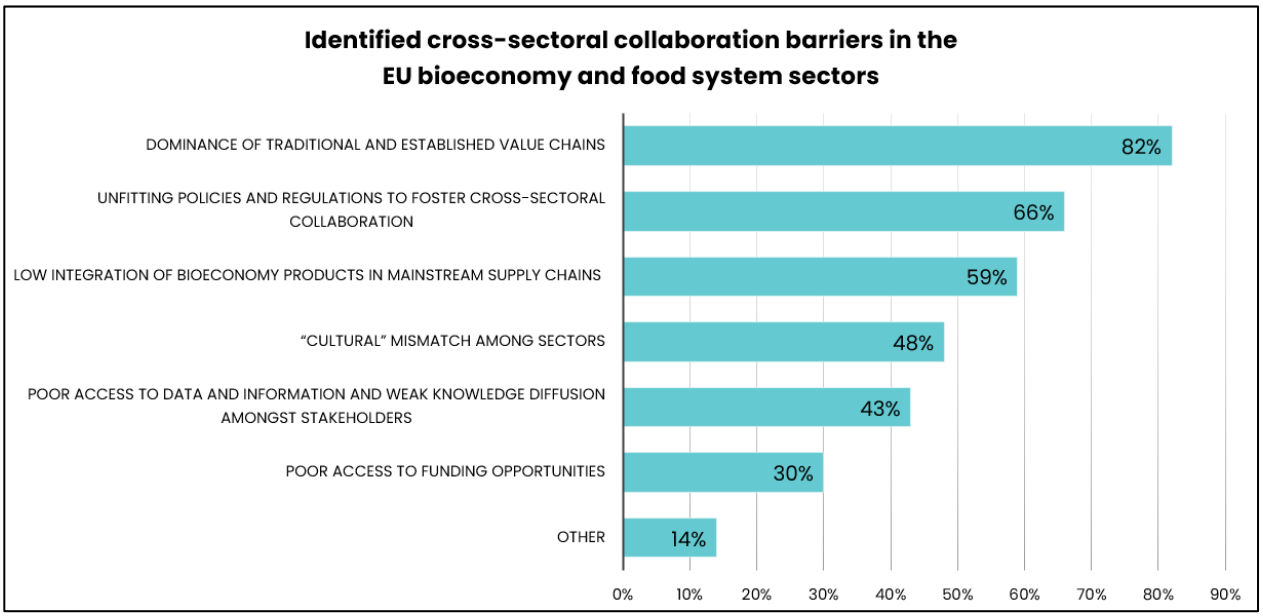

Figure 6. Cross-sectoral collaboration barriers in the EU bioeconomy and food system sectors according to survey responders. (% of responders to the questions, n=44).

Additional comments highlighted the lack of guidelines in how to make a proper business plan, and the low collaboration rate with actors that are not well established in the bioeconomy and food sectors scene.
According to the responders, the stages of the value chain that need collaboration efforts between stakeholders are "processing" and "production", followed in order of frequency of mention by "consumption and distribution".
Responders also reported some of biggest challenges in the terms of collaboration along the value chains; primary producers and waste producers seem to represent the main areas for a collaboration, followed by the involvement of societal actors, and then by the collaboration between academia and industry.
When asking the question: "Where do you see a need to intensify activities towards overcoming collaboration barriers in existing value chains", responders selected firstly the following activities (the values are calculated based on the total number of responders that answered the question, n=43, multiple answer choice was offered):

- 70% selected: "Cooperation for cascading and circular utilization of bio-based waste";
- 60% selected: "Establishing circular economy";
- 56% selected: "Better policy support (e.g. EU waste regulation)";
- 53% selected: "Better sectoral overview and knowledge diffusion (e.g., better insight on who to cooperate with)".

Cooperation to broaden competences and product portfolio and to find better funding opportunities were also mentioned, but with a lower frequency. In the additional comments field, one responder stated: "*To restore the broken bonds between environment, governance, politics, economics, culture and ethics, Earth's regeneration and mankind's regeneration must be tackled simultaneously, in space and time, for their mutual support, as sides of the same coin*" (Pilon, 2023).

Financing

Responders were asked which financial improvement strategies should be adopted to accelerate the deployment of the bioeconomy. Relevant governmental/institutional support was selected by the highest percentage of responders. The figure below (figure 7) shows their responses in relation to other items also.

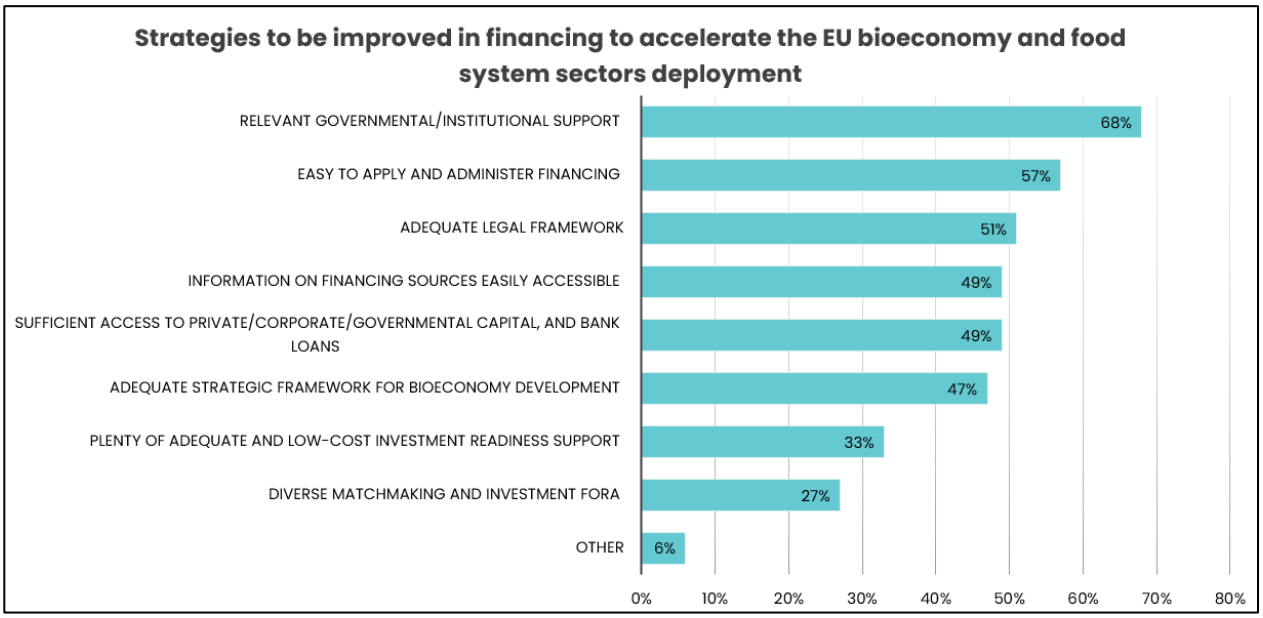

Figure 7. Strategies to be improved in financing to accelerate the EU bioeconomy and food system deployment according to survey responders. (% of responders to the questions, n=51).

Additional comments pointed at shortening the time needed to receive financial funding, developing inter-institutional collaboration, and increasing sector-focused education. Responders also highlighted aspects of financing start-ups and small and medium enterprises, from a pre-developed list, that would need to be improved (list available in annex). An increase in investment readiness level raising programmes and establishments (such as incubators and accelerators), and investments to enable and support bioeconomy pilot plants were identified as important. In the additional comments field ("other"), a responder wrote that *"Bioeconomy should be a driver for a more just and sustainable economy that should strengthen mainly small and medium enterprises avoiding further concentration of the economic power in the hands of few big industries".*

Communication channels and formats

Responders were asked to share their preferences about communication sources, formats, and modality, including characteristics of the events they prefer to attend. Figure 8 below shows the responders preferred information sources.

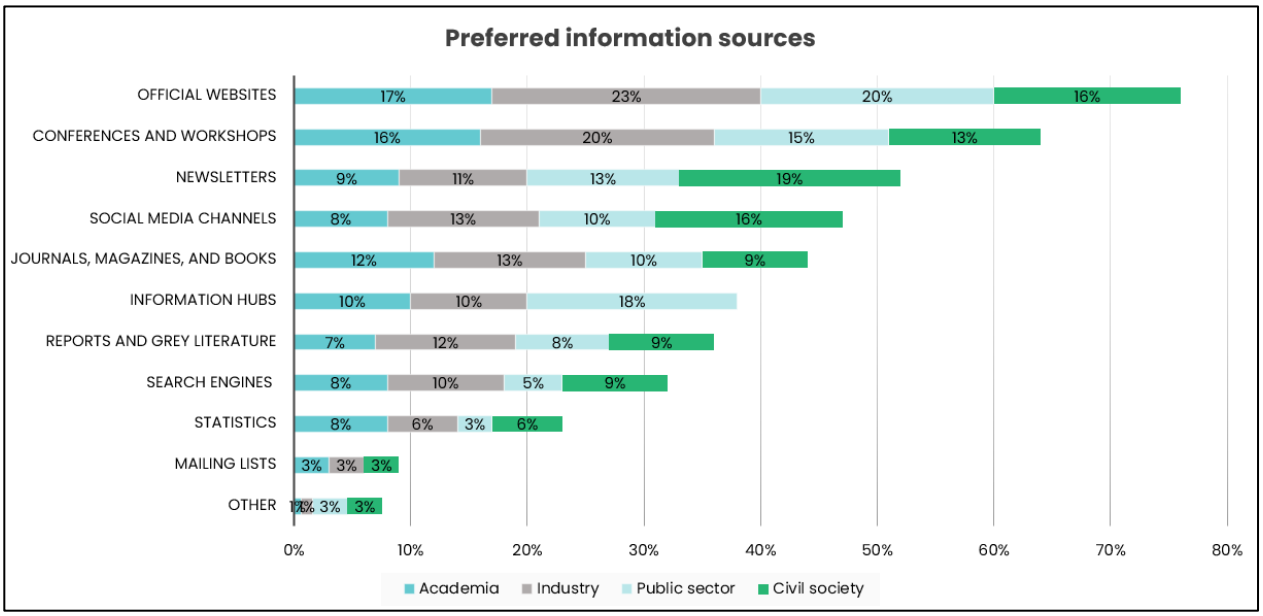

Figure 8. Responders preferred information sources, divided by sector. (% of responders to the questions, n=145).

Official websites were selected by 110/145 responders, and they seem to be the preferred option of academia, industry, and public sector. In contrast, civil society seems more interested in newsletters.
Mailing lists were the least frequently selected. Six responders shared (in "other") that scientific publications, thematic factsheets, and global networks were also highly appreciated.
When it comes to the favourite formats from which responders prefer to receive information and advice, infographics had the highest score, followed by reports and infosheets (see figure 9 below). Both academia and industry prioritized more conventional formats like reports and journal articles, while the public sector and the civil society showed the highest interest in more "modern" formats, such as infographics and infosheets. Under the option "other", one responder highlighted a preference for science-based content (doesn't matter the format).

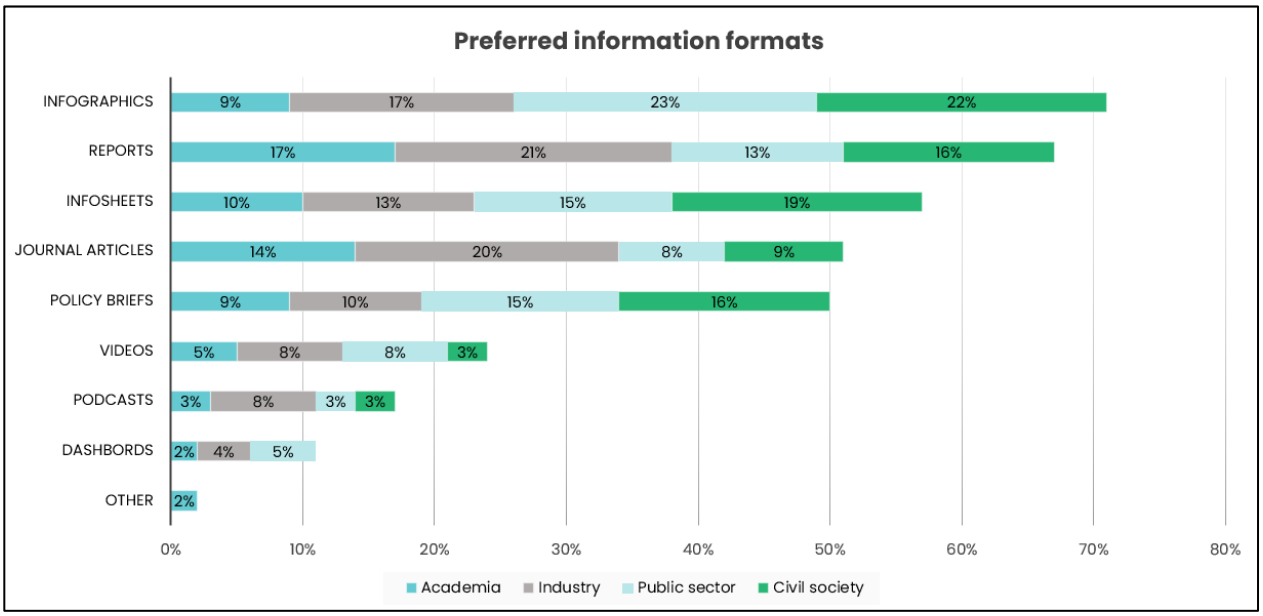

Figure 9. Responders preferred information formats, divided by sector. (% of responders to the questions, n=145).

The majority of the responders stated that English was the preferred language in which to receive information, and only a few preferring their own/national language.

A question was asked to see if the bioeconomy community is aware of the presence of opportunities to exchange good practises and, if so, if they were sufficient. The majority of the responders answered “yes” in relation to awareness. Nevertheless, opportunities were not so clear to the rest of responders, highlighting the need for increasing clarity and information sharing.

To receive information about the bioeconomy, webinars and EU-wide conferences (mostly physical/hybrid) were the preferred event choices (Figure 10). By selecting the option “other”, one responder shared a preference for recorded conferences, and two responders highlighted the value of physical meetings.

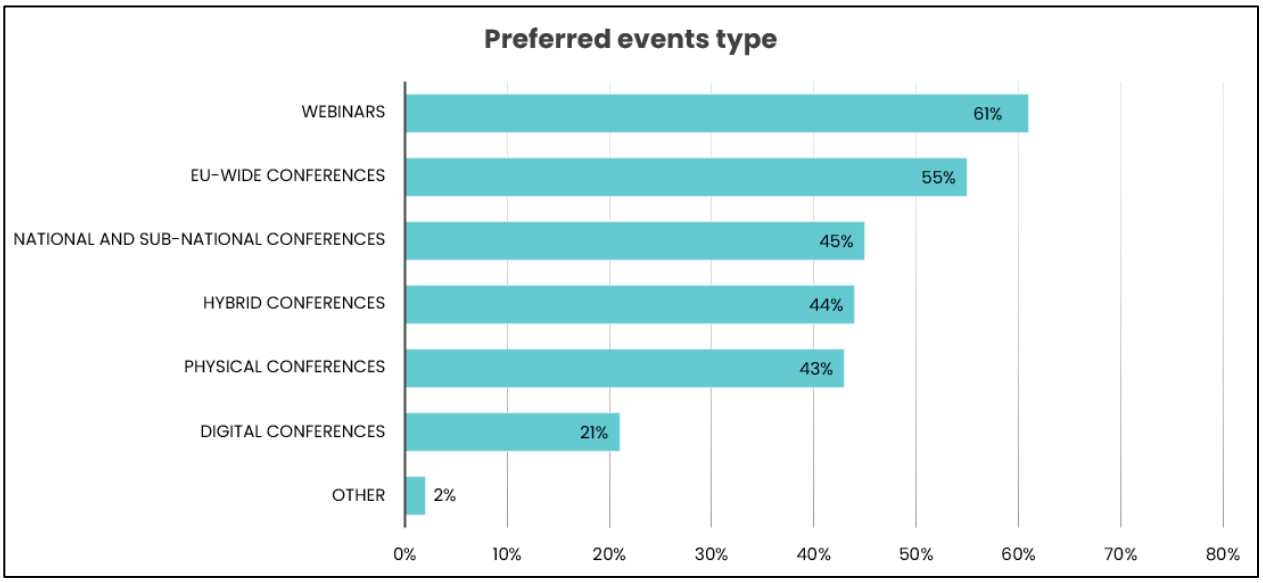

Figure 10. Responders preferred events type. (% of responders to the questions, n=145).

While asking for the preferred events format to which responders would like to interact, exchange information and experiences, co-create, and discuss, physical workshops, and co-creation workshops, were the most selected ones (see figure 11 below). By selecting the option "other", one responder shared an interest in any event as long as exchanges with other participants are possible.

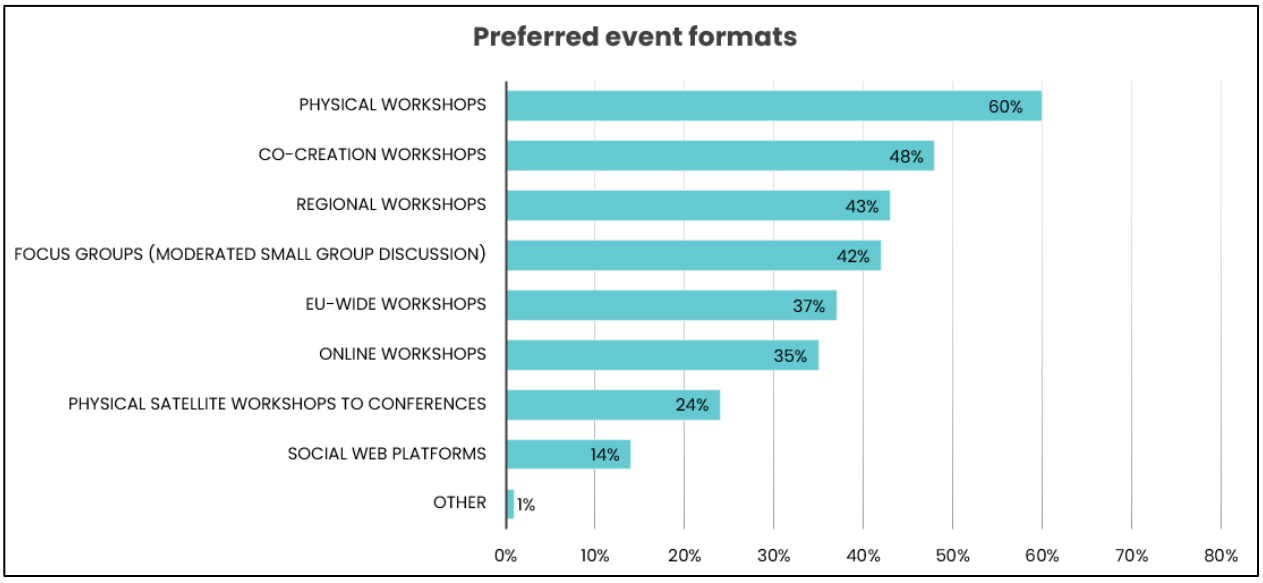

Figure 11. Responders preferred event formats, for interaction, exchange, co-creation, and discussion (% of responders to the questions, n=145).

Respondents also shared the main reason why they participate in an event. Their responses are listed below (the values are calculated based on the total number of responders that answered the question, n= 145; multiple answer choice was offered):

- 81% selected: “Interesting topic”;
- 47% selected: “Opportunity to make contacts and/or exchange nformation with interesting people”;
- 30% selected: “Interesting format”;
- 26% selected: “Anticipated information sharing (a few weeks or a few months later)”;
- 25% selected: “Reduced costs and travel”;
- 25% selected: “Possibility to combine the event with other activities”.

When it comes to the preferred event duration, the most preferred option from one day to five days was between one and two days.

5.3 Discussion

With the interviews and survey, we aimed to derive a better understanding of gaps in knowledge, information needs and preferred communication formats from different stakeholder groups in the bioeconomy across Europe. A total of 185 experts in the bioeconomy and food system sectors participated in the study, sharing needs, ideas, opinions, and experiences. Whilst diverse stakeholders participated in the interviews and survey, representation was not balanced across stakeholder groups. "Academia" and "Industry" were equally represented by 16 interviewees each in the interviews, while in the survey “Academia” submitted 86 forms and “Industry” 41 forms. "Public sector” and “Civil society” were underrepresented in both the interviews and the survey.

Despite the encountered biases, ShapingBio will benefit from the all the information collected that will be used as reference for the upcoming project activities (mostly during the multi-actor group meetings of WP2).

While the interviews provided richer and more detailed perspectives, the survey provided more quantitative information on the same issues. Despite minor differences, the overall results of the interviews and survey seem to be in line one with another. The integration of these two complementary tools provides understanding relating to stakeholders needs in the EU bioeconomy and food sector, highlighting a shared interest in the shaping bioeconomy in an inclusive and multilateral way. In this section, we discuss these results together, with a focus on the goals and forthcoming activities of ShapingBio and the implication the results may have on foci setting. As the number and professional background of interviews and respondents is of course not representative for the (potential) stakeholders in the EU bioeconomy, the identified issues should not be taken one-by-one as determination for further steps. Therefore, we first summarize current developments in the EU bioeconomy, as described in very recent EU reports (e.g. Mubareka et al., 2023), and discuss to which extent our interview and survey results correspond with these reports. Second, we draw conclusions on an aggregated level, what the implications for finetuning the upcoming working steps in ShapingBio are. However, the focus of in-depth studies (to be carried out in WP 1+2) or workshop topics in WP 3 depends not only on the needs expressed in interviews and survey. Although they will be seriously considered, additional aspects need to be taken into account, such as the value of in-depth studies to generate general insights.

Another key remark is that the interview results already provide quite a number of ideas for potential recommendations on how to improve the current situation of the bioeconomy. However, in ShapingBio the recommendations will be drawn from a comprehensive approach based on mapping and analysis in conjunction with multi-actor groups, as well as experiences from the implementation stage. Therefore, these will be considered as potential options in the forthcoming stages of ShapingBio and they will partly inspire activities in this project. However, they are not discussed explicitly in the forthcoming section. Still, the five main topics of investigation provided useful information as discussed below.

Policy and governance

Two recent reports on the current state of policy and governance in the EU bioeconomy ("EU Bioeconomy Strategy Progress Report" (EU Commission, 2018) and "Trends in the EU Bioeconomy" (Mubareka et al., 2023) show that EU, member states and member state regions differ substantially with respect to whether bioeconomy is an explicit policy priority, and in the extent to which bioeconomy strategies, action plans and implementation support have been developed (Figure 12, below). Therefore, there is a complex governance landscape, spanning governance levels from EU to regional or even local levels. The "EU Bioeconomy Strategy Progress Report" emphasizes the need for a multi-level governance approach and calls for better coordination between the EU and its member states to ensure the effective implementation of the EU Bioeconomy Strategy and to take into account the different levels of development of the bioeconomy in the EU. As bioeconomy addresses many policy goals (e.g., research and innovation, economic development and international competitiveness, environmental protection and mitigating climate change, sustainability transition of agriculture, circular economy), there is also a need for horizontal coordination of different policy domains. The reports also underline the significance of sustainable and circular bioeconomy and effective stakeholder engagement, which are crucial for the development of the EU bioeconomy.

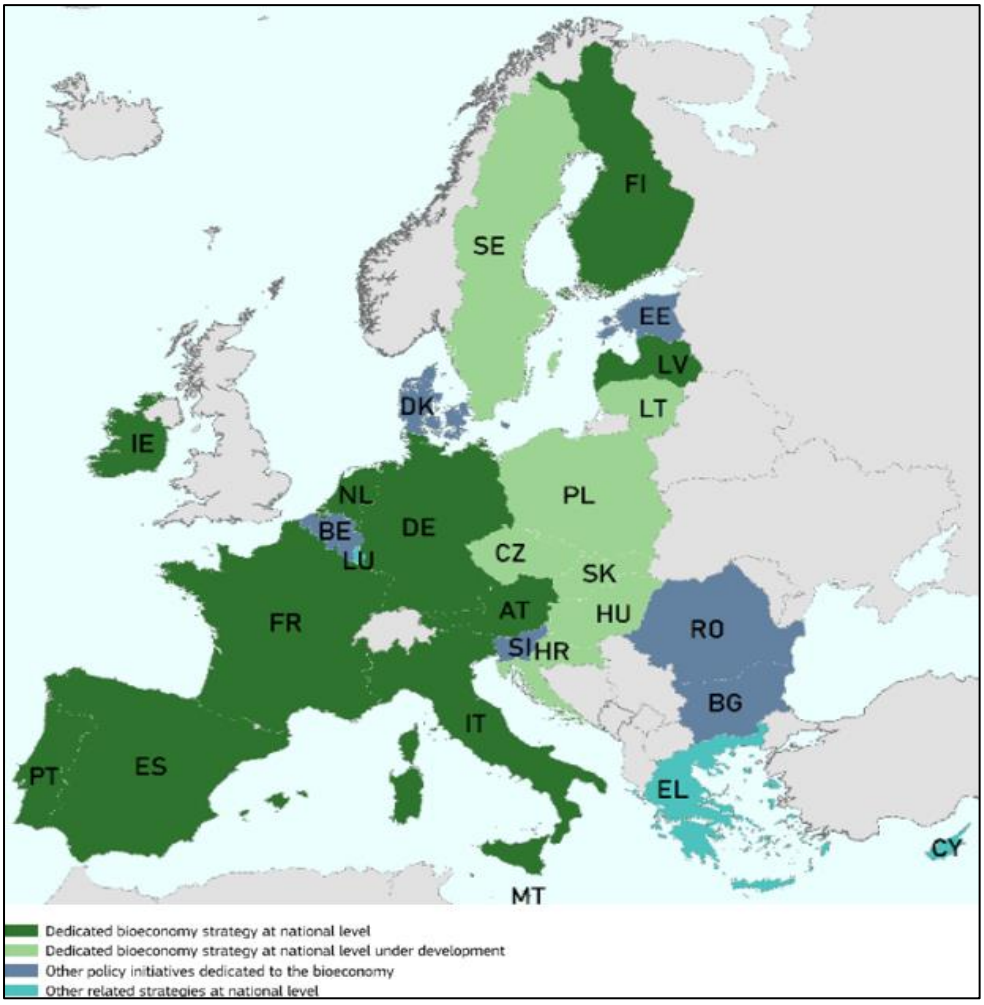

Figure 12. Status of national bioeconomy strategies in the EU (2/2022).

The interviews showed that EU level bioeconomy policy activities (strategy, action plan) were well appreciated by the interviewees. In several countries they triggered the initiation of national bioeconomy strategy activities, thus having a certain "trickle-down" effect. As a consequence, coordination of bioeconomy policies was perceived to work well to a reasonable extent between the EU and member states levels. There is a coexistence of both top down and bottom-up approaches in the EU bioeconomy governance, as is normal in EU policy processes. However, EU member states differ substantially in their bioeconomy policy activities (figure 12).
A remarkable result is that many experts experience an obvious gap of coordination at regional and local level. These governance levels are very important for the deployment of the bioeconomy but seem to be rather detached from current activities and initiatives at the EU and national level. One of the reasons seem to be a lack knowledge on the regional level and in relevant administrations regarding what bioeconomy is, what distinguishes it from related concepts (e.g., circular economy, green growth), and what the concrete benefits and leverage points could be for the individual region.
The current concept within ShapingBio in the topic "Policy and Governance" distinguishes clearly between vertical coordination of bioeconomy policies between EU, member states and regional levels on the one hand, and horizontal alignment of bioeconomy policy with other policy domains. A remarkable result from the interviews was that this distinction is not made so clearly by the interviewees. Rather, they emphasise a clear need for horizontal coordination within bioeconomy policy: In many countries, bioeconomy policy falls into the competency and responsibility of different ministries and departments. This is due to the cross-cutting nature of the bioeconomy and its numerous goals. However, these different ministries or departments have their own interests and policy priorities, which need to be synergistically aligned for a coherent bioeconomy policy. This is a difficult task, and several interviewees would like to learn from good practices about how this can be achieved. Overcoming policy silos through intensified communication, coordination and collaboration, taking a problem-oriented (or rather problem-solving) and systemic perspective, anticipating unintended trade-offs of policy measures and proactively addressing contradictory incentives by different policy measures were mentioned as promising approaches.
The ShapingBio team had hoped to derive suggestions for topics that require horizontal alignment of different policy domains for further analysis in WP2. Many examples were given where stakeholders perceive suboptimal horizontal alignment of policies, among them often circular economy and valorisation of biomass side and waste streams. Given the fact that stakeholders from academia were well represented in interviews and survey, further consideration from policy stakeholders' perspectives on whether these topics should be analysed in more depth in ShapingBio within the topic "Policy and governance" is required.
All in all, the results from survey and interviews show that the focus of ShapingBio on policy alignment in the context of governance addresses a key issue for the EU bioeconomy and confirms the project plan.

The following implications for the working steps on policy and governance in ShapingBio can be derived from the results of interviews and survey:

- The ShapingBio plan up to now is to clearly distinguish in the analysis between vertical coordination across governance levels and horizontal alignment of bioeconomy policy domains. This plan should be reconsidered. It may be good from an analytical point of view. However, stakeholders do not differentiate so clearly between vertical and horizontal alignment, and also several policy issues require vertical and horizontal alignment at the same time.
- In vertical bioeconomy policy coordination, a question that should be addressed further in ShapingBio activities is how the obvious gap in coordination between EU/national levels and regional/local levels can be narrowed and how regions be more actively integrated. A promising option would be to intensify links to other current Horizon Europe CSAs (e.g. BIOLOC,

BIOMODEL4REGIONS, ROBIN) that explicitly focus on governance at the regional and local level.

- In horizontal policy coordination, the coordination of different directorates/ministries/departments within bioeconomy policy should be addressed also.
- Regarding key topics for alignment, sustainability related issues of the bioeconomy, in particular looking on the valorisation of waste, but also broader the circularity may be considered as one priority theme for the focus of the policy and governance analysis of ShapingBio, provided this is not an artefact due to the fact that many experts from academia promoted this topic.
- Irrespective of the governance level or vertical or horizontal coordination, a key challenge to achieving better coordination seems to be how to effectively communicate and collaborate to overcome professional and policy silos. Consequently, the guidelines that will be developed in ShapingBio should not focus only on "what" has to be aligned but on “how” such alignment can be achieved. While this was already foreseen to some extent in this project, the results emphasize the need of this focus.
- The limited understanding of policy needs due to limited knowledge and experience in some administrative bodies and the lack of a common understanding of the bioeconomy are important issues that should be addressed. This may be a useful topic for some of the planned implementation workshops.

In addition, the interviews revealed interesting aspects that may be considered in developing guidelines and recommendations.

Applied R&D and technology transfer

The results of the interviews and surveys conducted in the field of applied research and technology transfer in the EU bioeconomy provide valuable insights into the challenges and opportunities in the field. The results highlight the need for improvements in several areas to enhance the effectiveness of R&D and technology transfer in the EU bioeconomy.

One of the main challenges identified by the responders was the fragmentation of support actors, both institutional players and collaborative actors, with each developing its own structures and lacking synergies. This fragmentation leads to a lack of coordinated and integrated support for R&D and technology transfer, resulting in poor support infrastructure and slow uptake of R&D findings. The poor exchange of knowledge between actors further exacerbates the problem, leading to a mismatch of R&D topics between academia and industry. To counteract these challenges, responders emphasized the importance of sharing open access pilot facilities, supporting start-ups and small and medium enterprises, and promoting regional networks. Flagships, public and private partnerships, matchmaking events, consultancy and accelerator programs, and exhibitions and conferences were also mentioned but with less frequency. In terms of business opportunities, responders recognized several areas that could benefit from a better alignment between academia/research institutes and industry needs/market requirements. The most frequently mentioned areas were biomass valorisation, biofertilizers/biopesticides, alternative proteins, materials, and personalized nutrition. Biosurfactants, cosmetics, specialty carbohydrates, and colorants were also considered but to a lesser extent. To improve the scale-up of processes and products, responders identified the need for improving collaboration with shared open facilities, collaboration between small and medium scale enterprises and big industries, and the offer of funding programs to sustain existing infrastructure. The results of the survey also showed that the accessibility of shared pilot facilities was the most frequently

mentioned activity that should be intensified to improve R&D and knowledge and technology transfer in the EU bioeconomy.
All in all, the findings from the interviews and surveys conducted as part of the ShapingBio project offer a basis for understanding the existing challenges and opportunities in the field of applied research and technology transfer in the EU bioeconomy. The results emphasize the need for better understanding of collaboration between stakeholders in terms of R&D and technology transfer, strengthening regional networks, and increasing the availability of shared pilot facilities for R&D purposes. These findings have important implications for the future direction and focus of the ShapingBio project in the mapping exercise and analysis of success and failure factors.

Collaboration

The development of the bioeconomy depends on the effective collaboration of various actors, including stakeholders from different sectors and disciplines. Cross-sectoral collaboration in the context of the bioeconomy refers to the cooperation between actors from different sectors such as agriculture, forestry, energy, and the bio-based industries, to achieve shared goals and contribute to the development of a sustainable, resource-efficient, and climate-neutral bioeconomy.
In this study, we analyzed relevant policy documents, interview results, and survey results to gain insights into cross-sectoral collaboration in the bioeconomy. Our analysis showed that there is a strong emphasis on the importance of cross-sectoral collaboration for the sustainable development of the bioeconomy. There is a need for an open and progressive approach, with a focus on democratizing knowledge and resources and fostering mutual understanding between actors. The policy documents also highlighted the importance of inclusive collaboration, involving all relevant actors, including NGOs.
The results of the interviews and surveys conducted with stakeholders in the bioeconomy provide valuable insights into their perceptions of cross-sectoral collaboration in the bioeconomy. The results indicate that cross-sectoral collaboration is seen as a critical factor for the successful development of the bioeconomy.
One of the main challenges identified in the research is the lack of mutual understanding between different sectors and stakeholders. This lack of understanding can result in a cultural mismatch, competition between stakeholders, and a lack of trust. The results also suggest that economic support is needed to overcome competitiveness between stakeholders and to encourage collaboration. This support can take the form of economic incentives and access to raw materials. Additionally, the results indicate that it is important to shape collaboration in a more inclusive way, by involving a wider range of stakeholders, such as NGOs, in the development of the bioeconomy.
The results also point towards the importance of shaping collaboration along value chains within the bioeconomy. Collaboration along value chains can help to ensure that all actors are aligned and working towards common goals, and can also help to facilitate the transfer of knowledge and resources between actors. However, the results indicate that there are also challenges to collaboration along value chains, such as the need for clear communication and the need to overcome competition between actors.
These findings highlight the critical importance of cross-sectoral collaboration for the successful development of the bioeconomy, as well as the significant challenges that must be overcome to achieve this goal. It is crucial to acknowledge that the nature of the bioeconomy is cross-cutting, making it difficult to distinguish cross-sectoral collaboration from collaboration within the bioeconomy. Therefore, we do not differentiate between across sectors and along value chains in ShapingBio.
Another major implication for ShapingBio is the need for a more inclusive approach to collaboration, with a focus on cross-sectoral collaboration. An adequate analysis has not only to analyze potential, but has to address solutions to the challenges of competition, lack of knowledge, and cultural mismatch, and to promote mutual understanding between actors. The findings also suggest that economic support will be important in overcoming competitiveness between stakeholders, both for economic incentives and raw materials.

Financing

Financing is a critical aspect of the development of the bioeconomy, as it facilitates the interplay of the (public and private) financial institutions community, research and industry in various stages of bioeconomy innovation developments and value chains. The findings from the interviews and survey provide valuable insights into the challenges faced by stakeholders in securing finance for bioeconomy projects and the importance of developing strong business models.

Interviewees and survey respondents stated that there are several partly interlinked challenges for financing. One of the key challenges identified was the lack of understanding of the bioeconomy by financial institutions and investors, which makes it difficult for bioeconomy projects to secure financing. The experts emphasized the importance of developing a strong business case that clearly demonstrates the economic viability of the project and its potential for positive environmental and social impact. The experts also highlighted the importance of a multi-faceted approach to financing, including a combination of public and private funding, as well as the use of innovative financing models such as impact investing and crowdfunding. In particular, the experts emphasized the need for public funding to support the development of the bioeconomy, as well as the use of innovative financing models to leverage private investment.

The survey results show that stakeholders face significant challenges in securing finance, particularly from traditional financial institutions, due to a lack of understanding of the bioeconomy. The survey also highlighted the importance of developing a strong business case, as well as the need for stakeholder engagement and collaboration in securing financing for bioeconomy projects.

What comes to public financing, the interviewed experts refer to the European Innovation Council (EIC) fund's work as appealing to venture capitalists due to its unique approach towards the bioeconomy sector. The fund is an example of good practice and scalability, particularly in the late stage, making it a compelling investment option. However, at this stage, challenges arise, such as the need to reconcile dilutive and non-dilutive funding sources like equity and quasi-equity with loans and grants, respectively. The EIC ScalingUP and EIC Accelerator initiatives illustrate the fund's effective promotion of blended financing by offering start-ups and SMEs up to €2.5 million in grants and encouraging private VCs to engage in deal analysis and exchange. Furthermore, building bridges among VCs is also a significant challenge that the fund must tackle. While the experts acknowledge Cleantech for Europe coalition as a positive example, its scope remains somewhat ambiguous.

The results showed that stakeholders recognize the importance of stakeholder engagement and collaboration in securing finance for bioeconomy projects, as it helps to build trust and increase understanding of the bioeconomy among financial institutions and investors. The results also emphasized the importance of developing a strong business case that clearly demonstrates the economic viability of the project and its potential for positive environmental and social impact.

The findings from the interviews and survey results have important implications for the success of the ShapingBio project. Firstly, the results highlight the need for a multi-faceted approach to financing. There are several challenges for financing identified in the mapping and analysis that should ideally address the existence and suitability of funding resources, regulatory issues, administrative aspects, investors awareness and persuasion of economic potential of the bioeconomy. Therefore, strong business models for bioeconomy projects are a crucial aspect in attracting both public and private funding and ensuring the sustainability of innovative business models. In order to secure financing, the business models may need to demonstrate their economic viability and social impact, as well as its potential for growth and scalability.

In addition to these factors, the results also suggest that there is a need to continuously explore new and innovative financing models. The bioeconomy is a rapidly evolving sector, and it is essential that financing models are able to keep pace with its growth and development. This could include exploring alternative funding sources, such as impact investment or crowdfunding, as well as developing new financial instruments that are tailored to the specific needs of the bioeconomy sector.

Hence, the results of the interviews and survey highlight the importance of analysing successful cases, exploring innovative financing models, and engaging with a variety of funding sources. Additionally, the results emphasize the need for stakeholder engagement and collaboration in securing finance for bioeconomy projects. By addressing these needs in the analysis and implementation, the ShapingBio project aims to support stakeholders to both provide and access finance to support the development of the bioeconomy.

Communication channels and formats

Despite the important investments, strategies, and action plans that have been implemented at the regional, national, and European levels, the updated Bioeconomy Strategy from 2018 states that:
"[…] increasing public awareness and knowledge about all areas of the bioeconomy remains a major challenge, which the European Commission aims to address by supporting communication initiatives to raise awareness of the environmental and socio-economic impacts of the bioeconomy and bio-based products, and its benefits".
The need for specific awareness and communication campaigns about the bioeconomy is important so that it is widely recognized as a sector that is growing and that will require more new employees in order to keep flourishing and innovating.
Initiatives to engage stakeholders and the public have been rare in the context of the bioeconomy; those that have been held have tended to focus on one-way information transmission, and bioeconomy policies have been criticized for paying too little attention to civil society (Overbeek et al., 2016).
Several initiatives have been launched in recent years at the European level to support and promote the transition towards a sustainable circular bioeconomy, ranging from projects that were funded by the European Commission, networks at the European, national, and regional levels, and by research and industrial clusters.
These initiatives have significantly contributed to the aforementioned transition by raising awareness, communicating, and educating a wide range of target audiences throughout Europe about the circular bioeconomy and its environmental and socio-economic impacts. There are also several projects that have facilitated mobilization and mutual learning among quadruple helix stakeholders (business, research, policy makers, civil society), thereby providing inspirational good practices, sharing knowledge, triggering debate, stimulating participation, assisting in the identification of challenges, and facilitating the co-creation of solutions (Albertini et al., 2022).
Nevertheless, it is evident that not all stakeholders play a central role in the debate or are in the position to determine policy and industrial agendas. According to Mubareka et al. (2023): "*bioeconomy is not only an enabler for a green transition, but also an envisaged result, hence a new way of life of Europeans. Thus, it stands to reason that citizens should be heavily involved in deliberating how this new way of life could look like, and how it could be realized"*.
This is in line with our results, where stakeholders enhanced the need to be better involved in activities, networking, and decision-making.
The following implications for the working steps on communication channels and formats in ShapingBio can be derived from the results of interviews and survey:

- Experts are calling for a centralized, official, and well-structured EU communication and learning platform, able to connect actors and disseminate information in a clear and organized manner. To comply with the updated European Bioeconomy Strategy (2018), the establishment of such platform becomes fundamental. It is by communicating and sharing information that valuable ideas can be shaped, and it is by experiencing reality (in a physical way) that solutions to problems can be formulated.

- The interviews and survey reveal that stakeholders are looking for information that is comprehensive and reliable to support their actions and decisions. This result is confirmed also by the stakeholders' preferred formats, which are reports and journal publications and also newer formats such as infographics and infosheets; dashboards, which were considered as one potential output format of ShapingBio, are only for a minority of stakeholders of relevance, and therefore an element that will be less prioritized in further working steps.
- Concerning events, stakeholders have a preference for online events but when they are looking for collaboration and engagement, the stakeholders prefer onsite events, where connections at the human-level are more likely to manifest. This is useful information concerning all the co-creation activities, foreseen in ShapingBio, where all voices are important and high-quality recommendations can be produced by the end of the project only with sufficient engagement and participatory action.

Interestingly, there are limited indications of significant differences in perspectives between stakeholder groups. While there are limitations to comparing stakeholder groups, because of the limited representation of some groups, additional descriptive analysis does not reveal clear differences between them. Anyway, a good practice could be to furnish a variety of communication options, aiming at reaching a wide spectrum of actors.

6 Conclusions

ShapingBio aims to provide evidence-based and concrete information and recommendations for better policy alignment and stakeholder actions to realize the cross-sectoral potential of the bioeconomy and to reduce the fragmentation across bio-based sectors and food system and policies across regions, domains and governance levels. It aims to deliver actionable insights and recommendations that would empower policy makers, industry professionals, and other stakeholders to effectively implement sustainable bioeconomy strategies, drive innovation, and catalyze the transition towards a circular bioeconomy.

In the first stage of the ShapingBio project, a multi-faceted research design is elaborated, combining qualitative and quantitative research methods to gather data from various sources and perspectives. This comprehensive approach included interviews, surveys, mapping and analysis of relevant policy documents, ensuring a rich and diverse dataset to inform the project's findings and future direction. The methodological design will be further specified in the respective forthcoming Work packages in ShapingBio.

In order to validate and specify the envisaged content foci and formats of ShapingBio, we assessed the stakeholder needs. Key stakeholders from various sectors, such as industry, academia, policy-making, and civil society, participated in semi-structured interviews. These conversations provided valuable insights into the information needs, challenges, and opportunities within the bioeconomy. To obtain quantitative data on stakeholders' information needs, perceptions, and expectations, a survey was administered to a wider audience, providing a more robust understanding of the bioeconomy landscape. In total, we reached to 160 bioeconomy stakeholders. Some limitations concerning the coverage of different macro-regions and stakeholder groups exist. While still the respondent sample may reflect the current composition of stakeholder in a reasonable manner, we abandoned further distinguishing answers of those respective groups as for some groups we haven’t sufficient amount of answers. Finally, policy documents were analyzed to identify common themes, priorities, and strategies related to the development of the bioeconomy at different governance levels.

The research shed light on several critical areas for stakeholders. In addition to those inisghts related to the four key topics of ShapingBio, public engagement and awareness emerged as a crucial aspect of implementing bioeconomy strategies. By aiming to achieve acceptance, and the adoption of sustainable practices, a strong foundation for a sustainable bioeconomy can be built. Furthermore, the research emphasized the role of education and training in equipping stakeholders with the necessary knowledge and skills to innovate, collaborate, and contribute to the bioeconomy's development.

Effective governance and policy frameworks were identified as essential components in guiding the transition towards a sustainable bioeconomy. The results highlighted the need for improved collaboration in terms of applied R&D and technology transfer and more accessible shared pilot facilities for R&D. Cross-sectoral collaboration among stakeholders was also recognized as a key factor in overcoming challenges, sharing knowledge and resources, and driving the development of a sustainable, resource-efficient, and climate-neutral bioeconomy. Financing emerged as a critical element in propelling innovation and growth in the bioeconomy sector. The research highlighted that there are several parallel challenges for financing in the bioeconomy; among others the importance of accelerating the innovation process and supporting the establishment of strong business models, lowering regulatory and administrative hindrances, and exploring innovative financing models to overcome challenges in this area were highlighted. Lastly, effective communication channels and formats were identified as vital tools for raising awareness, sharing information, and fostering dialogue among stakeholders.

The survey complemented the results of the interviews and showed in a nutshell that there is not a certain critical hot topic in governance, applied R&D and technology transfer, financing and collaboration, but that there are broader needs for improvement and various thematic issues are relevant for the stakeholders. ShapingBio has received various suggestions for topics and will consider those insights for further investigations in the next stages of project.

The ShapingBio project has gained valuable insights from the interviews and survey that can guide its efforts to achieve its goals. These insights cover a range of important areas that can inform the project's strategies and initiatives. Understanding stakeholders' perspectives is crucial for the project's success. The interviews and survey have revealed diverse viewpoints and concerns within the bioeconomy sector, and incorporating this knowledge can help ShapingBio better address these concerns and design initiatives that resonate with different stakeholder groups. Identifying information gaps is also vital for effective communication and outreach. The interviews and survey have uncovered areas where stakeholders lack sufficient information or have misconceptions about the bioeconomy. ShapingBio can use this information to develop targeted campaigns that promote a better understanding of the bioeconomy's potential benefits and challenges.

Engaging the public in the bioeconomy transition is also crucial, and ShapingBio can develop strategies to involve the general public in bioeconomy-related discussions through various means, such as public forums and social media platforms. According to the survey and interviews, a range of formats and channels are relevant for the stakeholders, and ShapingBio will use a mix to reach them.

Interdisciplinary cooperation is another key aspect of the bioeconomy transition, and ShapingBio can facilitate collaborations among stakeholders from different sectors to encourage the exchange of ideas, resources, and expertise. Fostering innovation and supporting entrepreneurs is also important for the success of the bioeconomy. ShapingBio can support the creation of an environment conducive to start-ups and innovators by providing access to funding, mentorship, and networking opportunities. Transparent and consistent governance structures and policies for the bioeconomy are crucial for sustainable growth, and ShapingBio will propose the implementation of effective regulations and policies that address potential risks and challenges.

In a nutshell, ShapingBio has gained valuable insights from the interviews and survey that can guide its efforts to achieve its goals. By incorporating these insights, ShapingBio can better address stakeholder concerns, and design initiatives that resonate with different stakeholder groups, facilitate informed decision-making, and contribute to the long-term success of the bioeconomy.

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8 Appendix

8.1 Example of e-mail to invite experts to the interview

Dear […],
I contact you in the frame of the newly funded European project ShapingBio to ask for your support as valuable expert in the […] sector.
Bioeconomy, as a catalyst for systemic change, tackles the economic, social and environmental aspects of the Green Deal, seeking new ways of producing and consuming resources while respecting our planetary boundaries and moving away from a linear economy based on extensive use of fossil and mineral resources. ShapingBio contributes to the development of the Strategic Deployment Agenda for the Bioeconomy by improving decision makers' knowledge base of the innovation ecosystem of the bio-based and food sectors. ShapingBio is looking for involving several actors (voices) to co-create recommendations, concrete tools and good practices to improve the policy and governance, the collaboration inside the innovation ecosystem, new business opportunities and the financial instruments available. For more information about the project please follow the link here.
Your experience and opinion is very important for the project and will add value to our analysis. For this reason I would like to ask for your availability for an interview. We are interested in your opinion which kind of information and which information formats, provided by ShapingBio, would be most useful for you and your peers. The interview will take appr. 45 to 60 minutes. It will cover the following topics:

- Policy and governance;
- Applied R&D and technology transfer;
- Collaboration (cross-sectoral);
- Financing;
- Communication formats.

The interview should take place in January 2023. I hope to receive soon your feedback.

My best regards,
[…Partner signature…]

8.2 Information sheet

You are being invited to take part in the activities carried out within the European funded project ShapingBio (Shaping the future bioeconomy across sectoral, governmental and geographical levels). Before you decide to take part to the project activities, it is important you understand what the project is doing and how you will be involved. Please take some time to read the following information carefully.

Description of the Project

ShapingBio is a three-year project (started in September 2022), which aims to:

1. Support and accelerate bioeconomy innovation and the deployment of new knowledge in the EU and its member states.
2. Provide evidence-based and concrete information and recommendations for better policy alignment and stakeholder actions to realize the cross-sectoral potential of the bioeconomy.
3. Reduce the fragmentation across bio-based sectors and food system and policies across regions, domains and governance levels.
4. Contribute significantly to the bioeconomy strategy and Action Plan, the farm to fork strategy, the EU Green Deal policy priorities and the EU's Climate ambition for 2030 and 2050.

through a series of activities, such as:

- Assessment of information needs of stakeholders through interviews of selected experts and survey of stakeholders.
- Validation of the results by a group of experts during validation workshops.
- Networking and Matchmaking Events to identify opportunities for new collaborations.
- Development of recommendations.

Kind of Data collected

In order to perform these activities, some personal information (e.g. name, surname, gender, email, country, working organisation, website of the organisation, sector and stakeholder group, opinions and experiences on bioeconomy and food systems) will be collected and then stored in the coordinator's server.

Processing and Storing of your Data

Your data will be processed in accordance with the General Data Protection Regulation (available at https://eur-lex.europa.eu/eli/reg/2016/679/oj/eng). All information collected about you will be kept strictly confidential inside the consortium. Only the ShapingBio beneficiaries will have access to the data collected. At the end of the project, August 2025, your personal data will be destroyed unless you agree to let us continue to use it for other EU projects. If a publication is not finished by this date, the data may continue to be used until the work is finalized. Processed data might survive the project, as it may become part of publications and other dissemination activities.

Your data will not be sent to third parties. Your data will not be sent to countries outside of the European Union. The sole purpose of storing your data is for project activities.

The interview can be electronically recorded for the purpose of the ShapingBio Project, summarised and, if necessary, transcribed. The recording will be deleted immediately after the summary or transcript has been created. The results of your interview will be anonymised and used for analysis and policy recommendations in the project. After completion of the research project, your data will be stored in order to be able to prove that guidelines for ensuring good scientific practice were adhered to.

Dissemination of Results
The data stored will be used for research purposes. This includes publications, the creation of a network, dissemination of information and events.

Supervision
Each ShapingBio beneficiary has its own ethical rules, taking into account the national legislation.

Data Breach
In case of a data breach, each beneficiary will immediately inform the Coordinator. Together they will undertake all steps necessary to minimize any possible negative consequences. You will receive a notification as soon as possible about the nature of the data breach, the information lost and the actions that are being taken to prevent or minimize any possible harm.

Data sharing and re-use
The data stored will be used for the activities relating to ShapingBio. This includes their processing for research purposes and dissemination activities. Your data could be re-used by other relevant EU funded projects. Your data will, under no circumstances, be sold to any third party.

Your rights
You have the right to ask for correction and/or deletion of your data and you can restrict the processing of your data, as granted in GDPR Article 15 -22. You can also withdraw your consent at any time according to GDPR Article 6(1) and Article 9(2) without any consequences sending an email to the project coordinator Dr. Sven Wydra, Fraunhofer ISI, Breslauer Straße 48, 76139 Karlsruhe, Germany, email: sven.wydra@isi.fraunhofer.de or to the APRE Team's email: shapingbio@apre.it. If requested, your local supervisory authority will provide you information on exercising your right according to Article 57(e) GDPR.
Contact details of the data protection officer of the consortium leader (Fraunhofer ISI): Ralph Harter, Fraunhofer Zentrale, Hansastraße 27c, 80686 München, +49 89 1205 2045, ralph.harter@zv.fraunhofer.de

8.3 Interview Informed consent

Informed consent - paper version

ShapingBio (Shaping the future bioeconomy across sectoral, governmental and geographical levels) is a EU funded project aiming at supporting and accelerating the bioeconomy innovation and the deployment of new knowledge in the EU and its member states. For complete information on the project please read the *ShapingBio Information Sheet*.

I, _____(name and surname), I acknowledge that:

- ✓ I have read the notes written above and the ShapingBio Information Sheet, and understand what the project is about. I have been given the opportunity to ask questions and have had them answered to my satisfaction.
- ✓ My personal details will be processed and handled in accordance with European legislation including the General Data Protection Regulation (EU) 2016/679.
- ✓ I am volunteering to be interviewed as an expert of the EU-Horizon Europe Project "ShapingBio".
- ✓ I will be asked to be eventually recorded during the interview.
- ✓ I understand that my participation is voluntary and that I am free to withdraw at any time without giving a reason without consequences.
- ✓ I have been given the information about the expected duration of the storage of the data.

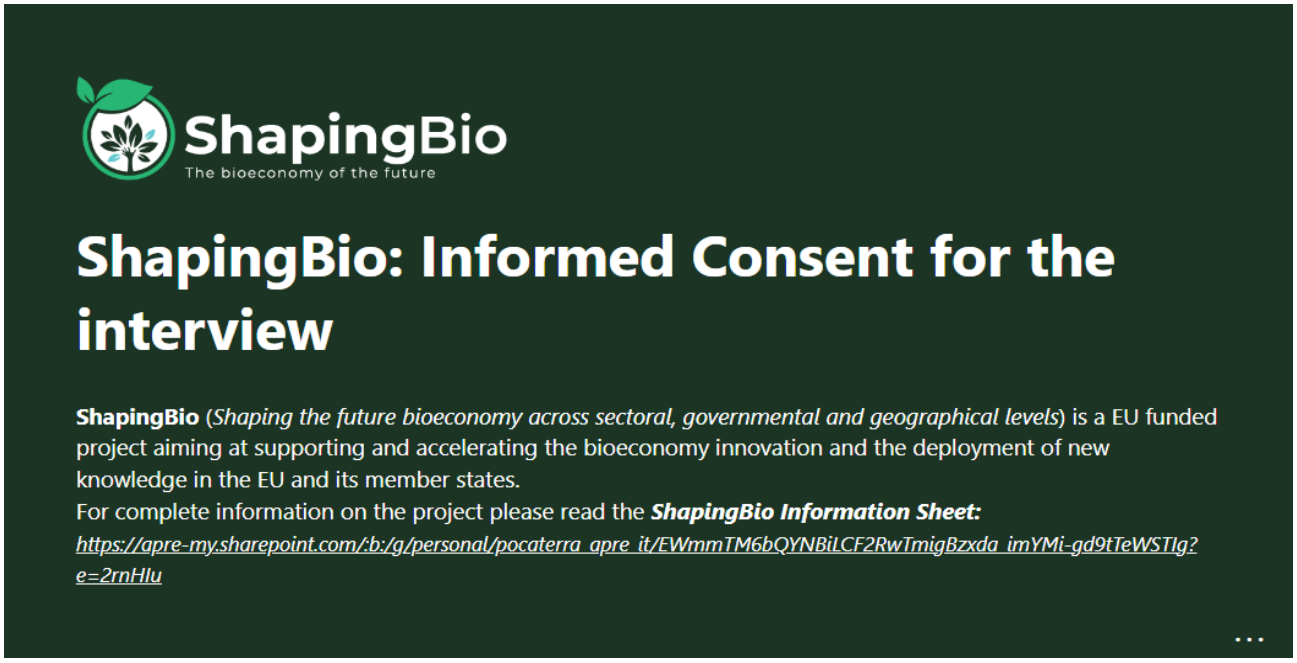
In the final publication (the analysis will be anonymised), I give my consent for (please select one):

- ☐ Both my name and organisation name;
- ☐ Only the organisation name;
- ☐ None of the above.

Date: _____

Signature: _____

Informed consent - online version



* Required

1. Name and Surname *

2. I acknowledge that:

- I have read the notes written above and the ShapingBio Information Sheet, and understand what the project is about. I have been given

the opportunity to ask questions and have had them answered to my satisfaction.

- My personal details will be processed and handled in accordance with European legislation including the General Data Protection

Regulation (EU) 2016/679.

- I am volunteering to be interviewed as an expert of the EU-Horizon Europe Project "ShapingBio".

- I will be asked to be eventually recorded during the interview.

- I understand that my participation is voluntary and that I am free to withdraw at any time without giving a reason without consequences.

- I have been given the information about the expected duration of the storage of the data. *

◯ I agree

3. In the final publication (the analysis will be anonymised), I give my consent for (please select one): *

Add both my name and organisation name

◯ Only the organisation name

◯

◯ None of the above

8.4 Interview forms

Part A

* Required

General interviewee information

1.Name *

2.Surname *

3.Gender *

- Woman
- Man

- Non-binary
- Prefer not to say

4.E-mail *

5.Position in the organisation *

6.Organisation Name *

7.Organisation Website *

8.Country *

9.ShapingBio Macro-Region: *

- Central and Eastern Europe (BG, HR, CZ, HU, PL, RO, SL, SK)
- Baltic Sea Region (EE, LV, LT, DK, FI, SE, PL, Northern DE, NO – EFTA country)
- Western Europe (BE, FR, DE, LU, NL, IRL, AT)
- Southern Europe (CY, GR, IT, MT, PT, ES)

10.Could you tell us a little bit about your background and your relationship to the topic of bioeconomy? *

11.Give a code: (partner organisation name - number of interview, e.g. APRE-1, APRE-2, ecc.) *

Submit

Part B

* Required

General interviewee information

1.Use the code given in the Interview form general information (1) *

Next

2.Country *

- Belgium
- Bulgaria
- Czechia

- Denmark
- Germany
- Estonia
- Ireland
- Greece
- Spain
- France
- Croatia
- Italy
- Cyprus
- Latvia
- Lithuania
- Luxembourg
- Hungary
- Malta
- Netherlands
- Austria
- Poland
- Portugal
- Romania
- Slovenia
- Slovakia
- Finland
- Sweden
- Other

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3.Type of organisation *

- University
- Research Institutes
- Business & innovation support centers
- Farmers and other suppliers
- Bio-based and food industries
- Tech providers

- Investors
- Associations and regional networks and clusters
- Policy-makers & administrative regulatory bodies
- Financing institutions
- Mass media and communication providers
- Consumers
- Citizens and societal groups
- NGOs

4.Sector on NACE 2-Level *

- Agriculture (A01)
- Forestry (A02)
- Fishing and Aquaculture (A03)
- Food, Feed and Beverages (C10+C11)
- Textiles (C 13-15)
- Pulp & Paper & Printing (C17 + C 18)
- Chemicals, Pharma & Plastics (C20-C22)
- Wood, incl furniture (C 16+C31)
- Waste and water management (E36+38)
- Bioenergy + Biofuels (no own nace code)
- Others (e.g. construction, financing, trade)

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Topic 1: Policy and governance

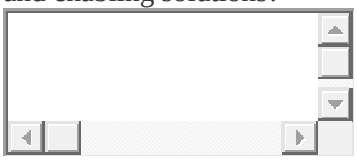
Bioeconomy policy is developed and implemented by different policy domains (e.g. science, technology and innovation; industry; agriculture/forestry/fisheries; environment) on different governance levels, ranging from the EU, its member states to regions, clusters or sectors. Effective policy co-ordination across these policy domains (= horizontal co-ordination) and governance levels (= vertical co-ordination) can help to overcome constraints and accelerate development of the bioeconomy.

5.**Q1: From your experience, how do you see coordination between bioeconomy policies on EU, national and regional level, i.e.=vertical coordination?**

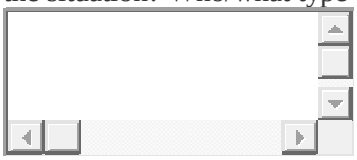
6.If not well coordinated, do you have examples in mind where better vertical bioeconomy policy coordination would be needed (e.g. EU vs. national level)? Why do you think this is needed? How might this be achieved?

7.If well-coordinated, do you have examples in mind where good vertical bioeconomy policy coordination has been achieved? What did such good coordination deliver? How was it achieved?

8.What are the reasons for good coordination/lack of coordination? Where do you see the main barriers and enabling solutions?

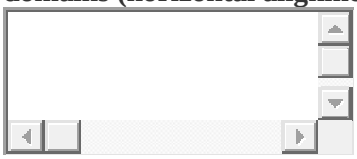


9.Which activities should be intensified to overcome existing barriers? What should be done to improve the situation? Who/what type of organisation has an important role here?



10.Different policies (e.g. environment, climate, agriculture, education, innovation) should synergistically support bioeconomy policies in order to effectively advance the bioeconomy in the EU.

Q2: From your experience, how do you see alignment between bioeconomy policies and other policy domains (horizontal alignment of different policy domains)?



11.If not good, do you have examples/topics in mind where better alignment would be needed (e.g. protein transition, land-use conflicts)? What additionality/synergies could arise as a result of improved alignment?

12.If good, do you have examples/topics in mind where good alignment has been achieved (e.g. protein transition, land-use conflicts)? How did this come about? How did it contribute to success?

13.What are the reasons for good/lack of alignment? Where do you see the main barriers/reasons for success?

14.Which activities should be intensified to overcome existing barriers?/What should be done to improve the situation? Who/what type of organisation has an important role here? **Technology Roadmaps** needed? Useful? Existing? Examples?

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Topic 2: Applied R&D and technology transfer

Innovative approaches in technology transfer for the bioeconomy need to take into account the specific requirements of the target groups such as entrepreneurs, industry, small and medium sized enterprises, academia, and infrastructure interested in supporting technology transfer on different levels.
Therefore a comparison between different approaches in different regions/countries would be needed. It will not only focus on the transfer from lab to industry, but will also take a broader view on open innovation approaches to create favourable conditions to stimulate collaboration between companies for knowledge transfer. A special focus group are the open access pilot and multipurpose demonstration infrastructures for the bioeconomy. The background and mission of the open access facilities is quite divers (technology centre, private company, university…), hence various cooperation models with respect to innovation approach and intellectual property rights exist. Different open access cooperation models need to be discussed between pilot infrastructure owners and users on how open access works in practice and how they can be supported by favourable ecosystem conditions trough local/regional/national government.

15.**Q1: From your experience, are applied R&D activities for tech transfer sufficiently developed in the EU/your country/your field of expertise?**

16.If no, do you have examples in mind where applied R&D and tech transfer activities should be improved?

17.If yes, do you have examples in mind where good performance in such activities has been achieved?

18.What are the reasons for good performance of applied R&D activities or deficits in applied R&D activities? Where do you see the main barriers?

19.Which activities should be intensified to overcome existing barriers? What should be done to improve the situation?

20.Q2: How do you see the role of open access pilot/demo plants as accelerator for the deployment of bioeconomy within EU?

21.Do you have any examples of good collaboration/ support of regions/nations for companies' access to pilot plants?

22.Do you have any bad examples? What could be improved?

23.Do you see a higher need for pilot plants to invest in equipment, specialization (protein, food, biomass, waste, etc.), retrofitting,…?

24.How do you judge the demand and offer currently available?

25.*Q3: How do you see the demand of industry/market linked towards academia research focus?*

26.In your opinion, which technologies/processes/products are large industry looking for and how is applied R&D handled in large companies? Could SME benefit from the same approach?

27.How do you see the engagement of industry in academia, through e.g. mentoring? Best practice examples?

28.Are you aware of acceleration programmes on different scales (TRL scale, geographical, governmental scale, institutional)?

29.How are the 3 dimensions of sustainability reflected in applied R&D and tech transfer activities and to which extent are existing organisations well positioned to address them?

30.Q4: From your experience is there a knowledge gap on start-ups/SMEs to further scale up and accelerate their business?

31.Start-ups/SMEs need to coordinate/ know about the whole value chain their innovation is part of. Do you agree? Otherwise?

32.With new innovations there is a chance that it is not compatible with commercially available production processes? Do you agree? Do you have examples bad/good?

33.How are the 3 dimensions of sustainability reflected in applied R&D and tech transfer activities and to which extent are existing organisations well positioned to address them?

34.Q5: How does the Bioeconomy Tech Transfer community look like?

35.Does it exist? Are you aware of good/bad examples?

36.What about human capital elements? What about advisory services? Are there links with intermediates?

37.Technology Roadmaps needed? Useful? Existing? Examples?

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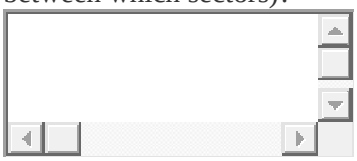
Topic 3: Collaboration between different sectors and along value chains

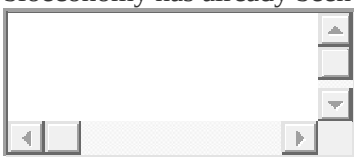
The deployment of bioeconomy innovations is often hampered by fragmentation of different bioeconomy sectors and the presence of sectoral silos. Furthermore, poor collaboration among stakeholders along new value chains exists. These challenges are important to tackle, as there is a high level of interdependencies between different bioeconomy sectors in terms of reliance on the same resources, integrative value networks in circular bio-based economy (e.g. use of food waste for material products), technological spill overs and integrated production (e.g. bio refineries). Collaboration between relevant stakeholders is a prerequisite to ensure the provision of suitable bio-based substrates, as well as, improvement of a cascade and circular use of waste and residuals along the value chains.

38.Q1: Is there a need to improve collaboration between stakeholders from different sectors in the EU bioeconomy?

39.If yes, do you have examples in mind where better coordination of collaboration would be needed (e.g. between which sectors)?



40.If no, do you have examples in mind where good collaboration between different sectors in bioeconomy has already been achieved?



41.What are the reasons for good/bad collaboration between different sectors? Where do you see the main barriers?

42.Which activities should be intensified to overcome existing barriers? What should be done to improve the situation?

43.Q2: Is there a need to improve collaboration between stakeholders along value chains within existing sectors in the EU bioeconomy?

44.If yes, do you have examples in mind where better coordination of collaboration would be needed (e.g. which sectors)?

45.If no, do you have examples in mind where good intrasectoral collaboration in bioeconomy has already been achieved?

46.What are the reasons for good/bad collaboration along value chains in different bioeconomy sectors? Where do you see the main barriers?

47.Which activities should be intensified to overcome existing barriers? What should be done to improve the situation?

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Topic 4: Financing

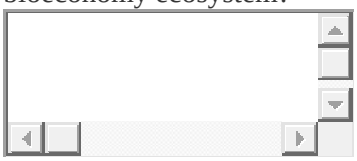
The access to finance is of vital importance for the bioeconomy ecosystems across Europe. With this survey, we will try to understand what the successes and hindrances in obtaining finance by various stakeholders are in the whole process: strategic framework enabling financing in bioeconomy, adequate information about relevant financing sources, level of investment readiness and suitable programmes to raise it, and investment and matchmaking fora. We will also try to identify best practice that illustrates or exemplifies the process of obtaining finance in bioeconomy from various European regions.

48.Q1: Which is the most prominent/developed bioeconomy sector for the relevant geographic region?

49.Q2: From your experience, are the sources of financing adequate to the needs of bioeconomy in the EU/your country/your field of expertise?

50.If no, do you have examples in mind what in financing of bioeconomy ecosystem should be improved?

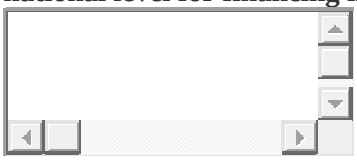
51.If yes, do you have examples in mind for efficient financing initiatives/sources/tools/practices for bioeconomy ecosystem?



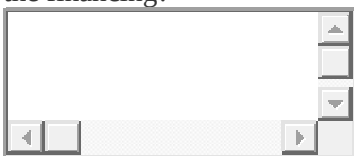
52.What are the reasons behind efficient financing initiatives/sources/tools/practices? Where do you see the main barriers/gaps?

53.Which activities should be intensified to overcome existing barriers? What should be done to improve the situation?

54.Q3: Which, to your knowledge, are the most adequate strategies at EU, regional, cross-border, national level for financing in bioeconomy/the most prominent sector?



55.How are these strategies operationalized? - Are the stakeholders well informed about them; are there corresponding financing programmes/financial means assigned to them; is it easy to apply, obtain and use the financing?



56.Are there programmes to prepare the companies for financing (industry clusters, accelerators, investment readiness level raising programmes, matchmaking/investment events)?

57.Do the companies have adequate access to private/corporate/governmental capital and bank loans?

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Topic 5: Communication channels and formats

This questionnaire assesses the availability and quality for information about bioeconomy and food systems. Information on structures, instruments and initiatives, their interactions and complementarities, asymmetries, spill-overs, causes of fragmentation, good practices and their transferability between sectors and geographical areas is also assessed. The aim of the questionnaire is to tailor the information to the needs of specific stakeholder groups and made readily available and accessible, by also exploring innovative formats, to inform the different target groups.

58.Q1: Where do you find currently documents and information about bioeconomy and food system?

59.Why do you prefer this channel?

60.Is it easy to access it? Is it always available?

61.Is this channel multi-language? Or is it just national with an English translation?

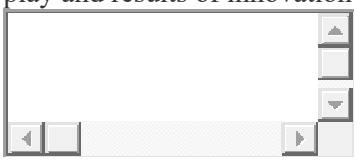
62.Q2: What kind of format do you prefer to use to receive information?

63.Why do you prefer this format?

64.Can you suggest innovative formats that could suit more your way to receive information?

65.Q3: What could be relevant information for stakeholders to be informed by ShapingBio and advised for the topics above?

66.Shaping Bio has the requirement to “Examine the possibilities for improved reporting on the state-of-play and results of innovation in the bioeconomy”? What would be your proposition?

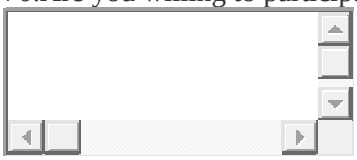


67.Q4: What kind of events do you prefer to attend?

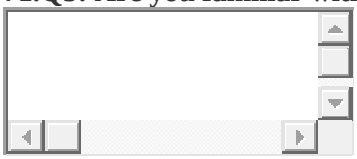
68.Why do you prefer this kind of event?

69.Do you appreciate more physical or virtual events? On which kind of considerations is based your choice?

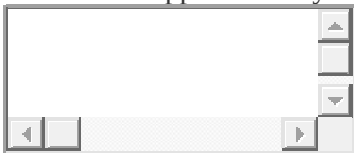
70.Are you willing to participate more in informative events or engaging (networking) events?



71.Q5: Are you familiar with co-creation workshops? Do you know the aim of such events?



72.Would you be available to participate in a ShapingBio co-creation workshop in order to address the barriers and opportunities you highlighted?



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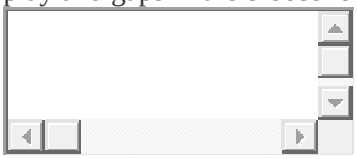
Topic 6: Other Questions

73.Do you have any current „real-use case“ in mind, which could be subject of analysis or of the implementation activities („interactive workshops) of ShapingBio?

74.Do you have any documents that you find very well valuable to map and analyze the current State-of-play and gaps in the bioeconomy?



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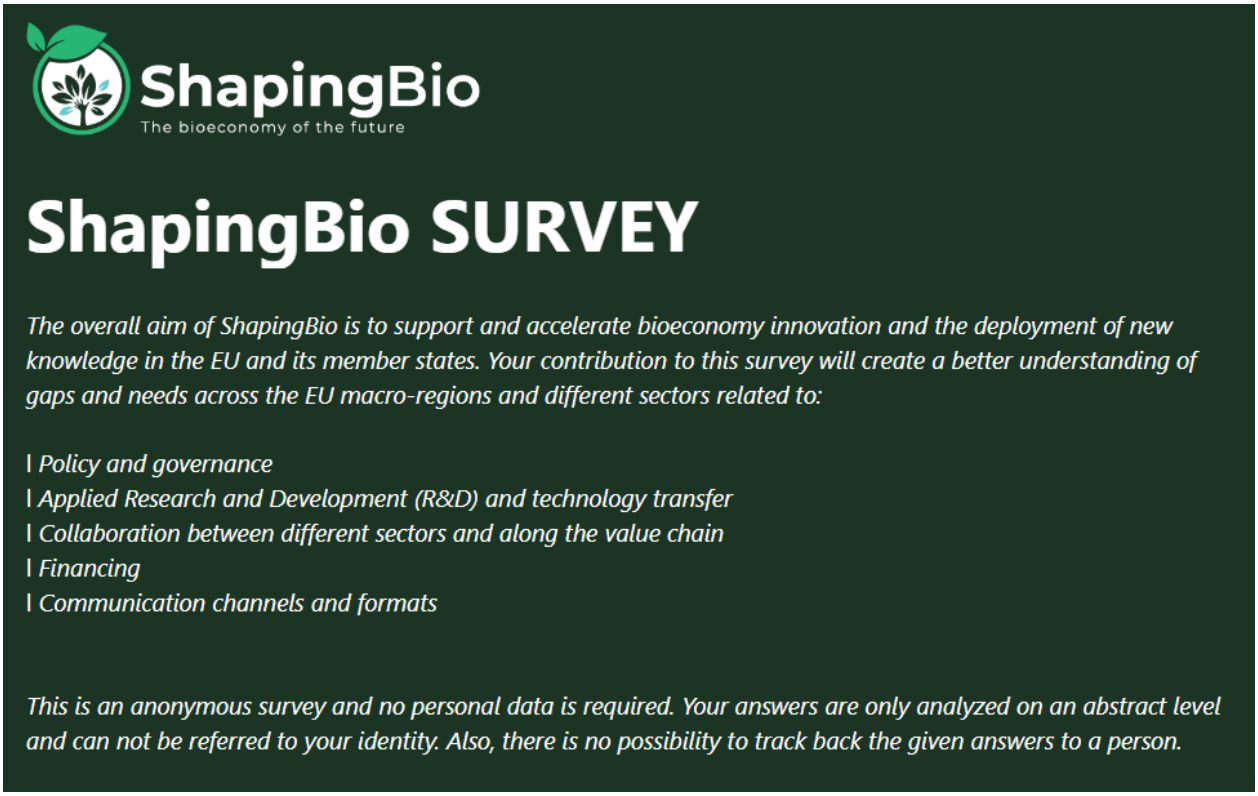
8.5 Survey form



Start the survey by answering the following main questions

You will be directed to the specific topic areas of your choice

* Required

Next

Topic 1_Policy and governance

1.From your experience, are bioeconomy policies on EU, national and regional level well-coordinated with one another?

- ○ Yes
- ○ To some extent
- ◉ No - Tell us more, go to Topic 1_Policy and Governance
- ○ Don't know / Not relevant to me

Next

Topic 2_Applied Research and Development (R&D) and technology transfer

2.From your experience, is applied R&D and technology transfer sufficiently well developed in the EU to allow deployment of bioeconomy innovations?

- Yes
- To some extent
- No - Tell us more, go to Topic 2_Applied R&D and technology transfer
- Don't know / Not relevant for me

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Topic 3_Collaboration between different sectors and along the value chain

3.From your experience, does collaboration between different sectors and along new value chains work sufficiently well in the EU bioeconomy?

- Yes
- To some extent
- No - Tell us more, go to Topic 3_Collaboration between different sectors and along the value chain
- Don't know / Not relevant for me

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Topic 4_Financing

4.From your experience, are sources of financing adequate to the needs of bioeconomy in the EU/your Country/your field of expertise?

- Yes
- To some extent
- No - Tell us more, go to Topic 4_Financing
- Don't know / Not relevant for me

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Topic 5_Communication channels and formats

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Demographics

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Topic 1_Policy and Governance

Bioeconomy policy is developed and implemented on different governance levels, ranging from the EU, its member states to regions, clusters or sectors and by different policy domains (e.g. science, technology and innovation; industry; agriculture/forestry/fisheries; environment). Effective policy co-ordination could help accelerate development of the bioeconomy.

2.From your experience, are bioeconomy policies on EU, national and regional level well-coordinated with one another?

- ○ Yes
- ○ To a fairly good extent
- ○ Small extent
- ○ No
- ○ Don't know / Not relevant for me
- ○ Other

3.Where do you see the need to improve bioeconomy policy coordination?
[You can select multiple answers]

- ☐ Between EU policies and national member state policies
- ☐ Between EU and subnational policies (e.g. regions, provinces, clusters)
- ☐ Between national and subnational policies
- ☐ Cross-border national policies
- ☐ Other

4.From your experience, are bioeconomy policies sufficiently well aligned with other policy domains (e.g. environment, climate, agriculture, education, innovation)?

- ○ Yes
- ○ To a fairly good extent
- ○ Small extent
- ○ No
- ○ Don't know / Not relevant for me

5.From your experience, which challenges would require better alignment of different policy domains (e.g. environment, climate, agriculture, education, and innovation) on EU or national level?
[You can select multiple answers]

- ☐ Resolving land use conflicts
- ☐ Resolving biomass use conflicts (e.g. food/feed, materials, energy)
- ☐ Valorization of biomass waste streams

- [ ] Establishing a circular bioeconomy
- [ ] Achieving climate change goals
- [ ] More sustainable agricultural practices for biomass provision to the bioeconomy
- [ ] Protein transition, i.e. substitutes for animal proteins in food and feed
- [ ] Qualified bioeconomy work force
- [ ] International competitiveness of the EU/member states
- [ ] Increasing EU autarky
- [ ] Other

6.Which activities should be intensified to overcome existing barriers in bioeconomy policy?
[You can select multiple answers]

- [ ] Formal fora for exchange to overcome existing policy silos, e.g. inter-ministerial working groups, regular inter-agency exchange
- [ ] Informal fora for exchange and mutual learning exercises
- [ ] Coordination of different strategies and action plans, cross-reference between the strategies and action plans
- [ ] Anticipatory policy impact assessments
- [ ] ex-post evaluations
- [ ] Designing and implementing better policy mixes
- [ ] Consultation/dialogues with stakeholder groups
- [ ] Financial support for policy coordination activities
- [ ] Organizational/managerial support for policy coordination activities
- [ ] Focus on action plans and implementation
- [ ] Focus on identifying and addressing conflicting goals
- [ ] Higher prioritization of specificities of bioeconomy
- [ ] Learning from success/unsuccessful cases
- [ ] Other

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Topic 2_Applied Research and Development (R&D) and technology transfer

Technology transfer for the bioeconomy need to take into account the specific requirements of target groups, such as entrepreneurs, industry, SMEs, academia, support infrastructure and, as a special group, the open access pilot and multipurpose demonstration facilities and their role for the deployment of bioeconomy.

These various needs, from lab to industry will be considered, when discussing how they can be supported by favourable ecosystem conditions trough local/regional/national governments.

3.Where do you see the major challenges in applied research and technology transfer in the bioeconomy in the EU? [You can select multiple answers]

- [ ] Poor support infrastructure (clusters and regional centers, knowledge and technology transfer services)
- [ ] Mismatch of R&D topics between academia and industry
- [ ] Poor exchange of knowledge between big industries and small and medium enterprises
- [ ] Slow uptake of R&D findings and new technologies by industry
- [ ] Sustainability of the shared pilot facilities
- [ ] Scale-up of small and medium enterprises and start-ups
- [ ] Fragmentation of support actors, both institutional and associative players, each developing its own structures and lacking synergies
- [ ] Other

4.Which 'support' infrastructures should be improved in applied R&D and technology transfer in the bioeconomy in the EU to gain maximum impact in deployment of bioeconomy? [You can select multiple answers]

- [ ] Shared open access pilot facilities
- [ ] Start-ups and young SMEs
- [ ] Research and development, research and innovation, and investment and advisory projects
- [ ] Flagships, Public and Private Partnerships
- [ ] Regional networks, clusters
- [ ] Knowledge and technology transfer offices
- [ ] Matchmaking events
- [ ] Exhibitions and conferences
- [ ] Consultancy/Accelerator Programmes
- [ ] Other

5.From your experience, in which innovation areas would R&D activities of academia and research institutes need a better alignment with industry needs or market requirements? [You can select multiple answers]

- [ ] Alternative proteins

- [ ] Personalized nutrition
- [ ] Materials
- [ ] Colorants
- [ ] Specialty carbohydrates
- [ ] Cosmetics
- [ ] Biosurfactants
- [ ] Biopesticides, fertilizers, biostimulants, etc.
- [ ] Biomass valorization
- [ ] Other

6.From your experience, where do you see a need for improvement in scale-up of processes and products?
[You can select multiple answers]

- [ ] Collaboration of small and medium scale enterprises with big industries
- [ ] Collaboration of small and medium scale enterprises with academia and research centers
- [ ] Collaboration with shared open access pilot facilities
- [ ] Identification of the main actors of the bioeconomy attached to the scale-up
- [ ] Offering funding programmes to sustain existing infrastructure (e.g. shared pilot facilities)
- [ ] Other

7.From your experience, which activities should be intensified to improve applied R&D and knowledge and technology transfer in the bioeconomy in the EU?
[You can select multiple answers]

- [ ] Technology roadmaps
- [ ] Convergence on common themes between bioeconomy actors and other fields
- [ ] Accessibility towards shared pilot facilities for scale-up of biobased products and processes
- [ ] De-fragmentation of support actors, both institutional and associative players
- [ ] Financing of bioeconomy and its infrastructures
- [ ] Other

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Topic 3_Collaboration between different sectors and along value chains

The deployment of bioeconomy innovations requires collaboration of stakeholders from different sectors and along existing value chains. Collaboration between relevant stakeholders is especially critical in order to ensure the provision of suitable bio-based substrates, as well as improvement of a cascade and circular use of waste and residuals along the value chains.

9.From your experience, where do you see the need to improve cross-sectoral collaboration in the EU bioeconomy? [You can select multiple answers]

- [ ] Between agriculture and bio-based industries
- [ ] Between forestry and bio-based industries
- [ ] Between fisheries and bio-based industries
- [ ] Between food sector and bio-based industries
- [ ] Others

10.Which barriers hinder the cross-sectoral collaboration in the EU bioeconomy? [You can select multiple answers]

- [ ] Dominance of traditional and established value chains
- [ ] Poor access to data and information and weak knowledge diffusion amongst stakeholders
- [ ] "Cultural" mismatch among sectors (different financial mechanisms, market outlook, ways of thinking of stakeholders. etc.)
- [ ] Poor access to funding opportunities (e.g. research, development and innovation funding, investment, and commercialization activities)
- [ ] Unfitting policies and regulations to foster cross-sectoral collaboration
- [ ] Low integration of bioeconomy products in mainstream supply chains
- [ ] Other

11.From your experience, at which stage of the value chain, the collaboration between stakeholders is lacking the most?

- ( ) Production
- ( ) Processing
- ( ) Distribution
- ( ) Consumption

12.Where do you see biggest challenges in terms of collaboration along the value chains? [You can select multiple answers]

- [ ] Academia-industry

- [ ] Primary producers-converting industries
- [ ] Waste producers-converting industries
- [ ] Involvement of societal actors
- [ ] Others

13.Where do you see a need to intensify activities towards overcoming collaboration barriers in existing value chains? [You can select multiple answers]

- [ ] Better sectoral overview and knowledge diffusion, e.g. better insight with whom exactly to cooperate
- [ ] Cooperation to broaden the competences and product portfolio
- [ ] Cooperation for cascade and circular utilization of bio-based waste
- [ ] Establishing circular economy
- [ ] Better funding opportunities
- [ ] Better policy support (e.g. EU waste regulation)
- [ ] Others

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Topic 4_Financing

The access to finance is of vital importance for the bioeconomy ecosystems across Europe. With this survey, we will try to understand what are the successes and hindrances in obtaining finance by various stakeholders. We will also try to identify best practice that illustrates or exemplifies the process of obtaining finance in bioeconomy from various European regions.

15.Please indicate the macro region you are referring to [You can select multiple answers]

- [ ] Central and Eastern Europe (BG, HR, CZ, HU, PL, RO, SL, SK)
- [ ] Baltic Sea Region (EE, LV, LT, DK, FI, SE, PL, Northern DE, NO – EFTA country)
- [ ] Western Europe (BE, FR, DE, LU, NL, IRL, AT)
- [ ] Southern Europe (CY, GR, IT, MT, PT, ES)
- [ ] Other

16.What shall be improved in financing for accelerating the deployment of the bioeconomy? [You can select multiple answers]

- [ ] Adequate legal framework
- [ ] Adequate strategic framework for bioeconomy development
- [ ] Relevant governmental/institutional support

- [ ] Information on financing sources easily accessible
- [ ] Easy to apply and administer financing
- [ ] Sufficient access to private/corporate/governmental capital, and bank loans
- [ ] Plenty of adequate and low-cost investment readiness support
- [ ] Diverse matchmaking and investment fora
- [ ] Other

17.From your experience, which aspects of financing of start-ups and SMEs would need to be improved? [You can select multiple answers]

- [ ] Foster involvement of private/corporate capital
- [ ] Develop adequate dedicated loan/banking schemes
- [ ] Support investment readiness level raising programmes and establishments (such as incubators and accelerators)
- [ ] Develop inter-institutional collaboration
- [ ] Enable and support bioeconomy pilot plants
- [ ] Host/organize more matchmaking/investment fora, including multisector
- [ ] Other

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Topic 5_Communication channels and formats

The aim of ShapingBio is to produce information on the state of play of the EU bioeconomy, and practical guidelines for specific stakeholder groups on how to improve the current situation. Moreover, ShapingBio will involve stakeholders in interactive and co-creative events. Your answers to the following questions will allow ShapingBio to tailor the information to your needs and preferences.

18.What are your preferred information sources if you look for information about bioeconomy? [You can select multiple answers]

- [ ] Official website (such as institutional, projects, and academia websites)
- [ ] Social media channels (such as LinkedIn and Twitter)
- [ ] Conferences and workshops
- [ ] Newsletters
- [ ] Mailing lists
- [ ] Journals, magazines, and books
- [ ] Statistics
- [ ] Information hubs (e.g. EC Knowledge center for Bioeconomy)
- [ ] Reports, grey literature

- [ ] Search engines such as Google
- [ ] Other

19.Which formats do you prefer for information about bioeconomy? [You can select multiple answers]

- [ ] Reports
- [ ] Journal articles
- [ ] Policy briefs
- [ ] Infosheets
- [ ] infographics
- [ ] Videos
- [ ] Podcasts
- [ ] Dashboards
- [ ] Other

20.What are your preferred online information sources to be informed of upcoming events about bioeconomy?

- ○ Websites
- ○ Newsletters
- ○ Magazines
- ○ Social media channels
- ○ Other

21.In which language do you prefer to receive information on bioeconomy? [You can select multiple answers]

- ○ English
- ○ National language
- ○ It depends on the information
- ○ Both are ok

22.With which formats should ShapingBio inform and advise you about the topics policy and governance, applied R&D and technology transfer, collaboration, and financing? [You can select multiple answers]

- [ ] Project Reports
- [ ] Infosheets
- [ ] Infographics

- [ ] Online Database with information about existing instruments, tools and activities
- [ ] Other

23.Do you think that there are enough opportunities at EU, national, and regional level for exchanging good practices for accelerating the deployment of bioeconomy?

- ○ Yes
- ○ Yes, but I am not interested
- ○ No, I am not aware of
- ○ I don't know how to find such opportunities
- ○ Other

24.What kind of events do you prefer for information about bioeconomy? [You can select multiple answers]

- [ ] Webinars
- [ ] EU-wide conferences
- [ ] National and sub-national conferences
- [ ] Physical conferences
- [ ] Digital conferences
- [ ] Hybrid conferences
- [ ] Other

25.What format of events do you pefer for interaction, exchange, co-creation, and discussion? [You can select multiple answers]

- [ ] Online workshops
- [ ] Physical workshops
- [ ] Physical satellite workshops to conferences
- [ ] EU-wide workshops
- [ ] Regional workshops
- [ ] Focus groups (moderated small group discussion)
- [ ] Co-creation workshops
- [ ] Social web platforms
- [ ] Other

26.What makes an event so interesting for you that you are likely to participate? [You can select multiple answers]

- [ ] Interesting topic
- [ ] Interesting format
- [ ] Opportunity to make contacts to/exchange with interesting people
- [ ] No need to travel
- [ ] Opportunity to combine the event with other activities
- [ ] Detailed information several months ahead of event
- [ ] Detailed information several weeks ahead of event
- [ ] No costs/costs are reimbursed
- [ ] Others

27.Which is your preferred event duration?

- ○ Less than 1 day
- ○ Maximum 1 day
- ○ Maximum 2 days
- ○ Maximum 3 days
- ○ I don't know, it depends from the event
- ○ Other

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Demographics

28.In which stakeholder group do you place your organisation? *

- ○ University
- ○ Research Institutes
- ○ Business & innovation support centers
- ○ Primary producers and suppliers of biomass
- ○ Bio-based and food industries
- ○ Tech providers
- ○ Investors
- ○ Associations and regional networks and clusters
- ○ Policy-makers, administrative and regulatory bodies
- ○ Funding institutions

- Mass media and communication providers
- Consumers
- Citizens and societal groups
- NGOs
- Other

29.In which country is your organisation located? *

- Austria
- Belgium
- Bulgaria
- Croatia
- Czechia
- Denmark
- Estonia
- Finland
- France
- Germany
- Greece
- Hungary
- Ireland
- Italy
- Latvia
- Lithuania
- Luxembourg
- Malta
- Multinational organisation
- Netherlands
- Poland
- Portugal
- Republic of Cyprus
- Romania
- Slovakia
- Slovenia

- Spain
- Sweden
- Other

30.Which is the sector of the organisation you are working for? *[You can select multiple answers]

- Agriculture
- Bioenergy + Biofuels
- Chemicals, Pharma & Plastic
- Fishing, Feed and Beverages
- Forestry
- Others (e.g. construction, financing, trade, research)
- Pulp & Paper & Printing
- Textiles
- Waste and water management
- Wood, incl. furniture
- Other

31.Select your gender *

- Woman
- Man
- Gender neutral
- Agender
- Non-binary
- Transgender
- Prefer not to say
- Other

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You have reached the end of the survey!

32.Here you have the opportunity to give comments, recommendations, and additional information to the ShapingBio team:

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ShapingBio

The bioeconomy of the future

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