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MAINSTREAM BIO

MAINSTREAMING SMALL-SCALE BIO-BASED SOLUTIONS ACROSS RURAL EUROPE

D1.2

Report on context and needs of rural stakeholders

White Research

12/06/2024

Funded by the European Union

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ABBREVIATIONS

BG	Bulgaria
CAP	Common Agricultural Policy
CHP	Combined heat and power
CIRCO	Creating business through circular design
DK	Denmark
DSS	Decision Support System
EAFRD	European Agricultural Fund for Rural Development
EC	European Commission
ECBF	European Circular Bioeconomy Fund
EIIT	European Institute of Innovation and Technology
ERDF	European Regional Development Fund
ES	Spain
GDPR	General Data Protection Regulation
IE	Ireland
LAG	Local Action Groups
MIPs	Multi-action Innovation Platforms
NL	Netherlands
PL	Poland
R&D	Research and Development
RDP	Rural Development Program
SCR	South Central Region
SE	Sweden
SIs	Social Innovations
TRL	Technology Readiness Level

Executive summary

The purpose of this deliverable is to present the findings from the analysis of needs, socio-economic context and framework conditions in target rural areas, conducted as part of the Horizon Europe MainstreamBIO Project. The report aims to **profile each MIP focal region, synthesizing the knowledge gained on farmers' needs, perceptions and socio-economic contexts. Thus, D1.2 key-findings will inform the development of key objectives within the project, including:**

- The ***Multi-actor Innovation Platforms*** (WP1): MainstreamBIO establishes regional Multi-Actor Innovation Platforms (MIPs) in 7 EU countries (Poland, Denmark, Sweden, Bulgaria, Spain, Ireland and Netherlands) that will engage and enhance cooperation among key regional stakeholders (farmers, agri-food and biobased industry, government, academia, civil society, etc.).;
- The ***Innovation Support Services*** **& Decision Support System** (WP2): MainstreamBIO builds on established models of project partners to offer hands-on business and technical support accounting for economic, social and environmental dimensions across all development stages of a project. To this end, MainstreamBIO aims to provide an online catalogue of small-scale biobased solutions, business models and social innovations as well as an inventory of best practices for nutrient recycling, along with a Decision Support System (DSS) to facilitate the identification of solutions that make the most out of local biomass in line with market demand.;

To this end the deliverable deploys a mixed-methods approach comprising findings extracted from **targeted desk research**, **semi-structured interviews and an online survey**.

The desk research component involves a **mapping of bioeconomy status quo in MainstreamBIO's focal regions**, in terms of: stakeholders' awareness and social acceptance; policy frameworks; progress, challenges and opportunities for bioeconomy development; barriers and supporting conditions and financial support and investments.

The semi-structured interviews consisted of **35 interviews with experts in the field, with the purpose of gaining a deeper understanding of local bioeconomy development and social acceptance; framework conditions; needs, challenges and market conditions as well as nutrient recycling practices.**

Finally, the online survey aimed on capturing awareness levels and perceptions regarding the bioeconomy and biobased solutions, products and nutrient circularity practices, amongst a broader group of stakeholders (including consumers).

This mixed-methods approach allows for a more comprehensive and nuanced understanding of the issues at hand.

The results reveal that there are differences both in the targeted countries and between the key-stakeholder groups. Regarding awareness and perceptions of bioeconomy development, biobased products and solutions, the main obstacles and needs appear to be of an economic nature (e.g. lack of investments & access to finance needed. However, there are also factors that determine the above and concern the applicable legislation (lack of policy & regulatory framework) and stakeholder engagement (e.g. lack of awareness). The analysis of these elements as well as the actions that can help the development of the bioeconomy and the adoption of biobased solutions are included in the final chapter of this report.

1. Introduction

The report was prepared as part of MainstreamBIO Task 1.2 Analysis of needs, socio-economic context and framework conditions in target rural areas. Its aim of is to shed light on the context of farmers and rural communities in our focal regions in terms of respective needs and barriers for bioeconomy development along with awareness and perceptions regarding biobased solutions, biobased products and nutrient recycling practices. A significant aspect of the twofold goal mentioned above is the profiling of each MIP focal region, synthesizing the knowledge gained on stakeholders' needs, perceptions and socio-economic context and framework conditions. To this end 3 different research activities took place, a targeted desk-research; 35 semi-structured interviews and an online survey. The desk-research phase was conducted both on EU and regional level while the interviews and survey phases were carried out using a tailored questionnaire.

The structure of the current report is as follows:

Chapter 2 | presents the overall approach and the methodological steps applied;

Chapter 3 | provides the findings on mapping of bioeconomy state in MIP's rural areas;

Chapter 4 | includes an analysis of the findings from the semi-structured interviews with relevant stakeholders;

Chapter 5 | presents a comparison on the survey findings at stakeholder group level;

Chapter 6 | includes the synthesis of the knowledge obtained from the 3 research activities along with all necessary conclusions.

About MainstreamBIO

MainstreamBIO sets out to get small-scale biobased solutions into mainstream practice across 7 EU countries (Netherlands, Poland, Denmark, Sweden, Bulgaria, Spain, Ireland), by establishing regional **Multi-actor Innovation Platforms (MIPs)** each with a variety of feedstocks, infrastructure, and expertise, with the aim of co-creating sustainable business model pathways in line with regional potentials and policy initiatives. Particularly, the targeted rural regions are the following:

- Flevoland (NUTS2: NL23), **Netherlands**
- Lubelskie (NUTS2: PL81), **Poland**
- Midtjylland (NUTS2: DK04), **Denmark**
- Middle Norrland (NUTS2: SE32), Upper Norland (NUTS2: SE33), **Sweden**
- South Central (NUTS2: BG42), **Bulgaria**
- Valencian community (NUTS2: ES52), Catalonia (NUTS2: ES51), **Spain**
- Navarre (NUTS2: ES22), Aragon (NUTS2: ES24), Andalucia (NUTS2: ES61), **Spain**
- Southern Ireland (NUTS2: IE05), **Ireland**

The project offers innovative **digital tools** which will enhance the engagement of key rural actors and create sustainable value chains and business models supporting the development of the EU bioeconomy, while it also provides free access in a Multi-actor Innovation Platform, where regional stakeholders with diverse backgrounds, expertise and interests are members and build networks

and partnerships between them, but also **free of charge innovation support services** and an open for all digital Toolkit.

Technical supporting services are meant to:

- support the deployment of small-scale biobased solutions with production processes
- advise on the collection of technical data (e.g., mass balance, energy costs) and different steps across a pilot project (e.g., on product characteristics and quality)
- scale up and optimize the efficiency of a specific project
- recommend best nutrient recycling practices, elaborate management nutrient plans, monitor recycling

Furthermore, **business support services** aim to:

- support the identification of suitable biobased solutions
- design sustainable business models, in line with regional specificities
- help to better understand biobased markets and the respective value chains, and support the addressing of challenges via experts and business leaders
- support the identification and securement of financing (e.g. loans) and funding opportunities
- provide networking via events and networks, in order to build partnerships, demonstrate solutions and find customers at local and EU level.

In cooperation with support services, **MainstreamBIO digital Toolkit** provides stakeholders with six useful tools:

I. **Catalogue of small-scale biobased technologies**, business models and social innovations, for cross-case comparison and assessment of opportunities for business endeavors;

II. **Collection of best practices for improved nutrient recycling**, to successfully manage nutrients and organic matter recycling back to soils;

III. **Decision Support System**, which helps in matching the available biomass and waste streams with small-scale biobased technologies, business models and social innovations;

IV. **Bioeconomy Repository**, whose purpose is to aggregate educational material from various biobased projects and raise awareness on bioeconomy educational resources;

V. **Tool Library**, which provides access to many bioeconomy tools (bioresource mapping, catalogues, side stream value tool, etc.) from other projects related to bioeconomy;

VI. **BioForum**, to communicate and exchange ideas, solutions and good practices and connect with other members of the multi-actor Innovation Platforms.

2. Methodological approach

Task 1.2 follows a blended study approach to gather both qualitative and quantitative information from primary and secondary sources. In the first phase, a targeted desk research was conducted aiming to collect existing evidence, available in the literature, on the needs, barriers, challenges and framework conditions in the European rural areas in relation to bioeconomy development. In parallel, the partners involved in Task 1.2 conducted their own desk research to gather relevant information for the target rural areas. This research involved the review of relevant study reports, policy documents, and case studies.

The second phase of Task 1.2 included some interviews targeting stakeholders from the four categories of the Quadruple helix (Industry, Academia, Government and Civil Society). The aim of the interviews was to gather insight into the context of farmers and rural communities in the target regions, focusing on the regional needs, challenges, barriers and framework conditions concerning the bioeconomy development.

Based on the information gathered from the interviews, an online survey was developed and coded using SurveyMonkey, an online survey platform. The survey was disseminated using the partner network in the 7 countries involved, with a target number of respondents of 350 across the quadruple helix categories.

The results of the survey will provide valuable information to guide the upcoming project activities and the development of the support services offered by the project. The profile for each region's bioeconomic landscape will also be created to ensure that the activities carried out in the development and implementation phases of the project will be relevant and effective.

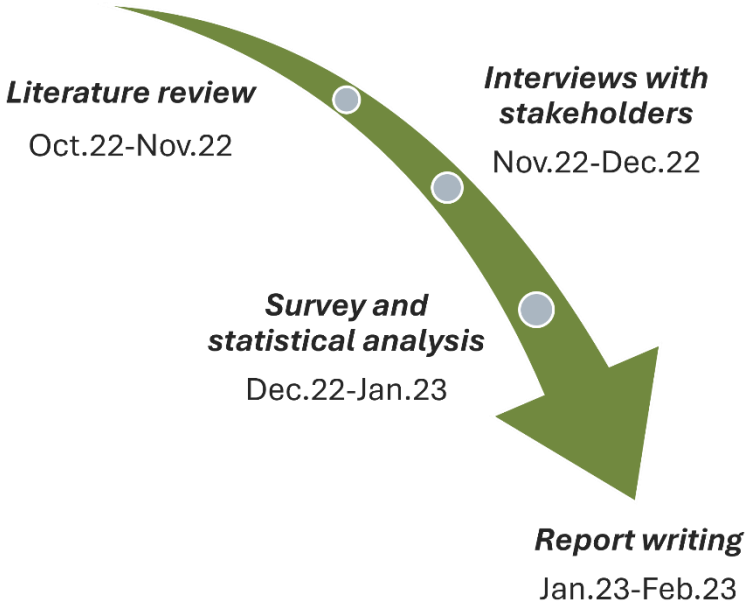

Figure 1. Task 2.1 activities - methodological approach

3. Exploratory Research

3.1 Objectives

The study started with an exploratory phase, aimed at understanding stakeholder awareness on the one hand, while also identifying barriers, supporting actions and legal frameworks on bioeconomy development within MainstreamBIO's focal regions. As a result, the research was divided into two parts: one European layer (conducted by White Research) and seven regional layers (conducted by MIP leaders). The following research topics were established for each focal region:

- Stakeholders' awareness and social acceptance
- Policy Framework
- Progress, challenges and opportunities for bioeconomy development
- Barriers and supporting conditions for bioeconomy development
- Financial Support & Investments
- Small-scale bio-based solutions
- Social Innovations

3.2 Methodology

The exploratory research was conducted through a traditional literature review. According to standard review procedures, recent literature sources and published information were analysed, and a summary table was compiled to consolidate the gathered knowledge. Literature review, as a form of secondary data analysis, offered a series of benefits from a research perspective. First, it was cost-effective and time-saving securing extra effort to invest in the interviews and survey rounds. Additionally, it offered high-quality data as a starting point to the consortium and opened new possibilities for re-interpretation of existing primary data. The latter advantage was particularly important, as it allowed for a holistic approach of the needs, socio-economic context and framework conditions in the target rural areas. This was achieved by synthesizing diverse data collected through research studies across countries and over time, into a single analytical framework.

Upon selection of the optimal methodological approach, the work allocation was the following: White Research focused on the general concept of bioeconomy at European level, as well as the linkages with official EU policies. Moreover, a comprehensive overview of drivers and obstacles regarding public and stakeholders' acceptance of bioeconomy activities was accomplished, so the reader can understand the general context on bioeconomy's enabling and hindering factors. Then, the MIP leaders (Netherlands-*WR*, Poland-*IUNG*, Denmark-*FBCD*, Sweden-*PROC*, Bulgaria-*AUP*, Spain-*INNV* and Ireland-*MTU*) narrowed their focus down on the status, trends and enabling/hindering factors at each MIP region. Each MIP leader undertook the responsibility to cover the literature for its respective country. The decision was taken on the basis that partners from MIP regions could consult literature sources (either primary or secondary) in their national language, thus enriching the findings. Once all partners had collected the required information, WR was responsible for merging everything together into a coherent narrative.

3.3 Mapping of the bioeconomic state across EU and the target rural regions

This section of the report outlines the results of a comprehensive desk research aiming to collect valuable insights into the socioeconomic context and framework conditions in relation to bioeconomy development at both an EU and a regional level. This analysis provides information for understanding the current bioeconomic state of the regions, focusing on the progress in relation to bioeconomy development, potential challenges and opportunities, framework conditions and successful biobased cases.

European study

Progress, opportunities and challenges for bioeconomy development in Europe

In recent years, Europe has made significant progress in developing the bioeconomy, with a worth estimated around 2.4 trillion euros and currently employing over 18 million people, making it a critical driver for economic growth and job creation[1].

According to the European Commission, the bioeconomy sectors in the EU, generate a 2 trillion turnover and employ 17-19 million people, with over half of the turnover from the food, beverages and tobacco industry[2]. It should be noted that the European agricultural sector accounts for over half of the jobs in the biobased sector.

One of the key drivers of bioeconomy development in Europe has been the European Union's (EU) Bioeconomy Strategy, which was first introduced in 2012[3]. The strategy aims to promote the shift towards a more sustainable and circular bioeconomy that can reduce the EU's dependency on fossil fuels and enhance its food and energy security. In that context, the EU has introduced a range of funding programs to support bioeconomy development, such as Horizon Europe, which is the EU's research and innovation funding program for 2021-2027. Horizon Europe includes specific funding streams for bioeconomy research and innovation[4].

The bioeconomy can bring opportunities and challenges for the European economy by creating jobs and generating growth, expanding agriculture beyond food production, and leading to innovation and new business opportunities[2]. However, it significant investments are required to transform production processing and products. Additionally, in terms of socioeconomic impacts, the transition to a bioeconomy could impact food prices, land use, and trade balances.

[1] Bio-based Industries Consortium (2021). Press release - Bioeconomy worth 2.4 trillion EUR to the European economy as bio-based industries mark sizeable jump in turnover and bio-based share of chemicals reaches record high of 15%. Available here

[2] European Parliament (2017). Bioeconomy – Challenges and opportunities. Available here

[3] European Commission (EC) (2022). Bioeconomy Strategy | Knowledge for Policy. Available here

[4] European Commission (EC) (2021). Bioeconomy & EU financing instruments. Available here

Another significant challenge is to ensure that the bioeconomy is truly sustainable and does not have negative impacts on the environment or society[5]. For example, the use of land for the production of biomass feedstocks can compete with food production, leading to food insecurity and the displacement of small farmers.

According to the Commission's expert group final report, published in 2017, one of the key challenges when it comes to bioeconomy development in Europe is the lack of awareness and understanding of bioeconomy among the general public, which can hinder the uptake of bio-based products and solutions[6]. This highlights the need for more effective communication and education about the benefits of bioeconomy, as well as the importance of sustainable production and consumption practices.

Lastly, engaging decision makers and stakeholders from various fields such as regional policy, environment, agriculture, industry, climate, trade, energy, research and innovation, among others, is crucial to overcome barriers to the sustainable growth of the bioeconomy and create more opportunities in Europe[6].

Bioeconomy development and social acceptance

Europe is leading the way towards a bioeconomy prioritising the sustainable production and use of natural resources. This shift has been also driven by the increasing public concerns around climate change, resources depletion and food security.

According to a Eurobarometer survey, at least 80% of European consumers are willing to buy products with a minimal impact on the environment[7]. In that manner, brands and companies are also taking steps towards the biobased transition to respond accordingly to consumers' needs and preferences. Furthermore, there are several EU-funded projects that have conducted consumer surveys to investigate the acceptance for biobased products and solutions and the results indicated a positive stance by European consumers, thus the lack of understanding about the bioeconomy and limited access to reliable product information appear to still hinder the wider adoption of these products.

Thus, despite the growing support for biobased products, there are still several challenges that need to be addressed in order to enhance the public support for the biobased sector, such as the high cost of biobased products compared to traditional fossil-based products. Additionally, the lack of standardization and regulation in the biobased sector is one major factor that can potentially lead to consumer confusion and reluctance to use these products[8].

[5] EPSO (2011) . The European Bioeconomy in 2030 Delivering Sustainable Growth by Addressing the Grand Societal Challenges. European Plant Science Organisation. Scientific Research Publishing. Available here

[6] COM (2017). Commission Expert Group on Bio-based Products – Final Report. Available at : here

[7] https://www.european-bioplastics.org/faq-items/how-accepted-are-bioplastic-products-by-consumers/

[8] BioBridges consortium (2020). D5.4 Improving the public acceptance of bio-based products and processes at regional and local level. Available here

Policy framework

Public support is crucial for the success of any initiative, including the development of biobased products in Europe. In recent years, there has been a growing awareness among Europeans about the importance of reducing the reliance on fossil fuels and transitioning towards more sustainable, biobased solutions.

To accelerate the development of the bioeconomy, the EU Bioeconomy Strategy highlights the importance of access-to-finance[9]. Significant investments in R&D from both public and private funding sources are required to transform the EU into a bioeconomy. The EU's green growth-targeted funding for research, business and development, along with Horizon 2020/Europe funding programmes and the European Regional Development Fund (ERDF) are some of the key contributors to the funding of bioeconomy development within European boundaries. Public institutions at both EU and national levels widely use loans and guarantee-based finance instruments to enable the bioeconomy and attract private investments[4].

The European Union (EU) has developed a comprehensive policy framework to support bioeconomy development. The EU's Bioeconomy Strategy, published in 2012, sets out a vision for a sustainable and circular bioeconomy in Europe. The strategy identifies three key areas for actions: understand the ecological boundaries of bioeconomy, deploying bioeconomy across Europe, and strengthening markets and competitiveness[10].

In 2018, the updated Bioeconomy Strategy was published, focusing strongly on the circular economy, climate change, and sustainable development[10]. In 2018, the bioeconomy strategy was revised to align with the latest EU policy priorities and contribute to the Sustainable Development Goals and Paris Agreement targets. The updated strategy focuses on supporting and expanding the biobased sectors, unlocking biobased market potential, and promoting regional bioeconomies within the EU while emphasizing the ecological limits of bioeconomy development.

Grants and financial instruments are the primary source of funding for bioeconomy development projects on an EU-level[10]. Europe has developed a range of funding programs to support bioeconomy development, including the Horizon 2020 program, which has allocated 3.85 billion euros to bioeconomy research and innovation, and the Horizon Europe initiative that provides financial support for R&I activities across a broad range of topics, including bioeconomy[10]. In particular, Cluster 6 Food, Bioeconomy, Natural Resources, Agriculture and Environment of Horizon Europe aims to transform EU's economy into a bioeconomy through fostering knowledge and supporting the development of innovative solutions, with the ultimate goal of creating a sustainable and circular bioeconomy in Europe.

The following tables outline the key components of the EU policy framework, including both existing policies and funding programs focusing on bioeconomy development[11]:

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[9] Albrecht Moritz, Ida Grundel, and Diana Morales (2021). Regional Bioeconomies: Public Finance and Sustainable Policy Narratives. Geografiska Annaler: Series B, Human Geography 103 (2): 116–32. Available here

[10] European Commission (EC) (2022), "Bioeconomy & EU Financing Instruments | Knowledge for Policy." n.d. Accessed November 9, 2022. Available here.

[11] European Commission (2022). Biobased-products. Available here

Table 1. European bioeconomy policy frameworks

Policy	Description
EU Bioeconomy Strategy	Sets out a vision for a sustainable and circular bioeconomy in Europe, identifying three key areas for action: investing in R&I, deploying bioeconomy across Europe, and strengthening markets and competitiveness. Updated in 2018 with a stronger focus on the circular economy, climate change and sustainable development[12].
Common Agricultural Policy (CAP)	Supports the transition to a more sustainable and circular bioeconomy by promoting agroecology, sustainable land use, and biodiversity[13].
Circular Economy Action Plan	Aims to make Europe's economy more sustainable and circular, with specific measures to support the transition to a biobased economy[14].
European Green Deal	Aims to make the EU's economy more sustainable and climate-neutral by 2050, with a focus on circular economy principles and sustainable production and consumption[15].
EU Biodiversity Strategy for 2030	Aims to protect and restore biodiversity, with measures to promote sustainable land use and support the transition to a circular and biobased economy[16].
The European Circular Bioeconomy Fund (ECBF)	A private fund providing access to finance to innovative bio-based companies, projects and technologies. The fund has a total investment capacity of €250 million and aims to contribute in achieving the European Green Deal goals to make Europe climate neutral by 2050[17].
The European Regional Development Fund (ERDF)	The fund enables investments to make Europe and its regions more competitive, smarter, greener, low-carbon and resilient, more connected, more social, and closer to citizens[18].

[12] https://research-and-innovation.ec.europa.eu

[13] https://agriculture.ec.europa.eu/common-agricultural-policy_en

[14] https://environment.ec.europa.eu/strategy/circular-economy-action-plan_en

[15] https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en

[16] https://environment.ec.europa.eu/strategy/biodiversity-strategy-2030_en

[17] European Union (2019). A European fund to support the circular bioeconomy. Available here

[18] European Commission n.d. European Regional Development Fund. Available here

Table 2. European bioeconomy financial support & investements

Funding program	Description
Horizon Europe	EU funding program from 2021-2027 with a budget of €95.5 billion (EC, n.d.)[19] that supports R&I activities in the area of the bioeconomy, including the development of biobased innovation systems, circular systems and transformative changes in rural areas[20].
Horizon 2020	EU's R&I funding program from 2014-2020, with an allocated budget of nearly €80 billion[21].
LIFE Program	EU funding program that supports projects related to nature and biodiversity, circular economy and quality of life, climate change mitigation and adaptation, and clean energy transition. Since 1992, the LIFE program has provided co-financing to over 5,500 projects throughout the EU and other countries[22].
European Agricultural Fund for Rural Development (EAFRD)	EU funding program that supports rural development, including measures to promote sustainable land use, agroforestry, and the development of bioeconomy value chains[23].

Meanwhile, several EU Member States have implemented their own bioeconomy strategies, while others are in the process of developing their own strategies[24]. At a regional level, there are at least 194 regions in the EU-27 that have established or are in the process of establishing a strategic framework concerning the bioeconomy development.

Figure 2 illustrates the EU regions that have developed or are developing multiple strategies relating to the bioeconomy. According to a JRC study, six countries, including Italy, Sweden, and France, have the highest number of regional strategies related to the bioeconomy[24]. In total, 359 bioeconomy-related strategies were identified at the regional level in the EU-27, with 83 being sectoral strategies and 209 treating the bioeconomy as an embedded topic within a wider strategic framework. The study also suggests that more bioeconomy strategies may exist at the local level. Three EU member states have their own bioeconomy strategy, while five member states are

[19] European Commission (EC) n.d. Research and Innovation – Horizon Europe. Available here

[20] European Commission (EC) n.d. Cluster 6: Food, Bioeconomy, Natural Resources, Agriculture and Environment . Available here

[21] European Commission (EC) n.d. Research and Innovation – Horizon 2020. Available here

[22] European Commission (EC) (2021). LIFE Programme: More than €290 million in EU funding for nature, environment and climate action projects*. Available here

[23] European Commission (EC) (2017). European Agricultural Fund for Rural Development (EAFRD). Available here

[24] Joint Research Centre (JRC) (2022). Bioeconomy strategy development in EU regions. Available here

developing their own. The remaining member states either had their own bioeconomy strategy prior to the introduction of the EU strategy or have other national strategies related to the bioeconomy[24].

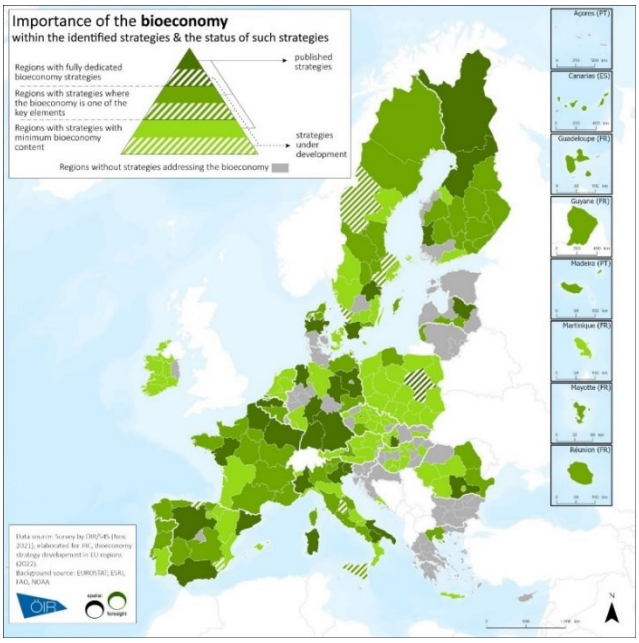

Figure 2. EU regions with bioeconomy strategies (JRC, 2022)

Netherlands

Flevoland and Friesland are Netherland's focal regions. Main challengers in this areas are close nutrient cycles as long as green energy production. Furthermore, the feedstock used in these is mostly based on crop residues, grass (roadside & nature) and animal manure.

Progress, challenges and opportunities for bioeconomy development in Netherlands

General practice of arable farmers is the use of manure on their fields as fertilizer. The manure is generally obtained from local livestock farmers[25]. This is common practice in both provinces. Especially in the province of Flevoland, the farmers produce a large amount of renewable energy[25]. This is due to the crop growers' enormous (relatively new) barns with a large rooftop surface area that can accommodate a substantial number of solar panels. Several farmers also own a small windmill. They utilize the energy, and any energy that isn't consumed right away is returned to the power grid. In addition, several farms in both provinces create biogas through digestion. For this, most people use half manure and half remaining ingredients[25]. Mono manure digesters are used to get started. Initially, the biogas was utilized to generate power using a CHP unit. The biogas has been refined to natural gas quality in recent years and is now sent to the Netherlands' gas system.

[25] Schaap, B. & Reidsma, P. & Mandryk, Maryia & Verhagen, Jan & Van der Wal, Merel & Wolf, Jonas & Ittersum, Martin K.. (2011). Adapting Agriculture in 2050 in Flevoland; Perspectives from Stakeholders. Available here

Studies have been made to list which rest materials on the farms is available for further product development[26]. At this moment part of these products are used for energy production, part stay on the farm as organic fertilizers and some examples of new products such as soup or juices from rest products, but with success they use complete crops to deliver. There is also a trend for production and selling of some products small scale on the farm (milk, cheese, meat, juices and jams, vegetables). During pandemic period the amount of customers swifting to these farms did increase and part of the organic farmers also have this business model. In the Flevopolder however, there are also some very big organic farmers cultivating vegetables and potatoes for the big supermarket chains[26].

Farmers income levels seem reasonable high in an European context in these provinces. The production levels of several crops and vegetables are high[27]. The infrastructure for processing the harvest into products for customers is very good (milk and cheese factories, potato using factories). Farms have reasonable sizes. One important aspect lowering incomes of farms in the Netherlands is the much higher soil price. Also, the growing legislation leads to extra costs for especially livestock farming but also for arable farming. Livestock farmers generally have more manure than land to distribute it and pay for this extra manure to be delivered[28]. Also, extra costs for reducing nitrogen emission in their stables. Arable farmers also must take additional measures for reducing nitrogen and pesticides emission as broadening their rotation, having part of their field close to ditches not treated and sometimes make grass and/or flower strips.

Examples of bioeconomy development in Netherlands are included in Annex I.

Stakeholders' awareness and social acceptance

Society

The public perception about bioeconomy is in general good in the Netherlands and more specific in the more rural areas Flevoland and Friesland. However, there is a big issue around nitrogen emissions[29]. Concerning livestock production (and manure) social acceptance is decreasing for part of the public but not in most rural communities. Green energy production in rural areas is increasing and the profitability for production is also increasing. Concerning biobased materials made from waste streams there is an increasing social acceptance but also difficulties with some regulations and the profitability[29].

[26] https://www.omgevingsvisieflevoland.nl/wp-content/uploads/2018/06/Circulaire-Atlas-provincie-Flevoland-RHDHV-080618.pdf

[27] https://www.cbs.nl/en-gb/news/2023/51/agricultural-income-further-up-in-2023

[28] https://www.thebullvine.com/news/dutch-dairy-farmers-face-30-40-income-loss-due-to-manure-crisis-report-by-wageningen-economic-research/

[29] Langeveld, J. W. A., Meesters, K. P. H., & Breure, M. S. (2016). The bio-based economy and the bioeconomy in the Netherlands (No. 59015257). Biomass Research Report 1601

Policy framework

In the Netherlands, bioeconomy strategies are mainly focused on support by the Dutch Government and activities in the province. Specifically, at this moment there is a discussion whether the Dutch Government should subsidize less profitable cultivation of crops for biobased products. Moreover, public authorities try to support renewable initiatives also by their procurement policy. Along with these, activities in rural areas, such as in Flevoland[30] and Friesland[31], promote the support of farmers in the context of the circular economy with the aim of developing several biobased opportunities. Examples of such actions are the creation of the platforms ACRRES and Vereniging circilair Friesland.

Financial Support & Investments

Most cases of financial support and investment in the Netherlands come from national or European funding as well as private investment. National financial support and subsidies are mainly organized by the agency RVO for many different tenders for different stakeholders and subjects (www.rvo.nl)[32]. Some national funding are provided within the province, but the province is in their turn supported 'Europese Fonds voor Regionale Ontwikkeling (EFRO). Moreover, CIRCO initiative activates – with support from the Dutch government – entrepreneurs and creative professionals to (re)design products, services and business models to develop circular business operations[33].

Private investment is mainly in renewable energy production and for innovative concepts which could convince the financers, e.g. Black soldier Fly production on waste streams.

Subsidies are provided for various biobased projects, for example for production of renewable industry, research and pilot development. Also, governmental organizations have a policy to buy more durable and recycled products[34].

Subsidy projects may involve multiple stakeholders, but in the context of procurement policy, it is primarily the producer who benefits. However, if appointments can be scheduled in advance, the financial sector can take advantage of enhanced investment and lending opportunities.

Barriers and supporting conditions for bioeconomy development in Netherlands

Main barriers for the development of a circular biobased economy are the price of the product or the application. If the fossil or another alternative is cheaper, people are more prone to take that option.

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[30] Jan Bart Jutte, Paul Mul, Carolien Huisman, Bart (2018). CIRCULAIRE ATLAS PROVINCIE FLEVOLAND. Available here

[31] Vereniging circulair Friesland (2023). Available here

[32] Ghanchi, F., Bourne, R., Downes, S., Gale, R., Rennie, C., Tapply, I., & Sivaprasad, S. (2022). An update on long-acting therapies in chronic sight-threatening eye diseases of the posterior segment: AMD, DMO, RVO, uveitis and glaucoma. Eye, 36, 1154-1167. Available here

[33] Circo n.d. Available at here

[34] https://www.rijksoverheid.nl/onderwerpen/zakendoen-met-het-rijk/maatschappelijk-verantwoord-ondernemen

Another incentive is needed, to give the buyer/user of the product/application an advantage. This could be financial, or regulations may be adapted, to pave the way for new biobased practices.

Also, the legislation is often a barrier. In case manure is used to cultivate insects, worms or algae, the end-product is still manure and end-of-waste status is very difficult to achieve[35].

Bulgaria

South Central Region (SCR) has been selected as Bulgaria's focal rural area. Most important challenges in SCR are mainly focused on utilization of: regional crops waste streams, food processing residues and food & waste manure. The feedstock used in this rural area is crop waste streams, food processing residues, food waste, oil and medical plants.

Progress, challenges and opportunities for bioeconomy development in Bulgaria

In order to measure the development of regional bioeconomy, one needs to calculate the bio economy shares of partly bioeconomy industries. A recent study measures the development of the national income share of the bioeconomy for all regions – including NUTS 2 in Bulgaria[36]. The study expands the model of Heijman[37], which accounts only for downstream effects as the study approach accounts for both downstream and upstream effects for calculating the shares of the bio economy on the value added of the whole economy.

- The cross-region comparison in Bulgaria showed that SCR have high value-added shares of the primary sector, the bioeconomy value added share is in decline except food sector. The analysis focuses on the value-added[38]. The results can be used to derive several additional indicators by relating them to employment, population and more.
- The food industry has the largest share in the industrial production structure in Plovdiv region. The development of the food industry is connected a) to the favorable opportunities that the region and the city of Plovdiv provide as markets for food produce, and b) the availability of appropriate raw materials (agricultural products, fibers, etc.) coming from the adjacent rural areas. The food industry ranks first in the territory of the Plovdiv region contributing to about 30% of the total production in the region. In the branch, the highest share of food, beverages and tobacco products accounts for 24.4% of the industry's net incomes[35].

[35] Sijtsema, S. J., Onwezen, M. C., Reinders, M. J., Dagevos, H., Partanen, A., & Meeusen, M. (2016). Consumer perception of bio-based products—An exploratory study in 5 European countries. NJAS-Wageningen Journal of Life Sciences, 77, 61-69. Available here

[36] CAPBIO4BG Project, Deliverable 3.1. Available here

[37] Heijman, W. How big is the bio-business? Notes on measuring the size of the Dutch bio-economy. NJAS Wagening. J. Life Sci (2016). Available here

[38] Ministry of economy of Bulgaria – report on mapping sectors related to bio economy in Plovdiv. Available here

- Plovdiv region has a significant concentration of enterprises in the processing of fruits and vegetables (canning, drying). Looking ahead, the production of the canning industry is expected to grow with the expected increase in agricultural output, which will restore innovation in this area[38].

At present, SCR has a significant forest resource as biomass source - forest areas occupy more than a quarter of the region. The area at 31.12.18 is 830,825 hectares, of which 78.80% are State forest areas managed by state-owned enterprises, (4.08%) are State forest areas managed by the Ministry of Environment and Water (MoEW), 0.27% - State forest areas which are experimental forest, 6.93% - forest managed by municipal authority, 9.07% - areas owned by private individuals, 0.5% - forest areas owned by private entities 0.35% - forest areas owned by religious communities[39].

Applied farming practices in Bulgaria

MAFF – Bulgaria provides data on the contribution of the three most important farm support schemes under Pillar 1 of the CAP 2014-2020. The single area payment scheme covered 71,264 farms, which is 58% of the total number of farms in SCR eligible to benefit from this scheme[40]. The payment scheme for agricultural practices beneficial for the climate and the environment was applied to 61,666 farms, which is 50% of the total number of farms in SCR eligible for financial support. The Redistributive Payment Scheme benefited 61,646 farms, which is also 50% of the total number of farms eligible for this support scheme[40].

Over the years, there is steady trend of increasing subsidies for agriculture in SCR. According to the survey of Stefanov (2020) the share of subsidies in net income is increasing from 65.3% to 85.6% for the period of 2009 – 2013 – based on FADN data[41]. The findings of the study points to the fact that income levels are sufficiently influenced by the level of subsidies allocated to the economic development of SCR. The received subsidies trigger more sales revenue and thus reduce the relative share of subsidies in the revenue generated by farmers[41].

The direct effect of the subsidies in SCR is that they lead to increase of income of the farms. Using more and more subsidies, farms raise the quality of agricultural products by investing in the pursuit of good production practices[41]. The subsidies have a multiplier effect on the activities of farms, generally they lead to an increase in the gross biomass production.

Overall, companies from the forestry industry in SCR have overcome the crisis of 2009 - 2010, and has seen an increase in production, it reached its peak in 2016 years[41]. The industry can be assessed as promising to the availability of sufficient raw material resources, sustainable internal and external market positions of the products and its importance as a source of income and employment for a significant portion of the population in mountain and rural areas.

[39] National Strategy for the Development of the Forestry Sector in the Republic of Bulgaria for the Period 2031 – 2020. Available here

[40] Strategic plan for agricultural and rural development for the programming period 2023-2027, co-financed by the european agricultural fund for rural development, the european agricultural guarantee fund and the state budget. Available at here

[41] Stefanov, N. (2020). Contribution of subsidies to the level of income of small farms in Bulgaria. Journal of bio-based Marketing, vol. 3.1, 35-42. Available here

Examples of bioeconomy development in Bulgaria are included in Annex I.

Stakeholders' awareness and social acceptance

Society

The local population is sensitive to environmental protection and supports all initiatives for the conservation of natural resources and the sustainable development of the regional economy. In general, the community is of the opinion that biobased products are good for the local community and economy - (67.9% of respondents are of this opinion)[41]. Due to the scarcity of raw materials and products during this period, circular economy principles were implemented in all sectors and regions of the country. In this context, the older population that lived in this economic regime and remembers it, accepts and approves of following the principles of the bioeconomy. The younger part of the population is susceptible to following good examples and can be effectively involved in practicing the principles of the bio economy.

Policy Makers

The engagement practices for participative governance, particularly with publics and CSOs/NGOs, in the bioeconomy of SCR are rare[42] . Particularly at the regional level, public engagement tends to constitute one-way communication focused on providing information to stakeholders. Engagement practices for participative governance within national bio economy strategies, on the other hand, often include explicit guidelines encouraging public participation. However, the involvement of other publics (e.g. civil society) in the bioeconomy has just started.

Policy framework

As a member of the European Union, Bulgaria follows European policies, including in the field of bio economic development. In the adopted Ministry of Agriculture, Food and Forestry website the adopted policies and programs in the main sectors of the bioeconomy - agriculture, forestry, agriculture, fisheries, and organic production can be found[43]. However, Bulgaria has not yet developed a specific development strategy of the national and regional economy.

Other strategies and policies which are in interplay with the concept of bioeconomy in South Central Region (SCR) of Bulgaria are[44]:

- National Development Programme Bulgaria 2030 ;
- National Strategy for Small and Medium Enterprises 2021-2027;
- Strategy for the digitalization of agriculture and rural areas of the Republic of Bulgaria;
- National Climate Change Adaptation Strategy and Action Plan;
  Integrated Energy and Climate Plan of the Republic of Bulgaria 2021-2030;
- Draft of Strategy and Action Plan for the Transition to a Circular Economy of the Republic of Bulgaria for the period 2021-2027

[42] The results of studies and activities in BioSTEP project verified by local stakeholders. Available here

[43] https://www.mzh.government.bg/en/

[44] European Investment Bank (2014-2023). Fund Manager of Financial Instruments in Bulgaria – a multi-sector fund of funds. Available here

Bulgaria develops a local initiative located in town of Plovdiv – the biggest city in the SCR. This initiative is called Establishment of Regional Bioeconomy Hub – RBH – Plovdiv[45]. The RBH-Plovdiv structure reflects the focus on provision of a large range of services in the field of Regional Bioeconomy. Moreover, at the moment two local strategies are developed and update which interplay within the concept of bioeconomy and they are:

- Strategy to strengthen the role of the agricultural sector in the bioeconomy;
- Regional innovation development strategies for the regions in SCR.

Financial Support & Investments

The Fund Manager of Financial Instruments in Bulgaria (FMFIB) is a Holding Fund that manages EU shared management resources through 13 different financial instruments on behalf of five Bulgarian managing authorities[45]. A robust organisational structure has been set up which has allowed specialist expertise to be recruited and retained. This has allowed standardised procedures to be developed, for example in connection with selection, monitoring and audit, securing economies of scale and ensuring experience gained with one financial instrument to benefit future operations[44]. The most popular and significant instruments for development of biobased practices in farms from SCR are (1) the Single Area Payment Scheme; (2) the Payment Scheme for agricultural practices beneficial for the climate and the environment; and (3) the Redistributive Payment Scheme.

Main challenges and opportunities

The main challenges regarding the development of the bioeconomy are[46]:

- access to biobased technologies;
- the availability of specialists with experience in the field;
- the mindset of actors along the value chain

Another critical factor in an already established business model is the complexity of the conversion process to the use of biobased technologies. Overall, it can be concluded that biobased technologies can be applied in business models that are in the start-up phase.

The main opportunities regarding the development of the bioeconomy are[47]:

- The bio-economy has not yet reached its full potential in bio-based production and job creation. Thus, the multipliers of production and employment show that many sectors related to the bioeconomy have more opportunities, especially those with higher added value.
- Agriculture provides a biomass from the production of feed and bio-based products. The biomass includes the production of crops (economic biomass) and residues (waste). So far, the farmer's attention has been focused on the production and processing of economic biomass, but policymakers have been increasingly payed attention to the use of waste products. The benefits

[45] https://www.fmfib.bg/en/page/9-financial-instruments

[46] Popova, Iv. (2022). The Role of Bio economy in Regional Development of Bulgaria. Journal of Bio-based Marketing, vol.1 (1), 70 – 82. Available here

[47] Sarov, A., D. Tsvyatkova (2019). The Necessity of Knowledge, Serving The Needs of the Bio-economy in Bulgaria. Journal of Agriculture, Food and Environmental Science, vol. 73, #2 (2019). 98 – 106. Available here

are mainly directed towards a more efficient use of resources, environmental protection and economic growth.

- Production of food and organic products. Bio-based products have advantages in terms of climate, environment, resource efficiency and sustainability. Nevertheless, the introduction and validation of innovative bioeconomic products and market processes is still a major challenge, as they must compete with products already known to consumers and benefit from established marketing channels, recognition and infrastructure.

Barriers and supporting conditions for bioeconomy development

Main barriers in Bulgaria are considered to be:

- Low, unstable and unbalanced growth, insufficient domestic and foreign investments in bio economy[48]
- There is a need for an integrated knowledge dissemination policy for the bio-economy sectors. This means accesses to biotechnology knowledge designed to contribute to the development of environmentally sustainable technologies[47].
- There is a need for a long-term strategic framework (e.g. a common understanding of the bio-economy and better awareness), a clear allocation of roles (e.g. which ministry / public authority is responsible for the bio-economy). These requirements are linked to public bioeconomic policy not only at national, but also at regional / local level. In particular, when it comes to important infrastructure investment decisions or to support clusters, government and sectoral ministries, as well as ancillary agencies, should give priority to thematic areas and chains for the creation of new knowledge and added value. This is especially important in regions that are still detached from the approaches to the implementation of bio economic principles[47].
- Another reason for the low credit worthiness is the delay in government payments, which makes financial management of the farm even more difficult[49].
- The banking sector has low activity in the credit market needed to develop the prime sectors (agriculture, forest cultivation), providers of inputs of bioeconomy. On the other hand, the few banks that offer credit resources to farmer's demand high bank collateral for loans and charge high interest rates[49].
- Investment activity of primary sector producers is low due to limited access to credit; the established routine in farm management; insufficient income; the added complexity of farm management; and the lack of an assured market for the additional output that results from the investment made[49].
- The prices of basic inputs have increased dramatically over the past years. The structurally determining costs for small farms and small producers, which are a significant proportion of farms in the area, are irrigation costs as well as the costs for fertilizers[49].

All above shape the picture that local bioeconomy is heavily reliant on import of biomass and by-products from border regions. This leads to contamination of local biomass and spread of new deceases in local areas.

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[48] Georgieva, N., & Zaimova, D. POLICIES FOR INCREASING THE SHARE OF BIOMASS IN ENERGY PRODUCTION. Available here

[49] Financial needs in the agriculture and agri-food sectors in Bulgaria, project Fi-compass; National report – Bulgaria. Available here

The needs of development of local bioeconomy should be covered by the following decisions[50]:

- Effective state control over the activities of bio-resource suppliers and traders;
- Working state guarantees for granting credit for the needs of small players in value chain, as well as the creation of conditions for the creation of mutual credit, guarantee and insurance funds;
- According to the individual measures, there should be more advance payments and the amount of these payments should be increased;
- State support for hiring additional labour in small farms and firms in strategic biobased value chains;
- Encouraging local enterprises to work with local biobased raw materials;
- To increase the capacity of the National Agricultural Advisory Service (NAAS) in order to meet the expectations of small farms/primary producers for providing more advisory assistance.

Some of the supporting conditions include[50]:

- The established and preserved traditions in the production of products that can be easily converted into bio products and raw materials in the different regions of the South Central region are the basis for the establishment and development of the bioeconomy;
- Achieving more direct sales, establishing local brands and increasing the quality of manufactured bio products will be achieved if there are more truly functioning local markets. Their establishment and development can be achieved with the active participation of local initiative groups (LAGs).
- Local initiative groups as well as local entrepreneurs who are pioneers in the development of the bioeconomy can be initiators of development. Also, NAAS is a key factor in transfer of knowledge to farm community. NAAS gain a lot of trust among farmers/prime producers as an authority.

Denmark

Denmark's Midtjylland & Sjælland are the two selected focal regions for this country. Main reason for these areas is the fact that they face challenges of nutrient recycling, GHG emissions as well as food productions and biodiversity conservation. Concerning the feedstock mostly used in these areas, this is mainly focused on grass, manure, energy crops, starfish, straw and beet tops.

Progress, challenges and opportunities for bioeconomy development in Denmark

In the future, Denmark will to a greater extent use residual products and new and old crops in new contexts, for value chains within, for example, food, feed, biobased products and bioenergy. The bioeconomy is about using sustainable biomass better and more intelligently, including for completely new purposes in high-value products[51]. The National Bioeconomy Panel in Denmark is

[50] Nikolov, D., T. Radev, P. Borisov. (2015). Status and prospects for the development of small farms, Avangard Prima, ISBN 978-619-160-558-3, 128 p. Available here

[51] Anbefalinger fra Det Nationale Biookonomipanel; Bioressourcer til gron omstilling (2022). Available here

established with the aim to prepare recommendations to the government on the development of bioeconomy in Denmark. The recommendations will support the national economy and help prioritise between considerations such as economy, employment, environment, nature, biodiversity and climate. Bioeconomy is the production of renewable biological resources, refining raw materials into products such as food, feed, biomaterials and bioenergy. The goal is for Denmark to become a growth centre in this area in terms of knowledge, technology and production. The panel has described concrete measures that can contribute to the green transition, focusing on business and export value chains[51]. The initiatives that can lead to early commercialisation and export have the highest priority. The panel consist of representatives from academia, large companies, industry associations, organizations, NGOs, clusters etc[52].

Today, there are 2.6 million ha of agricultural land in Denmark, while the remaining 1.7 million ha are forests, towns and roads. By 2050, it is expected that land for cities, roads and forests will have increased, while the total agricultural area will have decreased accordingly. Due to increasing productivity in the food sector, existing agricultural production in 2030 could be maintained on an area reduced by approximately 10%. This means, among other things, that the amount of feed for livestock production can be grown on a reduced area in the future, which contributes to releasing land for other uses, such as nature-based solutions to compensate for climate change and for pure biodiversity purposes. Increased use of perennial grass-legume mixtures that cover the soil year-round, green biorefining of fresh green leaves from grass, clover, lucerne, beetroots etc. and increase in low-trophic regenerative aquaculture of mussels and seaweeds has been stated as scenarios for potential Danish biomass production and utilization in 2030[53].

These scenarios for the future land-use development in agriculture and forestry, described by the Bioeconomy Panel, offer different ways of using the released land for other and new purposes[51]. For example, the scenarios show how the yield from the released land could be doubled by 2030 by focusing on biomass production alone, while an extensification scenario shows the way to a 50% increase in bioresource yields, while areas are also set aside for nature and biodiversity as a main priority. For each of the scenarios, it is also calculated what the impact of 20% or 50% reduction of animal production in 2030 and 2050, respectively, is on total yield of bioresources[51].

Some of the changes in agricultural land use included in the scenarios are the wetting of the 50,000 -100,000 ha of lowland carbon soils, conversion of about 400,000 ha of annual crops to, among other, intensive clover grass, of which about 44,000 ha are beet, and, harvesting of about 200,000 ha of catch crops for biomass[51]. In addition, the use of cereal varieties with increased straw yields, more efficient straw collection and more efficient slurry handling.

The different scenarios show pathways to positive environmental and climate impacts. For example, calculations show, even at the high biomass yield, reduced nitrogen emissions to coastal waters of about 7,000 tonnes N by 2030, while there would be reduced greenhouse gas emissions from the land of up to 4 million tonnes CO^2_e per year[51].

Examples of bioeconomy development in Denmark are included in Annex I.

[52] https://viborg.dk/service-og-selvbetjening/bolig-og-byggeri/affald-energi-og-miljoe/affald/affald-fra-din-private-bolig/

[53] Potential Danish biomass production and utilization in 2030 Advisory report from DCA – Danish Centre for Food and Agriculture. Available here

Stakeholders' awareness and social acceptance

Society

Danish public discussion is aware of the importance of bioeconomy, although for many a rather marginal subject. However, farmers and foresters and public waste handling companies are very aware of the concept and some of the solutions. Several events such as conferences are organised in several Danish municipalities[54]. The establishment of the national bioeconomy panel also supports the joint work of knowledge institutions, companies, stakeholders and society in Denmark. Moreover, society is highly involved in bioeconomy via initiatives directed at reducing waste, especially food waste and Waste sorting facilitated by recycling centres[52]. Another important factor relevant for society in sustainable bioeconomy is also the potential to create and retain jobs, especially in rural areas[51].

Policy Makers

Generally, bioeconomy concept is well respected, but when it comes to specific planning obstacles can be faced, due to smell, traffic, sound etc. (e.g., biogas, wind turbines etc.). Municipalities in Denmark are obliged to carry out a public consultation for all matters that may concern civil society, that is construction of new biogas facilities, changes in how waste water is handled, construction of buildings, roads etc[55].

Academia & Research

Researchers are highly involved in the field of bioeconomy, and for instance, Aarhus University has established Centre for Circular Bioeconomy (CBIO)[54]. The centre researches and develops bioeconomic production systems and concepts for recycling, e.g., production and handling of different types of biomasses, biorefining methods, ingredients for feed-, and food production etc.

To be at the forefront of the development of the bioeconomy, the government wants Denmark to become a growth centre within knowledge, technology and production[56]. The development opportunities for the bioeconomy are promising, but also complex. This is because bioresources are limited and the demand for bioresources for the green transition is high. The National Bioeconomy Panel will describe concrete initiatives within primary production, biorefining, consumption and recycling that help ensure that bioresources make the best possible contribution to the green transition and the overall economy[56]. At the same time, the panel's recommendations must focus on the business and export potential of new bioeconomy value chains, while considering the impact on existing value chains. Actions that can lead to early commercialisation and commercialisation and export are a high priority. The work of the panel must be seen in the context of policy objectives at national, European and international level. Examples include the Agreement on the green transition of agriculture, Green Deal, Fit for 55, Strategy for PtX and carbon capture and storage, Climate plan for a green waste sector and circular economy, realisation of the business lighthouse on Zealand and the islands within biosolutions, Circular Economy Action Plan, Water Framework Directive, etc[56].

[54] https://cbio.au.dk/

[55] https://www.tv2east.dk/vordingborg/borgere-klager-igen-over-biogasanlaeg

[56] Danmark som vækstcenter for en bæredygtig bioøkonomi; Udtalelse fra Det Nationale Bioøkonomipanel (2014). Available here

Policy framework

Existing policy frameworks in Denmark are developed under public support policies, financial incentives and local initiatives. The Green Transformation of Danish Agriculture Agreement (2021)[57] and the National Bioeconomy Panel[51] are typical examples of these kind of policies and initiatives. The latter, set the direction towards bioeconomy transition including targets for land use, biorefining and cascading. Moreover, the National Bioeconomy Panel recommends that a national bioeconomy strategy is to be developed to set the direction for a major bioeconomy transition[51]. The strategy should include targets for land use, biorefining and cascading, as well as increased optimised bioresource yields to free up land for other uses. The National Bioeconomy Panel assesses the need for the lower end of the cascade (pyrolysis and HTL) to be developed and commercialised as integrated industrial symbioses. It is essential to consider, inter alia, the recycling of nutrients, including phosphorus, and the achievement of recycling and carbon storage objectives. Framework conditions for biogas, CO^2 recycling, carbon storage and Power-to-X should be designed to ensure that the full potential of the resource is exploited[51].

Financial Support & Investments

Most of Denmark's funding programs are oriented from public finance. It is planned that 6 tenders for biogas and other green gases will be held in the period 2024-2030. The support offers must contribute to increased competition, lower costs and thus reduce the level of support for biogas. Other initiatives, e.g. the Danish Climate Agreement & the Danish Energy Agency[58], aim to support the country's decarbonization by utilizing green technologies and fuels.

Barriers and supporting conditions for bioeconomy development in your region

The main actors of the value chain are researchers, industry and producers and collaboration between agriculture, industry, NGOs and research facilitated by the National Bioeconomy Panel[51]. The goal of being independent from imported gas from Russia as well as the goal of being able reduce the use of fossil fuels, are driving factors for developing and securing a steady and reliable supply of biomass for the power, heat and manure production. The aim of making use of biomass for multiple purpose (e.g., gas production, improved manure and production of biochar) has a high priority among stakeholders of the entire value chain, and value chains is one of the keys in the national strategy for sustainable bioeconomy[51].

There are several barriers complicating full implementation and utilization in bioeconomy such as lack of market pull, lack of political objectives, restrictive regulation, insufficient sustainability criteria, difficulties in moving from research to pilot projects and from pilot to full-scale projects[56] and here the recommendations from the National Bioeconomy panel can be a tool in overcoming many of these barriers in collaboration with the government, agriculture, industry, NGOs and research.

Moreover, the resistance against increasing green production of energy from solar panels at the expense of nature preservation, constitutes a great deal in the local region at present.

[57] https://agriculture.ec.europa.eu/cap-my-country/cap-strategic-plans/denmark_en

[58] https://ens.dk/ansvarsomraader/bioenergi/stoetteudbud-til-biogas-og-andre-groenne-gasser

At the present, the major barrier to develop bioeconomy in the region, is the establishment of requirements for the future scenario and scope of Danish agricultural production. The increased expenditures for energy, feed and fertilizer combined with the notified CO^2 tax, result in uncertain futures many farmers[51]. There is no doubt that all stakeholders of the Danish value chains within agricultural production are willing to support development of the bioeconomy and are willing to initiate solutions within the possible framework. However, financial support and suitable framework conditions for sustainable bioeconomy and to develop grass bioeconomy is necessary in both Danish and European context[59,60,61]. Additionally, it is necessary to promote the current bio solutions and technologies and the potential of the developed and accessible technologies to increase acceptance of the public/consumers regarding increased area used for e.g., biogas and electricity production.

Spain

Catalonia, Navarra and Aragon are the three focal regions for Spain. These rural areas are under our topic of interest because of the challenges that they faces that are use & production of renewable energy and the biomass valorisation. Main feedstock used in these regions is: brewery spent grain, forestry residues, manure, lucerne (forage) and vineyard pruning waste.

Progress, challenges and opportunities for bioeconomy development in Spain

In each of the Spanish autonomous communities there is a similar level of development of policies to promote the bioeconomy and the circular use of resources. In terms of agricultural practices, which are the most applied in the rural environment, in each of the communities of the Ebro River basin, there is a Guide of Good Agricultural Practices promoted by the local government (Navarra, Aragon, Catalonia). These documents include guidelines on storage and use of manure as fertiliser, considering the composition of the main nutrients (NPK) as well as their distribution on the ground, production of renewable energy, land rotation, prevention of aquifer contamination, etc. In the last decade, 30% of the smallest farms have disappeared while intensive and macro farms have increased[62]. In general, in Spain, wages for farmers range from 1,196 to 1,700€ per month[63].

One success case on bioeconomy development is the EU funded project AGROinLOG, coordinated by CIRCE, a technological centre based in Aragon, aimed to demonstrate the technical,

[59] Bentsen, N.S., Larsen, S. & Stupak, I. Sustainability governance of the Danish bioeconomy — the case of bioenergy and biomaterials from agriculture. Energ Sustain Soc 9, 40 (2019). (https://doi.org/10.1186/s13705-019-0222-3). Available here

[60] https://stateofgreen.com/en/news/discover-the-secrets-to-denmarks-path-to-a-circular-bioeconomy/

[61] Orozco R, Mosquera-Losada MR, Rodriguez J, Adamseged ME, Grundmann P. Supportive Business Environments to Develop Grass Bioeconomy in Europe. Sustainability. (2021); 13(22):12629. (https://doi.org/10.3390/su132212629). Available here

[62] Newtral (2022). Article - El debate sobre la ganadería intensiva y las macrogranjas en cinco datos. Available here

[63] HOY (2022). Article - Esto es lo que cobrarán los trabajadores del campo. Available here

environmental and economic feasibility of Integrated Biomass Logistics Centres (IBLCs) for the production of food and non-food products in agro-industries[64]. In Aragon, the feasibility of using an IBLC in the fodder sector to produce blend pellets using materials from herbs and wood was demonstrated in the premises of a local enterprise working on lucerne production for animal feed[64].

In April 2022, a workshop to share the vision for 2030 of different actors from the autonomous communities conforming the Ebro River basin region was held in the framework of the BRANCHES project[65]. The principal conclusions pointed out the crucial role of farmers and agro-industries in driving a change. The need for raising awareness and solving some cultural barriers in perception, and the need to work in the quadruple helix to generate confidence and to trigger coordinated regional initiatives for the more complex value chains were highlighted. Challenges and opportunities for bioeconomy development were identified[65]:

Challenges:

- Overcome the cultural barriers of farmers and agroindustry sector to work and trust agro-biomass (social acceptance) and make the key actors to make a move and invest.
- Need to make technologies competitive and appealing to the eyes of farmers, agroindustry and users.
- Establish new logistics for underutilised feedstock.
- Create the collaborative structures (like regional bio-clusters) with all actors inside (quadruple helix).
- Attract abilities, technicians and young /medium aged persons to the underpopulated areas.

Opportunities:

- High potential of unused field agricultural residues and compatibility for energy and bioeconomy uses.
- Bioenergy and other bioeconomy practices in expansion.
- High prices of electricity and fossil fuels target for Renewable Energies and bioeconomy in Europe.
- Increasing prices of CO_2 ETS and coming EU Carbon Border Tax.
- Communication infrastructure and relevant industrial and agro-industrial activity.
- Biomass use considered an engine for rural development and the empty Spain.
- Growing social interest in preventing burning.

[64] European Commission (EC) (2020). Developing a bioeconomy in rural Europe. Available here

[65] Bioeconomía con restos agrícolas leñosos y herbáceos en el valle del Ebro – INTercamBIOM – BRANCHES. Available here

Stakeholders' awareness and social acceptance

Society

There is a limited understanding of decision makers and citizens of the goodness of using agricultural field residues for other circular bioeconomy purposes, sometimes supported by the lack of knowledge or vision by public administrations[66].

Policy Makers

The political perception is negative as biomass is considered a pollutant resource, and other renewable energies are preferably considered (PV, wind)[62].

Policy Framework

The Spanish Bioeconomy Strategy Horizon 2030 was published in 2015[67]. Since then, several regions in Spain have developed its own specialised strategy, including the Bioeconomy Strategy of Catalonia. In other cases, bioeconomy has been included as part of circular economy, as is the case of the Agenda for the development of the Circular Economy in Navarra 2030 or the strategy Aragón Circular 2030[67].

Each autonomous community also counts on a specific Rural Development Programme (see Financial Support & Investments) with common elements such as sustainable management of natural resources, balanced territorial and rural development and improving the competitiveness of the agri-food system[67].

Financial Support & Investments

In *Navarre* several grants are linked to small-scale or rural scenes, such as grants for investment in agri-food industries[68], for energy efficiency on agricultural holdings[69] or SMEs[70], self-consumption and storage[71], implement participatory local development strategies[72], or subsidy lines for the support and promotion of the forestry sector[73].

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[66] Ministerio de Agricultura, Pesca y Alimentación. (2022). Available here

[67] Aragón Circular 2030. Available here

[68] Navara.se (2021). Ayudas a la inversión en industrias agroalimentarias. Available here

[69] Navara.se (2021). Ayudas para la realización de actuaciones de eficiencia energética en explotaciones agropecuarias. Available here

[70] Navara.se (2021). Ayudas para actuaciones de eficiencia energética en PYME y gran empresa del sector industrial. Available here

[71] Navara.se (2021). Ayudas al autoconsumo y al almacenamiento con fuentes de energía renovable. Available here

[72] Navara.se (2021). Ayudas para implementar estrategias de desarrollo local participativo e impulsar la cooperación entre grupos. Available here

[73] Navara.se (2021). Ayudas forestales Navarra. Available here

In *Aragon* there exists a specific subsidies program (PAIP) for industry and SMEs from the ERDF (European Regional Development Fund[74]) and an Erasmus + program Key Action 2 related to Small-scale Cooperative Partnerships (KA210).

In *Catalonia*, some examples of subsidies are those for sustainable forest management for investments for the processing and marketing of forest resources or directed to the agricultural sector for advice and technical support for sustainable fertilization.

Barriers and supporting conditions for bioeconomy development

The main barrier obstructing bioeconomy development is the lack of knowledge and awareness of biomass potential, and the lack of connection between relevant agents[62]. The boost of demonstrative facilities and programs and direct transfer actions could help to overcome the cultural barriers of farmers and agroindustry. Coordinated action and the creation of collaborative structures is needed for a bigger uptake of the bioeconomy in the region[62].

The main supporting condition for bioeconomy development is the great amount of biomass resources. In total the area of Ebro valley basin, agricultural and farm production concentrates in valleys counts for 30 % of agricultural land (herbaceous and permanent crops) and 30 % of the meat production in Spain. In the mentioned BRANCHES's workshop, a total availability of herbaceous and woody biomass of 4 Mt of dry matter per year was estimated[62].

In terms of political support, Catalonia has a specific strategic plan for the bioeconomy, whereas Aragon and la Rioja or Navarra include the bioeconomy inside the circular economy strategies[62]. Either with more or less direct policy instruments the regions have deep interest in the development of agribusiness and bioeconomy. Furthermore, these regions have relevant funding for agroindustry and farmers through the EAFRD (European Agricultural Fund for Rural development) funds and are very well positioned networks of farmers, and stakeholders working through bio-clusters. The expansion of bioeconomy is expected to continue growing, with sub-regional differences due to diversity in regulations and actors[62].

Poland

Lubelskie's, the focal region in Poland, faces the challenge of the utilization of local agricultural residues. In addition, this rural area's available feedstock to be used is mostly grass, manure and cereal residues.

Progress, challenges and opportunities for bioeconomy development in Poland

When Poland joined the European Union in May 2004, this moment became a turning point for agriculture - always one of the key sectors of the Polish economy[75]. EU funds contributed to the modernization of Polish agriculture. It involved a technological leap, which covered both agricultural

[74] https://ec.europa.eu/regional_policy/in-your-country/programmes/2014-2020/es/2014es16rfop004_en

[75] Ciszewska M, Paca D, Patorska J, Pichola I. (2018). Zamknięty obieg – otwarte możliwości. Raport Deloitte. Available here

production and food processing. Thanks to this the agri-food sector has become more competitive and efficient (agriculture, food and beverage production, inland fishing). Poland has not yet prepared a bioeconomy development strategy, while individual regions of Poland have already done so.

The bioeconomy sector in Poland accounts for 20% of employment and generates a value of EUR 82 billion[75]. According to the data, the largest share in the bioeconomy turnover in the EU and Poland is generated by the food, feed and beverage production sectors, which account for nearly half of the total turnover. In turn, the turnover of the bio-industries, including the production of chemicals and chemical products, pharmaceutical products, plastics, paper, textiles, biofuels and bioenergy, and the wood industry sector, is worth around EUR 600 billion[75].

Applied farming practices

According to the census data, the area of arable land in Poland has decreased by nearly 200 thousand hectares in the last 10 years[76]. When it comes to the structure of crops, 73% of all agricultural land is sown, and 21.8% is grassland. Of this 73%, cereals account for 70% of the crop.

Compared to 2010, the number of farms in Poland decreased by 13%. As for the average area of farms, it increased from 9.80 ha to 11.1 ha[77]. In Polish agriculture, a significant decline was recorded in pig farming, the number of pigs decreased by 4,000 head compared to 2010, which gives us a decrease of about 26%, while cattle farming has increased by 10%[77].

In recent years, precision agriculture has been gaining popularity, which consists in measuring and adjusting specific activities to a given crop with an accuracy of up to several centimetres[77].

The direction of production and the economic size of an agricultural holding are important factors determining the level of non-farm income. The size and generic structure of income of farmers' families depends on the economic size class and ranges from 2,000 to 8,000 PLN for very small, 8,000 ≤ 25,000 PLN for small; 25,000 ≤ 50,000 PLN for medium small; 50,000 ≤ 100,00 PLN for medium large and 100,000 PLN ≤ 500,000 PLN for large agricultural holdings[78].

Examples of bioeconomy development in Poland are included in Annex I.

Stakeholders' awareness and social acceptance

Society

Deloitte's report Closed circulation - open opportunities shows that Poland is a promising country for the development of bioeconomy[79]. Unfortunately, there is low awareness at various levels of stakeholders in the field of circular economy, sustainable industrial production and sustainable consumption, bioeconomy and new business models. The low level of investment in research and

[76] Munnink, B. O. O., Sikkema, R., Nieuwenhuijse, D., Molenaar, R., Munger, E., Molenkamp, R., .Koopmans, M. (2020). Transmission of SARS-CoV-2 on mink farms between humans and mink and back to humans. Science. Available here

[77] Banku Ochrony Środowiska (2020). Barometr ekologiczny Polaków. Available here

[78] Kambo K. (2021). Poziom i struktura dochodów rolników w gospodarstwach prowadzących rachunkowość w 2019 roku. Ubezpieczenia w Rolnictwie – Materiały i Studia. Available here

development and the insufficient use of scientific potential contributes to the limited creation of new, innovative, local products and services necessary for the functioning of the circular economy.

Based on Banku Srodowiska's study[79], when making pro-ecological investments, Poles are primarily driven by long-term economic benefits (90%). Caring for the environment is almost as much important - this aspect is indicated by 86 percent of respondents. For a quarter of respondents, the motivation is the possibility to take advantage of the national government programs (27%) or local government support programs (25%)[80].

Policy framework

In Poland, the bioeconomy plays an increasingly important role, constituting a crucial element of the National Smart Specializations (KIS)[81]. Creating a sustainable environment in line with the idea of a bioeconomy requires coordinated efforts from public authorities and industry. State institutions can play an important role in overcoming the existing barriers and creating conditions that support the development of the bioeconomy. In 2015-2018, Poland made its first efforts to implement the idea of bioeconomy by preparing a draft map, namely the Circular Economy Roadmap[82] in which it defines its strategy, outlines the key areas of activity and identifies projects involving a wide range of stakeholders. The project indicates five priority areas with sub-areas and proposals for actions in each of them[82].

Bioeconomy strategy in Poland is mainly focused on Bioeconomy related strategy documents[80]:

- National Energy and Climate Plan for the years 2021-2030[83]
- National Smart Specialisation Strategy 2014[84]
- Plan for Rural Areas (bioeconomy as one of the priority projects named Agriculture for Ecology) 2014[85]
- Roadmap on circular economy (GOZ), government document (2019)[82]
- Polish National Strategy for Adaptation to Climate Change (NAS2020) with the perspective by 2030. (2013)[86]
- Strategy for Sustainable Rural Development, Agriculture and Fisheries 2030 (SZRWRiR 2030) (2019)[87]

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[79] Banku Ochrony Środowiska (2020). Barometr ekologiczny Polaków. Available here

[80] Kozyra J, Chmieliński P, Jurga P, Maciejczak M, Borzęcka M, Rozakis S. (2023): Strategic concept paper for bioeconomy in Poland: executive summary. Open Res Europe 2023, 3:217. Available here

[81] https://s3platform.jrc.ec.europa.eu/s3-for-sdgs-in-poland

[82] GOZ (2019). Roadmap on circular economy. Available here

[83] National Energy and Climate Plan for the years 2021-2030 - submitted in 2019. Available here

[84] Poland: Towards a RIS3 strategy (2014). Available here

[85] https://ec.europa.eu/commission/presscorner/detail/en/MEMO_14_2621

[86] The Polish National Strategy for Adaptation to Climate Change by 2020 with the perspective by 2030 (NAS 2020). Available here

[87] https://www.agroberichtenbuitenland.nl/actueel/nieuws/2019/10/16/pl-strategy-2030

- 2030 National Environmental Policy (PEP2030) (2019)[88]
- Energy Policy of Poland until 2030[89]
- The Polish Strategic Plan of the Common Agricultural Policy (CAP)[90]

Besides these, there are financial incentives established to provide support on bioeconomy development. A typical example of this is the Strategic Plan for CAP (Common Agricultural Policy). Furthermore, Poland has developed certain local initiatives (e.g., political institutions, technology transfer centres and cluster) in regions such as Lubelskie and Lublin that are deeply involved in bioeconomy and other related sectors (e.g., Soil Science, Plant Cultivation, Science and Technology etc.)[80].

Financial Support & Investments

Poland uses a range of financial and investment measures mostly focused on national funding programmes and cooperations along with private investments. Examples of national level financial support are:

- The Polish Agency for Enterprise Development (PARP): involved in the implementation of national and international programmes financed from the EU structural funds, state budget and multi-annual programmes of the European Commission. The PARP supports six major areas of activities implementation[91]:
    - Start-up market,
    - Training and skills improvement,
    - Investment in innovation, Services for enterprises,
    - Internationalisation,
    - Infrastructure for development,
    - Research activity, Publications.
- The National Centre for Research and Development (NCBiR): an executive agency that works as a centre for supporting and developing innovative technological and social solutions, creating an ecosystem of knowledge and information about innovation[92].
- Netrix Ventures: development finance institution dedicated to fund investments. Netrix is an investment fund operating since 2017, focused on investments in early-stage projects[93].
- Interreg Baltic Sea Region 2021-2027, European Territorial Cooperation: this programme creates suitable framework conditions in the Baltic Sea region. The Programme targets public authorities at local, regional and national levels, business support organisations, specialised

[88] The 2030 National Environmental Policy – the Development Strategy in the Area of the Environment and Water Management. Available here

[89] Energy Policy of Poland until 2040 (EPP2040). Available here

[90] https://www.farm-europe.eu/blog-en/poland-cap-national-strategic-plan/

[91] https://en.parp.gov.pl/

[92] https://www.gov.pl/web/ncbr

[93] https://netrix.ventures/?lang=en

agencies, and infrastructure and service providers as the main forces responsible for the structural transition into a more resilient and innovative region[94].

- Lubelski Regionalny Fundusz Rozwoju- Lubelski: regional development fund with limited liability was established on the initiative of the Management Board of the Lubelskie Voivodeship to develop and implement a long-term investment program to support micro, small and medium-sized enterprises.

In addition, banks are responsible for approx. 80% of financing investments in Poland[95]. n*mBank* is currently the leader in financing renewable energy sources (RES) in Poland. In the segment of large investments, such as photovoltaic or wind farms, over 2,000 MW of capacity are so far financed[95].

Barriers and supporting conditions for bioeconomy development in Poland

In Poland, barriers to the development of bioeconomy occur not only on the side of the consumer and companies, but also on the part of public authorities. The development of the necessary solutions may be hampered not only by the unreliability of market mechanisms, but also by public policy aimed at solving other socio-economic problems, which may result in opposing goals.

One of the main barriers relates to the development and transfer of knowledge towards bioeconomy, especially in terms of entrepreneurship development in the bioeconomy area[86].The solution to this problem may be the creation of cross-sectoral and supra-regional cluster structures aimed at integration and concentration of needs of various stakeholders operating in the field of bioeconomy.

Blocking the development of the bioeconomy may be an unintended consequence of existing national legislation (regulation) and, above all, the lack of a national bioeconomy strategy[86]. It is important to develop strategic documents covering the directions of bioeconomy development in the country, while considering EU sectoral policies.

The third significant barrier is the lack of education, promotion and social communication. In Poland, there is low awareness at various levels of stakeholders in the field of bioeconomy, sustainable industrial production and consumption, bioeconomy and new business models. This can be improved by creating cluster or association structures whose activities would include the creation of national and international cooperation networks[86].

Ireland

Southern Ireland is the focal region for this country. Main reason of this selection are the challenges and the available the feedstock. An important challenge in this rural area is the GHG emissions. In terms of feedstock availability, this is mostly focused on grasses, manure, cereal crops and residues, seaweed and horticulture.

[94] https://www.ewt.gov.pl/strony/o-programach/programy-interreg-2021-2027/program-interreg-region-morza-baltyckiego-2021-2027/

[95] Ramotowski Jacek Polska u progu wielkich inwestycji. Kto to sfinansuje? "Banki są za małe. Available here

Progress, challenges and opportunities for bioeconomy development in Ireland

There has been a general increase in bioeconomy activity over the last decade nationally and in the Southwest Region of Ireland. The greater focus on bioeconomy in Ireland has coincided with the launch of European Bioeconomy Strategy and the Biobased Industries Joint Undertaking in 2012 and 2014, respectively[96].

Following the Department of Agriculture funded project BioEire, which examined the potential of Ireland's bioeconomy, a National Bioeconomy Policy Statement was published in 2018, with a Whole of Government Circular Economy Strategy launched in 2021, and Bioeconomy Action Plan due for release in 2023[97,98]. The country has seen a surge of Investment in the bioeconomy sector, including[99]:

- €18 million investment in BiOrbic National Bioeconomy Research Centre (BiOrbic, 2022)
- €4.6 million investment in National Bioeconomy Piloting facilities (Dept of An Taoiseach, 2018)
- Investment in several regional clusters and Research and Innovation projects

Within the region, several initiatives are underway demonstrating the bioeconomy at various scales, these including the Glanbia-led AgriChemWhey aiming to produce bio-materials from dairy residues, Biorefinery Glas aiming to produce protein for cattle and pigs along with co-products from grass, Farm Zero C aiming to develop a world's first climate neutral dairy farm, Libre project looking to produce composite materials from lignin-rich residues and several marine biorefinery companies aiming to produce products such as nutraceuticals and biofertilizers[100,101].

Since agriculture currently produces almost 37.5% of national greenhouse gas emission, there is a major focus on the bioeconomy to support a reduction of these emissions[102,103]. At the same time, many sectors of agriculture, including beef farming, experience quite low returns in income, and rural depopulation is a major threat, therefore the bioeconomy may help to sustainably reinvigorate these regions.

The main sectors of agriculture include dairy farming, and the region is home to large dairy co-operatives including Kerry Group, Carbery, Glanbia and Dairygold[104]. There is a large beef sector, with smaller production of pig and poultry. While tillage production has declined in recent decades, its production is still quite substantial, with some vegetable, fruit and horticulture production, such as

[96] Dept of An Taoiseach (2018). National Bioeconomy Policy Statement. Available here

[97] BioEire (2017). BioEire Project. Available at: here

[98] Department of Communications, C.A.a.E. (2022). Whole of Government Circular Economy Strategy 2022 – 2023 'Living More, Using Less'. Available at: here

[99] BiOrbic (2022). BiOrbic SFI Centre. Available here

[100] AgriChemWhey (2022). AgriChemWhey Dairy Biorefinery. Available here

[101] Libre Project (2022). Libre - Lignin-based carbon fibres for composites. Available here

[102] Biorefinery Glas (2022). Biorefinery Glas - Small-scale Farmer-led Green Biorefineries. Availablehere,

[103] EPA (2022). Agricultural Emissions Share 2022. Available here

mushroom, potatoes, apple and strawberry production at smaller scale apart from a few major producers[104].

Stakeholders' awareness and social acceptance

Society

On the consumers' front, a 2021 study of consumer perspectives relating to biobased materials found that Irish consumers had an overall positive perspective of biobased products[105]. 92% of Irish consumers surveyed agreed that their individual consumer choices can have a positive impact on the environment. However, while 93% of Irish consumers would prefer to buy biobased over fossil-based materials, only 28% of Irish consumers were able to identify brands which could be described as biobased, indicating a broader need to improve consumer awareness of the bioeconomy and its products[106].

Biomass producers

There has been limited research conducted to date regarding primary producers, public perception of Irish stakeholders' level of awareness of the bioeconomy. A 2021 survey among primary producers (mainly livestock farmers) in Ireland found that 64% of primary producers had heard of the bioeconomy though when asked what the term meant to them, very few had a firm grasp what the correct definition of the term was[106]. More than 88% of farmers indicated that they would be open to measures to reduce fertiliser and feed bills to increase profitability even if this meant reducing stocking rates, while carbon trading was seen as an opportunity with 76% seeing it forming part of their business within the next 5-10 years[106].

Policy Framework

The EU's Single-Use Plastics Directive which has been transposed into Irish legislation in 2021, can help to stimulate a market for biobased alternatives[107]. Other relevant policies include the National Bioeconomy Policy Statement which was published in 2018, while key bioeconomy actions have been outlined in the Climate Action Plan 2021, including the publication of a National Bioeconomy Action Plan covering the 2023-2025 period which is currently under development[107].

The Support Scheme for Renewable Heat[108] is currently in place to support the delivery of renewable heat. This offers a tariff based on useable heat output in renewable heating systems, in new

[104] Sustainable Energy Authority of Ireland (2022). Support Scheme for Renewable Heat. Available here

[105] Gaffey, J., McMahon, H., Marsh, E., Vehmas, K., Kymäläinen, T., Vos, J. (2021). Understanding consumer perspectives of biobased products—A comparative case study from Ireland and The Netherlands. Sustainability 13(11), 6062. Available here

[106] Brosnan, J. (2021). 'The Second Crop' Unlocking the Potential of the Bioeconomy for Primary Producers in Ireland through Innovative Policy and Business Models (Unpublished Thesis). Munster Technological University.

[107] Dept. of Environment, C.a.C. (2021). Climate Action Plan 2021. Dublin, Ireland. Available here

[108] Sustainable Energy Authority of Ireland (2022). Support Scheme for Renewable Heat. Available here

installations or installations that currently use a fossil fuel heating system and convert to using the following technologies:

- Biomass boiler or biomass HE CHP heating systems
- Biogas (anaerobic digestion) boiler or biogas HE CHP heating systems

Other supporting measures currently activated in Ireland include the following:

- The Biofuels Obligation Scheme has been in place since 2010[109]. Under the scheme, suppliers of certain fuels to the road transport market are required to include a certain proportion of biofuels, which must meet strict sustainability criteria, as part of their fuel mix.
- The Climate Action Plan[110] sets out a target to raise the blend proportion of biofuels to B20 in diesel and E10 in petrol by 2030.

Financial Support & Investments

Various programs are currently supporting R&D activities relating to the bioeconomy. These include Science Foundation Ireland which has funded centres in bioeconomy and renewable energy (the BiOrbic[111] and MarEI[112] centres), as well as individual calls for proposals on topics related to the bioeconomy, such as:

- the *Department of Agriculture, Food and the Marine research call* (funded projects include INFORMBIO[113], U-Protein[114] and NXTGENWOOD[115])
- *the Sustainable Energy Authority of Ireland Research Call* (funded projects include GROW GREEN BURN BLUE and AgriCircular Bioeconomy)
- *the Environmental Protection Agency Research Call* (funded projects such as CircBioCityWaste).

Project Ireland 2040 funding has also many exciting open calls, including the disruptive technologies fund and climate action fund, open to companies and consortia aiming to scale-up technologies in different sectors, with the bioeconomy fully in scope.

In addition to the above mentioned, several universities and companies have also availed of European funding for bioeconomy initiatives through programs such as Horizon EU and CBE JU.

[109] Dept. of Environment, C.a.C. (2010). Biofuels Obligation Scheme. Dublin, Ireland. Available here

[110] https://www.gov.ie/en/publication/a8a1e-what-is-e10/

[111] BiOrbic. Available here

[112] MaREI. Available here

[113] INFORMBIO. Available here

[114] U-Protein. Available here

[115] NXTGENWOOD. Available here

Prominent groups and centres in the region include MaREI at UCC, CircBio[116] and Shannon ABC[117] at MTU and Bernal Institute at UL.

Barriers and supporting conditions for bioeconomy development

One barrier to bioeconomy development is the need for demonstration and significant capital investment in certain sectors[118]. For bioeconomy to develop, it is necessary to bring research from the lab into the real world, first to demonstration and later to commercialisation. But this requires significant investment and this comes with risk. This is challenging for industry, but even more challenging for farmers. For a bioeconomy to scale but also to replicate, real working demonstrators are required.

The CBE JU has demonstrated at EU level, a mechanism for the de-risking of funding to support the scale-up of these initiatives[119]. This has de-risked the investment of the AgriChemWhey dairy biorefinery using a public-private partnership model, which saw an investment of 22 million from EU funding[120]. Such a model could be deployed in Ireland to support innovative industries.

Other infrastructure funds in bioeconomy activity within the region include the Climate Action Fund investment into the Green Renewable Agricultural Zero Emissions (GRAZE renewable gas project). This project includes the development of a large-scale central injection hub on the Irish gas network, along with a fleet of gas storage trailers and trucks, to transport biomethane by road to the injection hub. Other innovative biobased technology companies such as BHSL and Hexafly have been successful in raising funding for their operations[121]. In 2023, Ireland's Department of Agriculture, Food and the Marine announced a €3 million investment to develop an integrated green biorefinery and anaerobic digestion demonstration unit based in Cork, led by MTU, UCD and Carbery.

Despite these examples, raising funding for a technology development is still a model which may be difficult for farmers to become involved in. So specific mechanisms may be required to support this process. Importantly the business models which ensure farmers are fully integrated within the value chains (e.g., as cooperatives) may also be considered[122]. Several EIP-Agri bioeconomy actions are underway in the region including Biorefinery Glas, Biomass for Farm Bioeconomy and the Small Biogas Demonstration Programme[123].

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[116] CircBio. Available here

[117] Shannon ABC. Available here

[118] Philp, J. and Winickoff, D.E. (2018). Realising the circular bioeconomy. OECD Science, Technology and Industry Policy Papers. November, 2018. Issue 60. Available here

[119] CBE JU (2022). Circular Biobased Europe Joint Undertaking. Available here

[120] AgriChemWhey (2022). AgriChemWhey Dairy Biorefinery. Available here

[121] Ryan, E. (2022). Animal feed firm Hexafly set to close €40 million funding plan, Business Post. Available here

[122] Lange, L. (2022). Business Models, Including Higher Value Products for the New Circular, Resource-Efficient Biobased Industry. Frontiers in Sustainability 3. Available here

[123] National Rural Network (2022). EIP-AGRI - Supporting innovation, competitiveness and sustainability in agriculture and forestry. Available here

Another barrier is the lack of in-depth knowledge among the public along with primary producers and other stakeholders on the potential benefits of the bioeconomy[124]. There is sometimes a disconnect between the research that happens in universities and research centres, and the information that reaches farmers e.g., through advisory services, and therefore a closer connection between these channels (i.e., university-advisory-farmers) may be required to achieve this[124]. Projects funded under the EIP-Agri bioeconomy topics have been working to address this by using a multi-actor approach which enables researchers, farmers and others to work together towards project implementation. Similarly, while many new products produced from biomass are landing on our shelves every year, there is little in the way of public awareness campaigns to promote the benefits of these to the public, excluding the annual Bioeconomy Ireland Week[124]. Therefore, there is a need for a greater level of awareness raising on the potential of the bioeconomy among different stakeholder groups.

Outside of the dairy co-operative sectors, fragmentation exists in Irish agriculture which makes cooperation on bioeconomy initiatives more challenging[125]. In Ireland's beef sector for example, farmers primarily sell individually to the factory. To build new value chains, collaboration is essential along all stages of the value chain, as all parties will require some needs to be met in order to participate.[125] There is therefore a need to support networking, engagement, and collaboration of interested parties to support the building of these new values. Clusters can play a valuable role in supporting this process.

Sweden

Middle and Upper Norland in Sweden are project's focal regions for this country. These regions face the challenges of biomass valorisation and small-scale biorefinery projects. Furthermore, available feedstock is mostly based forestry residues and forestry side streams.

Progress, challenges and opportunities for bioeconomy development in your region

Within Sweden's innovation system, there are a number of both regionally, locally and country-wide innovation support actors[126]. Examples include : the regional incubator BizMaker[127], Miun Innovation[128], Almi Mitt[129], Coompanion Västernorrland, the Västernorrland Association of Local Authorities[130], the county's municipalities and the Västernorrland County Administrative Board[131].

[124] Bioeconomy Ireland Week (2022). Available here

[125] Singh, A., Christensen, T., Panoutsou, C. (2021). Policy review for biomass value chains in the European bioeconomy. Global Transitions 3, 13-42. Available here

[126] Västernorrland's Regional Innovation Strategy for Smart Specialisation. Available here

[127] https://bizmaker.se/en/om-oss/

[128] https://www.miun.se/en/

[129] https://www.almi.se/

[130] https://coompanion.se/vasternorrland/

[131] https://www.hb.se/en/research/research-portal/funders/county-administrative-board-of-vasternorrland-/

Investments in R&I

RISE[132] was awarded 350 million SEK by the Swedish government to intensify work on sustainable solutions in the bioeconomy. With the investment, RISE is now establishing a world-class centre with test beds for biorefinery.

Cluster and networks

In addition to RISE Processum and its associated clusters, there several other actors in Västernorrland's networks, innovation and cluster initiatives. They bring together strong functional geographically unrestricted networks and clusters in their fields locally, regionally, nationally and internationally. Examples:

- Bron Innovation[133];
- Swedish Civil Aviation Authority's Aviation Research Centre – LARC[134];
- High Coast Destinations Development[135];
- the Swedish Federation of Business Owners[136] and
- the Federation of Swedish Farmers[137].

Applied farming practices in Sweden

In the north of Sweden the forest industry is the focus. To understand this, a useful example is Västernorrland's case[138]. In this area, the proportion of agricultural land in relation to the total land area is only 2 percent. The corresponding proportion of forest land is considerably greater, with a total of 77 percent of the land area. This is a huge difference compared to other parts of the country and especially compared to other parts of Europe. Almost 160 000 hectares is forest land that is owned by agricultural companies. Most of the farmers in this region are dependent of income from forestry[138].

Examples of bioeconomy development in Sweden are included in Annex I.

Stakeholders' awareness and social acceptance

Forestry and agriculture are really important in Sweden. The importance from a national supply as well as from a climate perspective is regionally well understood and accepted. The awareness among industry, citizens and government stakeholders of Bioeconomy as an important key to

[132] https://www.ri.se/en/processum/about-us/rise-processum-ab

[133] https://www.broninnovation.se/

[134] https://www.lfv.se/en/about-us/innovation/larc---lfv-aviation-research-center

[135] https://www.hkdest.se/en/

[136] https://www.foretagarna.se/om-foretagarna/in-english/

[137] https://www.lrf.se/om-lrf/sa-arbetar-lrf/about-lrf/

[138] Jordbruksstatistisk sammanställning (2022). Available here

address climate change is in general good in Sweden[139,140]. It is well known that the related industry is an important sector of Sweden's economy.

Policy framework

Sweden's innovation strategy in Västernorrland region aims on identifying and visualizing prioritized areas of strength and development under the topics of[141]:

- Renewable energy
- Complex production and operational systems
- Forest bioeconomy

Financial Support & Investments

Sweden has developed a set of regional funding mechanisms. In the regions of Västernorrland and Västerbotten EU regional development funds are used (e.g. programs like Inter-reg. Sverige-Norge[142] and Inter-reg. Aurora[143])[126]. Also, regional development strategies are applied to promote biorefinery as an important and prioritized field. National & EU funding programs and cooperations are activated (e.g. Vinnova, the Swedish Energy Agency[144] etc.) focused on society's green transition. In this framework there are several projects, such as BIORECER[145], that follow the same purpose. Furthermore, SMEs can apply for Innovation funding gaining a max amount of 25 MSEK, (approx. 250,000€), which corresponds to about 15-40% level of support[146].

Besides public finance and national funding, an amount of private investments is currently available focused on research, education, industry and other sectors[147]. Examples of this kind of financial support measures are the following:

- Kempestiftelserna[148]: founding for research or education within the counties of Norrbotten, Västerbotten or Västernorrland.

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[139] Iris Maria Hertog, Sara Brogaard, Torsten Krause, Barriers to expanding continuous cover forestry in Sweden for delivering multiple ecosystem services, Ecosystem Services, Volume 53, 2022, 101392, ISSN 2212-0416. Available here

[140] Strategy for fossil free competitiveness; Bioenergy and bio-based feedstock in industry transition. Available here

[141] https://www.skogsindustrierna.se/siteassets/bilder-och-dokument/rapporter/valfard/skogsnaringens-betydelse-for-valfarden-aug-upt-2022.pdf

[142] https://www.interreg-sverige-norge.com/

[143] https://www.interregaurora.eu/about-us/

[144] https://www.vinnova.se/en/

[145] https://biorecer.eu/

[146] Nordic Entrepreneurship Check 2016. Available here

[147] https://norrlandsfonden.se/en/

[148] https://www.umeastudentkar.se/en/kempes-scholarship-fund/

- Ekonord Invest AB[149]: includes the industries of soil, forestry, horticulture, tourism, renewable energy, environmental technology, food and health.
- Inlandsinnovation[150]: a state venture capital company with the mission to develop business life in northern Sweden's western parts.
- Almi[151]: offers advice, loans and risk capital in all phases of business.
- Norrlandsfonden[152]: a foundation with the task of promoting development in companies with growth ambitions. Norrlandsfonden offers flexible prime loans for new establishment, development and expansion and has close cooperation with banks, venture capital companies, etc.
- Norra Skogs Forskningstiftelse[153] : an independent foundation with the purpose of non-profit promoting research and development that is of importance to forestry and forest industry activities in northern Sweden.

Barriers and supporting conditions for bioeconomy development

The main barrier for Sweden relates almost exclusively to National and EU policies development and economic initiatives driven by current political leadership[154]. Specifically, it can be observed that the development of the bioeconomy is influenced by changes in political direction. The most recent example is the change of government in autumn of 2022 were the new budget eliminated incentives designed to accelerate the transition to a fossil free car transportation[154].

Another significant barrier that is currently increasing uncertainty for new forest based biorefining initiatives is the drive for policy to decrease the use of forest biomass and where the policies fail to differentiate between sustainable forest management practices in different regions of Europe. The most prominent example is the proposed EU law LULUCF (Land Use, Land Use Change and Forestry)[155] which if implemented in its current form would decrease the possibility to use forest-based biomass for new circular biobased products. According to the Swedish Forest Industries a reduction in harvest by 10% will indeed increase the carbon stock in the forest. But this will be counteracted by higher fossil emissions because of fore gone displacement by forest products as well as a slower increase of carbon storage in harvested wood products[156,157].

[149] https://www.allabolag.se/5567698625/ekonord-invest-ab

[150] https://www.inlandsinnovation.se/en/

[151] https://www.almi.se/en/

[152] https://norrlandsfonden.se/en/

[153] https://www.norraskog.se/forskningsstiftelse/

[154] https://www.diva-portal.org/smash/get/diva2:686333/FULLTEXT01.pdf

[155] Skogsindustrierna (2021). Article - LULUCF-förordningen. Available here.

[156] Börjesson, P., Hansson, J., & Berndes, G. (2017). Future demand for forest-based biomass for energy purposes in Sweden. Forest Ecology and Management, 383, 17-26. Available here

[157] Time to dispel; The forest carbon debt illusion (2021). Available here

To drive the bioeconomy forward we also need more SME's that develop new conversion technologies targeting the residual streams of the traditional forest industry. Some of the barriers that need to be addressed are[158]:

- Dedicated lots of land at the different industrial areas where the regional development actors can guide new biorefining companies towards.
- There is a range of national and European funding instruments available for the development and scale up of new biorefinery technologies. However, the area could benefit from a stronger network of venture capital investors that can follow new concepts early on and support the scale up journey at the right times and level of maturity.
- The continued development of the region as an attractive place to live and work is also important for the provision of a skilled work force that can grow alongside the bioeconomy. The region is not densely populated and does in some regard lack the diversity of leisure activities available in the big city. This could and most likely do influence the location strategies of developing companies.
- Lack of regional and national market for biobased material and chemicals.

In terms of *supporting conditions*, an important supporting condition for the development of the bioeconomy is the regional commitment to grow the forest-based bioeconomy industry. In the smart specialization strategy of Västernorrland Forest Bioeconomy is identified as an area of strength, ensuring its continued focus[159]. This will benefit all regional bioeconomy stakeholders. Large forest industries are also supportive of new conversion technology developers (often SMEs) and several synergistic partnerships have been established where residual streams are used to produce new bioeconomy products[159].

Sweden in combination with the EU also have a rich landscape of various funding mechanism available for the industry (large industry and SMEs) making it possible for innovative companies to be developed[140]. Even though the bioeconomy can still be considered as an emerging industry compared to the petrochemical industry that has grown and evolved over the past 100+ years there is a critical mass of companies regionally now growing and making investments in fossil free conversion technologies towards food, feed, chemicals, materials and fuels[140]. In order to achieve a full transition into a bioeconomy over the coming decades the growth needs to continue at an accelerated pace. To achieve this, finances along with activities to stimulate bioeconomy innovation will continue to be vital.

[158] Palgan, Y.V. and McCormick, K. (2016), Biorefineries in Sweden: Perspectives on the opportunities, challenges and future. Biofuels, Bioprod. Bioref., 10: 523-533. Available here

[159] Karen Refsgaard, Michael Kull, Elin Slätmo, Mari Wøien Meijer, Bioeconomy – A driver for regional development in the Nordic countries, New Biotechnology, Volume 60, 2021, Pages 130-137, ISSN 1871-6784. Available here

4. Interviews

4.1 Interviews Methodology

This section outlines the methodology followed for identifying the needs, specificities and challenges of the target regions in relation to bioeconomy development. The main components of this section are the following:

1. Interview and Sampling Methodology
2. Target groups
3. Procedure followed
4. Questionnaire Overview

Additionally, MainstreamBIO's Interview Questionnaire; guidelines; invitation letter and consent form, are annexed to this document (Annex II).

The following sections provide a comprehensive description of each one of the elements embodied in the methodology applied.

4.1.1 *Interview sampling and methodology*

The interview-based analysis of the needs, specificities and challenges of the target regions, in relation to bioeconomy development, is based on a semi-structured, in-depth, qualitative study. Particularly, a well-tailored sampling frame was employed to include participants across various stakeholder groups, based on the Quadruple Helix. The project partners were responsible for mapping the relevant stakeholders, and then selecting the most impactful to the project's expected outcomes for participating in the interview process. The sampling frame is thoroughly clarified within the following section.

4.1.2 *Target groups*

The stakeholders interviewed were divided into the four main categories of the Quadruple Helix:

- Category 1: Industry (Biomass producers, Farmers, Agri-food and bio-based industry, rural entrepreneurs, tech providers, etc.);
- Category 2: Academic and research institutions (experts, researchers, etc.);
- Category 3: Government agencies & public bodies (political decision-makers, policymakers, etc.);
- Category 4: Civil society (non-governmental organisations, consumer associations, etc.).

Each of the involved project partners, located in the seven target countries, was assigned a minimum number of five interviews (target: 35 interviews overall) . To ensure equal representativeness, WHITE initially allocated two out of the five interviewees to either Category 2 or Category 3, whereas the rest three participants should come from any or each one of the remaining groups - Category 1 & 4 (Table 3). The interviews addressed both female and male respondents.

Table 3. Interviewees' allocation per consortium partner

	WR	IUNG	FBCD	PROC	AUP	INNV	MTU
Category 1, 4	3	3	3	3	3	3	3
Category 2, 3	2	2	2	2	2	2	2
TOTAL	5 (NL)	5 (PL)	5 (DK)	5 (SE)	5 (BG)	5 (ES)	5 (IE)

4.1.3 *Procedure followed*

Participants were recruited from diverse backgrounds and domains, including biomass producers, actors from the agri-food and bio-based industry, academics and researchers, policy-makers, and general citizens. It should be noted that the privacy of the participants was assured at all stages of the interview study, according to the principles of GDPR.

All interviewees were first informed about the scope of the project through a promotional brochure developed by WHITE. The ones interested in participating in the interviews were given the option of having either a face-to-face or over-the-phone/digital means interview. The procedure followed is described in detail within the following figure:

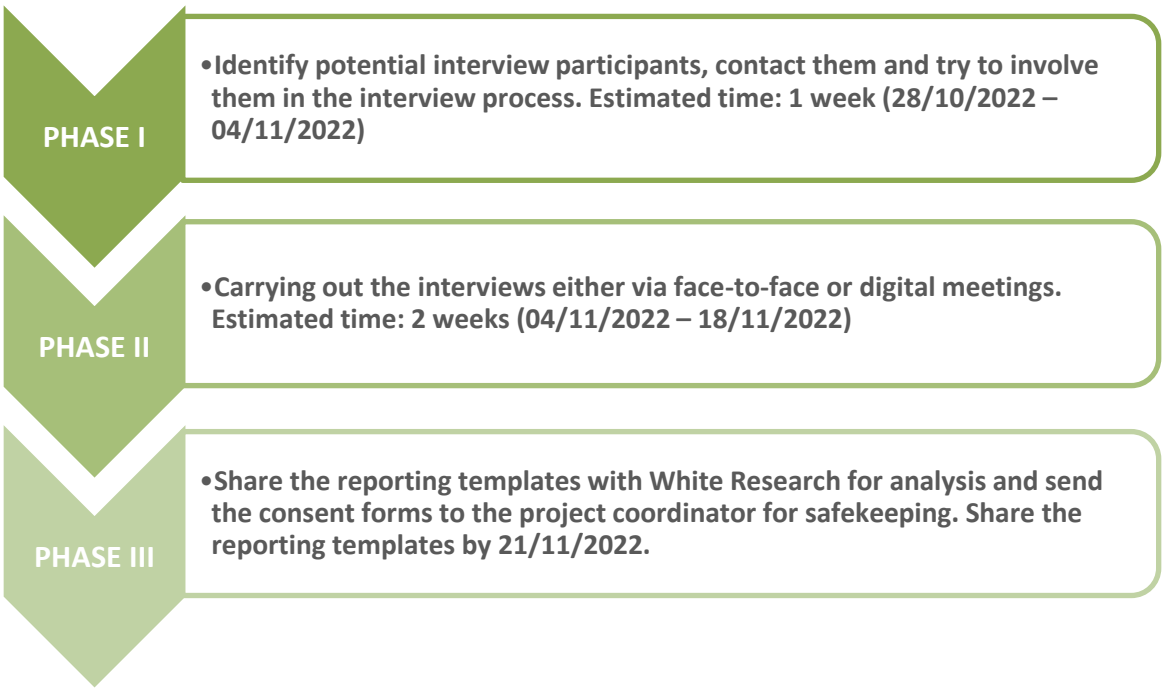


Figure 3. Procedure followed on interviews' implementation

4.1.4 *Interview Questionnaire Overview*

To evaluate the status of bioeconomy development in the target regions, focusing on the regional needs and challenges, as well as, the social acceptance of bioeconomy and biobased products/solutions, the following research topics have been defined:

1. Identify factors hindering or supporting bioeconomy growth and social acceptance in the 7 target countries;
2. Analyse the needs and challenges of various stakeholders in the 7 target regions regarding bioeconomy development and the uptake of biobased solutions;
3. Investigate the regulation and market conditions in the 7 target regions regarding biobased products/solutions;
4. Explore the current status of nutrient recycling practices application in the 7 target regions.

Based on the research topics, the interview questions have been grouped into the following topics:

i. Bioeconomy development and social acceptance:

The objective of the first set of questions was to get an overview of the status of bioeconomy development in the target regions. In particular, it aims to evaluate the current progress towards developing a bioeconomy and identify key factors hindering or enhancing bioeconomy development, focusing on the level of social acceptance of biobased products and solutions.

ii. Framework conditions

The second part of the questionnaire is focused on the existing policy/financial measures supporting the bioeconomy development, as well as, on the biobased market conditions in the target regions. Specifically, it aims to identify regional or national support measures encouraging the growth of the biobased market and to investigate any potential needs and challenges of key actors in the biobased value chain.

iii. Nutrient recycling practices

The last part of the questionnaire focused explicitly on the nutrient recycling practices applied in the focus areas. Particularly, it aims to capture the extent to which such practices are applied by the local farmers and identify the barriers that prevent or slow down the wider adoption of nutrient recycling practices within the target regions.

4.2 Interview Results

This part of the report provides an analysis of the interviews' results based on the information collected by the partners who conducted the interviews in the target countries and seeks to remark on the key findings on the current development of bioeconomy across the various target regions and the deployment of biobased solutions.

According to the task's objectives, the following research topics[160] were identified and investigated:

1. Perceptions regarding biobased products and solutions in the region

[160] The full questionnaire is available in Annex II.

- Bioeconomy development in the interviewee's region.
- Social acceptance of bioeconomy development in the interviewee's region.

2. Framework conditions
   - Regulation and bioeconomy development in the interviewee's region.
   - Needs, challenges and market conditions in the interviewee's region.
3. Nutrient recycling practices
   - Application of nutrient recycling practices in the interviewee's region.

As previously mentioned, the participants in the study are representative of the four main categories of the Quadruple Helix. The figure below illustrates the final number of participants per country and stakeholder group across the target countries:

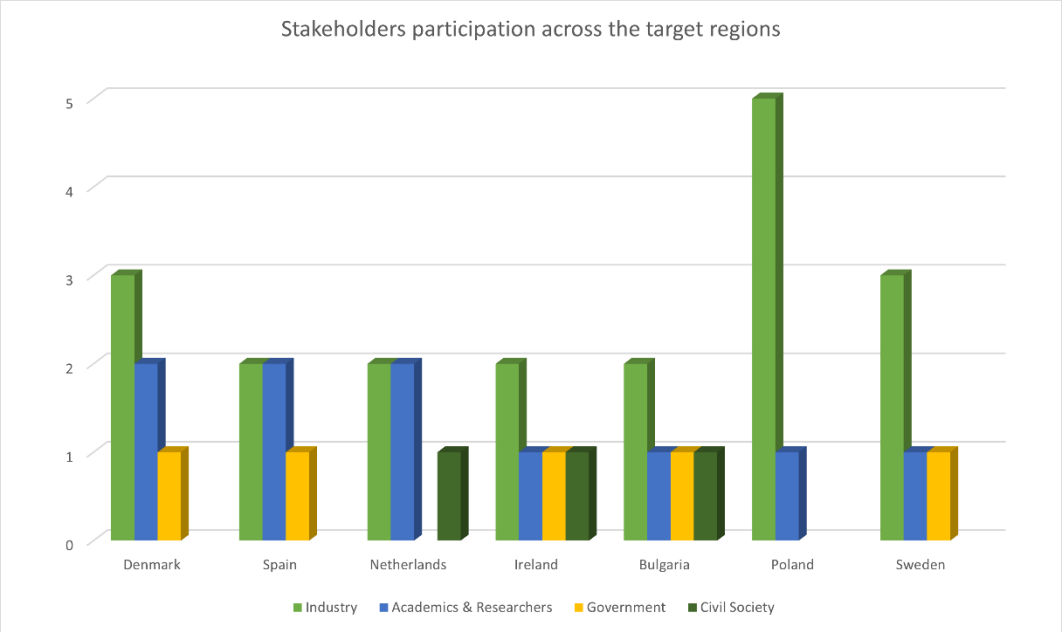


Figure 4. Participation of stakeholders per country and stakeholders' group

Overall, the participants in the interview represented a diverse range of perspectives and stakeholders from the industry sector, academia/researchers, government, and civil society. Each of these groups provided valuable insights and perspectives on the challenges and opportunities facing the industry and society.

Particularly, the majority of the participants belonged to the industry sector. These individuals represented companies and organizations from various industries, such as agri-food & bio-based industry, forestry, and logistics. Following the industry sector, the next largest group of participants were academics and researchers. These individuals represented universities, research institutions, and other organizations that conduct research in various fields. The third largest group of participants were from the government sector. These individuals represented various branches and levels of government, such as local, state, and federal agencies. Finally, a smaller group of participants

represented civil society. These individuals represented non-profit organizations, advocacy groups, and other organizations that work to promote the public good.

Another notable aspect of the interviews was the gender distribution of the participants. The majority of the participants were males. The low participation of females in the interviews could be indicative of a broader trend in the biobased market and the industry in general, where women may not be as active or represented as men.

The findings presented in the following section are derived from the interview reports conducted by the MainstreamBIO partners, who interviewed various stakeholders in their respective countries. These reports provided a wealth of information that was analysed to gain insight into the perspectives and experiences of these stakeholders in relation to the topic at hand.

4.2.1 *Netherlands*

Bioeconomy development and social acceptance

Most of the respondents were in agreement that **significant progress** has been made in the development of the bioeconomy in the Netherlands. When discussing the foundation of bioeconomy development in the Netherlands, participants noted that subsidised projects have played a crucial role. These projects involve collaboration between agricultural colleges and regional associations, with a focus on projects related to materials recycling.

All of the individuals agreed that two major factors driving bioeconomy growth in the Netherlands are the **highly productive agricultural sector** providing the necessary resources and the **motivated entrepreneurs** driving innovation and investment in the sector.

From the consumer's standpoint, the participants acknowledged that while there are consumers who are willing to pay a premium for biobased products, the **high cost and lack of awareness** remain major barriers to the widespread adoption of these products by consumers. However, a small number of consumers, referred to as early adopters, have chosen to switch to biobased products despite their higher costs. They also acknowledged that the **lack of a clear and consistent policy on biobased products** and the **lack of information** make it difficult for consumers to make informed choices. Finally, the majority of the respondents emphasized the **need of reducing the cost of biobased products** as a way to increase the public's acceptance, whereas two of the respondents reported that there are no particular factors hindering social acceptance.

Framework conditions

With regard to the country's bioeconomy strategy, only two of the participants were aware that a national bioeconomy strategy is in force, however, the majority of them reported regional regulations currently applied. In general, most of the participants agreed that **national laws and regulations are not tailored to local needs**, making it difficult to make a solid business case for biobased solutions. They reported that government bodies do have some frameworks available in which they stimulate biobased solutions using **subsidies**. The participants also noted that while federal goals are set on energy consumption and energy production, biobased initiatives have difficulties getting started if they are not "forced by policy" and **lack governmental support**. Additionally, they reported that **limited quality standards** that are specifically fit for biobased products are in place.

Additionally, three out of five respondents argued that the cooperation between actors in the value chain in bio-based sectors is not effective and noted that they should be given more space and opportunities to create a network.

Considering the existing opportunities for bioeconomy development, respondents observed the following:

- High amounts of **primary production** from the agricultural sector
- **Many subsidized projects** in the bioeconomy field
- Highly **active research** institutions
- Many highly skilled and productive farmers, with a good **entrepreneurial mindset**.

Lastly, the main measure recommended by the respondents for the development of bioeconomy in the region was governmental financial support in the form of subsidies.

Nutrient recycling practices

In general, all of the respondents reported that **nutrient recycling practices are applied in the region**, however, they highlighted the **lack of consistent policy** when it comes to the uptake of nutrient recycling. They reported that EU law requires Dutch farmers to remove manure and purchase artificial fertilizers, which is not a circular approach. They also acknowledged that from the farmers' standpoint there is a willingness to innovate, but legislation is often a problem.

Additionally, the **absence of quality standards** was noted as a major issue. Most of the participants reported that currently, the cost of implementing nutrient recycling practices is high, with **vague laws** and a **lack of proven methods and technologies** that are still mostly experimental or on a pilot scale, which is not conducive to change.

4.2.2 *Bulgaria*

Bioeconomy development and social acceptance

The majority of the respondents in Bulgaria agreed that the **progress towards bioeconomy development is slow**, which is in contrast to the regional findings presented in Chapter 3. Additionally, they reported that there are very **few initiatives in place**. However, it was reported that the situation is slowly improving. The participants also noted that there is a lot of **underutilised biomass**, and highlighted the need for cheap houses and flats, especially in rural areas, suggesting that this could be an opportunity to provide biomass, bio-products, and technologies in the construction sector.

The participants identified several key factors that are crucial for the growth of bioeconomy in the region, including the availability of **qualified employees**, **equipment**, and **technologies**, **subsidies** for bio-based industries and **governmental support**. Additionally, one of the respondents noted that **farmers are a closed society** and may not be open to new ideas, particularly the older generation of farmers. Most of the individuals agreed that the major factors currently hindering bioeconomy growth in Bulgaria are the **inflation**, **economic stagnation**, and **the war in Ukraine**, which can lead to **high energy prices** and make it **difficult for bio-based industries to operate**.

Overall, the community's attitude towards biobased products and solutions is positive. The participants also noted that biobased products and solutions are becoming more **widely accepted by the society**. Factors that were identified as hindering the social acceptance of biobased products and solutions include **poverty**, which can make bio-based products more expensive, **inflation**, and a **loss of consumer purchasing power**.

Framework conditions

In the light of the country's bioeconomy strategy, it was found that only a small number of participants were aware of the existence of a national bioeconomy strategy. However, the majority of participants reported **a variety of measures implemented in rural areas to support the development of the bioeconomy**, such as the Rural Development Program (RDP), and initiatives/funding from the European Institute of Innovation and Technology (EIT) have been found to be beneficial for the bioeconomy. The Interreg program was also identified as a key player in the development of the bioeconomy in bordered regions. Moreover, Local Action Groups (LAGs) were deemed vital and were noted as key actor in the development of the bioeconomy in rural areas.

Furthermore, the majority of the participants observed a lack of cooperation between actors in the value chain in bio-based sectors and noted that **entrepreneurs tend to prefer competing over collaborating**. Additionally, the participants highlighted the **need for more research infrastructure and pilot projects**, as well as an increase in the number of **living labs and case studies**.

In view of the existing opportunities for bioeconomy development, the respondents noted that:

- Trakya Economic Zone is a good place to situate hubs and tech-parks,
- Large quantities of underutilised biomass

Lastly, the main measures recommended by the respondents for the development of bioeconomy in the region are the establishing of free economic zones for bio-based products, along with protective measures to encourage local business to use local bio-based products.

Nutrient recycling practices

One of the respondents, belonging to the Academics/Researchers group, claimed that is aware of nutrient recycling practices applied in the region, and argued that **more successful stories and evidence** are required to increase farmers' willingness to adopt these practices. Still, **four out of five respondents reported unaware**.

4.2.3 *Denmark*

Bioeconomy development and social acceptance

In Denmark, all of the respondents identified the fact that **bioeconomy development in the country is rapidly progressing** and that there is a lot of focus on it due to the **rising food**, **energy**, **and fertilizer prices**. When discussing the main factors hindering bioeconomy growth in Denmark the respondents emphasized on the high costs of biomass transportation and the lack of motivation to invest in biobased sector.

In relation to social acceptance, the respondents declared that **the public has a positive attitude towards the green transition**, as long as it does not have negative environmental effects (e.g.

odours). Despite these challenges, the **consumers trust biobased products** and support the biobased markets. One of the respondents claimed that **Danish consumers often place a high priority on the "good story" behind the production of a product**, such as family-owned production of eggs or pigs.

Framework conditions

The majority of the respondents reported that **the country does not yet have a dedicated bioeconomy strategy**. Though, there is a **plan for CO2 neutrality** and a focus on promoting the use of organic food in canteens, as well as the operation of electric cars in municipalities and regions. Strategies have also been implemented in relation to biodiversity and the environment, including a prohibition on using pesticides on public land.

The participants discussed plans for the future use of residual products and different crops in new contexts for value chains in areas such as food, feed, bio-based products, and bioenergy. Overall, the participants agreed that governmental **financial support is needed**, since they acknowledged that there are many opportunities to support bioeconomic investments, but emphasized on the importance of creating **optimal framework conditions for farmers** to support the biobased sector. They further highlighted the **challenges in logistics**, **transport**, **access to biomass**, **and resistance from civil society**.

Moreover, some of the participants mentioned that **many pilot facilities have been established**, and are currently fully operational, whereas one of the respondents highlighted that biogas companies are vacuuming the market for feedstocks, resulting in a **competition for the available biomass**.

In addition, many of the respondents highlighted the **strong cooperation among the key players of the value chain**, though underlined that there is an **increasing competition for capital funds**.

The respondents referred to a variety of opportunities for bioeconomy development in the region, amongst which are the following:

- Green protein
- Pyrolysis and power-to-x
- Biogas production and biorefineries

Lastly, the majority of the respondents were not aware of potential measures to stimulate bioeconomy development in the region, though, one of the respondents emphasized on the importance of **further financial support** provided by the local governments.

Nutrient recycling practices

All of the respondents were aware of nutrient recycling practices applied within the region, while they noted that there are **strict requirements for manure management and storage**. One of the participants provided the example of **HedeDanmark's business model,** which is based on the use of sludge from sewage treatment plants directly as fertilizer on fields.

Some of the participants argued that farmers are willing to implement new technologies, however, the main barriers to the widespread adoption of nutrient recycling practices are **regulations**, **financial limitations**, and **geographical constraints**. Lastly, one of the participants belonging to the industry actors focused on the upcoming reform in Danish agriculture, which suggests that 4% of total area at each farm is to be taken out of production, arguing that it is an issue that currently concerns many farmers and may hinder the further uptake of nutrient recycling practices.

4.2.4 *Spain*

Bioeconomy development and social acceptance

The participants of the interviews in Spain represented **three distinct areas of the Ebro River basin**, including 1) Aragon, 2) Navarre, and 3) Catalonia.

In terms of bioeconomy development, all of the participants in Spain acknowledged progress in bioeconomy development, however they admitted that the **progress is still slow**. One of the primary barriers to the development of the bioeconomy in the region identified by the participants is the **lack of awareness** of the benefits and possibilities of the bioeconomy among the general public and the primary sector. Other barriers identified include the **lack of knowledge transfer to high TRLs**, **bureaucratic slowness in obtaining permits** and **logistics**, and the **lack of scale**.

Regarding public perception, most of the participants concurred that while there is a growing positive attitude towards bio-based products, the population tends to be **less supportive of having biorefineries located near residential areas**. The reason behind this stems from **mistrust towards the origins and processes** involved in biorefinery operations. Moreover, the participants also identified a **lack of communication and dialogue between stakeholders** as a factor contributing to the reluctance of society towards biorefineries.

Overall, it is important to note that no significant variations were detected across the different regions with respect to bioeconomy progress and social acceptance.

Framework conditions

While the regions of **Catalonia has adopted a dedicated bioeconomy strategy**, the regions of Aragon and Navarre have not yet implemented a specific strategy to support the development of bioeconomy. In particular, Catalonia has its own Bioeconomy Strategy and an Action Plan covering the period 2022-2024, while Navarre and Aragon have included bioeconomy as part of their circular economy strategies.

Each of the regions has implemented distinct initiatives and allocated resources to support the implementation of circular practices and business models. For instance, Catalonia has introduced measures to encourage investments in bioeconomy-based business models and to enhance biomass logistics through public infrastructure investments. On the other hand, Aragon has recently implemented support for the formation of energy communities, which have been widely accepted by the population.

Despite the presence of supportive initiatives for bioeconomy development, respondents note that their effective implementation is crucial for success. They suggested that **targeted funding** for later-stage research and development, as well as the **creation of specific strategies for both industrial and rural communities** could further boost bioeconomy development.

The participants identified **numerous examples of bioeconomy development** in their respective regions, which are presented in Table 1. However, they also emphasized the importance of addressing **challenges in logistics**, **social acceptance**, and **administrative support** through further research and innovation.

Table 4. Bioeconomy examples across three different Spanish regions

Region	Bioeconomy examples
Ebro River Basin – Aragon	• Use of straw waste to make pellets for energy purposes • Use of woody pruning products to make wood chips • Wine farms
Ebro River basin – Navarre	• Regional initiative Navarra Circular" • A Socio-Labor Association called Josenea": projects focusing on renewables, circular economy and social innovation, through the reintegration of people at risk of exclusion into the labour market. • Various farmers' associations to support access to finance
Ebro River basin – Catalonia	• The AGROinLOG project: The main goal of AGROinLOG was the demonstration of Integrated Biomass Logistic Centres (IBLC) for food and non-food products, evaluating their technical, environmental and economic feasibility

In summary, despite the variation in the adopted measures across the three regions, it becomes evident that all of them are actively working towards promoting and advancing the bioeconomy development through various means.

Nutrient recycling practices

All of the participants claimed that nutrient recycling practices, such as the use of organic fertilizers and amendments and the recycling of pruning residues, have been implemented for a while. They also noted that these practices are now being encouraged by an increasingly restrictive regulatory framework, including the **Common Agricultural Policy (CAP)**, as well as farmers' growing awareness of how different products impact soil quality.

Furthermore, the participants in all three regions acknowledged that there are obstacles to the widespread adoption of nutrient recycling practices, including **the absence of a ban on synthetic fertilizers** together with a **lack of understanding among farmers** about the technologies and methods involved.

4.2.5 *Poland*

Bioeconomy development and social acceptance

The results of the interviews conducted in the region of Lublin Voivodeship indicate that overall, **the bioeconomy in the region is underdeveloped**, though with significant potential and **visible rapid improvements**. Respondents underlined that the region is characterized by a relatively large fragmentation of farms, with a **small share of livestock production**. However, it is considered a

typical agricultural area, with **untapped potential** for the development of renewable energy sources and the acquisition of raw materials.

One major obstacle to the development of the bioeconomy, in addition to **financial issues**, is the instability or **lack of legal regulations in Poland**. Furthermore, there is a consistent agreement among the participants, that the **media messages** are often directed negatively, which results in a lack of social acceptance towards biobased products and solutions. However, there is a **noticeable increase in social awareness** about the depletion of natural resources and the need for alternative sources of raw materials.

Framework conditions

With respect to the regulatory framework, according to the respondents, the Lublin region currently lacks a specific bioeconomy strategy. However, the **Development Strategy for the Lublin Voivodship until 2030** sets goals for environmental protection, resource and energy savings, and the implementation of **waste management measures**.

Additionally, the participants noted that there are some **funding opportunities available** through public institutions, such as the National Fund for Environmental Protection and Water Management, the Agroenergy program, and the regional Operational Program for the Lubelskie Voivodeship. However, respondents have noted that the **process of obtaining funding is complex** and the amount of funding available is limited. In addition, many of the respondents emphasized on the **weak cooperation among the actors of the value chain**, whereas one of the respondents highlighted the **ineffective cooperation with public administration**.

Overall, the respondents provided several examples of bioeconomy in the region:

- Horticultural and nursery licenced farms and farms with berry production
- Large industrial biogas plants (AZOTY Group)
- Research and development centre (IUNG-PIB)
- A Science and Technology Park supporting the development of industry and start-ups in the biobased sector
- Production of oils for biofuels and use of wood biomass for heating purposes
- Waste composting

Lastly, the participants discussed a variety of measures to support the growth of bioeconomy, including **financial support**, the **introduction of national-wide measures** along with **measures aiming to strengthen the cooperation of key actors** of the value chain.

Nutrient recycling practices

The majority of the respondents stated that **the number of farmers adopting nutrient recycling practices is growing**, while the noted that the major barrier for the limited uptake of such practices is the **low awareness of farmers**. It was also underlined that the increasing awareness of farmers is primarily due to the introduced **legal requirements**, such as the Nitrogen Programme and the Water Law. Lastly, according to some of the interviewees, another potential factor that has contributed to the expanded adoption of such practices could be the **increasing costs of fertilizers and production**, in general.

4.2.6 *Ireland*

Bioeconomy development and social acceptance

In terms of bioeconomy development, the participants were in full agreement that **the region has enormous potential to establish itself as a global leader in the bioeconomy sector**, due to the availability of renewable feedstocks such as seaweed, manure, and other agricultural feedstocks. On top of that, **the region is home to world-renowned research and educational institutions** that are actively engaged in researching and developing the bioeconomy sector.

Despite this, **progress in the sector has been slow**, particularly within the business and primary producer sectors. According to the interviewees, the **lack of awareness** and the **feasibility** of implementing biobased projects constitute some of the major barriers to bioeconomy development in the country.

In terms of social acceptance, the importance of **addressing social resistance and increasing education efforts** was emphasized by the majority of the interviewees as a key factor in effectively promoting the development of the bioeconomy in Ireland. Particularly, the respondents highlighted the need for educating society, starting at an early age, about the concept of the bioeconomy in order to build a better understanding and acceptance of its development in the country.

Framework conditions

Even though **the region does not currently have a dedicated bioeconomy strategy**, the respondents argued that it is evolving and is rooted in the Food Vision 2030, the European Green Deal and national policies. Additionally, one of the participants noted that the region is also a part of the broader 2018 National Bioeconomy Statement.

Nonetheless, the interviewees acknowledged the **requirement for tailored and specific strategies** that will foster growth and support the progress of the bioeconomy in the region. Additionally, they accentuated the **necessity of financial incentives** that will be directed towards specific sectors, such as the blue bioeconomy, as well as the relevance of cooperation among value chain actors and efficient communication in breaking down silos.

In terms of **funding opportunities**, the participants identified general support from Local Enterprise Office grants (LEO) and Enterprise Ireland, as well as the LEADER fund, EIB funding, and other financial support options. Overall, some of the respondents agreed that the existing support measures are sufficient to stimulate the bioeconomy growth, whereas the majority underlined the **need for further financial support**.

Moreover, the participants identified **various examples of bioeconomy development** in the region, some of which are the following:

- The Blue Bioeconomy/Marine sector in Kerry/Cork: Various companies produce noteworthy products for the cosmetics and pharmaceutical sectors
- Ormond Organics: An anaerobic digestion company
- Nutrimara: Production of value added products from seaweed
- EcoVillage in CloughJordan in county Tipperary
- Research centres focusing on biobased research
- Seaweed based fertilizers

- Biorefineries

Nutrient recycling practices

Most of the respondents were not aware if nutrient recycling practices are applied in the region, though one of the respondents belonging to the Biomass producers group argued **that the majority of the farmers have adopted nutrient recycling practices**.

The results of the interviews revealed that there are **major water quality issues in the region** caused by farmers spreading excessive amounts of manure. The **high cost of transporting excess manure** often leads to farmers spreading more than is needed on their own land, resulting in water pollution. On that note, some of the participants argued that the development of **precision agricultural technologies** could prevent the overuse of manure and drive down costs for sustainable agricultural practices. Lastly, two of the respondents argued that **knowledge transfer groups** and **demonstration models** are crucial in providing farmers with a tangible understanding of the developments taking place.

4.2.7 *Sweden*

Bioeconomy development and social acceptance

The respondents from Sweden agreed that the **bioeconomy in the region is experiencing significant growth and developmen**t, with numerous innovative companies working in the biobased sectors. Thus, they also identified the **lack of funding** for large-scale production and **lack of expertise** as potential barriers to the development of the bioeconomy.

With respect to social acceptance, the public appears to be generally positive, with people showing a **favourable attitude towards the transition**. According to the respondents, this could be attributed to the region's long history of natural resource-based business development. However, one of the main **public concerns** comes from the perception that the practices used in the forest industry are not sustainable and erode the forest, leading to deforestation and loss of biodiversity. On that note, the participants underlined the **need to inform the public about the benefits of sustainable forest management** and the role of forests in the bioeconomy.

Framework conditions

In Sweden there is **no regional strategy dedicated to bioeconomy growth**, however, foodtech, renewable energy, and the forest-based bioeconomy have been identified as areas of strength and development within Västernorrland's **Innovation Strategy for Smart Specialization**, which is a priority condition within cohesion policy in the EU.

The majority of the interviewees concurred that there is an abundant supply of **forest products** and a **high level of expertise in the biobased sector**. However, there was consensus that the **support for stimulating investments in bioeconomy development is insufficient** and there is a **lack of risk capital** for biorefineries. The respondents further identified that the **lack of long-term political commitment** to support sustainable forestry poses a hurdle for large-scale investments. Additionally, **strict regulation** surrounding feedstock sources and bio-based commodities, such as biofuels, can make investors hesitant.

Considering the existing opportunities for bioeconomy development, the interviewees mentioned the following examples:

- District heating plants and cogeneration plants
- A variety of sustainable companies: Renewcell, RISE, Processum, Holmens new sawmill, Ciniz Fertilizer, Liquid Wind
- Swedish University of Agricultural Sciences (SLU): quantify the available biomass and the growth of the forest in the region to monitor the development
- Forest-based biorefining and biofuels production
- R&D on new technologies

Nutrient recycling practices

One of the existing regulations in Sweden requiring forest owners to **leave forestry residues after cutting down a forest** is widely regarded as one of the most effective and commonly utilized nutrient recycling practices in the country. Furthermore, a part of the participants noted that there is currently a **minimal amount of forest fertilization**, due to both economic and environmental reasons. Overall, it appears that the current regulatory framework for forest management is effective in allowing the forest to naturally regenerate and maintain its ecological balance.

4.3 Interviews' key findings

The interviews conducted for this task provided valuable insights into the context of farmers and the framework conditions in the target rural areas. Through a thorough analysis of the data collected, several key findings emerged. The following table highlights the major themes and patterns that emerged from the interviewees' responses and provides a deeper understanding of the topic under investigation.

Table 5. Summary of interviews' key findings

Theme	Number of interviewees	Percentage of interviewees	Key findings
Bioeconomy Progress	25	67.5%	There is substantial progress in bioeconomy development in Denmark, Sweden, Ireland, Spain and Netherlands, whereas, in Bulgaria and Poland, progress is still poor. Thus, all of the respondents identified existing opportunities for bioeconomy development in their respective regions, amongst which the production of biofuels, agriculture and forestry, and biorefining.
Social acceptance	33	89.1%	The majority of the participants highlighted the need for more effective communication with consumers to build trust and acceptance for biobased products and solutions. On a positive note, most of the participants reported that there is a positive attitude towards the biobased market, though, the high prices remain a major obstacle. ***Note:*** The need for early education was highlighted by the respondents in Ireland, in order for the public to develop the knowledge required to assist the transition towards a bioeconomy development. Additionally, respondents from Sweden identified the importance of

			addressing societal concerns about the environmental impact of biobased solutions in relation to deforestation and biodiversity loss.
Governmental support	20	54%	A supportive regulatory framework was reported as a major requirement to stimulate investments in the biobased sector. Particularly, in Denmark, governmental support was valued as sufficient by the respondents, thus, all of the interviewees across the target regions argued that there is a need for further financial support.
Supply chain	16	43%	Additionally, there is a need for more efficient and sustainable supply chains in all of the target countries. Approximately half of the participants acknowledged the importance of collaboration among key value chain actors, which appears to be effective only within the Scandinavian countries and Spain.
Infrastructure	5	13.5%	Some of the respondents, particularly from Spain and Bulgaria, identified the need for more investments in infrastructure, including processing facilities, storage and logistics systems to increase efficiency. On that note, a small number of respondents emphasized the need for more public-private partnerships.
Network	5	13.5%	A small part of the participants acknowledged the importance of networking and collaboration to promote knowledge sharing among farmers.
Needs	18	48.6%	As presented in Figure 5, less than half of the participants reported that the major need for bioeconomy development is financial support, though, additionally underlined the importance of the resources' availability and regulation stability. A strong emphasis was also given to the need for investment particularly in the areas of research and policy, as shown in Figure 7. Lastly, at least 24.3% of the respondents also claimed that there is a high need for demonstration plants to showcase new technologies and processes to increase their uptake.
Barriers	29	78.3%	The barriers reported by the participants are illustrated in Figure 6, where it becomes evident that the high costs constitute a major obstacle both from the consumers' and the farmers' front, followed by public resistance and the unsupportive regulatory framework.

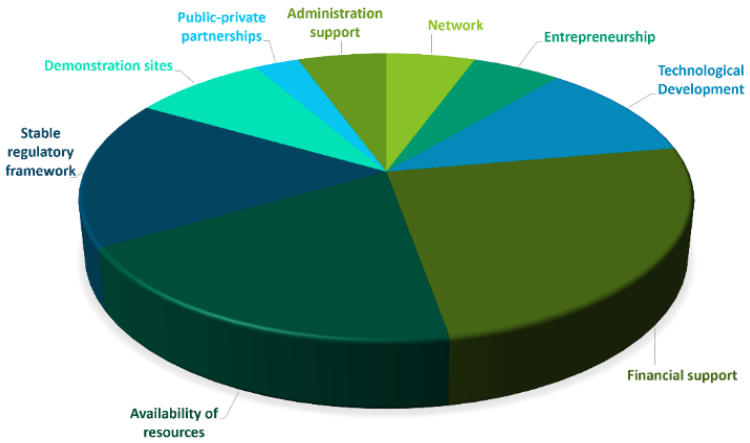


Figure 5. Enabling factors for bioeconomy development

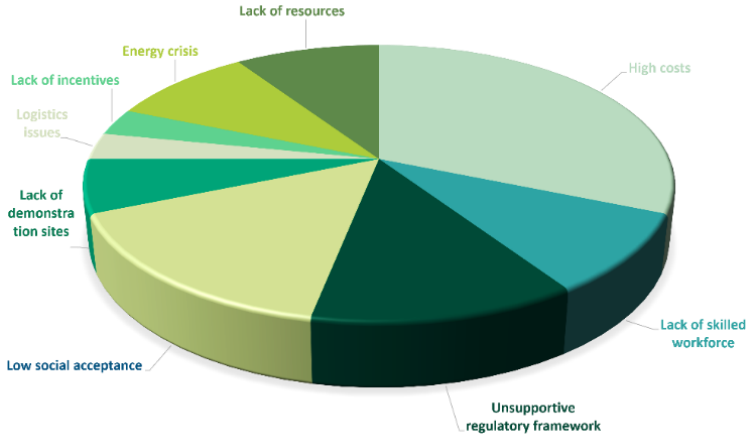


Figure 6. Hindering factors for bioeconomy development

Figure 7. Investment priorities for bioeconomy development

Overall, the findings of the interviews conducted for Task 1.2 align with the results of the desk research, providing further validation for the needs, challenges and opportunities identified in the initial phase of the study. However, the interviews have also provided new insights and perspectives on the subject, particularly related to the specific areas where investments are needed, adding depth and nuance to our understanding of the current state of bioeconomy development in the target regions.

5. Online survey in targeted areas

5.1 Objectives

The target of the large-scale survey, which constitutes the final step of this research endeavour, is to quantitatively capture awareness levels and perceptions regarding the bioeconomy, bio-based solutions, products and nutrient circularity practices, amongst a broader group of stakeholders, in MainstreamBIO's seven pilot areas. As such, the survey aims to present numeric data and to translate them into meaningful insights regarding general needs, socio-economic context and framework conditions. The final objective is to supply the seven focal regions with concrete evidence about their farmers' and other stakeholders' awareness on bioeconomy, in order for the established MIPs under the MainstreamBIO framework to address genuine needs and concerns.

5.2 Survey Methodology

5.2.1 *Sample*

The survey uses the quantitatively data out of 268 completed answers in the total which were given from the following stakeholder groups: biomass producer, business, academic/researcher, government/policy-maker/public authority and civil society in seven Countries where they are busy the project (Netherlands, Poland, Denmark, Sweden, Bulgaria, Spain and Ireland) (Figure 8). These seven countries represent the areas in which they will be established Multi - actor Innovation Platforms of MainstreamBIO. The data collection took place from December 2022 to January 2023. Taking into account the available demographic data, the total number of responses was influenced by the availability of participants and the varying levels of bioeconomy development in each rural area resulting in a total of 268 responses .

Except for the cores questionnaire sections of the survey have also included demographic questions with the aim of providing more information about the background of the participants regarding their age, their area of residence, their educational level and their annual income. Another important factor that the survey examines is the stakeholder group to which the participant belongs, giving him the possibility to choose between biomass producer (e.g. farmers , forestry , aquaculture , unions , associations etc.), business (e.g. agri - food & bio - based industry , logistics , financing etc.), academic / researcher , government / policy - maker / public authority and civil society . A final important point that was collectively agreed by all partners was that the sample should be representative in terms of gender for all countries.

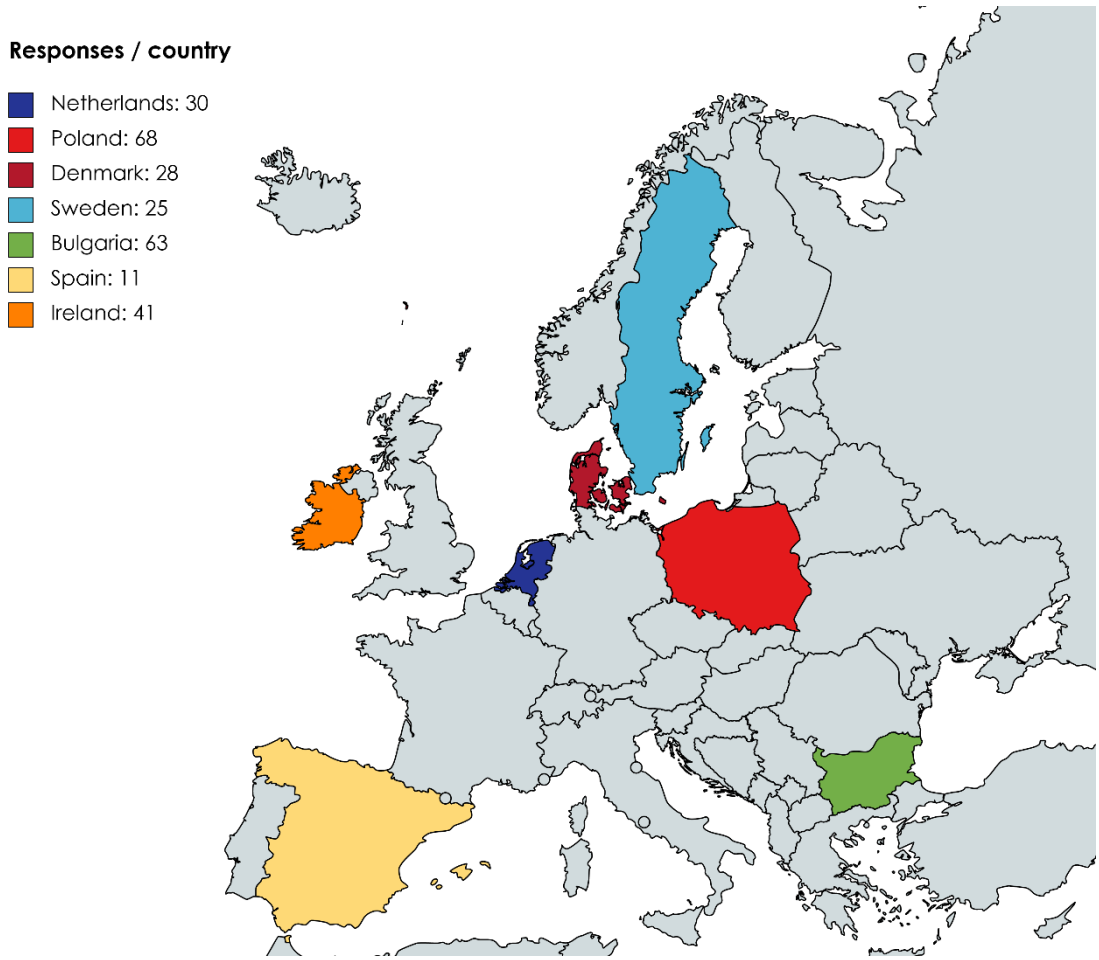


Figure 8. Surveyed countries and distribution of sample (source: MapChart.net)

White Research (WHITE), as Task 1.2 leader , was responsible for coordinating the activities, to prepare the questionnaire as well as launching the survey . The initial draft questionnaire was shared by WHITE with the rest of the consortium for comments and improvements. After WHITE adapted all the comments from the other partners, the survey was translated into the language of each targeted rural area and was sent back to the consortium for proof - reading of the translated versions. Together with the survey questionnaire WHITE circulated guidelines on how to promote the survey by the partners as well as what is the goal that everyone should achieve in terms of participants . As included in the guidelines document , each partner was responsible for approaching people from its own network or other, who should belong to one of the key stakeholders groups , inform them about the assets of MainstreamBIO and promote the survey link to submit their responses. Survey Monkey, an online survey software, was used to launch the survey.

The time given by WHITE to gather the requested responses was one month. After this interval, WHITE deactivated the responses collector, gathered the results and analyzed them.

5.2.2 *Questionnaire structure*

Based on the results of the literature review (Step 1) and the semi - structured interviews (Step 2) that were carried out in the context of T1.2 actions, which identified the existing stakeholders ' perceptions and awareness regarding bioeconomy , development in their focal region as well as the needs and obstacles they face, WHITE created the survey questionnaire with the aim of getting additional insights about these topics , as well as to verify quantitatively the correctness of the results

from the previous results ' analysis . The description of the sample of participants and the analysis of the surveys response is included in the continuation of this chapter.

Regarding the process followed for the development of the questionnaire and its final structure, WHITE incorporated the findings from the literature review along with interviews ' questionnaire structure and presented a draft version of survey questionnaire that the rest of the consortium. The final version of the questionnaire (full questionnaire available in Annex III) includes, as much as possible, the comments made by all partners .

Survey questions were clustered in 6 main parts, each of which consisted of a number of questions. Each part is briefly presented below:

1. Section I – Background Information: In this section, stakeholder's associated group is identified, along with gender, age, area of residence, the level of education and the Net Annual Household Income. Furthermore, this part gives a first insight on stakeholder's familiarity with bioeconomy and biobased products.
2. Section II – Bioeconomy development: In this section, stakeholders identify the potential benefits that bioeconomy can offer to their respective regions, specify the areas where bioeconomy can be most effectively promoted, and determine the key partners and collaborators necessary for the development of their local economy and the production of biobased products.
3. Section III – Needs & Barriers: In this section, stakeholders' are asked to point out which they considered as the most important needs and barriers according to bioeconomy development and biobased solutions.
4. Section IV – Biobased products: In this section, the views and the receptiveness of the stakeholders in terms of familiarity with biobased products, their willingness to purchase these, and their perspective compared to fossil fuels, are investigated
5. Section V – Biobased solutions: In this section, stakeholders' awareness on biobased solutions is investigated also regarding the existing nutrient recycling practices.
6. Section VI – Support services: In this section, stakeholders' opinion on the provided technical and business support services is examined with regard to the potential biobased market of their region, and the need to scale opportunities.

All demographic information was collected in compliance with the general data protection regulation (GDPR) of the European Union and used solely for research and statistical reasons. In addition, to participate in the survey all research subjects had to fill-in a consent form that was included in the introductory session of the questionnaire. Finally, the management of datasets including such information adheres to the project's data management plan.

5.3 Survey Findings

5.3.1 *Demographics and sample structure*

The survey aimed to gather information on the perceptions and understanding of the concepts of bioeconomy, bio-based products, and bio-based solutions among the seven target regions, including the Netherlands, Poland, Denmark, Sweden, Bulgaria, Spain, and Ireland. Responses have been gathered from Wednesday the 14th of December to Monday the 13th of January. The total amount of complete surveys collected was **268**. The figure below provides an overview of the participants' distribution per country and per Quadruple Helix category.

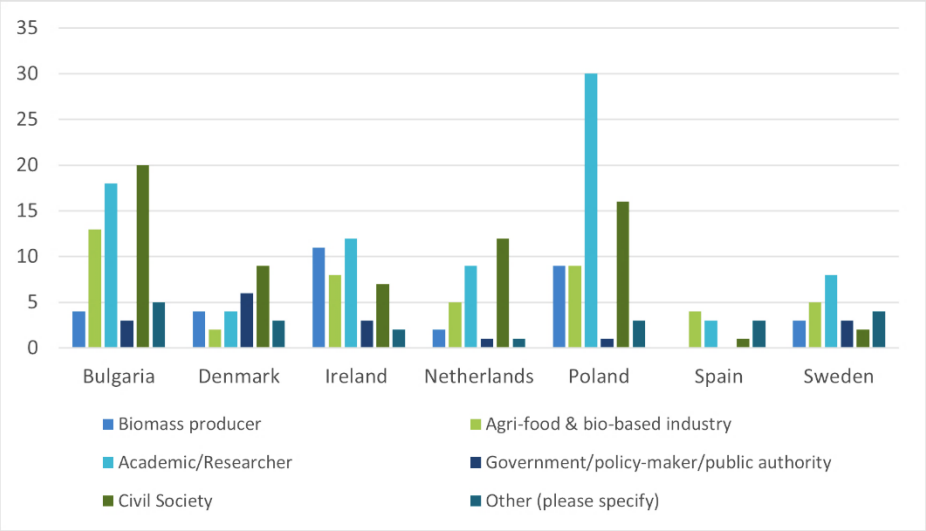


Figure 9. Interviews' participants - country distribution

In Figure 9, it can be observed that Poland and Bulgaria recorded the highest participation of 27% and 23% respectively, whereas Sweden and Spain had the lowest participation corresponding to 8% and 6% respectively. Overall, the majority of participants across the various regions were comprised of individuals from academia/research (33.8%) and civil society (27.5%), followed by industry actors (19.1%) and biomass producers (14.3%). Policy makers and governmental bodies had the lowest participation among the different types of stakeholders represented in the survey, with only a 6% representation.

Table 6. Interviewees' distribution per country

Country	Number	Share
Bulgaria	63	23.51%
Denmark	28	10.45%
Ireland	43	16.04%
Netherlands	30	11.19%
Poland	**68**	**25.37%**
Spain	11	4.10%
Sweden	25	9.33%
Total	268	100%

In terms of age, as it can be deduced from the following pie charts, the majority of the participants were in the 40-49 years range, accounting for 27.6% of the responses, followed by the 30-39 years range with 24.5% and the 50-59 years range with 20.3%. 14.3% of the participants were in the 20-29 years range, 10.4% were older than 60 years, whereas the smallest representation was from individuals under 20 years at 3.0%. Lastly, the gender distribution among participants was balanced, with 51.8% male and 44.9% female.

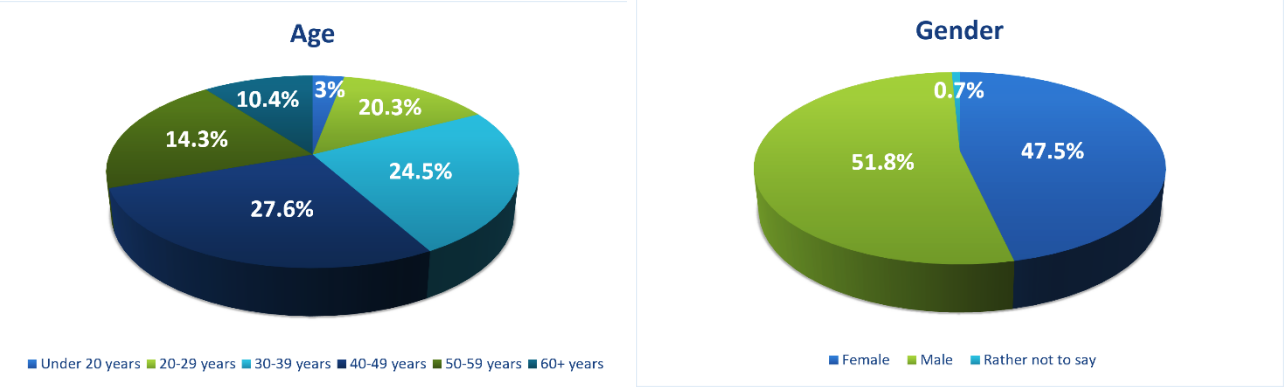


Figure 10. Interviewees' age and gender distribution

In terms of the area of residence, the largest segment of participants, 49.3%, resided in urban areas, whereas 20.6% of them lived in semi-urban areas and the remaining 28.7% in rural areas.

Table 7. Interviewees' area of residence distribution

Area of residence	Responses	Percentage (%)
Urban	**132**	**49.2**
Semi-urban	54	20.2
Rural	78	29.1
Skipped	4	1.5
Total	268	100

5.3.2 *Country Analysis*

In the following section, we delve deeper into the findings of the survey, analyzing them by country. This allows us to gain a better understanding of the specific needs and challenges faced by each pilot country, as well as the types of support services that would be most effective in these regions.

Netherlands

In the Netherlands, a sample of 30 responses was gathered from a diverse range of stakeholders, including 2 Biomass producers – 5 Industry actors – 9 Academics/Researchers – 1 Governmental body/Policy-maker – 12 Civil society representatives – 1 Other groups. The majority of the respondents were located in semi-urban areas (45.7%), with a significant proportion also residing in rural (31.4%) and urban areas (22.9%). It is important to highlight that a majority of 45.7% of the participants were based in semi-urban areas, followed by a 31.4% and 22.9% living in rural and urban areas respectively.

The results show that the majority of participants acknowledge the **advantages of bioeconomy development** for their area. A significant proportion of participants, 80%, agreed that bioeconomy development can reduce the **dependence upon fossil fuels**, with **waste reduction** being another benefit that 77% of participants considered important. However, recognition of the health benefits of bioeconomy, such as improved public health, was limited to a smaller number of respondents, 53%.

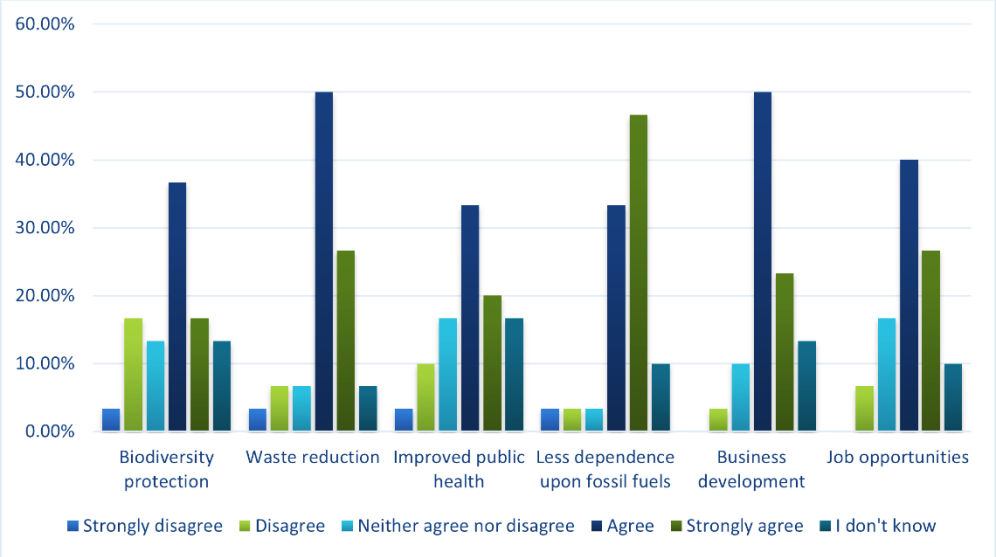
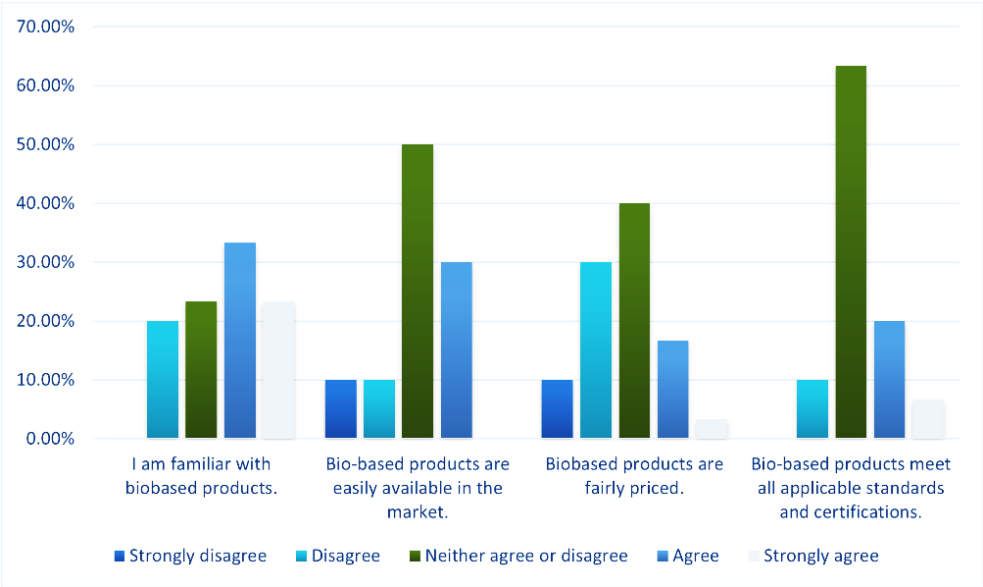


Figure 11. Netherlands' perception on regional bioeconomy benefits

With regards to the familiarity of the respondents with biobased products and solutions, the majority of the participants (80%) had some degree of familiarity. It is noteworthy that a substantial number of respondents, approximately 45.7%, correctly indicated that biobased products can be partially or wholly derived from biomass.



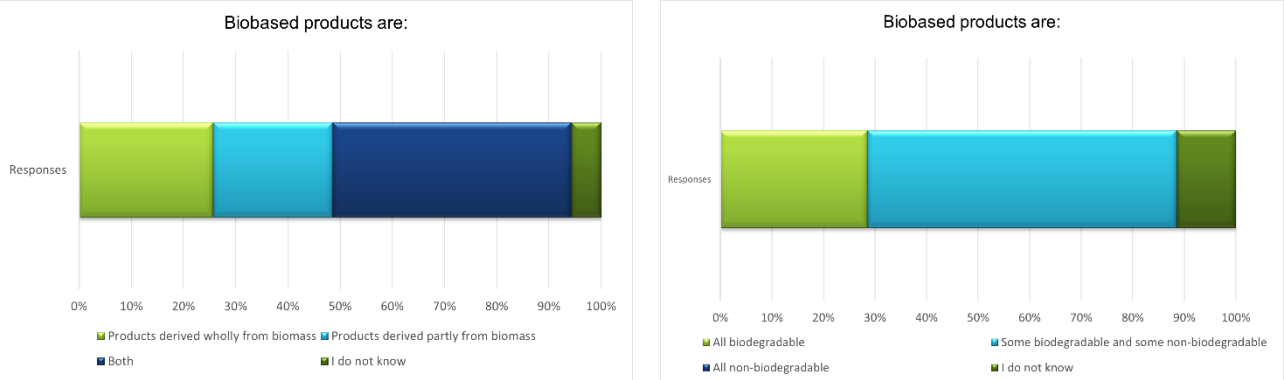


Figure 12. Netherlands awareness levels on biobased products

Additionally, 60% of the participants were aware that some biobased products are biodegradable (Fig. 12). This highlights a **positive level of awareness** and understanding of the nature of biobased products among the participants. This understanding is critical in promoting the use of biobased products and solutions, as it helps to dispel common misconceptions and promote accurate information. In regards to cost, the participants appeared to be **uncertain about the affordability of biobased products** and were inclined towards the belief that they are **overpriced**. A similar trend was observed in terms of accessibility, as many of the participants were **unsure about the sufficient availability of biobased products in the market**. In addition, the level of trust in the certification of biobased products also yielded mixed results, with 60% expressing doubt and uncertainty.

Additionally, the results of the survey in the Netherlands indicate that the top three **priorities** for the region in terms of needs for bioeconomy development are **access to finance**, **public and private investments in R&D** and **investments in infrastructure**. These priorities were identified by over 80% of the respondents, as depicted in Figure 13.

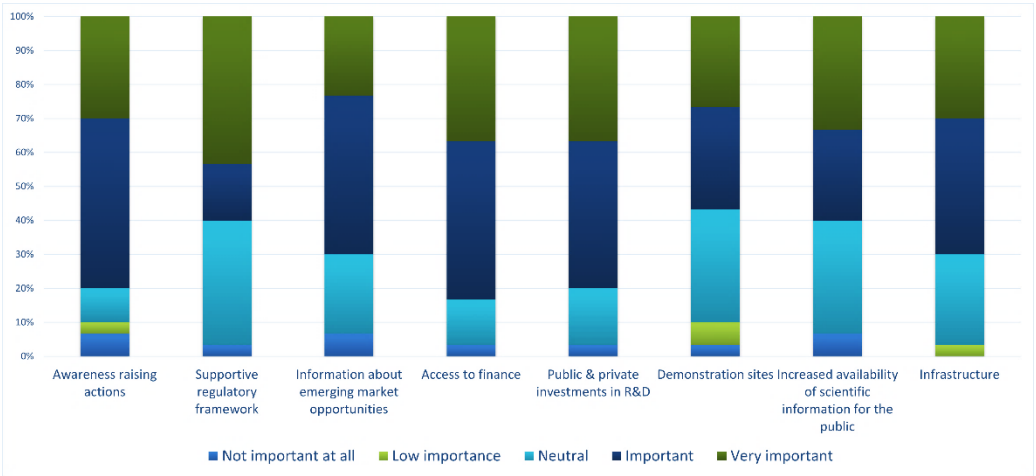


Figure 13. Netherlands perceptions on regional needs for bioeconomy development

When analyzing the challenges, the highest-rated **barriers** to the development of bioeconomy in the region was found to be **high costs** according to 76.6% of the participants, as shown in Figure 14. Limited feedstock availability was less important, which is explained by the fact that the agriculture sector in the Netherlands is highly productive.

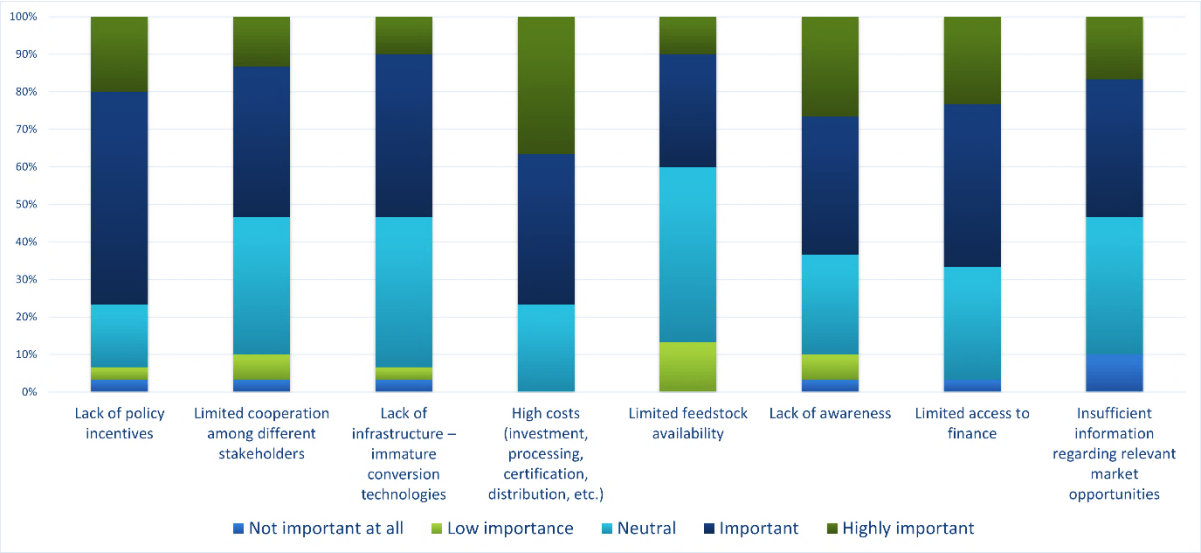


Figure 14. Netherlands perceptions on regional barriers hindering bioeconomy development

In addition, when it comes to biobased solutions, approximately 40% of the participants reported that farmers in the region are actively engaged with biobased solutions, though another 43% stated that farmers in the region are not highly aware of such practices.

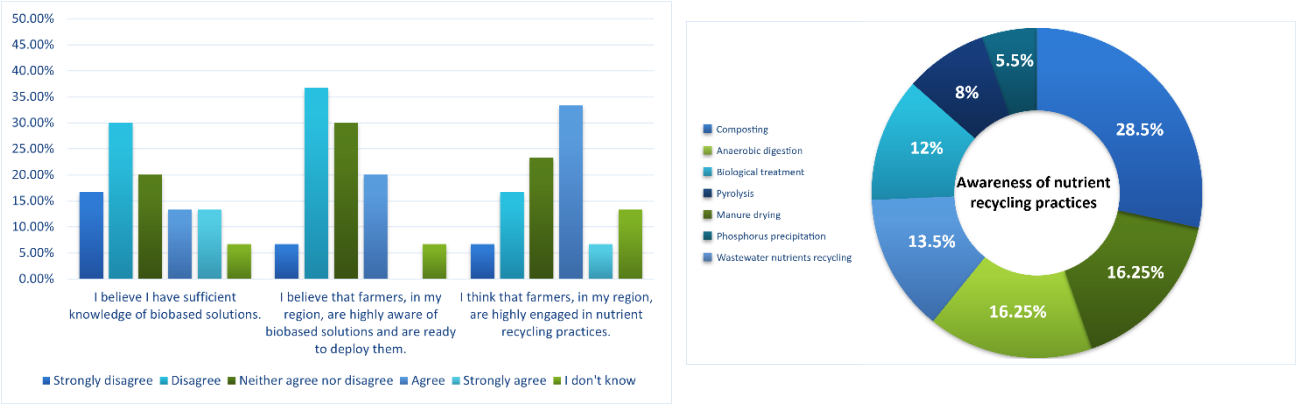


Figure 15. Netherlands perceptions levels on biobased solutions & nutrient recycling practices

The results of the study indicate a **high level of familiarity** among the participants regarding the **nutrient recycling practices** implemented in the region. The most commonly recognized methods were **composting** (28.5%), **drying of manure** (16.25%), and **anaerobic digestion** (16.25%), whereas the least recognized method was phosphorus precipitation, with only 5.5% of the participants being aware of it.

The analysis of **technical support services** required to upscale the biobased sector in the Netherlands, as demonstrated in Figures 16 & 17, indicates that **field lab and testing** along with **scale-up and optimization for increased efficiency and yields** were the top technical support services cited by at least 83% - 90% survey participants in the Netherlands. Secondary in importance were services such as pilot project implementation advice and soil nutrient management. Further, training and consultancy services were considered the least important factor in driving the uptake of biobased solutions.

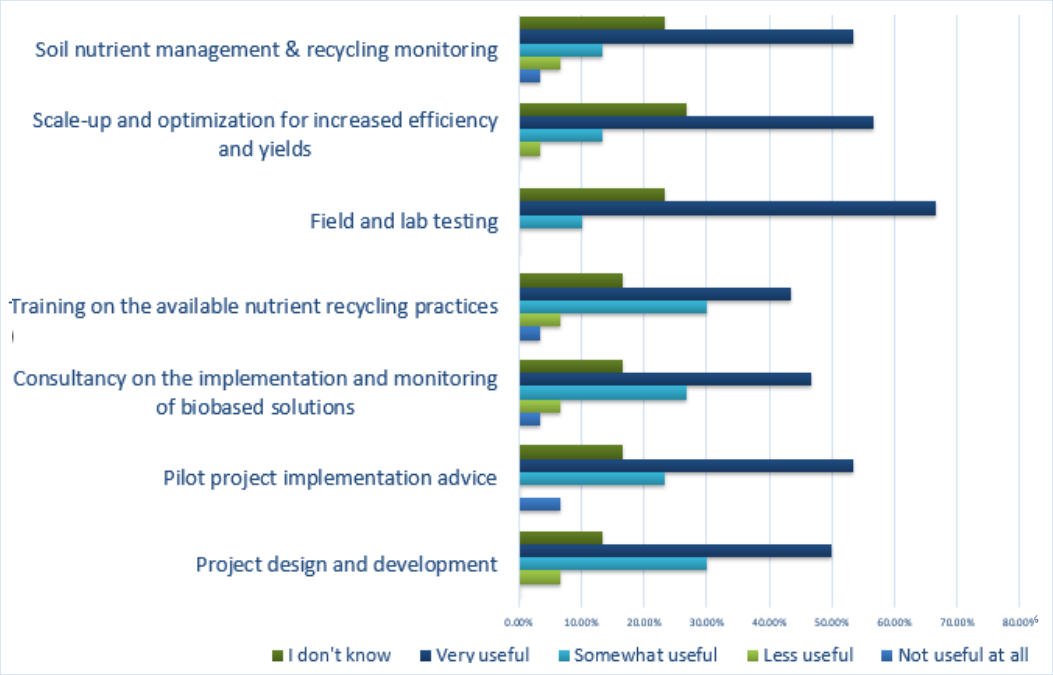


Figure 16. Netherlands' perception on MainstreamBIO technical support services

In terms of **business support services**, **business mentoring services** received the highest level of responses, with 76% of participants evaluating them as useful. The responses were relatively evenly distributed among the various types of business support services, with the majority of participants finding them all to be somewhat useful. Additionally, only a small percentage of participants (less than 6%) considered some services to be of limited usefulness.

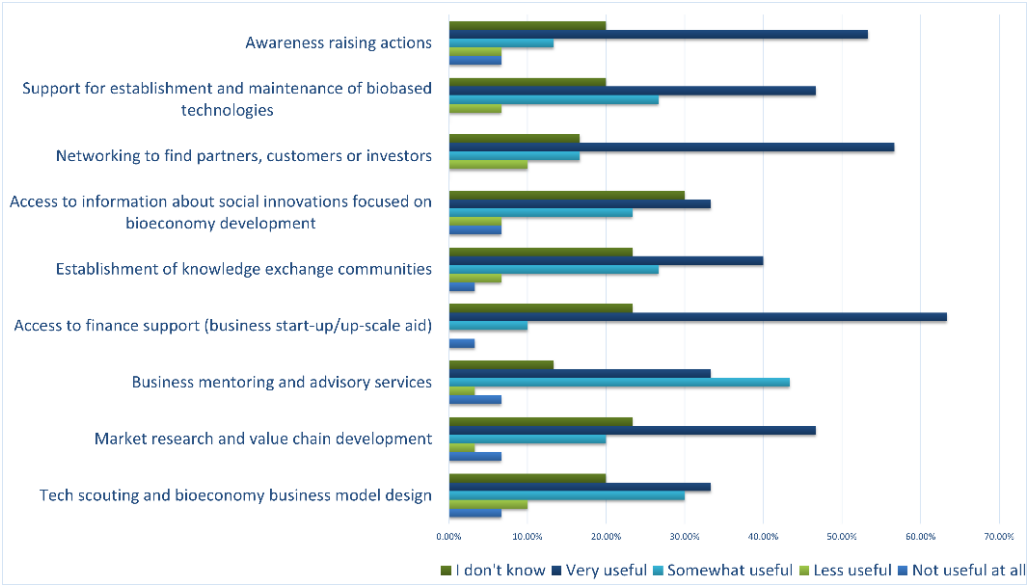


Figure 17. Netherlands' perception on MainstreamBIO business support services

Additionally, the survey results shed light on the perception of the necessity for **digital tools** to support the growth of the bioeconomy. The majority of 63.49% of participants in the Netherlands expressed their support for the use of these tools, while 14.29% were against it. Lastly, approximately 20% of participants had no definite opinion.

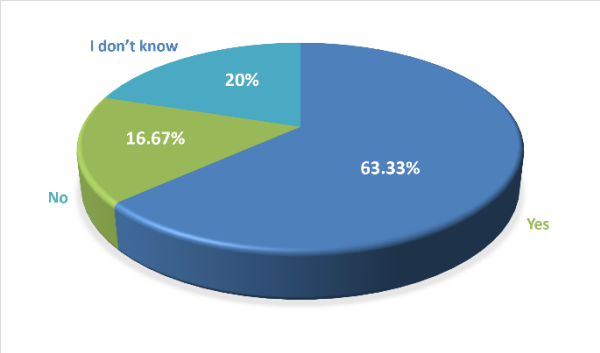


Figure 18. Netherlands perception on the necessity for digital tools to support bioeconomy development.

Bulgaria

In the case of Bulgaria, we have managed to collect an overall sample of 63 responses covering all different types of stakeholders (4 Biomass producers – 13 Industry actors – 18 Academics/Researchers – 3 Governmental bodies / Policy-makers – 20 Civil society – 5 from Other groups). It should be noted that 81.4% of the participants resided in the urban.

Moreover, the majority of the respondents were able to recognize the potential **benefits of bioeconomy development** for their region. Of the given benefits, at least half of the participants agreed that bioeconomy development can lead to the **creation of job opportunities**. It is worth noting that a small proportion of the participants were unable to identify any benefits. Improved public health was also considered to be a significant advantage by a considerable number of participants. On the other hand, the recognition of environmental benefits, such as the minimized dependence upon fossil fuels, was limited to a smaller percentage of respondents.

These findings suggest that the respondents have a good level of awareness of the potential benefits that the development of the bioeconomy can bring, with a focus on **job creation** and **improved public health**. However, there is room for increased recognition of the environmental benefits of bioeconomy.

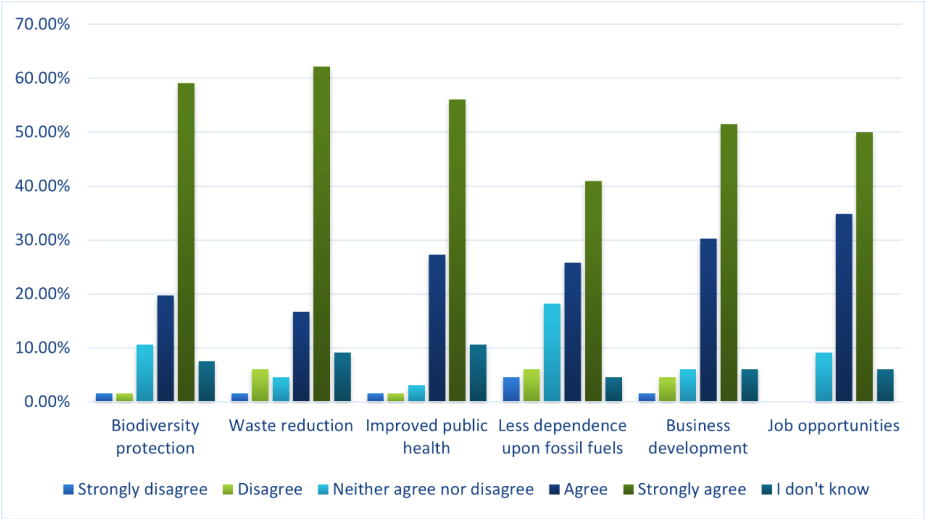


Figure 19. Bulgaria's perception on regional bioeconomy benefits

Moving on to the **awareness of biobased products and solutions**, the majority of survey respondents, 81.43% as depicted in Figure, had **some level of familiarity** with biobased products and solutions. However, only 40% were aware that biobased products could be partially or wholly derived from biomass, and **only a limited number were cognizant of the fact that biobased products are not necessarily biodegradable**. The prevailing perception among the participants was that biobased products are derived entirely from biomass and are biodegradable.

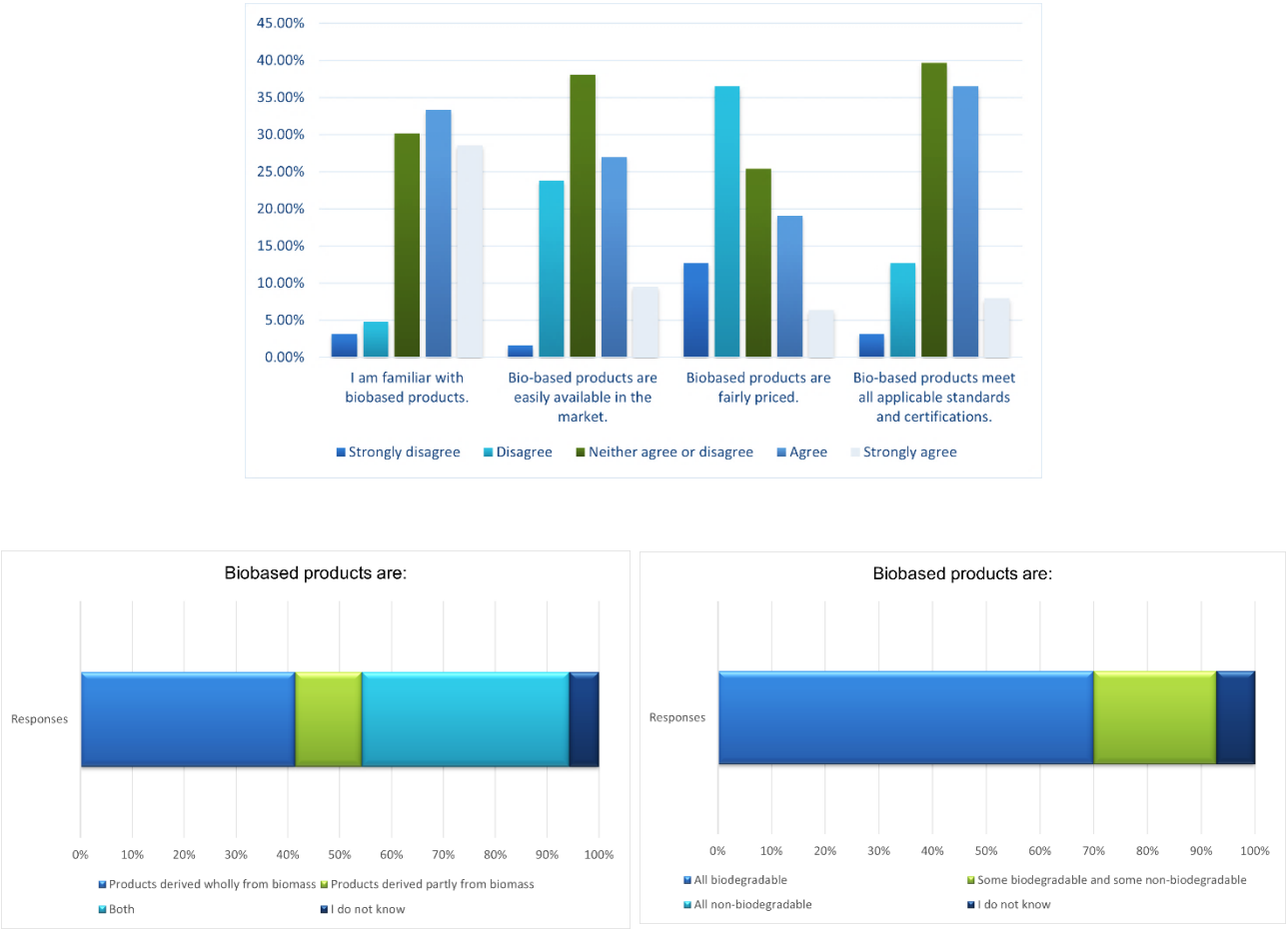


Figure 20. Bulgaria awareness levels on biobased products

Additionally, the results regarding the level of trust in biobased products in terms of **certification** revealed a mixed response from the participants. While 44% expressed their belief that the biobased products should be certified, a significant portion of 39.6% indicated their **uncertainty about the certification standards**. This highlights the **need for further information and education** to improve the understanding and confidence of the participants in the biobased products. Furthermore, the results indicated that only 30% of the participants found biobased products easily available in the market. Finally, in terms of cost, a small number of participants (25.3%) reported that they considered the pricing of biobased products to be unjust.

Moving on to the analysis of the **needs**, it is important to consider the various perspectives and requirements of the stakeholders involved. According to the survey results, the top three identified needs for the region are 1) **investments in research and development** (R&D), 2) **awareness-raising actions** and 3) improved **access to finance**, with each receiving support from over 90% of respondents (Figure 21). The needs that received the lowest support among the survey participants

include a supportive regulatory framework, demonstration sites, and increased availability of scientific information to the public.

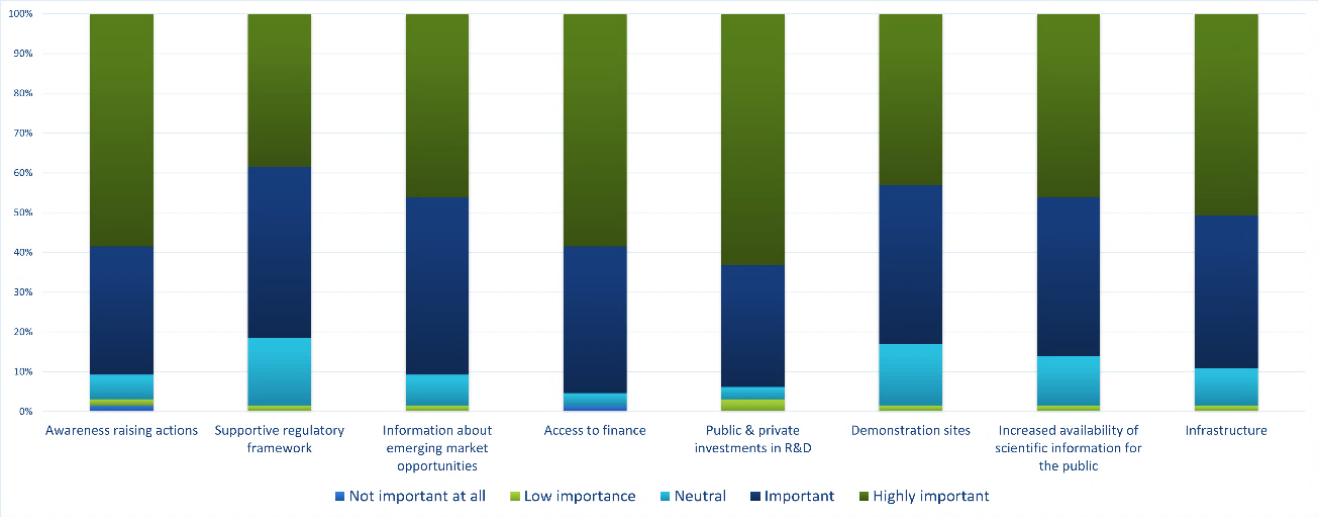


Figure 21. Bulgaria perceptions on regional needs for bioeconomy development

When analyzing the **challenges**, the highest-rated barriers to the development of bioeconomy in the region were found to be limited **access to finance**, **the lack of infrastructure**, and **high costs**, as shown in Figure 22

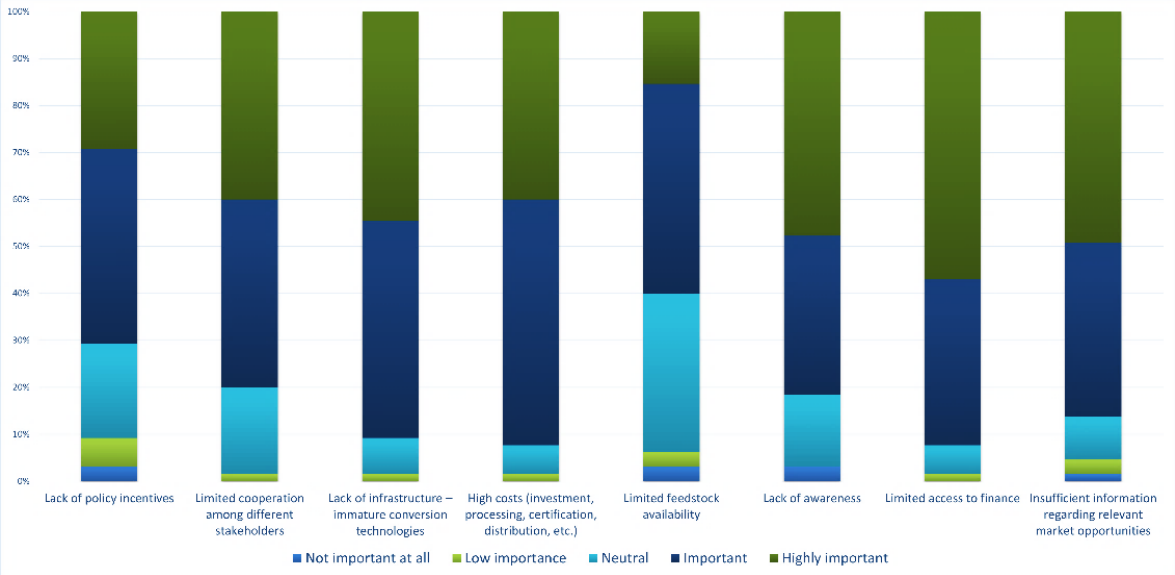


Figure 22. Bulgaria perceptions on regional barriers hindering bioeconomy development

Concerning the biobased solutions, half of the participants reported that **farmers in the region are not actively engaged with biobased solutions**, despite being highly aware of them. This result highlights a disparity between knowledge and action in the adoption of biobased solutions among farmers in the region. Furthermore, the results show that the participants have **a good level of awareness of the nutrient recycling practices** applied in the region, with a majority recognizing **composting** (29%), **manure drying** (20%), and **biological treatment** (13%) as the most commonly applied methods. Conversely, phosphorus precipitation had the lowest recognition (4%) among the participants.

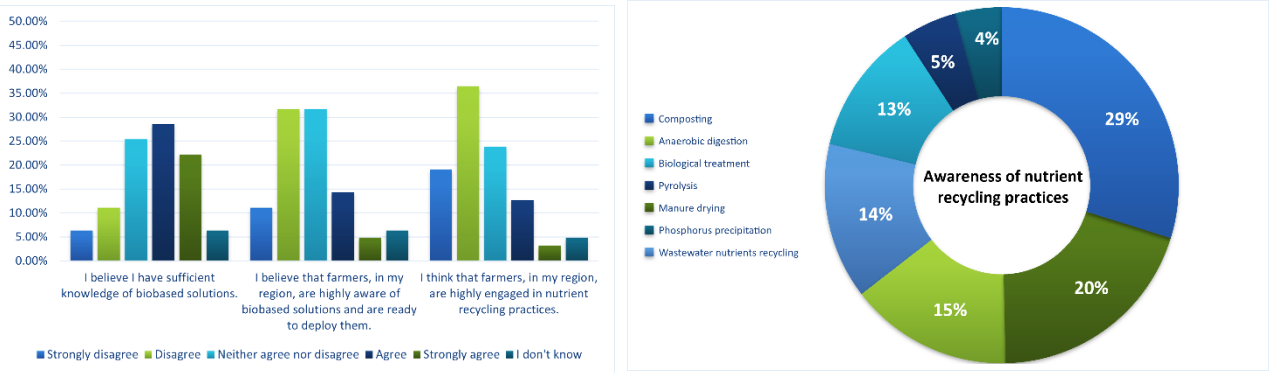


Figure 23. Bulgaria perceptions levels on biobased solutions & nutrient recycling practices

Upon investigating the various support services that could enhance the upscale of the biobased sector (as depicted in Figures 24 & 25), it can be observed that, in terms of **technical support services**, **soil nutrient management and monitoring**, along with **field and lab testing and training on the available nutrient recycling practices**, are the most commonly cited responses among survey participants in the Bulgarian case. Subsequently, the pilot project implementation advice, the consultancy on the implementation and monitoring of biobased solutions and project design and development are considered to be of secondary importance. Lastly, the scale-up and optimization for increased efficiency and yields are deemed to be of lesser demand for the enhancement of biobased solutions' uptake.

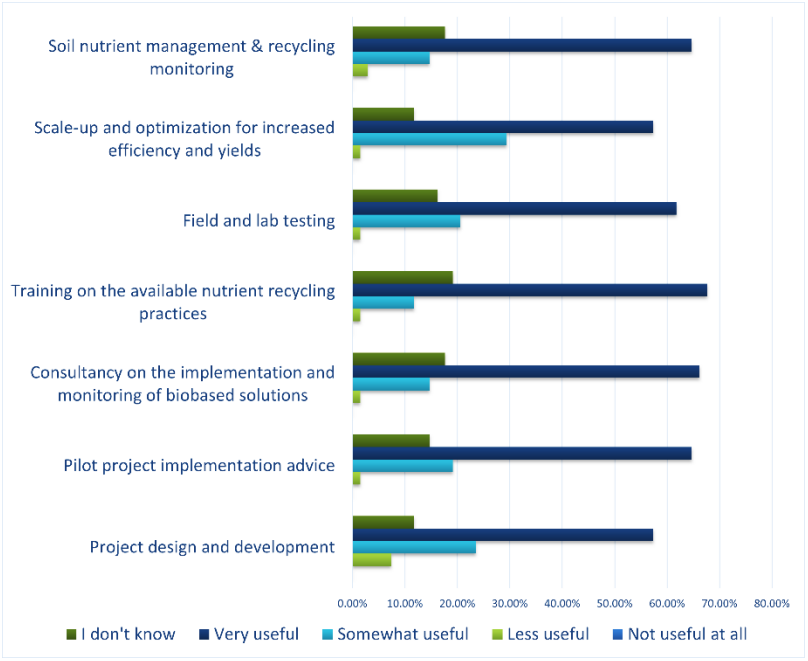


Figure 24. Bulgaria perception on MainstreamBIO technical support services

The analysis of the **business support services** (Fig. 25) reveals that **awareness raising actions** received the highest level of support among the participants, with 74.6% indicating that it is a highly useful service. The results demonstrate a relatively even distribution of responses among the various types of business support services, with the majority of the participants finding all of them to be useful. Only a small fraction of participants (less than 5%) deemed some of the services to be of

limited usefulness. Overall, the results suggest that there is a high level of appreciation for the various business support services offered to upscale the biobased sector.

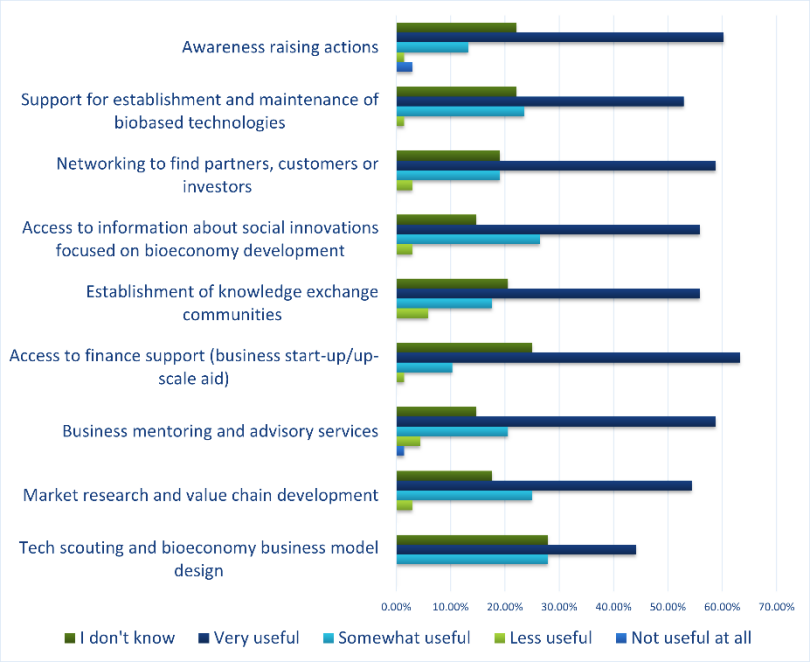


Figure 25. Bulgaria perception on MainstreamBIO business support services

Lastly, the results of the survey also shed light on the perception of the **need for digital tools** to support the development of the bioeconomy. A majority of 63.49% of the participants expressed their belief in the usefulness of such tools, while 14.29% held the opposite viewpoint. This can be considered a positive sign for the future adoption and integration of digital tools in the sector. The remaining 22.22% of the participants had no clear opinion on the matter.

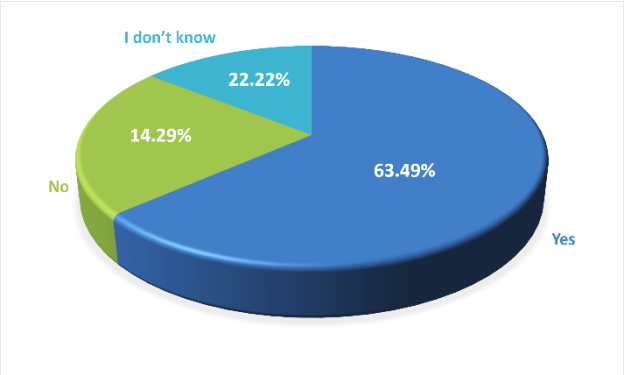


Figure 26. Bulgaria perception on the necessity for digital tools to support bioeconomy development.

Denmark

In Denmark, a total of 28 responses were obtained from various types of stakeholders (4 Biomass producers – 4 Industry actors – 5 Academics/researchers – 7 Government bodies/policy-makers – 10 members of Civil society – 3 from Other groups). Also, the majority of the participants (39.4%) were based in rural areas.

The participants showed a general understanding of the **benefits of bioeconomy growth** in their area, particularly in terms of **business development**. The **creation of job opportunities**, along with the **decreased dependence upon fossil fuels** were also acknowledged as considerable benefits by many participants (80%). Improved public health was recognized as the least acknowledged benefit among the participants.

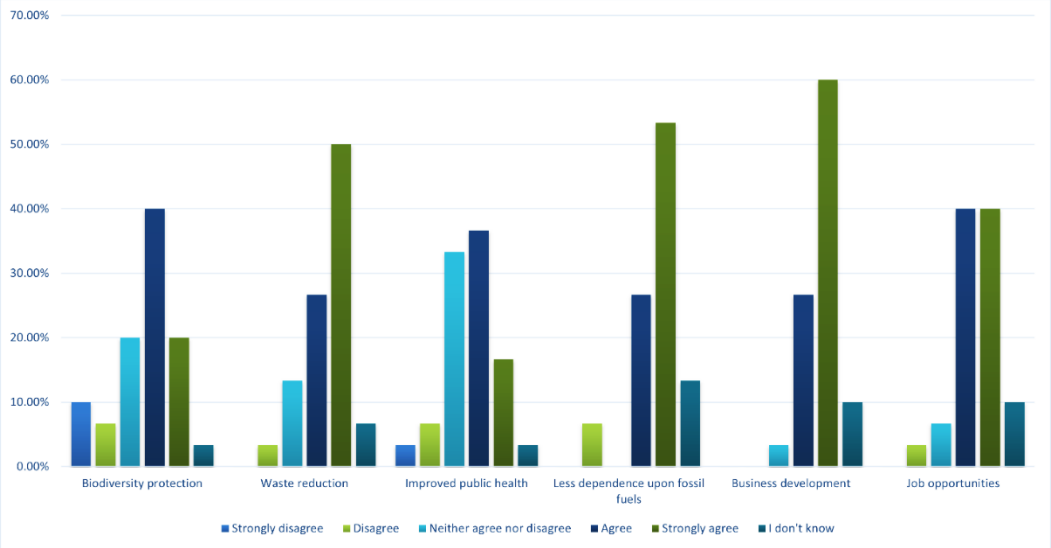


Figure 27. Denmark's perception on regional bioeconomy benefits

Regarding the **knowledge of biobased products and solutions**, the survey results show that a substantial portion of the respondents, as illustrated by Figure 28, were **familiar with biobased products**, with only 2/28 respondents declaring non-familiar with biobased products. Nearly half of the respondents (45.4%), were informed that biobased products can be partially or entirely derived from biomass, and that biobased products may not necessarily be biodegradable. Overall, the general perception among the respondents was that biobased products are all biodegradable, which may is not accurate.

Figure 28. Denmark's awareness levels on biobased products

The participants showed a mixed response when it comes to trust in biobased products and their certification. While 44% trusted in certification, 39.6% were **uncertain about the certification standards**. Furthermore, only 30% reported that biobased products were readily accessible in the market, suggesting the **need for better accessibility** and **visibility** of these products to encourage wider adoption. Additionally, a small portion, 25.3%, considered the cost of biobased products to be unfair.

Considering the **needs** of the region in relation to bioeconomy development, the survey results reveal that the major needs identified by participants were **investments in R&D**; **a supportive regulatory framework** and access to finance supported by over 40% of the respondents (as shown in Figure 29). The needs with the lowest support among participants were awareness actions, demonstration sites, and infrastructure supported by less than 65% of the respondents.

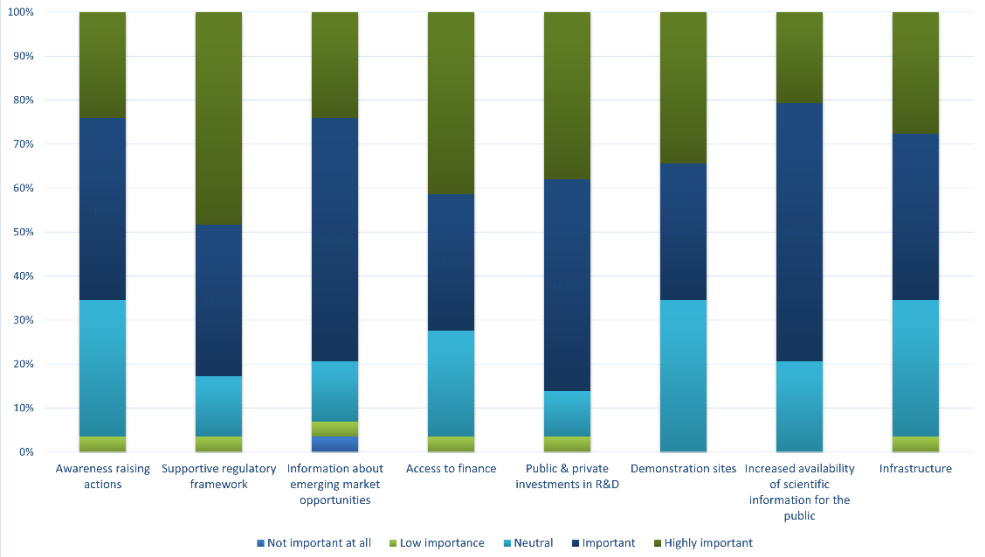


Figure 29. Denmark's perceptions on regional needs for bioeconomy development

The analysis of the challenges in the development of bioeconomy in the region revealed that the major **barrier** for the Danish regions is the **lack of policy incentives**, according to 82% of the respondents. The **high costs** of investing in the biobased sector and the **limited access to finance** amongst stakeholders in the value chain were two additional highest rated barriers (Figure 30).

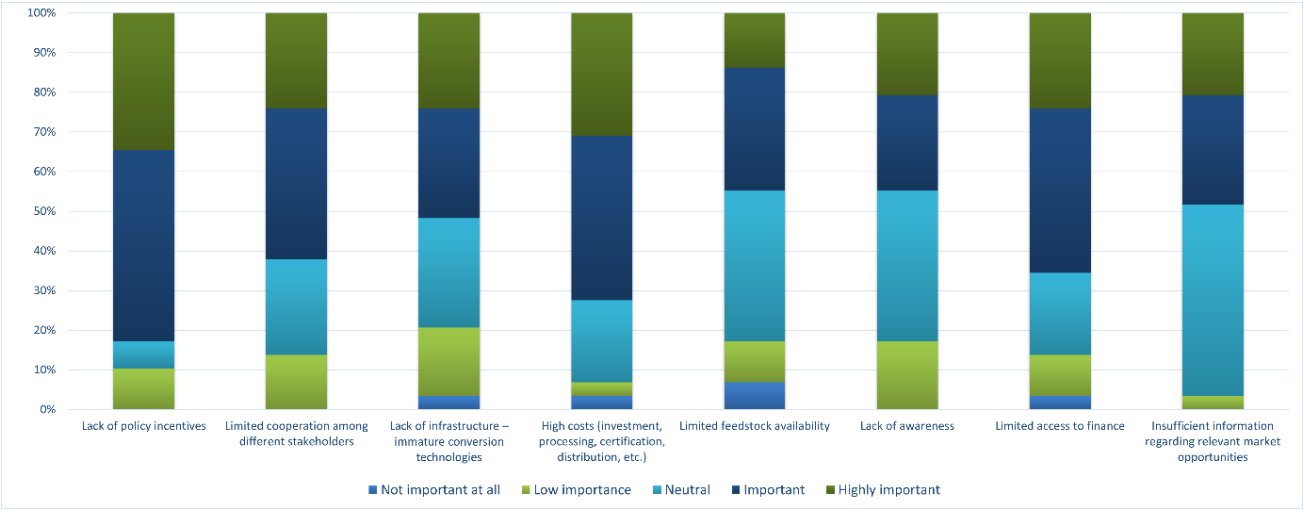


Figure 30. Denmark's perceptions on regional barriers hindering bioeconomy development

With regard to biobased solutions more than half of the participants (57.1%) reported that **farmers in the region are actively engaged with biobased solutions**, whereas 46.2% stated that farmers are well aware of biobased solutions.

Even though only a small percentage of 25% believe they have sufficient knowledge of biobased solutions, the majority of the participants were able to recognize common nutrient recycling practices applied in the region, such as **composting** (26.3%), **anaerobic digestion** (23.2%) and **biological treatment** (16.2%). However, the lowest recognition among the participants was for manure drying (5%).

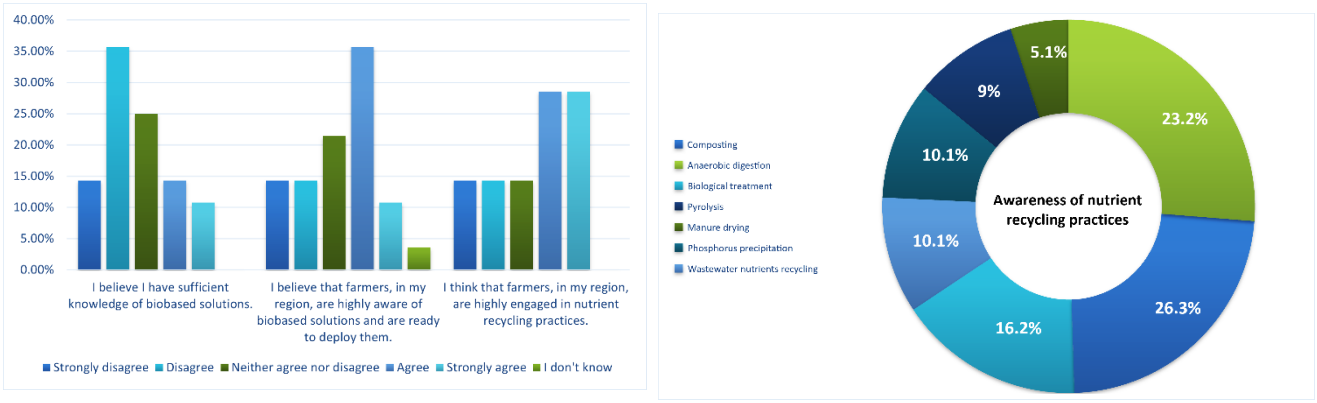


Figure 31. Denmark's perceptions levels on biobased solutions & nutrient recycling practices

In terms of **technical support services**, **scale-up and optimization** for increased efficiency and yields and monitoring and **training on nutrient recycling practices** are the most frequently mentioned among survey participants in Denmark. In general, all of the technical support services listed are considered to some extent impactful on the adoption of biobased solutions. However, project design and development is considered to be the least impactful of these services.

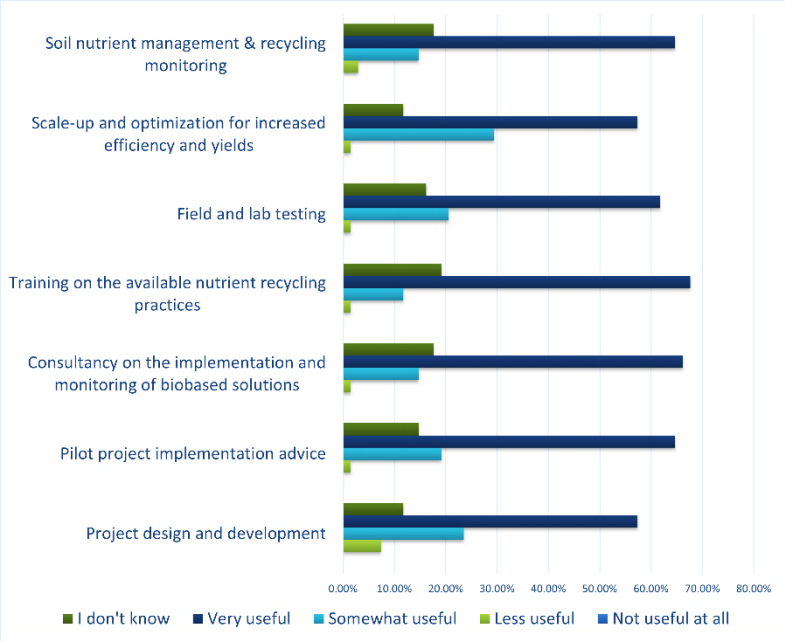


Figure 32. Denmark's perception on MainstreamBIO technical support services

In relation to potential **business support services** that could assist the growth of the Danish biobased sector, the results showed that **access to finance** received the highest level of support, with 82.1% of participants agreeing that it is a useful service. **Market research** and **value chain development** received a comparable amount of support.

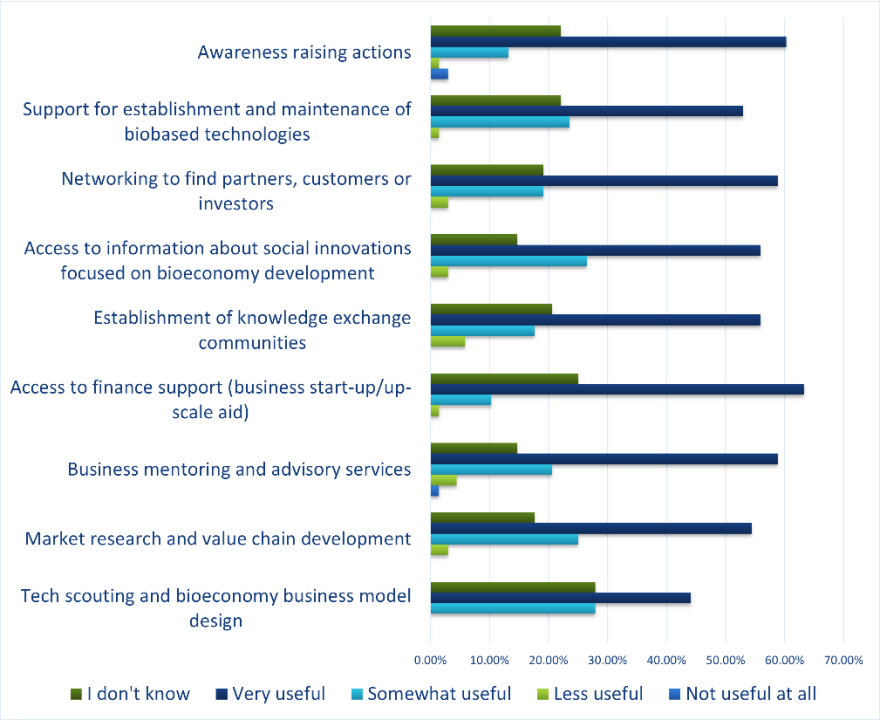


Figure 33. Denmark's perception on MainstreamBIO business support services

Lastly, concerning the respondents' perception on the **need for digital tools** to support the development of Danish bioeconomy, a majority of 57.2% expressed their belief in the efficacy of such tools, while 10.7% held a contrasting view. Though, approximately 32.1% of participants had no discernible stance on the matter. This may underlines the need for further awareness and education about the benefits and potential of digital tools in supporting the growth of the bioeconomy sector.

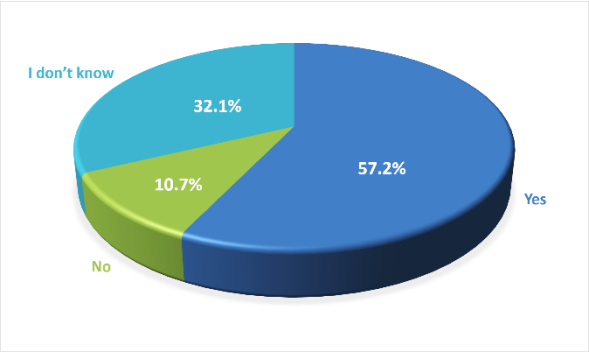


Figure 34. Denmark's perception on the necessity for digital tools to support bioeconomy development.

Spain

In Spain, a total of 11 responses were gathered from a diverse group of stakeholders (4 Industry actors – 3 Academics/researchers – 1 Civil society – 3 from Other groups). The majority of the participants, residing in urban areas, accounted for 70% of the total respondents.

The participants demonstrated an **overall understanding of the advantages of bioeconomy growth** in their region, particularly in terms of **biodiversity protection**, which was acknowledged by 86.6% of them. Moreover, the **creation of job opportunities** was also highly regarded as a benefit by many participants, with 80% of them recognizing its significance. No significant differences were noted among the rest of the listed benefits.

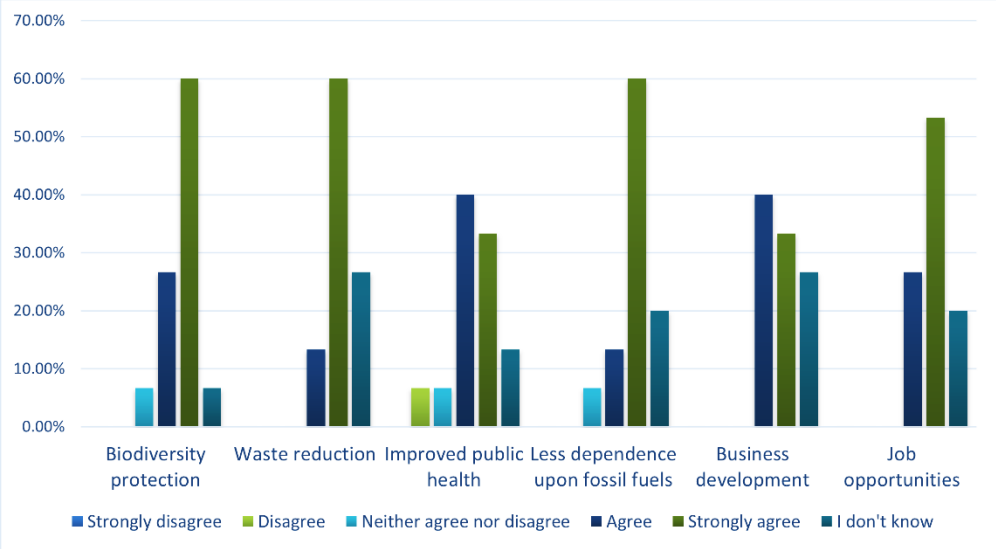
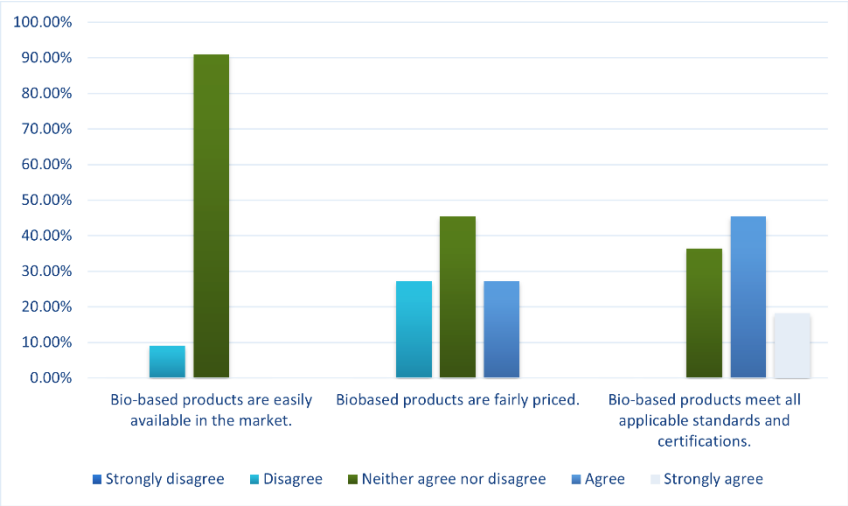


Figure 35. Spain's perception on regional bioeconomy benefits

The survey results regarding the knowledge of biobased products and solutions indicate that **all the respondents were familiar with biobased products** to some degree, with 40% of them declaring themselves as highly knowledgeable. While 40% of the respondents were aware that biobased products could be partially or entirely derived from biomass, another 45% recognized that biobased products may not necessarily be biodegradable. Despite this, the general perception among the participants was that biobased products were derived solely from biomass and were biodegradable.



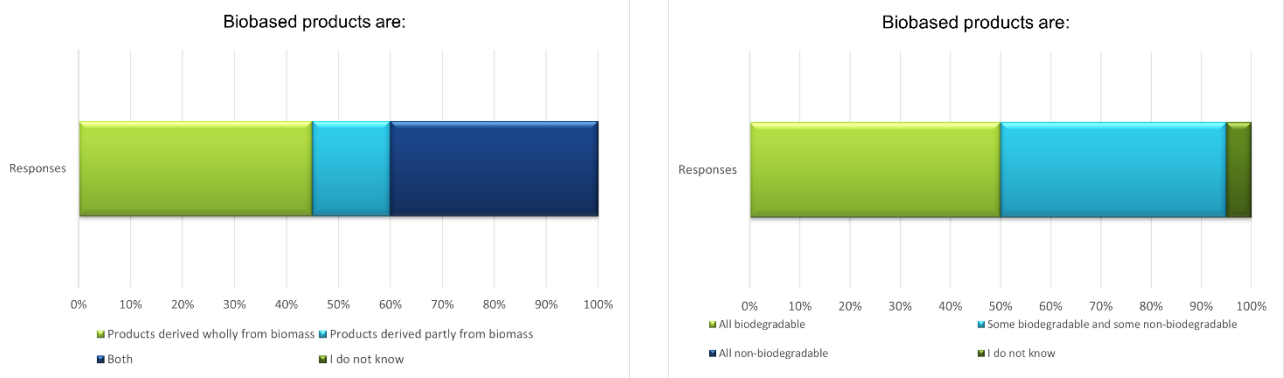


Figure 36. Spain's awareness levels on biobased products

Regarding the level of trust in biobased products' certification, the results showed a mixed response from the participants. While 63.6% expressed their belief that **biobased certification schemes are trustworthy**, a significant portion of 36.3% were uncertain about the certification standards. Furthermore, only 90.9% of the participants neither agreed nor disagreed with the fact that there is sufficient availability of biobased products in the market, indicating **room for improvement in their accessibility**. Finally, the survey results with regards to cost revealed a split opinion among the participants, with 27.3% considering the pricing of biobased products to be fair and another 27.3% disagreeing. The majority of the respondents, 45.4%, held a neutral stance on the issue.

The next part of the analysis focuses on the **needs** of the region in relation to bioeconomy development. The majority of the listed options got similar support from the participants (84.6%). The needs receiving less support include demonstration sites (69.2%) and more scientific information available for the public (53.8%).

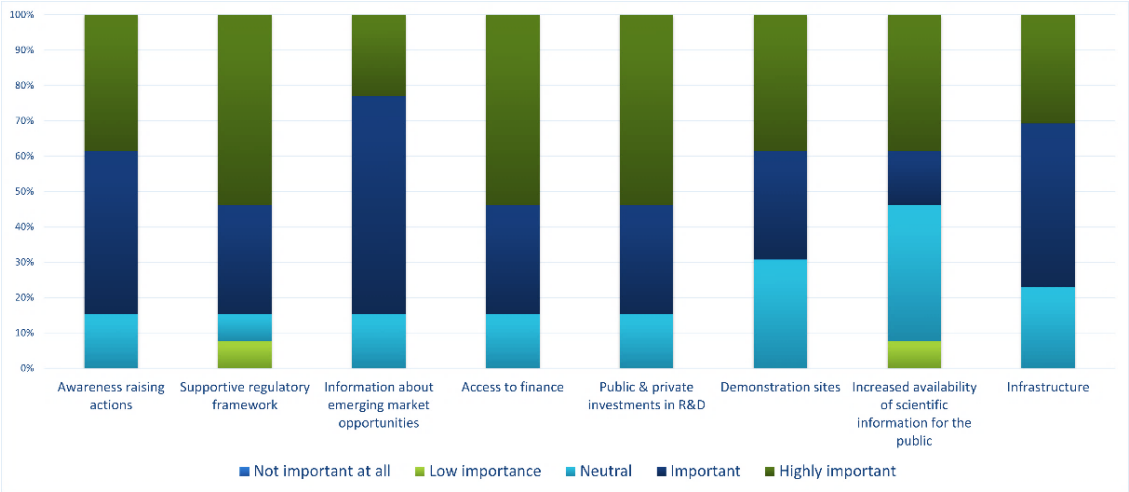


Figure 37. Spain's perceptions on regional needs for bioeconomy development

Funded by the European Union

Regarding the **challenges** faced in the development of bioeconomy in Spain, the survey results reveal that three main issues were identified by the participants. These include the **high cost** associated with biobased investments (92.3%), the **insufficient knowledge** about available market opportunities (84.6%), and a general **low level of awareness** about the topic (76.9%).

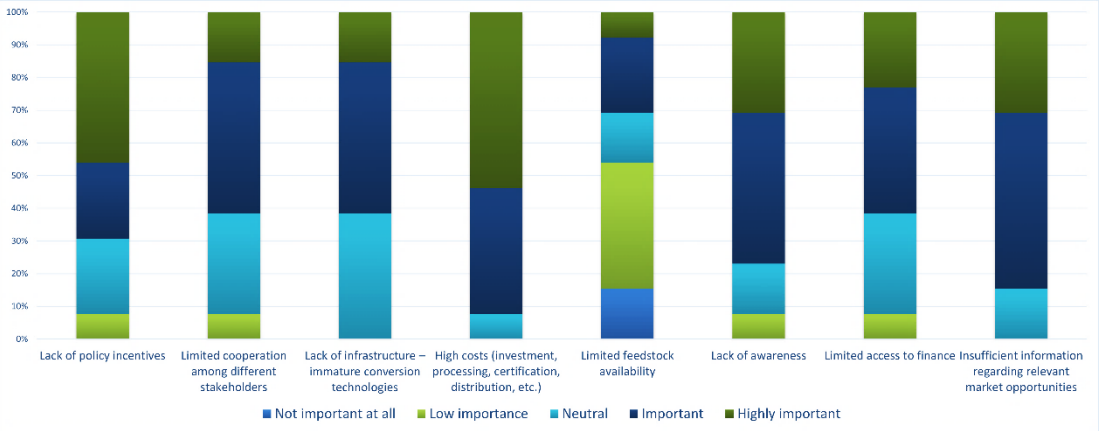


Figure 38. Spain's perceptions on regional barriers hindering bioeconomy development

Regarding **biobased solutions**, many participants (45.5%) disagreed that farmers are using them, and even more (54.5%) said that **farmers are not aware of them**. However, most participants were aware of the nutrient recycling practices in the region, with **composting** (24.3%), **manure drying** (21.6%), and **anaerobic digestion** (16.2%) being the most recognized methods. Phosphorus precipitation had the lowest recognition (2.7%) among participants.

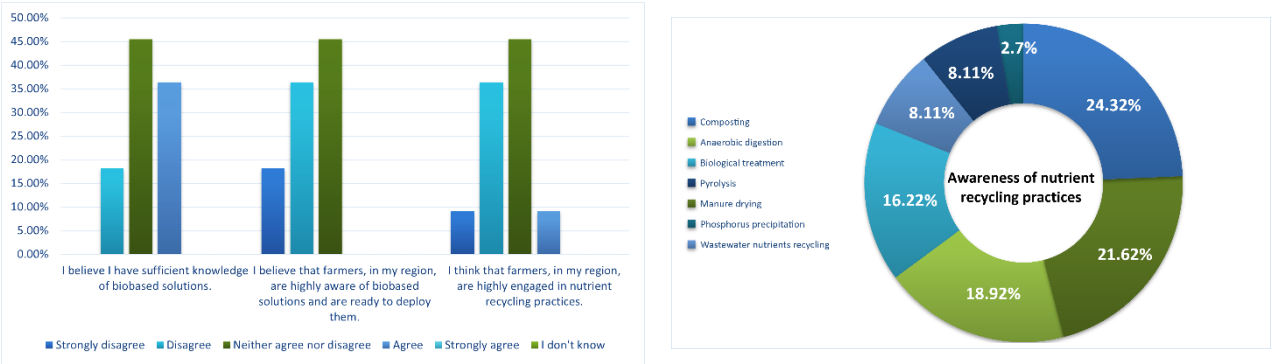


Figure 39. Spain's perceptions levels on biobased solutions & nutrient recycling practices

When it comes to **technical support services**, Spanish participants in the survey found **pilot project implementation advice** to be the most valuable service. The other services received similar levels of support (63.6%). However, consultation on the implementation and monitoring of biobased solutions and training on nutrient recycling practices were considered of less importance for enhancing biobased solutions.

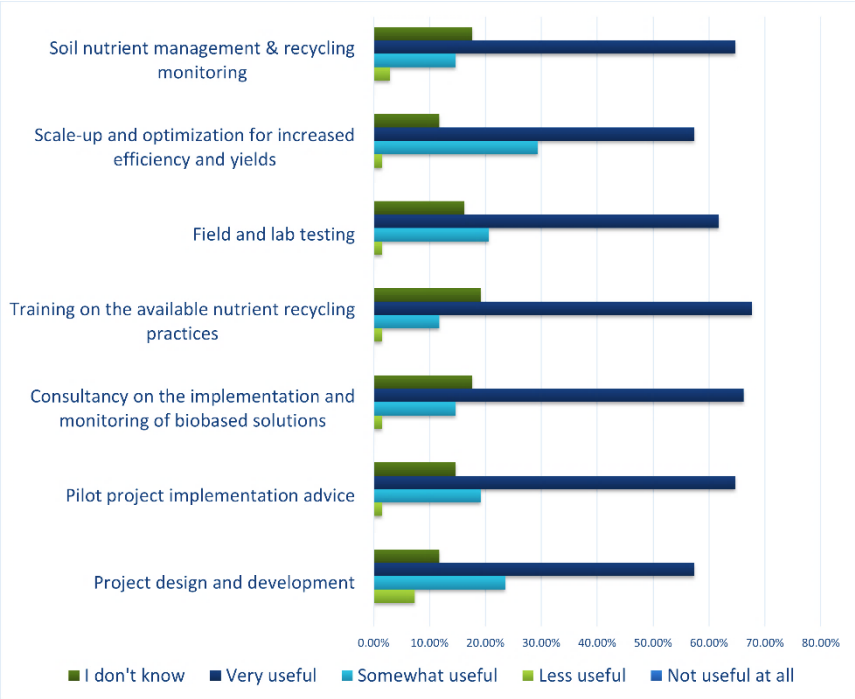


Figure 40. Spain's perception on MainstreamBIO technical support services

The analysis of **business support services** showed that Spanish participants largely valued **consultancy on the implementation and monitoring of biobased solutions**, as well as **access to information about social innovations** in bioeconomy development (63.6%). However, awareness raising and market research and value chain development received lower levels of support (27.2%). The majority of respondents in Spain reported not being aware of the majority of the business support services offered.

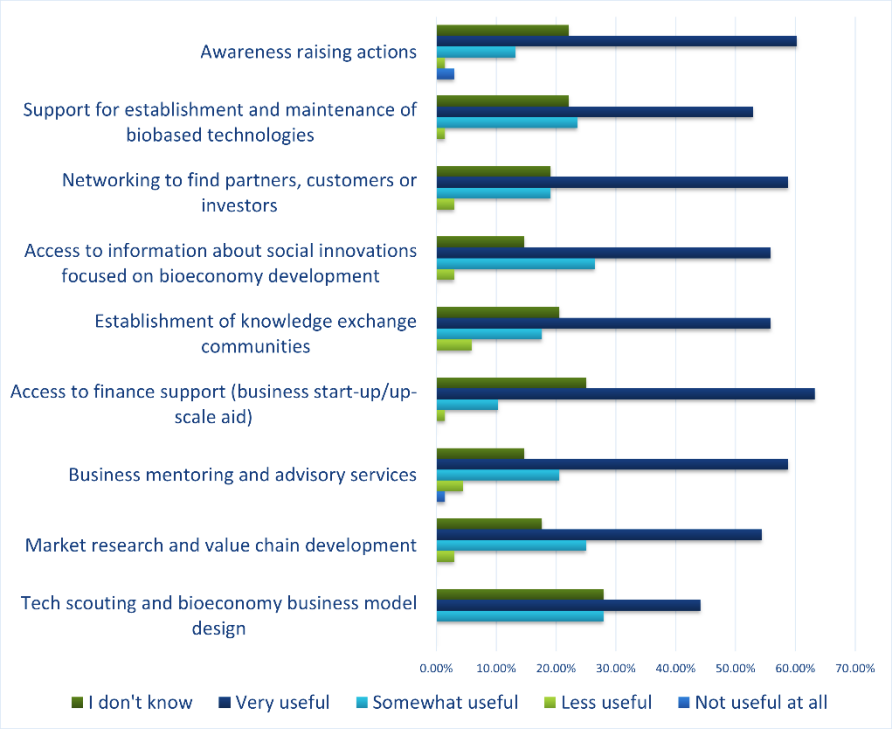


Figure 41. Spain's perception on MainstreamBIO business support services

Finally, the results of the survey revealed a significant number of participants who recognize the **potential usefulness of digital tools** in supporting the development of the bioeconomy, with 81.8% expressing a positive view. Only 9% held a contrary perspective, while the remaining 9% had no clear opinion.

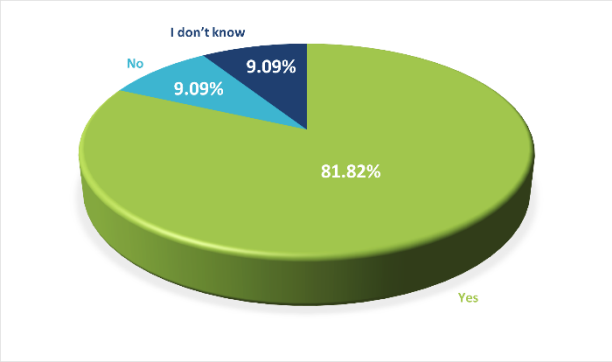


Figure 42. perception on the necessity for digital tools to support bioeconomy development.

Poland

In Poland, 68 stakeholders participated in the survey (9 Biomass producers – 9 Industry actors – 30 Academics/researchers – 1 Government bodies/policy-makers – 16 Civil society – 3 from Other groups). The majority of the participants (66.6%) were based in urban areas.

The survey results indicated that participants had a **general understanding of the benefits of the bioeconomy**, with **waste reduction** and **decreased dependence on fossil fuels** being widely recognized as benefits (74.3%). The creation of job opportunities was the least acknowledged benefit among participants.

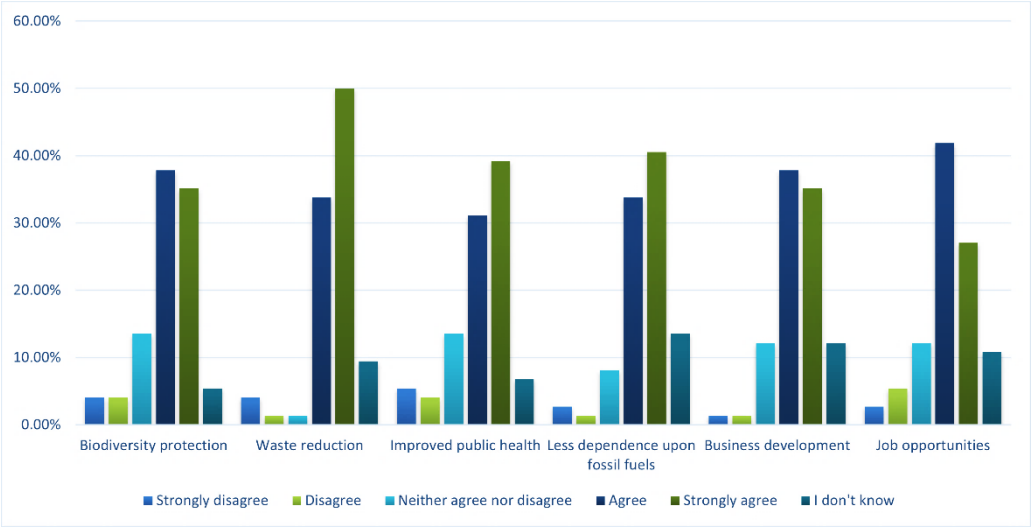


Figure 43. Poland's perception on regional bioeconomy benefits

The survey results regarding knowledge of biobased products and solutions indicated that a vast majority of the participants, approximately 88.4%, were **familiar with biobased products**. On the other hand, only 12% of the respondents stated that they were not familiar with biobased products. It was noted that over half of the participants, or 52.5%, were aware that biobased products could be either partially or completely derived from biomass. Conversely, a smaller percentage of

respondents, approximately 32%, were cognizant of the fact that biobased products may not necessarily be biodegradable.

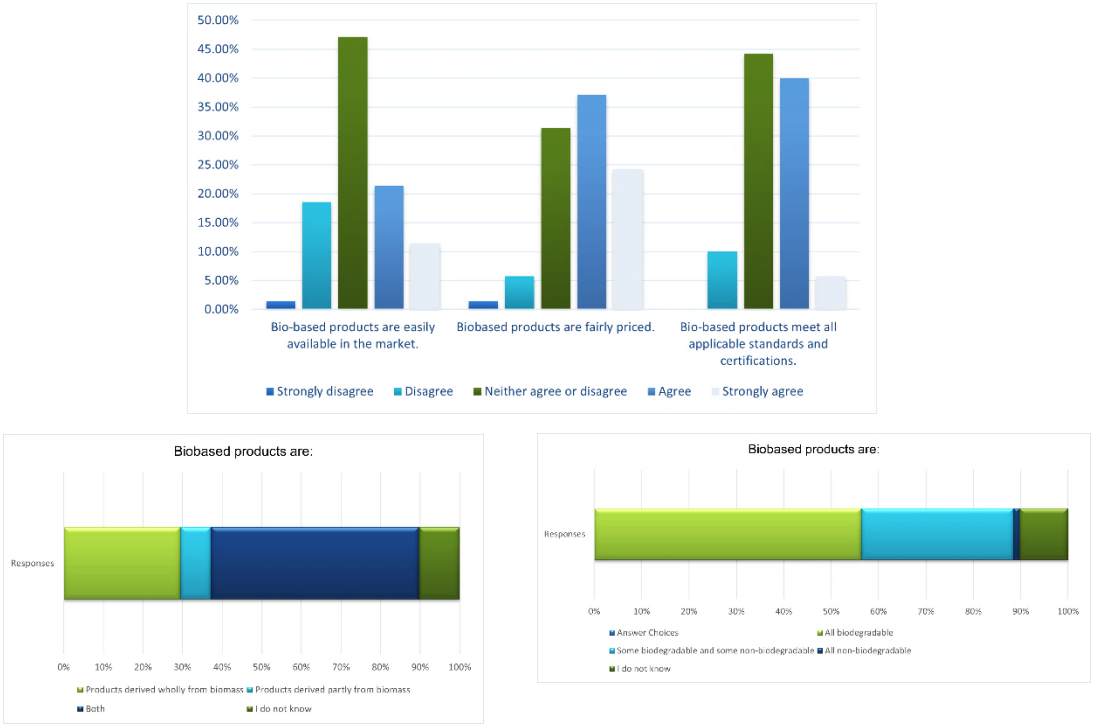


Figure 44. Poland's awareness levels on biobased products

In terms of the level of **trust in biobased product certification**, the participants showed **a mixed response**, with 40% expressing their trust in certification, while 44.3% expressed uncertainty. Additionally, the results showed that only 32.8% of participants found biobased products easily accessible in the market, indicating that there is a need for improved access to the biobased market. Concerning the cost, while 61.4% of participants considered the pricing of biobased products to be fair, 31.4% had no clear opinion.

When it comes to the analysis of the regional **needs**, the top three identified needs in the region, as indicated by the survey results, are **access to finance**, **awareness-raising actions**, and **a supportive regulatory framework**, each receiving support from over 89% of the respondents. In general, all of the listed needs received a similar amount of responses, with none appearing to be of lesser importance.

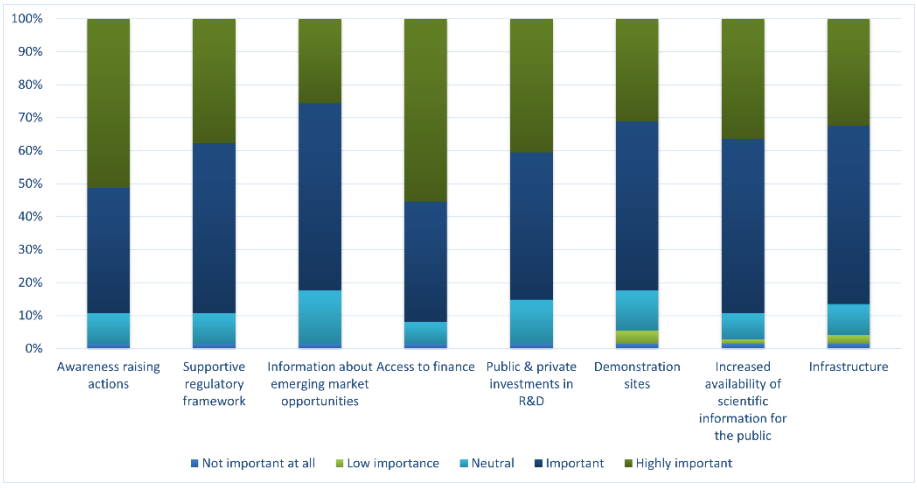


Figure 45. Poland's perceptions on regional needs for bioeconomy development

Funded by the European Union

The results of the survey revealed that the highest-rated **barriers** to the development of the bioeconomy in the region were the **lack of infrastructure**, **limited awareness**, and **limited feedstock availability**, as shown in Figure 46.

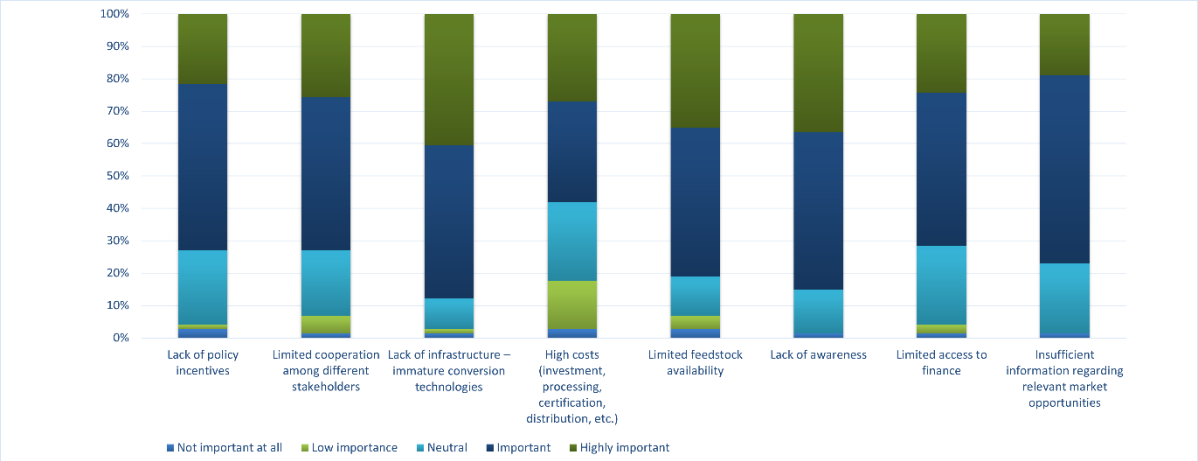


Figure 46. Poland's perceptions on regional barriers hindering bioeconomy development

With regards to the engagement of farmers with biobased solutions, the results showed that more than half of the participants (57.1%) reported that **farmers in the region are not actively involved with biobased solutions**, and an equal proportion of responses (57.1%) indicated that **farmers lack relevant awareness**. These findings suggest that there is a need for efforts to increase farmers' engagement and understanding of biobased solutions.

On the other hand, the results showed that the participants have a **good level of awareness of the nutrient recycling practices applied in the region**. The majority of participants recognized **composting** (34.4%), **biological treatment** (16.23%), and **anaerobic digestion** (15.58%) as the most commonly applied methods. However, recognition of phosphorus precipitation was the lowest among the participants (1.95%).

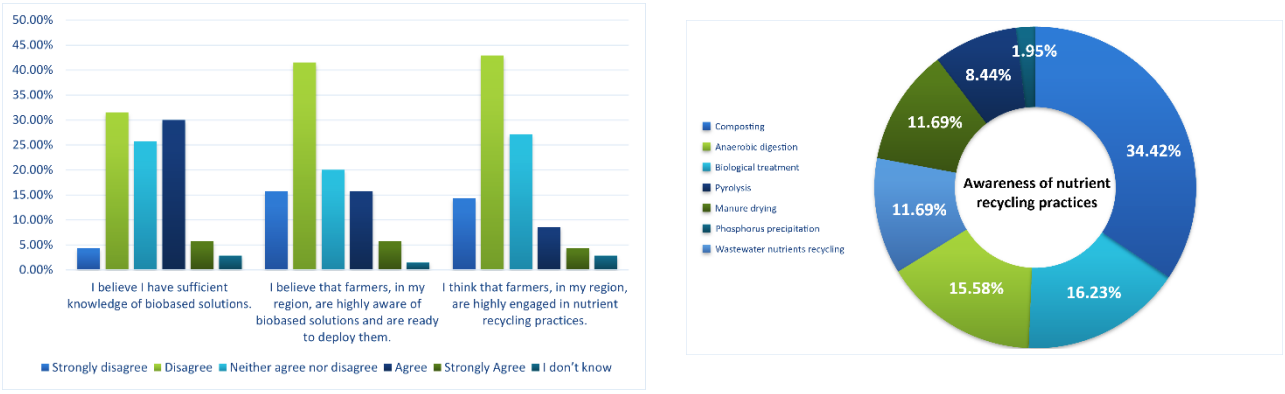


Figure 47. Poland's perceptions levels on biobased solutions & nutrient recycling practices

Upon analysis of the **technical support services** necessary for the growth and expansion of the Polish biobased sector, the survey results indicate that **field and laboratory testing**, **advice on pilot project implementation**, and **support for scale-up and optimization for increased efficiency and yields** are the most highly valued services, receiving the support of over 80% of the participants. The remaining technical support services also received a comparable level of support from the participants.

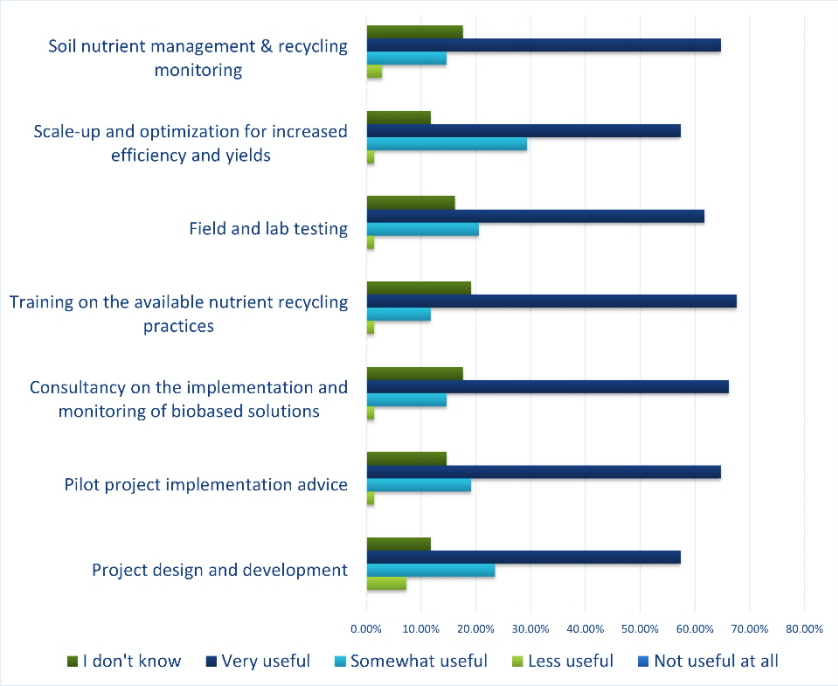


Figure 48. Poland's perception on MainstreamBIO technical support services

In terms of **business support services**, the results highlight the need for **access to information regarding social innovations** in the bioeconomy, with a majority (82.3%) of the participants recognizing its significance. The results demonstrate an even distribution of support among the various business support services, with the majority of participants finding all of them to be useful.

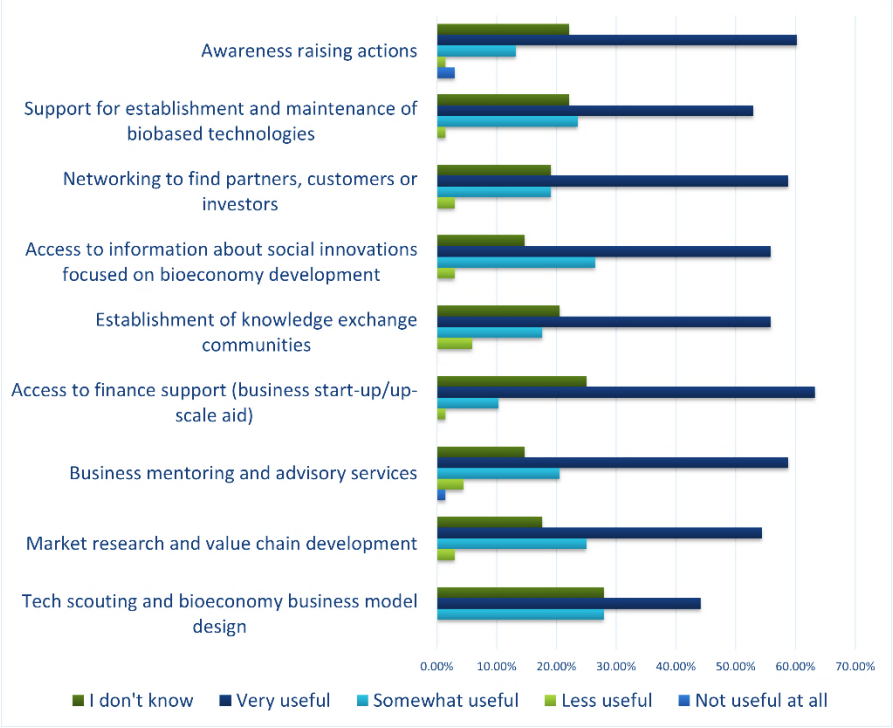


Figure 49. Poland's perception on MainstreamBIO business support services

Lastly, concerning the **adoption of digital tools** to support the development of the bioeconomy, the survey results suggest that a majority (67.4%) of the participants **believe in their usefulness**, while

a smaller portion (11.7%) hold a different view. The remaining participants (20.59%) had no clear opinion on the matter.

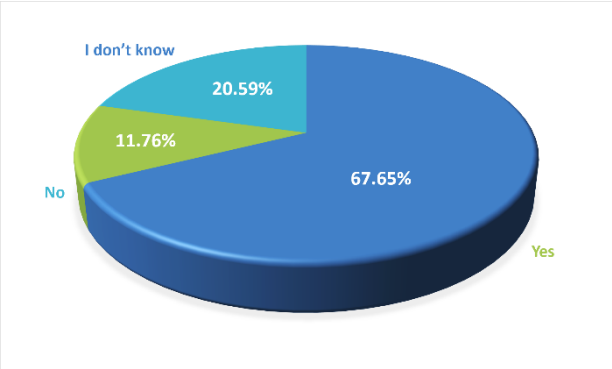


Figure 50. Poland's perception on the necessity for digital tools to support bioeconomy development.

Ireland

In Ireland, a total of 43 responses were obtained from various types of stakeholders (11 Biomass producers – 8 industry actors – 12 academics/researchers – 3 Government bodies/policy-makers – 7 members of civil society – 2 from Other groups). Most of the participants (60%) were based in rural areas.

The results of the survey revealed that the participants had a general understanding of the **benefits of bioeconomy growth**, with the majority recognizing **waste reduction** (82.2%) and **decreased dependence on fossil fuels** (80%) as the most significant advantages. The least acknowledged benefit among the participants was improved public health.

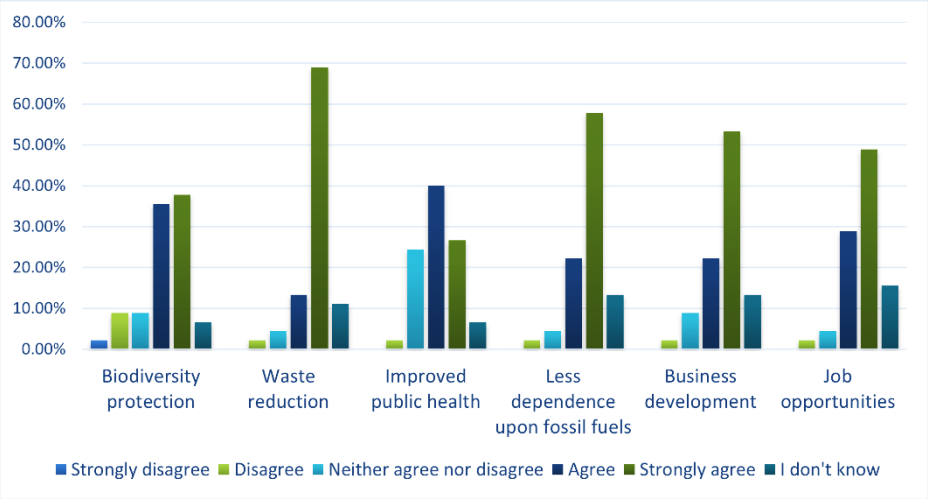


Figure 51. Ireland's perception on regional bioeconomy benefits

With regards to the knowledge of biobased products and solutions, the results indicated that a substantial proportion of the respondents, constituting 93.3% of the total, were **familiar with**

biobased products and solutions. Over half of the respondents, constituting 63-66% of the total, were informed that biobased products can be partially or entirely derived from biomass and may not necessarily be biodegradable.

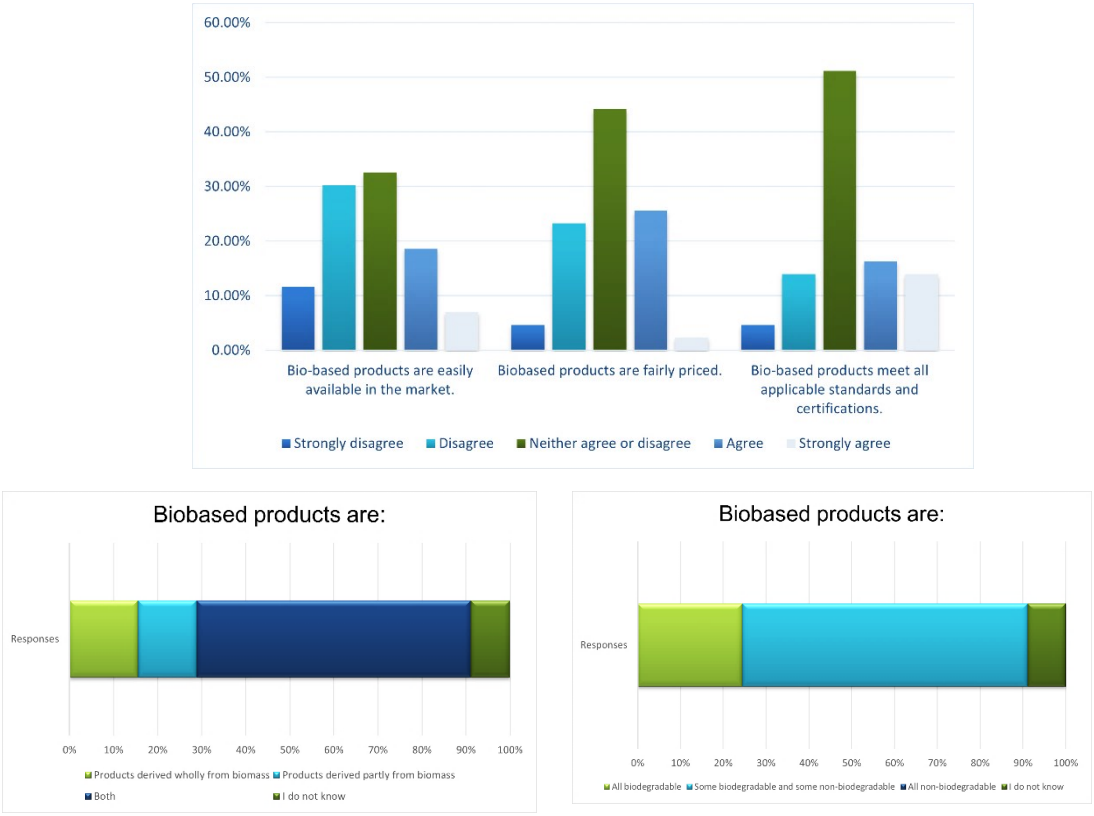


Figure 52. Ireland's awareness levels on biobased products

The level of trust in biobased products in terms of certification revealed a mixed response from the participants in Ireland, with 30.2% agreeing that biobased products meet all applicable standards and certifications, 18.6% disagreeing, and 51.1% indicating **uncertainty about the certification standards**.

Additionally, the results indicated that the majority (41.8%) of the participants disagreed with the notion that biobased products are readily available in the market, while **only 25.6% reported that they are easily accessible**. It should be noted that a significant portion of the respondents (38.1%) had no clear stance on the market availability of biobased products. In terms of cost, 27.9% of the participants considered the pricing of biobased products to be unjust, whereas 27.9% held a different opinion. Meanwhile, 44.1% had no clear opinion.

The survey also analyzed the **needs** of the region, with the results revealing that **access to finance** was the most significant requirement, receiving the support of 97.7% of the participants. The remaining needs listed received comparable levels of support (84% - 87%). The need that received the lowest support among the participants was the increased availability of scientific information to the public.

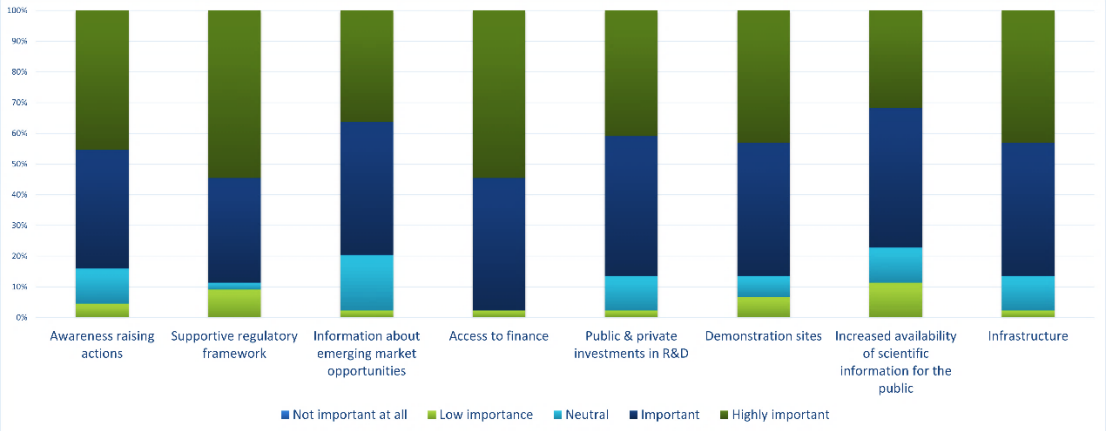


Figure 53. Ireland's perceptions on regional needs for bioeconomy development

When analyzing the **regional challenges**, the results indicate that the most significant barrier is the **absence of policy incentives**, receiving the support of 93.2% of the participants. Two additional significant challenges identified were the **lack of infrastructure** and **high costs**, receiving support from 84% - 86% of the participants. The limited availability of feedstock was reported as a smaller issue by only 54% of the participants.

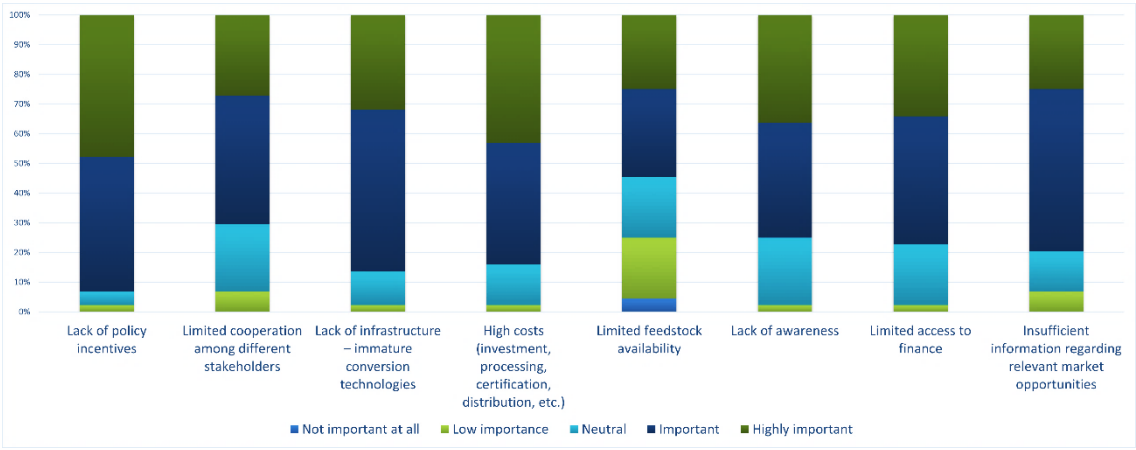


Figure 54. Ireland's perceptions on regional barriers hindering bioeconomy development

The survey also explored the perception of the participants on the involvement of farmers in biobased solutions and their level of awareness. 34.9% of the participants disagreed with the idea that farmers in the region are actively engaged with biobased solutions, while 25.6% held the opposite opinion. The remaining 37.2% of the participants had no clear opinion on the matter.

Regarding the level of awareness of farmers, the results indicated that the majority of the respondents, 67.4%, believed that farmers' **levels of awareness regarding biobased solutions were inadequate**, while only 9.3% believed they were sufficient. The remaining participants had no clear opinion on the subject.

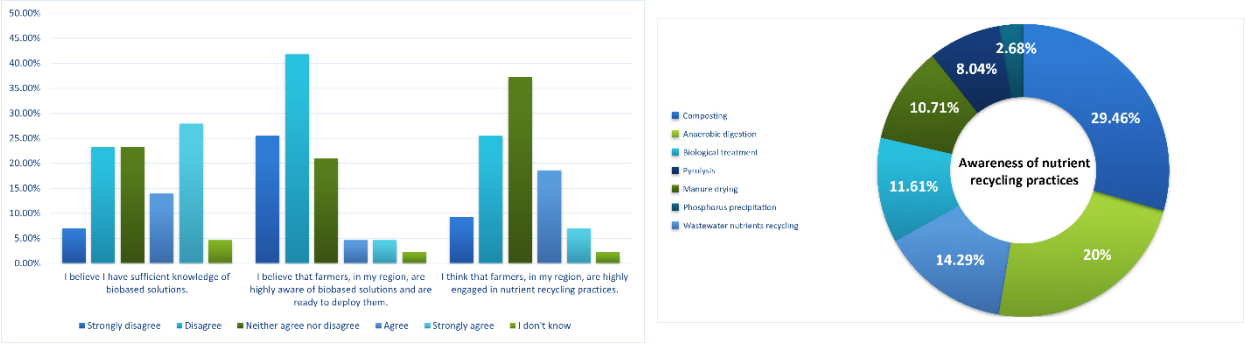


Figure 55. Ireland's perceptions levels on biobased solutions & nutrient recycling practices

Additionally, the results indicate that the participants possess a strong level of awareness of the **nutrient recycling practices** prevalent in the region. The most widely recognized methods among the participants were **composting** (29.46%), **anaerobic digestion** (20%), and **wastewater nutrients recycling** (14.29%). In contrast, the recognition of phosphorus precipitation was the lowest among the participants, with only 2.68% recognizing this method.

The results of the survey reveal that the majority of the participants acknowledge the significance of **technical support services** for enhancing the growth of the biobased sector in Ireland. **Pilot project implementation advice** and **field and lab testing** were cited as the most crucial technical support services, receiving support from 82% to 85% of the participants. The other technical support services listed were also considered to be of importance, with comparable levels of support, except for project design and development service, which received slightly lower support at around 70%.

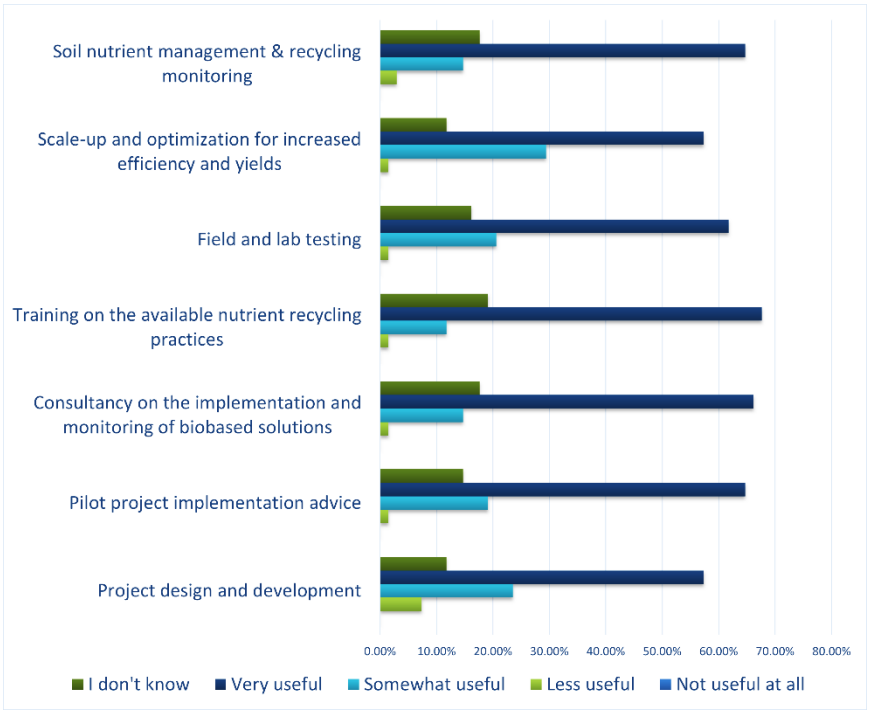


Figure 56. Ireland's perception on MainstreamBIO technical support services

With regards to **business support services**, **access to finance** and **networking** received the highest level of support among the participants, with 97.5% to 100% indicating that they are of medium-high usefulness. The majority of the participants found all of the listed business support services to be at least somewhat useful, with responses evenly distributed among them. However, tech scouting and bioeconomy business model design received lower levels of interest, with 41.5% considering them somewhat useful and 9.8% considering them not useful at all.

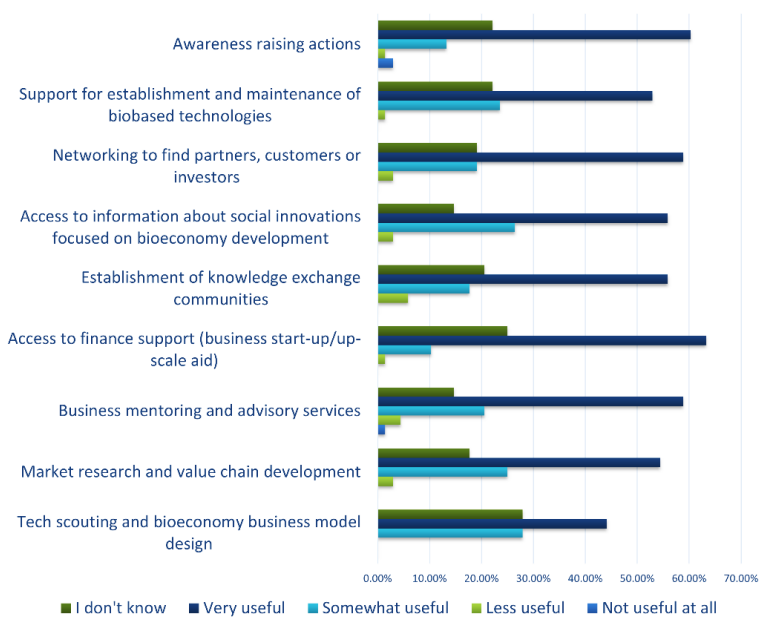


Figure 57. Ireland's perception on MainstreamBIO business support services

Lastly, the survey results suggest that a significant proportion of participants (57.14%) consider **digital tools** to be **crucial for the growth of the bioeconomy in Ireland**, while a smaller percentage (10.71%) disagree. The rest of the respondents had no definite stance on the matter.

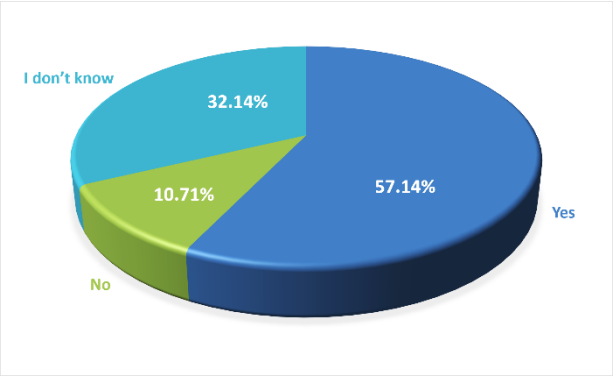


Figure 58. Ireland's perception on the necessity for digital tools to support bioeconomy development.

Sweden

In Sweden, a total of 25 responses were obtained from various types of stakeholders (3 Biomass producers – 5 Industry actors – 8 Academics/researchers – 3 Government bodies/policy-makers – 2 Civil society – 4 Other groups). Also, the majority of the participants resided in urban (38.46%) and semi-urban areas (38.46%).

The participants largely agreed on the positive impact of the bioeconomy, particularly in terms of **business and job opportunities** (84%) and a **reduced dependence on fossil fuels** (80%). However, improved public health and biodiversity protection received less recognition with most respondents (36% - 48%) having no clear opinion on these benefits.

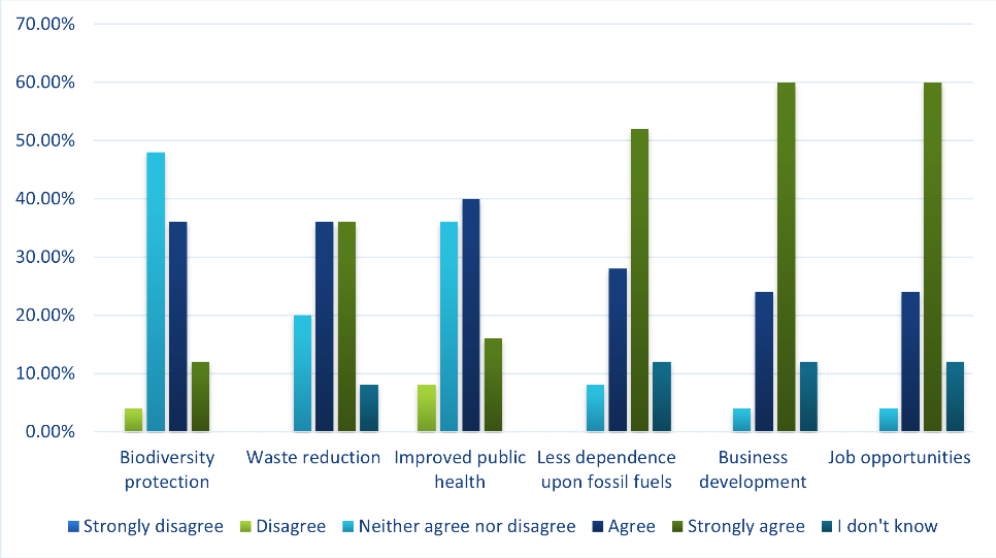
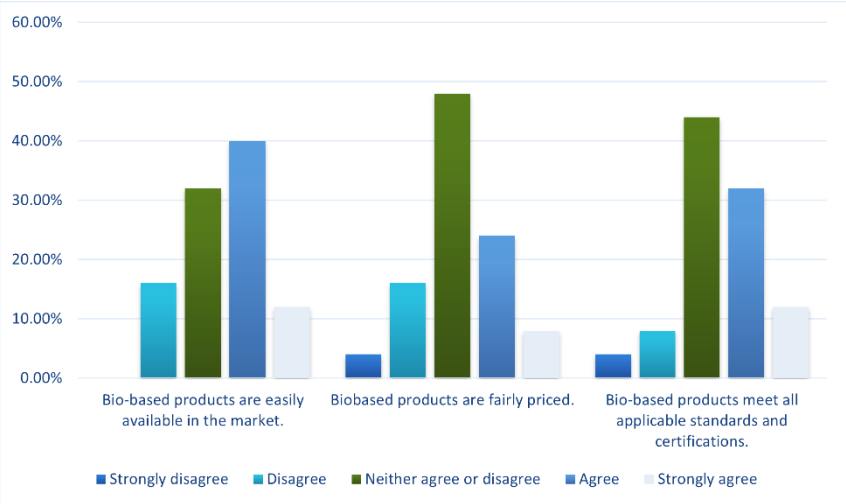


Figure 59. Sweden's perception on regional bioeconomy benefits

Regarding the knowledge of biobased products and solutions, the survey results indicate a **high level of familiarity with biobased products** among the respondents, with 92.3% reporting being familiar and only 8% stating they are not familiar. When it comes to understanding the origin of biobased products, only 34.6% of the respondents were aware that they can be derived from biomass. However, a majority of 84.6% correctly answered that biobased products can be both biodegradable and non-biodegradable.



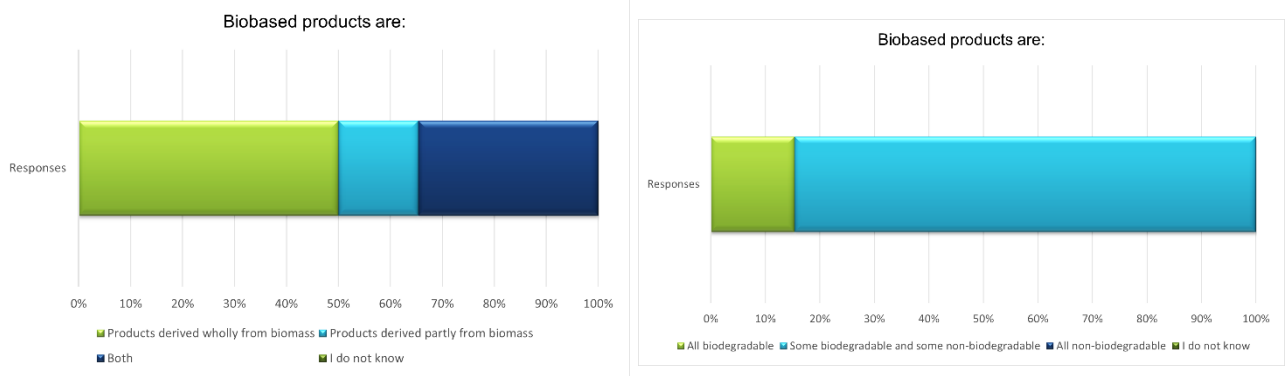


Figure 60. Sweden's awareness levels on biobased products

Concerning the level of trust in biobased products in terms of certification, 44% expressed their belief that the certification of biobased products is trustworthy, while 44% expressed uncertainty and 12% disagreed.

Regarding market availability, the majority of participants (52%) agreed that **biobased products are readily available**, while 16% reported difficulty in accessing them and 32% had no clear stance. In terms of pricing, 32% of participants considered the biobased products to be reasonably priced, 16% held a different viewpoint, and the remaining 48% had no clear opinion.

In terms of **regional needs**, the survey results indicated that **investments in R&D and demonstration sites** having equal shares of responses 96%. Other needs (e.g. infrastructure; access to finance) have comparable levels of support ranging from 84% to 88%, with the lowest level of support received for the need for increased availability of scientific information to the public (44%).

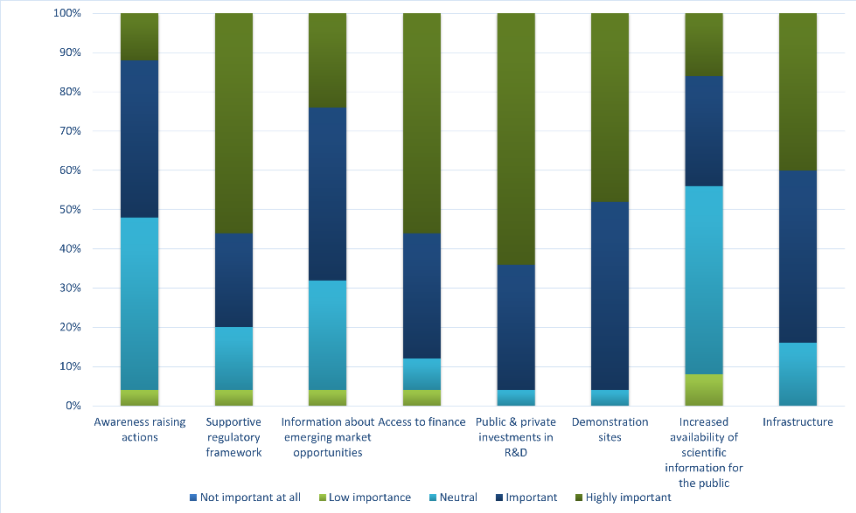


Figure 61. Sweden's perceptions on regional needs for bioeconomy development

Focusing on the **regional challenges**, a substantial proportion of the respondents, ranging from 76% to 80%, regarded the **absence of policy incentives** and the **high costs** as the most critical regional challenges, whereas the rest of the barriers were considered to be of less importance. It is worth mentioning that the respondents were divided on the issue of the lack of awareness being a major challenge, with 32% disagreeing and an equal number agreeing, while 36% held an unclear opinion.

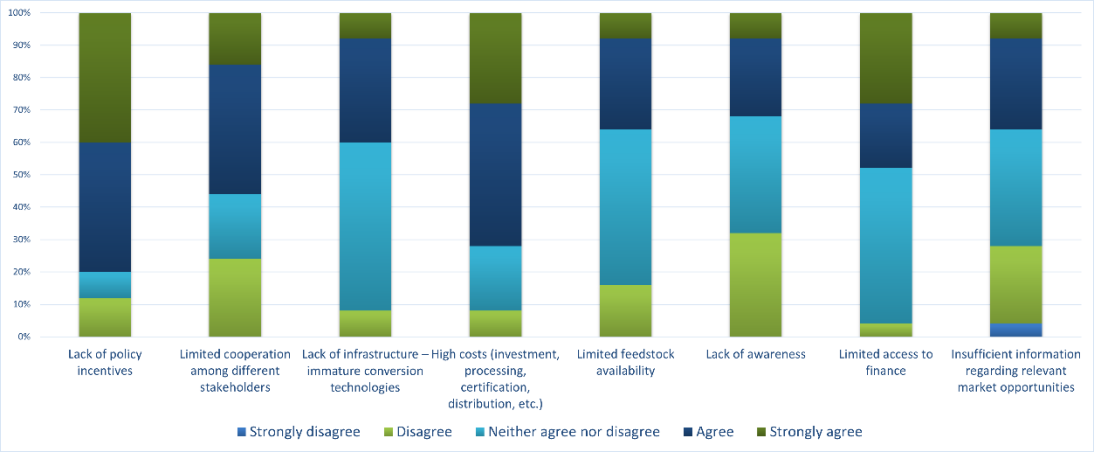


Figure 62. Sweden's perceptions on regional barriers hindering bioeconomy development

In reference to biobased solutions, 24% of the participants indicated that farmers in the region are actively involved with such solutions, while an equal number disagreed and 44% had no clear stance. The results on the level of awareness among farmers showed that the majority of the respondents, 48%, had no clear viewpoint, while 28% agreed and 16% disagreed.

Additionally, the survey results revealed that the participants had a **high level of awareness of the nutrient recycling practices** implemented in the region. A majority of them recognized **composting** (28.8%), **anaerobic digestion** (24.7%), and **wastewater nutrient recycling** (16.4%) as the most prevalent methods. On the other hand, phosphorus precipitation was the least recognized method, with only 4.1% of the participants being aware of it.

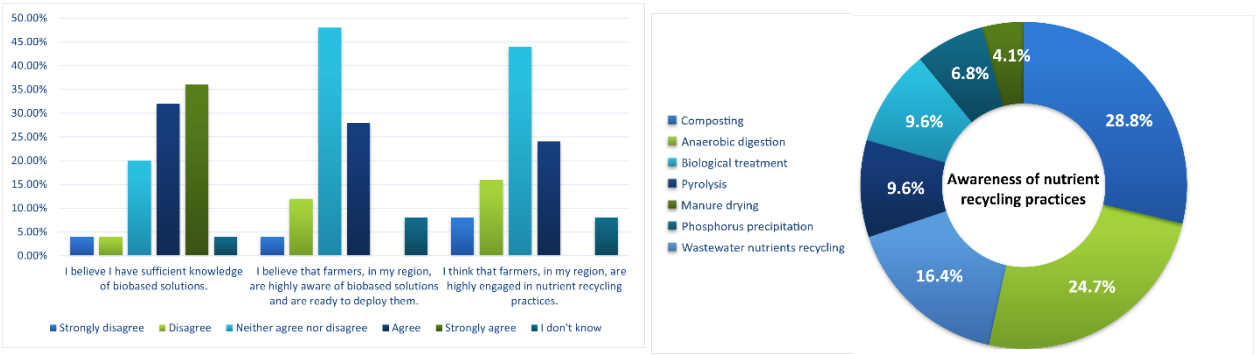


Figure 63. Sweden's perceptions levels on biobased solutions & nutrient recycling practices

With reference to the **technical support services** that could assist the uptake of biobased solutions in Sweden, it can be observed that **soil nutrient management and recycling monitoring** is considered the most useful service according to 80% of the respondents. Additionally, **project design and development**, **consultancy on the implementation and monitoring of biobased solutions** and **training on the available nutrient recycling practices** were all deemed equally important (76%). Fields and lab testing appears to be less significant (48% of the responses).

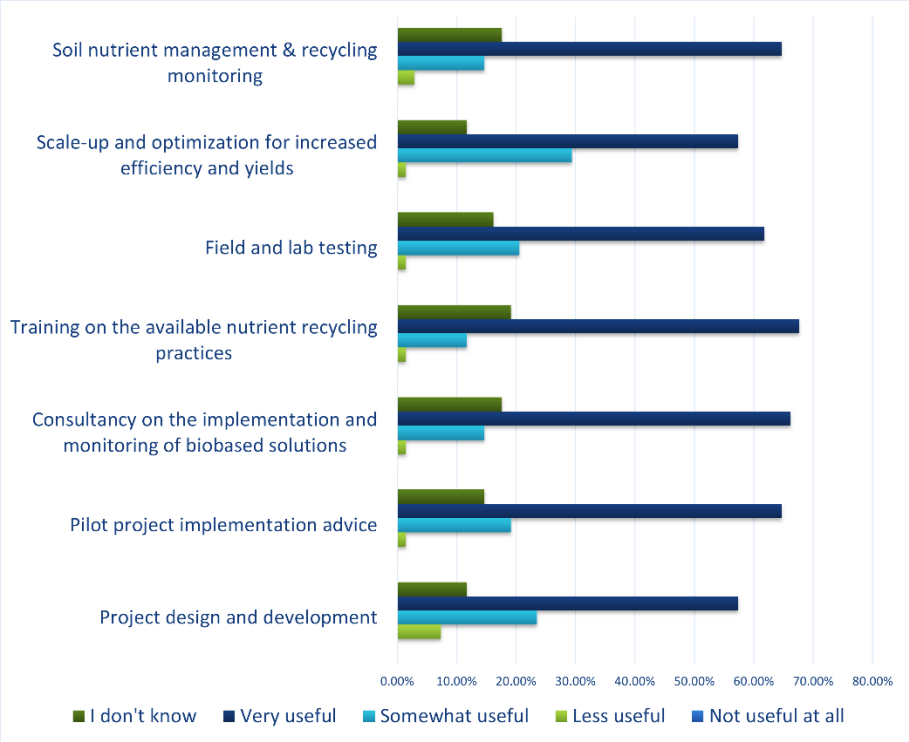


Figure 64. Sweden's perception on MainstreamBIO technical support services

On the other hand, focusing on the **business support services** (Fig. 65) it becomes evident that **business mentoring and advisory services** received the highest level of support among the participants, with 80% considering it a somewhat-high useful service. The results demonstrate a relatively even distribution of responses among the various types of business support services, with the majority of the participants finding all of them to be useful. Only a small fraction of participants (less than 5%) deemed some of the services to be of limited usefulness.

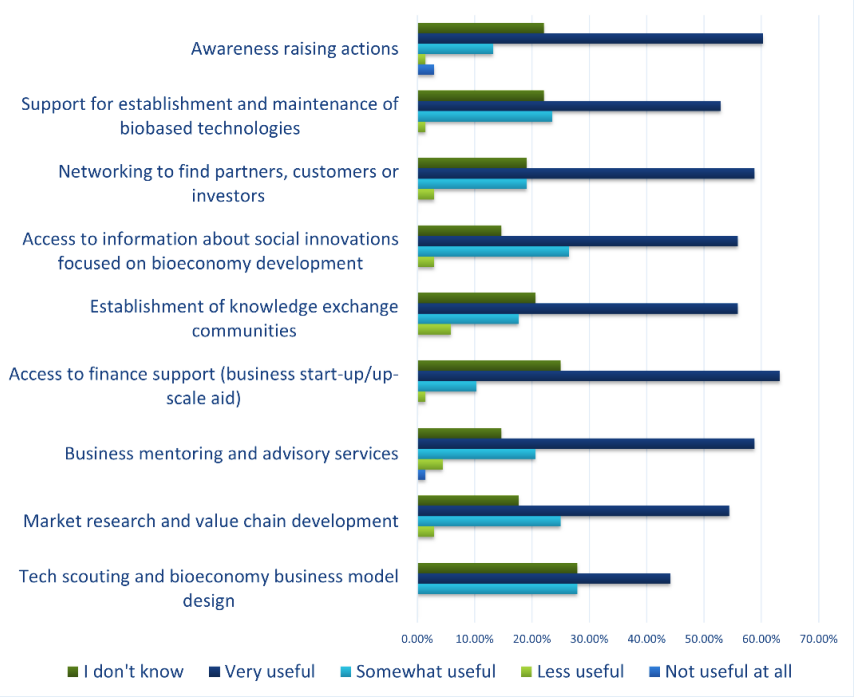


Figure 65. Sweden's perception on MainstreamBIO business support services

Funded by the European Union

Lastly, the survey results revealed the participants' perceptions on the utilization of digital tools for the development of bioeconomy in Sweden. 44% of the respondents indicated that they consider such tools to be necessary, whereas 36% held the opposite view, and the remaining 20% had a neutral stance on the issue.

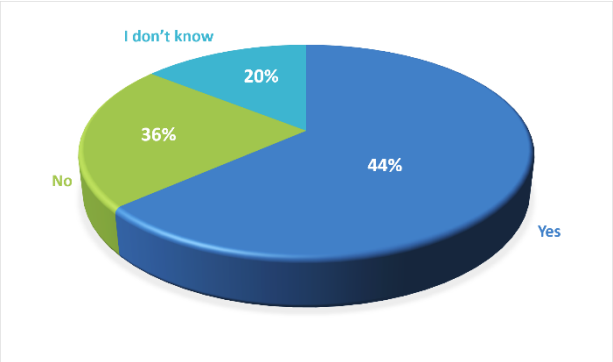


Figure 66. Sweden's perception on the necessity for digital tools to support bioeconomy development.

5.4 Statistical analysis at stakeholder group level

As mentioned at the beginning of this chapter, this survey aims to raise awareness levels and perceptions regarding bioeconomy, bio-based solution, bio-based products and nutrient circularity practices in the wider field of stakeholder groups. Participants had the option to choose their group among biomass producers (e.g. farmers, forestry, aquaculture, unions, associations), business (agri-food & bio-based industry, logistics, financing), academy / research, government / policy makers / public authorities and civil society. For this reason, the results included in paragraph 5.3 were further analyzed for each target group of responders in order to make the necessary comparisons between the groups that got involved in the survey phase. Of particular interest in this analysis is to see the differences that exist between the stakeholders' awareness and perceptions on the aforementioned topics, while making a comparison with the results obtained from the overall summary of the submitted answers. In this way, the trends can be highlighted in terms of what are considered the obstacles, needs and benefits for each stakeholder group regarding the adoption of bioeconomy practices, whether each group is aware of bio-based products and bio-based solutions as well as to state the opinion of each group on the support services resulting from MainstreamBIO.

Below, the analyzed results for each group are presented, while at the end of the chapter the comparison between them is also included.

Table 8. Number of participants per stakeholder group

Stakeholder group	No. of participants
Biomass producer (farmers, forestry, aquaculture, unions, associations, etc.)	34
Business (agri-food & bio-based industry, logistics, financing)	44
Academic/Researcher	85
Government/policy-maker/public authority	17
Civil Society	68
Other (please specify)	21
Total: 268	

Biomass producers

To begin with, it is interesting to notice that the majority of participants defend the opinion that the bioeconomy can have several benefits if applied in their area, as shown by their answer to question Q#11 regarding the benefits it can provide the bioeconomy in their area. From the resulting percentages, it is clear that the biomass producers believe in all the benefits proposed through the question with waste reduction (58.8%), public health improvement (47.1%) and business development (47.1%) dominating.

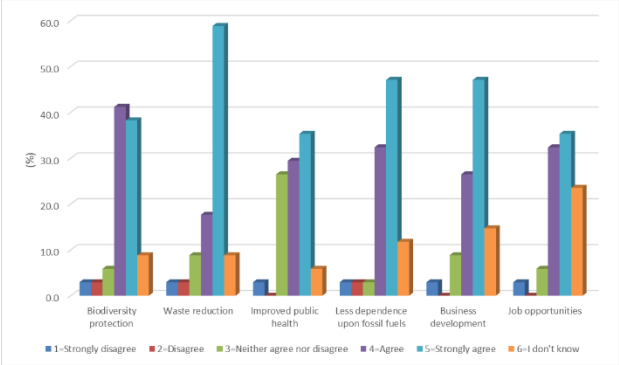
With respect to biomass producers' needs and barriers that they face regarding the uptake of bio-based solutions and bioeconomy development in their region. There is more general agreement regarding the needs (Q#14) and obstacles (Q#15) included in the survey questions, with some of them being considered the most important, but not dramatically different from the rest. Specifically, the main need for the uptake of biobased solutions appears to be access to finance (61.8%), while the most obstacles they face are mainly the high costs of investments, processing, certification and distribution (47.1%). These two results are in proportion to each other as the strengthening of investments and the better access of stakeholders to financial resources can overcome the obstacle of high costs.

In terms of biomass producers' familiarity with biobased products (Q#17), 32.4% of the participants state that they are informed about them (32.4%). At the same time, they neither agree or disagree as to whether these products are easily available on the market (35.3%), as to whether their price is justified (44.1%) and whether specific standards and certifications are applied to biobased products (41.2%).

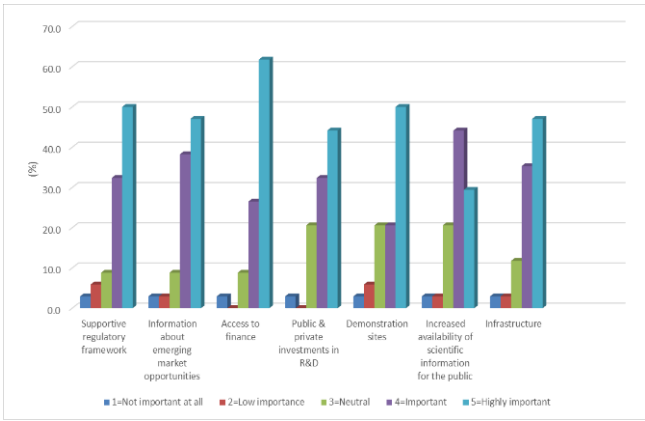
In regards to nutrient recycling practices (Q#21), the majority of participants are knowledgeable about composting (75.5%), anaerobic digestion (50.0%), and manure drying (41.2%). However, a significant percentage of biomass producers, 41.2% for pyrolysis and 44.1% for phosphorus precipitation, report not being familiar with these methods.

Finally, to the questions, the stakeholders answered to what extent they consider certain technical (Q#23) and business support services (Q#24) useful. The responses show that all the proposed services are considered primarily useful with those that stood out being the technical services of consultancy on the implementation and monitoring of biobased solution (58.8%) and the soil nutrient management & recycling monitoring (50.0%). Moreover, biomass producers agree that the most useful business services are access to information about social innovations focused on bioeconomy development (58.8%), establishment of knowledge exchange communities (55.9%) and access to finance (55.9%).

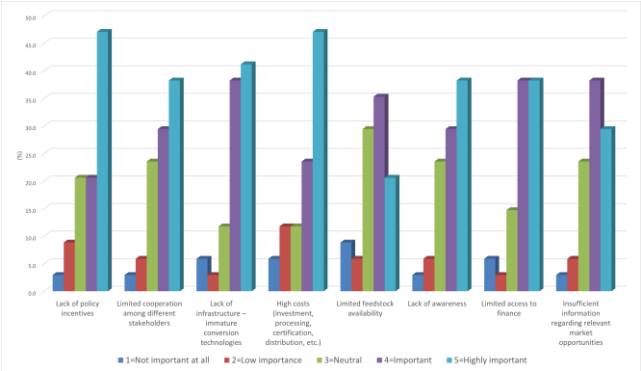
Q#11: Please indicate your agreement with what bioeconomy can provide to your region:[1=Strongly disagree; 2=Disagree; 3=Neither agree nor disagree/No opinion; 4=Agree; 5=Strongly agree; 6=I don't know]



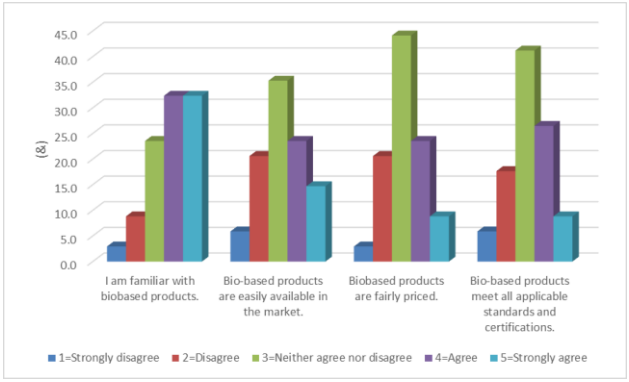
Q#14: Which of the following do you consider as important needs of your region when it comes to the uptake of biobased solutions? [1=Not important at all; 2=Low importance; 3=Neutral; 4=Important; 5=Highly important;]



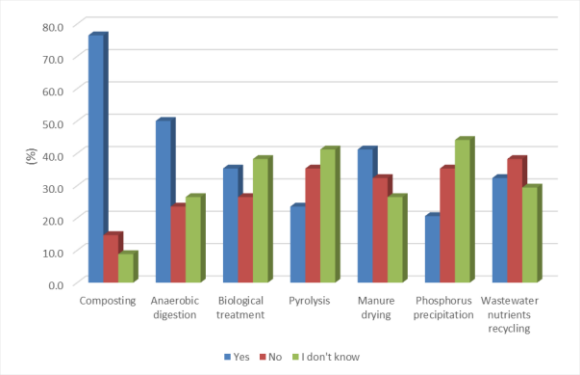
Q#15: Which of the following barrier(s) do you consider as important for your region to overcome when it comes to bioeconomy development? [1=Not important at all; 2=Low importance; 3=Neutral; 4=Important; 5=Highly important;]



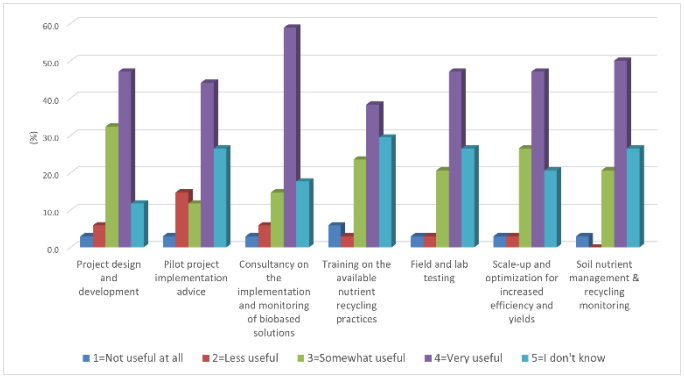
Q#17: Please indicate your agreement with the following statements: [1=Strongly disagree; 2=Disagree; 3=Neither agree nor disagree/No opinion; 4=Agree; 5=Strongly agree;]



Q#21: Are you aware if any of the following nutrient recycling practices is applied in your region? [1=Yes; 2=No; 3=I don't know]



Q#23:How useful do you consider the following technical support services for supporting investments in the biobased market? [1=Not useful at all; 2=Less useful;3=Somewhat useful; 4=Very useful; 5=I don't know]



Q#24: How useful do you consider the following business support services for supporting investments in the biobased market? [1=Not useful at all; 2=Less useful;3=Somewhat useful; 4=Very useful; 5=I don't know]

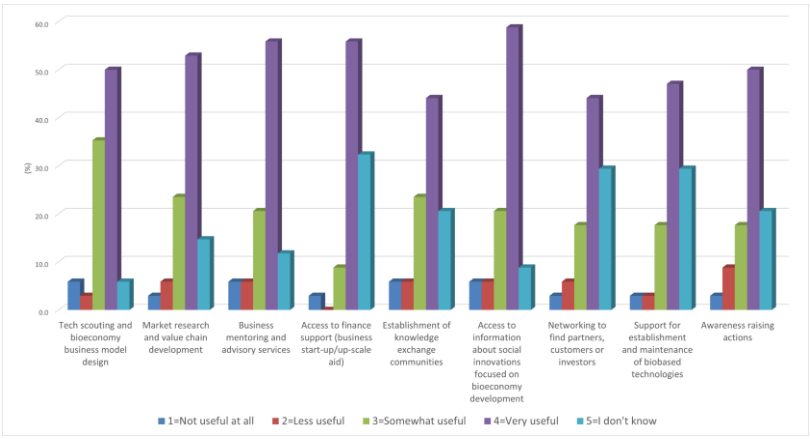


Figure 67. Biomass producers' responses analysis

Business

The next group analyzed is business, which includes stakeholders from agri-food & bio-based industry, logistics and financing. This stakeholder group is also quite important as it is active in the field of bioeconomy emphasizing the upscaling of bioeconomy practices, but at the same time it is also involved in economic affairs which are of great importance for the realization of the actions needed for wide bioeconomy diffusion.

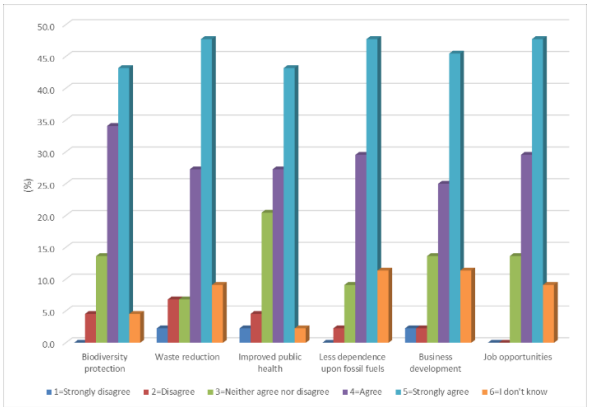
To begin with, the results of the answers given by the participants regarding the benefits that the bioeconomy can have in their area (Q#11) are of particular interest and are considered important. Business participants claimed that bioeconomy's regional benefits would be waste reduction (47.7%), job opportunities (47.7%), and less dependence in fossil fuels (47.7%). At the same time, they recognize the needs and obstacles that exist for the adoption of biobased solutions and the development of the bioeconomy in their region, as shown by questions Q#14 and Q#15. As it turns out, the main needs recognized from the business aspect are the information about emerging market opportunities (59.1%) and the development of infrastructures (52.3%). These are also partially aligned with the obstacles encountered for the development of the bioeconomy. As it is clear from

the answers, the main obstacles are considered lack of policy incentives (61.4%), high costs (50/5%) and limited access to finance (45.5%).

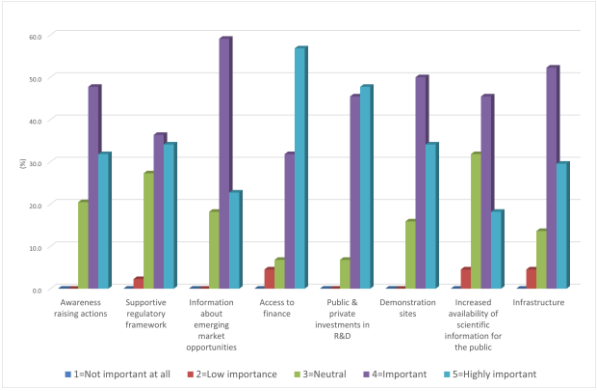
Regarding business group familiarity with biobased products and their point of view on these (Q#17), the participants state that a major proportion of the participants are informed about them (40.9%). Furthermore, participants sit on the fence whether biobased products are easily available in the market (43.2%), if their price is fair (43.2%) and regarding the standards and certifications that they meet (45.5%). Moving on to the answers of the business stakeholders on the nutrient recycling practices (Q#21), the participants state that they are not familiar with the mentioned practices. Exceptions to this are composting (84.1%) and anaerobic digestion (56.8%).

The last step in the analysis of the responses from the business groups was the responses they gave citing their opinion on technical (Q#23) and business (Q#24) supporting services. Analyzing responses, it appears that the technical services that mostly considered useful are the training on the available nutrient recycling practices (79.5%) and the pilot project implementation advice (75.0%). Regarding business supporting service, answers are in proportion to the needs and obstacles that arose from questions Q#14 and Q#15 respectively. Thus, according to business stakeholders, participants responded that agree on access to finance (79.5%) and support for establishment and maintenance of biobased technologies (77.5%).

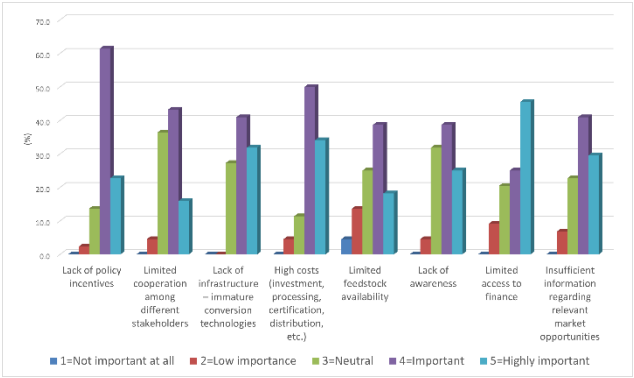
Q#11: Please indicate your agreement with what bioeconomy can provide to your region:[1=Strongly disagree; 2=Disagree; 3=Neither agree nor disagree/No opinion; 4=Agree; 5=Strongly agree; 6=I don't know]



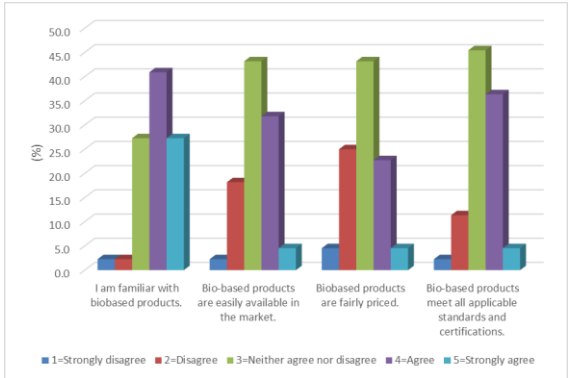
Q#14: Which of the following do you consider as important needs of your region when it comes to the uptake of biobased solutions? [1=Not important at all; 2=Low importance; 3=Neutral; 4=Important; 5=Highly important;]



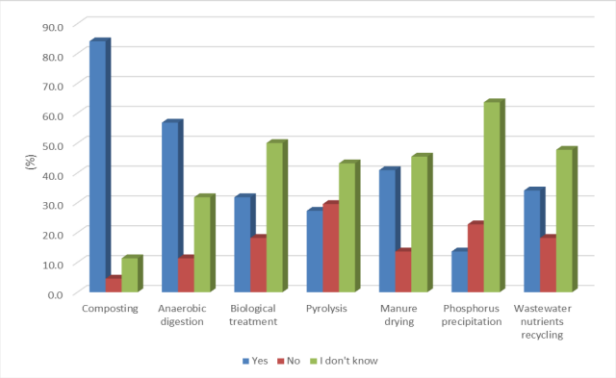
Q#15: Which of the following barrier(s) do you consider as important for your region to overcome when it comes to bioeconomy development? [1=Not important at all; 2=Low importance; 3=Neutral; 4=Important; 5=Highly important;]



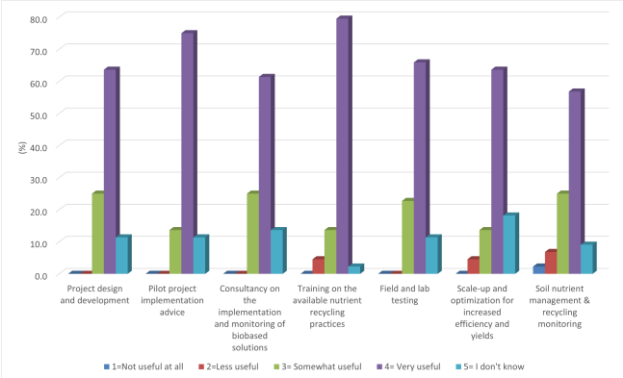
Q#17: Please indicate your agreement with the following statements: [1=Strongly disagree; 2=Disagree; 3=Neither agree nor disagree/No opinion; 4=Agree; 5=Strongly agree;]



Q#21: Are you aware if any of the following nutrient recycling practices is applied in your region? [1=Yes; 2=No; 3=I don't know]



Q#23:How useful do you consider the following technical support services for supporting investments in the biobased market? [1=Not useful at all; 2=Less useful;3=Somewhat useful; 4=Very useful; 5=I don't know]



Q#24: How useful do you consider the following business support services for supporting investments in the biobased market? [1=Not useful at all; 2=Less useful;3=Somewhat useful; 4=Very useful; 5=I don't know]

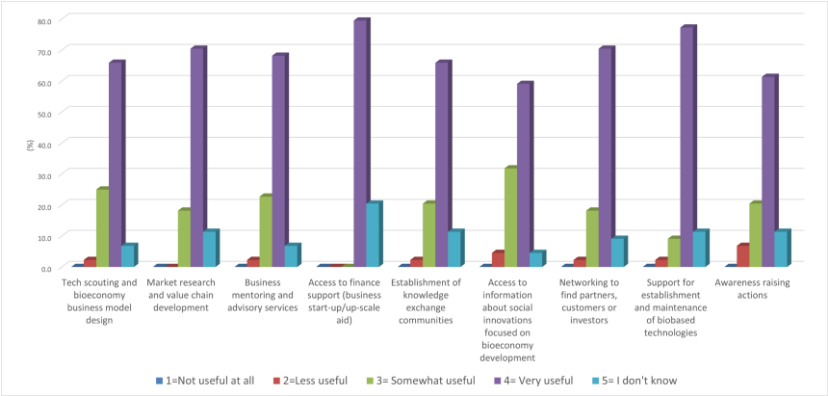


Figure 68. Business stakeholders' responses analysis

Academy and research community

The next category of stakeholders in terms of which the results of the survey were analyzed is that of the academia and research community. This group is of particular importance as their research activities often result in technological achievements and new methods in the rural sector, while their involvement in the educational process makes them capable of distinguishing the knowledge gaps that may exist. Thus, examining the results of the analysis for this group of particular interest, some differences appear in their responses to certain topics compared to the past stakeholder groups that were presented.

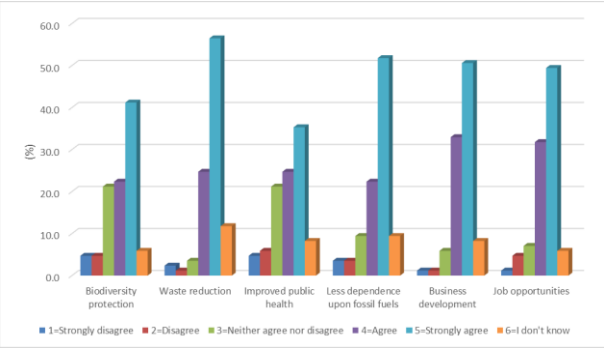
Based on the responses of stakeholders about the benefits that the application of the bioeconomy can have in their area (Q#11), from analysis' results it is argued that the main advantages are focused on waste reduction (56.5%) and less dependence on fossil fuels (51.8%). This result is directly interpreted by the fact that the management of wastes arising from industry and other urban activities has been the subject of research for several years and is seriously engaging the scientific community. Regarding the needs of the academy and scientific community for the adoption of

biobased solutions (Q#14), these appear to be mainly financial, as the largest percentage of agreement is focused on access to finance (58.8%), public & private investments in R&D (57.6%) and the development of a supporting regulatory framework (57.6%). Regarding the obstacles that this stakeholder group faces for the development of the bioeconomy (Q#15), the answers show that the three main obstacles are considered to be the lack of infrastructure-immature conversion technologies (47.1%), the lack of policy incentives (44.7%) and the high costs on investment, processing, certification and distribution (43.5%).

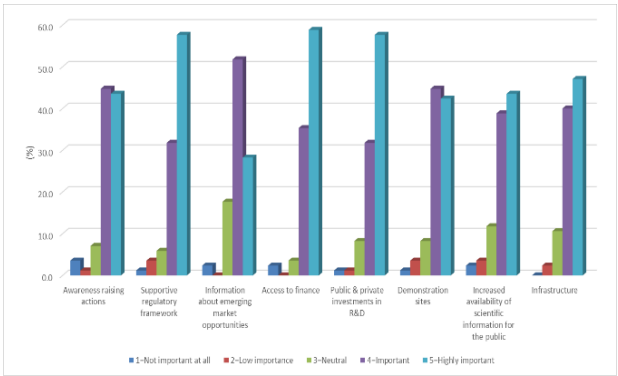
Moving on to the level of information about bio-based products (Q#17), academics and researchers claim that they are familiar with these (55.3%). Although, their agreement regarding the ease of finding biobased products on the market, their cost and whether they apply certain standards and certifications is moderate. Additionally, the results for stakeholders' familiarity with nutrient recycling practices (Q#21) are also important, as the only group that claims to know most of them, e.g. composting (83.5%), anaerobic digestion (57.6%), biological treatment (43.5%) and wastewater nutrients recycling (42.4). In comparison with the rest stakeholder groups, it seems that there is a knowledge gap when it comes to these kind of practices.

Finally, their answers to supporting services are of the same nature as the answers given regarding needs and obstacles. Specifically, all the suggested technical support services included in Q#23 are believed to be useful, with significant percentages already obtained by soil nutrient management & recycling monitoring (58.8%) and consultancy on the implementation and monitoring of biobased solutions (56.5%). Furthermore, most stakeholders stand of the opinion that the most useful business support services (Q#24) are the awareness raising actions (57.6%) and access to finance support (57.6%).

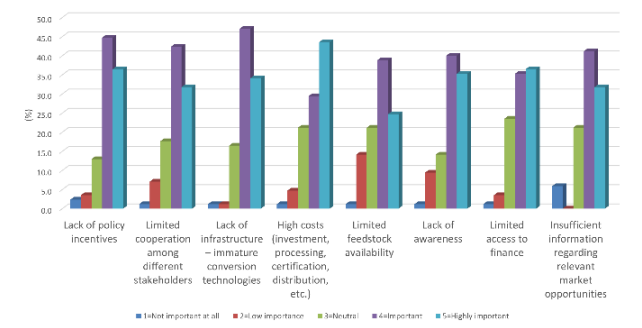
Q#11: Please indicate your agreement with what bioeconomy can provide to your region:[1=Strongly disagree; 2=Disagree; 3=Neither agree nor disagree/No opinion; 4=Agree; 5=Strongly agree; 6=I don't know]



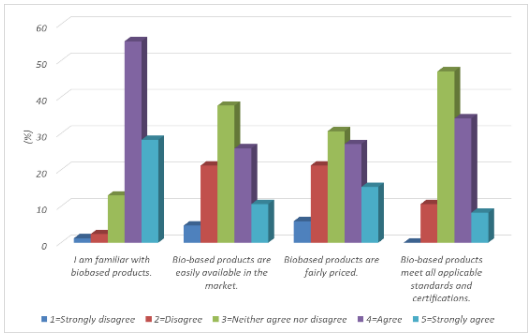
Q#14: Which of the following do you consider as important needs of your region when it comes to the uptake of biobased solutions? [1=Not important at all; 2=Low importance; 3=Neutral; 4=Important; 5=Highly important;]



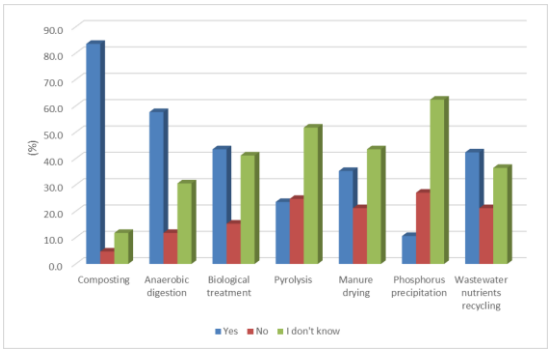
Q#15: Which of the following barrier(s) do you consider as important for your region to overcome when it comes to bioeconomy development? [1=Not important at all; 2=Low importance; 3=Neutral; 4=Important; 5=Highly important;]



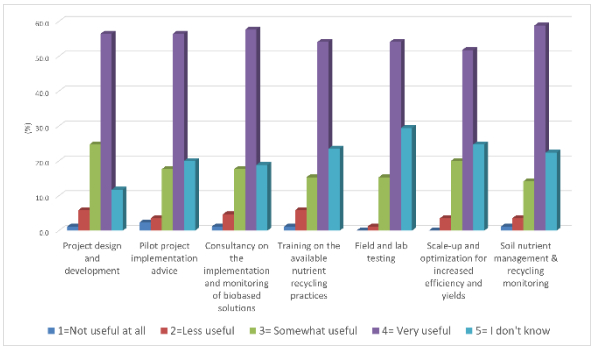
Q#17: Please indicate your agreement with the following statements: [1=Strongly disagree; 2=Disagree; 3=Neither agree nor disagree/No opinion; 4=Agree; 5=Strongly agree;]



Q#21: Are you aware if any of the following nutrient recycling practices is applied in your region? [1=Yes; 2=No; 3=I don't know]



Q#23:How useful do you consider the following technical support services for supporting investments in the biobased market? [1=Not useful at all; 2=Less useful;3=Somewhat useful; 4=Very useful; 5=I don't know]



Q#24: How useful do you consider the following business support services for supporting investments in the biobased market? [1=Not useful at all; 2=Less useful;3=Somewhat useful; 4=Very useful; 5=I don't know]

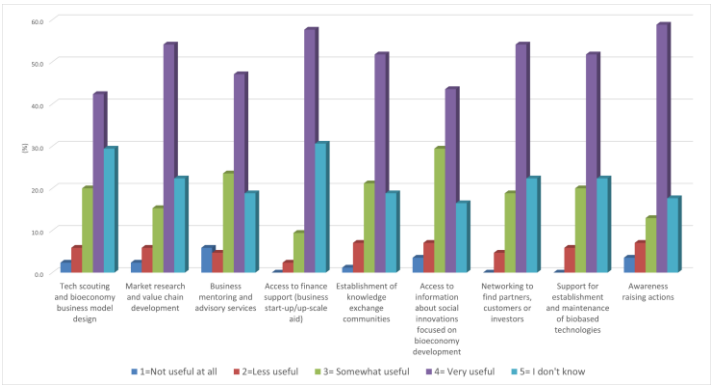


Figure 69. Academia and research community responses analysis

Government/policy-maker/public authority

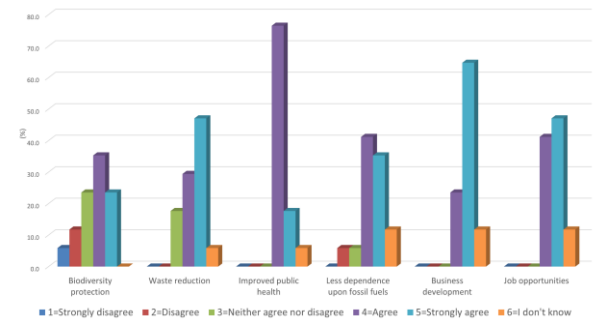
The next category presented in the analysis of the results is that of government / policy-maker / public authority. The level of awareness and perceptions for this stakeholder group is of great importance as it determines the legal frameworks and regulations that must be fulfilled so that the various activities in the context of the bioeconomy and not only can take place. Also, these stakeholders are often involved in financing and economic decisions which, as shown by the results for the previous stakeholder groups, significantly determine the bioeconomy development.

In the question about what they think will be the benefits of bioeconomy implementation in their region (Q#11), participants believe that the main advantage will be public health improvement (76.5%) and business development (64.7%). Regarding the needs (Q#14) and obstacles (Q#15) related to the development of the bioeconomy in their region, stakeholders focus their needs on public & private investments in R&D (58,8%) and access to finance (52.9%). These two needs are perfectly connected to each other as they determine both the undertaking of new bioeconomy projects and the development of technologies as well as already related projects. As far as the obstacles are concerned, limited access to finance (58.8%) and high costs (52.9%) emerge as the main obstacles, while a large percentage defends that insufficient information regarding relevant market opportunities is also important (47.1%).

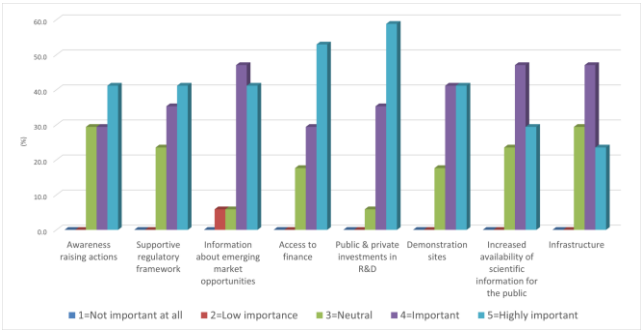
Regarding the level of awareness of biobased products (Q#17) and their opinion on issues concerning them, the largest percentage of participants declares familiar with bio-based products (41.2%). Furthermore, they stand with the opinion that bio-based products are easily available in the market (35.3%), are fairly priced (41.2%) and meet all applicable standards and certifications (52.9%). Moving on to nutrient recycling practices (Q#21), participants this group state that they are aware of composting (82.4%) and anaerobic digestion (64.7%), but not with the rest of the practices contained in this question.

The last question in the analysis is the one regarding the stakeholders' opinion on MainstreamBIO's technical (Q#23) and business (Q#24) support services. As can be seen from their answers, most services are considered important for supporting investments in biobased market. More precisely, the most useful services are field and lab testing (64.7%), access to finance support (88.2%) and networking to find partners, customers or investors (82.4%).

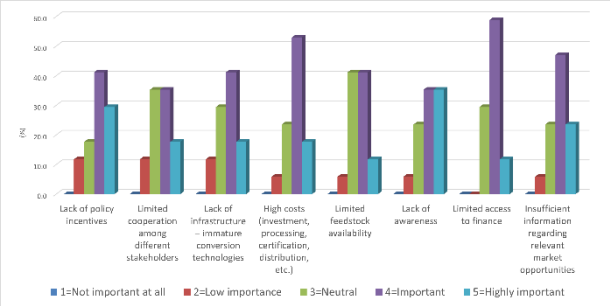
Q#11: Please indicate your agreement with what bioeconomy can provide to your region:[1=Strongly disagree; 2=Disagree; 3=Neither agree nor disagree/No opinion; 4=Agree; 5=Strongly agree; 6=I don't know]



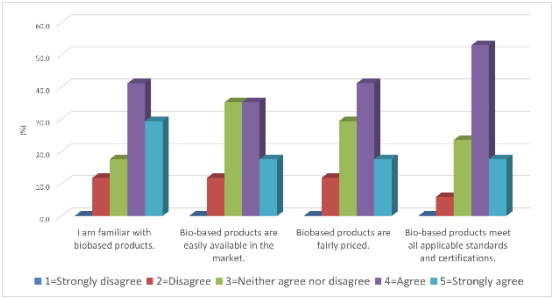
Q#14: Which of the following do you consider as important needs of your region when it comes to the uptake of biobased solutions? [1=Not important at all; 2=Low importance; 3=Neutral; 4=Important; 5=Highly important;]



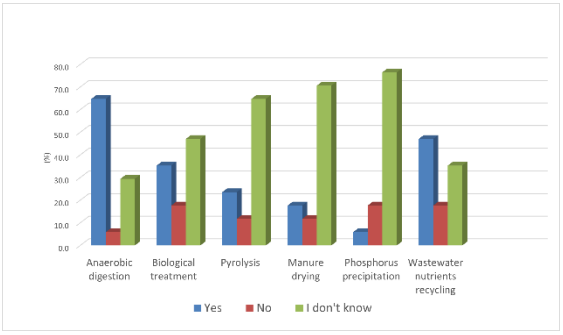
Q#15: Which of the following barrier(s) do you consider as important for your region to overcome when it comes to bioeconomy development? [1=Not important at all; 2=Low importance; 3=Neutral; 4=Important; 5=Highly important;]



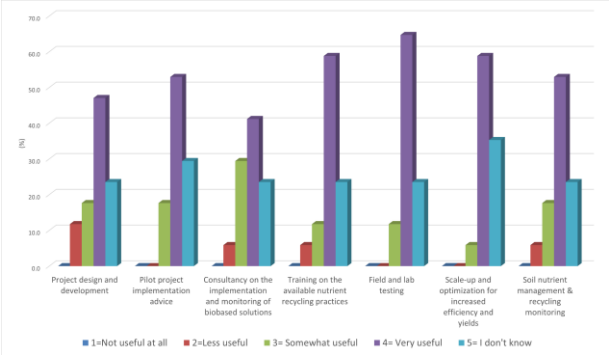
Q#17: Please indicate your agreement with the following statements: [1=Strongly disagree; 2=Disagree; 3=Neither agree nor disagree/No opinion; 4=Agree; 5=Strongly agree;]



Q#21: Are you aware if any of the following nutrient recycling practices is applied in your region? [1=Yes; 2=No; 3=I don't know]



Q#23:How useful do you consider the following technical support services for supporting investments in the biobased market? [1=Not useful at all; 2=Less useful;3=Somewhat useful; 4=Very useful; 5=I don't know]



Q#24: How useful do you consider the following business support services for supporting investments in the biobased market? [1=Not useful at all; 2=Less useful;3=Somewhat useful; 4=Very useful; 5=I don't know]

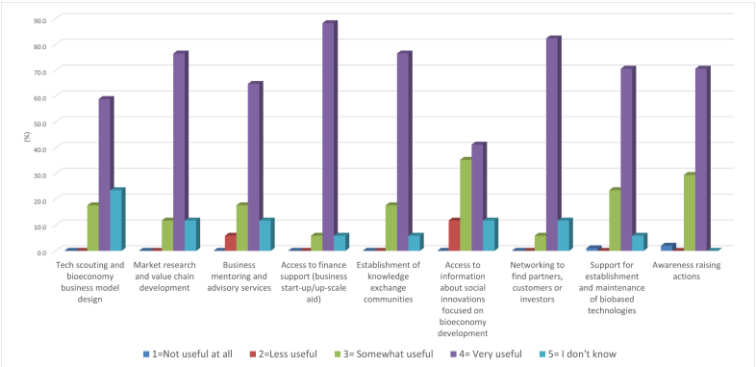


Figure 70. Government / policy-makers / authorities responses analysis

Civil society

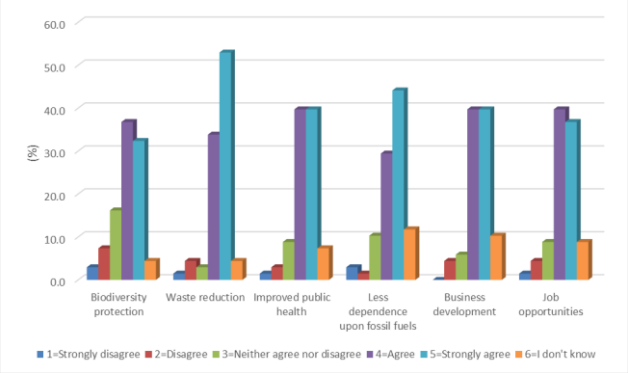
This category includes citizens, women, children and youth, indigenous peoples, non-governmental organizations, workers and consumers. Their opinion about the bioeconomy and their level of awareness reflects social barriers and gaps that may exist in terms of the development of the bioeconomy and its widespread acceptance by society. The resolution of such issues can respectively determine the actions to be taken by the other stakeholder groups for a more sustainable and green economy.

The participants from civil society state that they agree with the benefits that the bioeconomy can have in their region (Q#11), focusing mainly on waste reduction (52.9%) and less dependence upon fossil fuels (44.1%). As the main needs when it comes to the uptake of biobased solutions (Q#14), they recognize access to finance (51.5%) and getting informed about emerging market opportunities (51.5%). Then, regarding the obstacles that their region must overcome for bioeconomy development (Q#15), the main obstacles are considered to be the insufficient information regarding relevant market opportunities (50.0%), the high costs (48.5%) and the lack of infrastructures (48.5%).

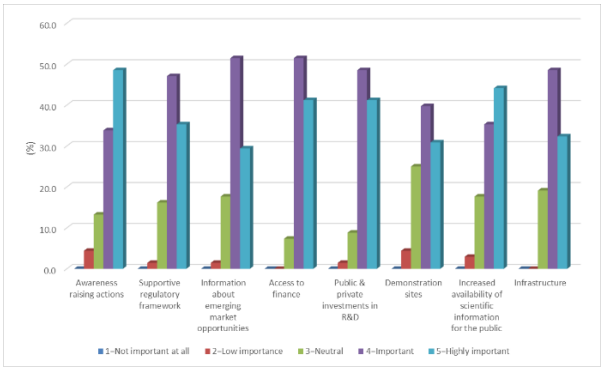
In terms of familiarity with biobased products (Q#17), these stakeholders indicated that they are partially informed about them. Despite this, responders agree to whether these products are easily available on the market, they have a fair price and whether they fulfill specific standards and certifications. Also of interest are the results regarding whether civil society is aware of nutrient recycling practices (Q#21). As in some of the previous analyzed stakeholder groups, in this one as well, the participants stated that they were mainly familiar with composting (55.9%), agreeing that there is a lack of awareness regarding the other practices presented in this question.

Moreover, according to questions Q#23 & Q#24 on technical and business support services, consultancy on the implementation and monitoring of biobased solutions (64.7%) and establishment of knowledge exchange communities (67.6%) stand out as the most important. The practices field and lab testing (67.6%) and access to finance support (66.2%) also received high percentages.

Q#11: Please indicate your agreement with what bioeconomy can provide to your region:[1=Strongly disagree; 2=Disagree; 3=Neither agree nor disagree/No opinion; 4=Agree; 5=Strongly agree; 6=I don't know]

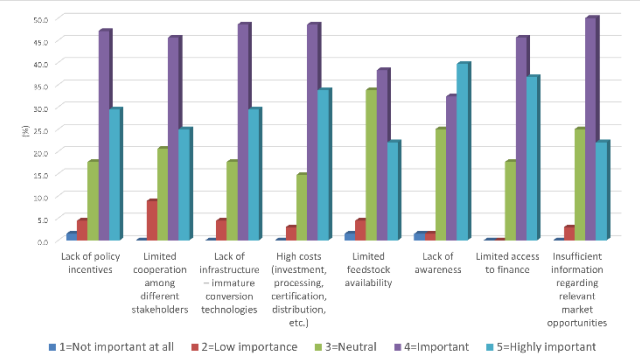


Q#14: Which of the following do you consider as important needs of your region when it comes to the uptake of biobased solutions? [1=Not important at all; 2=Low importance; 3=Neutral; 4=Important; 5=Highly important;]

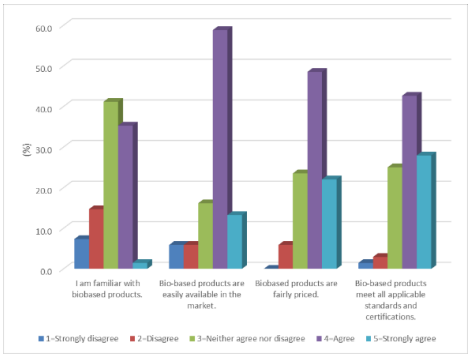


Funded by the European Union

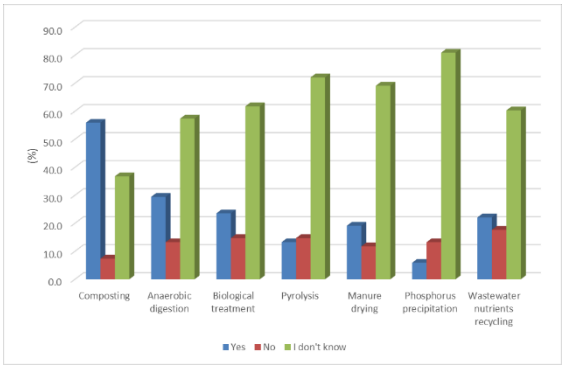
Q#15: Which of the following barrier(s) do you consider as important for your region to overcome when it comes to bioeconomy development? [1=Not important at all; 2=Low importance; 3=Neutral; 4=Important; 5=Highly important;]



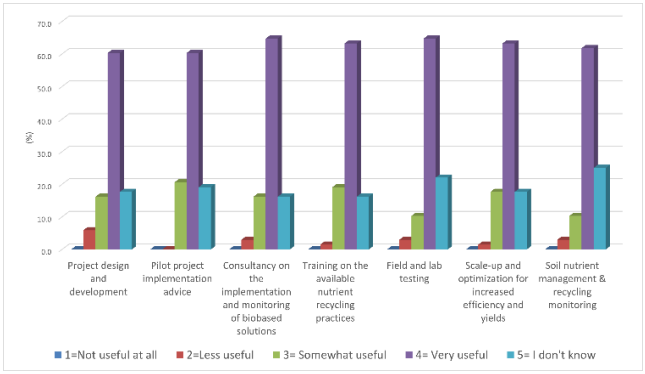
Q#17: Please indicate your agreement with the following statements: [1=Strongly disagree; 2=Disagree; 3=Neither agree nor disagree/No opinion; 4=Agree; 5=Strongly agree;]



Q#21: Are you aware if any of the following nutrient recycling practices is applied in your region? [1=Yes; 2=No; 3=I don't know]



Q#23:How useful do you consider the following technical support services for supporting investments in the biobased market? [1=Not useful at all; 2=Less useful;3=Somewhat useful; 4=Very useful; 5=I don't know]



Q#24: How useful do you consider the following business support services for supporting investments in the biobased market? [1=Not useful at all; 2=Less useful;3=Somewhat useful; 4=Very useful; 5=I don't know]

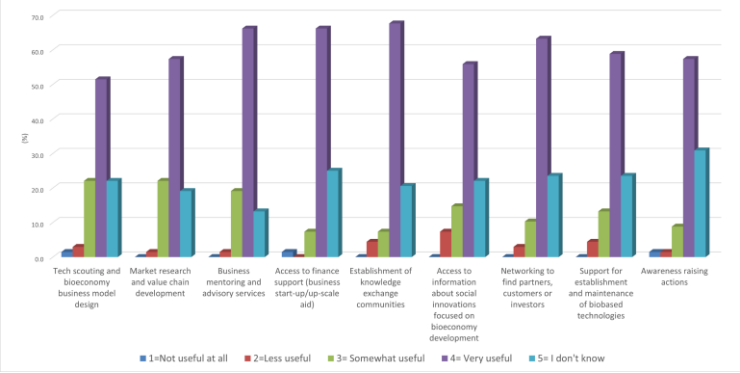


Figure 71. Civil society responses analysis

Other

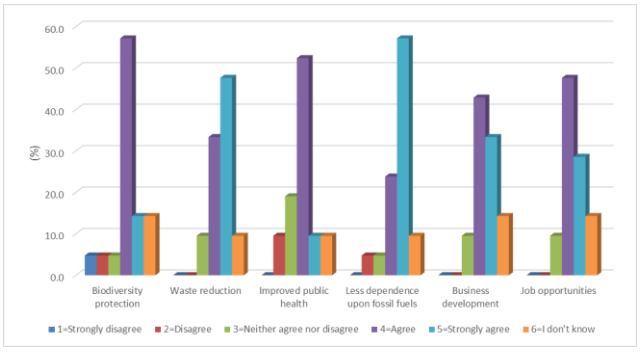
This group includes people like students, consultants, and those interested in new technologies such as nanotechnology. Ignoring them might result in reinforcing the opinions of individuals or organizations that aren't already involved in the bioeconomy field.

In question Q#11 regarding the proposed benefits of the bioeconomy in their area, the participants answered that they agree with what it is suggested that the bioeconomy can provide. The percentages in the answers do not differ significantly, while the two main ones turn out to be less dependence upon fossil fuels (57.1%), biodiversity protection. Regarding needs and obstacles (Q#14 & Q#15), those that received the highest percentages are mainly focused on raising awareness levels. In summary, increased availability of scientific information for the public (61.9%) and awareness raising actions (57.1%) are the most important needs according to results' analysis. Furthermore, main difficulties are the limited cooperation among different stakeholders (52.4%) and the limited access to finance (52.4%)

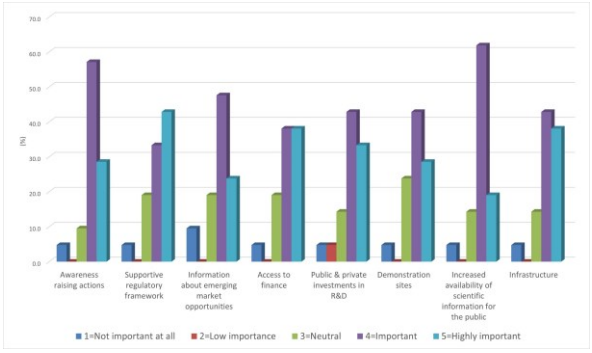
Moving on to the awareness level on biobased products (Q#17), participants do not state totally familiar with them. While regarding the ease of accessibility to biobased products in the market, on fair prices and applied standards, their agreement is also partial. Then, regarding nutrient recycling practices, stakeholders claimed that they are more aware of composting (76.2%) and anaerobic digestion (57.1%) rather than the other practices included in question Q#21.

Finally, regarding the usefulness of technical and business support services (Q#23 & Q#24), the participants consider that all the proposed services are particularly useful for supporting investments in the biobased market. Those that obtained the highest percentages are consultancy on the implementation and monitoring of biobased solutions (76.2%) and networking to find partners, customers or investors (61.9%).

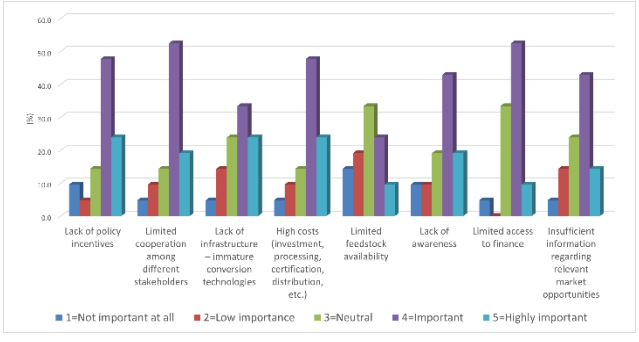
Q#11: Please indicate your agreement with what bioeconomy can provide to your region:[1=Strongly disagree; 2=Disagree; 3=Neither agree nor disagree/No opinion; 4=Agree; 5=Strongly agree; 6=I don't know]



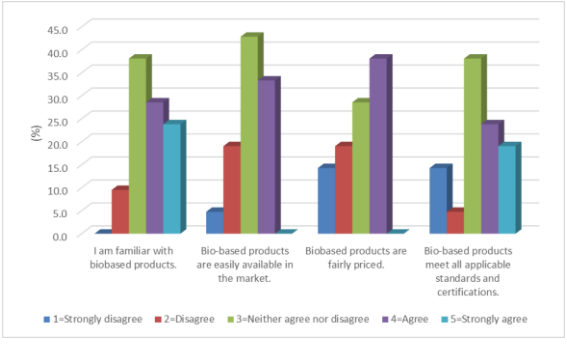
Q#14: Which of the following do you consider as important needs of your region when it comes to the uptake of biobased solutions? [1=Not important at all; 2=Low importance; 3=Neutral; 4=Important; 5=Highly important;]



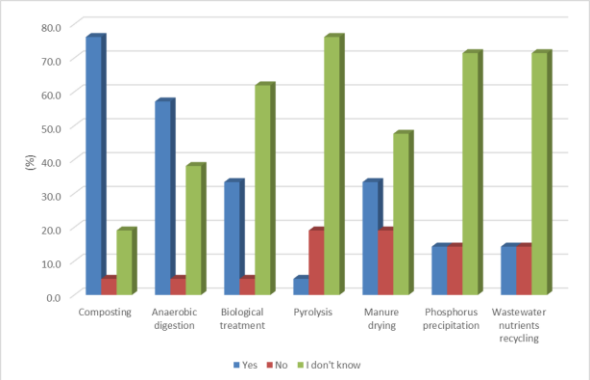
Q#15: Which of the following barrier(s) do you consider as important for your region to overcome when it comes to bioeconomy development? [1=Not important at all; 2=Low importance; 3=Neutral; 4=Important; 5=Highly important;]



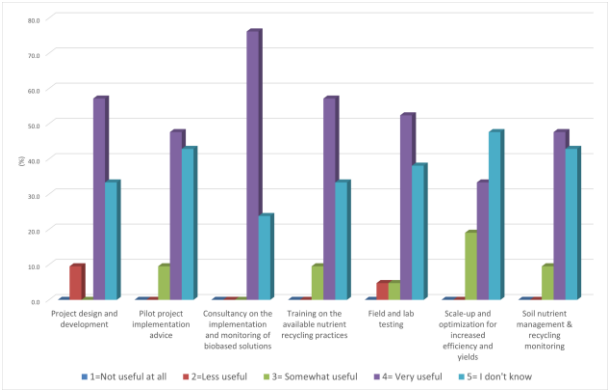
Q#17: Please indicate your agreement with the following statements: [1=Strongly disagree; 2=Disagree; 3=Neither agree nor disagree/No opinion; 4=Agree; 5=Strongly



Q#21: Are you aware if any of the following nutrient recycling practices is applied in your region? [1=Yes; 2=No; 3=I don't know]



Q#23:How useful do you consider the following technical support services for supporting investments in the biobased market? [1=Not useful at all; 2=Less useful;3=Somewhat useful; 4=Very useful; 5=I don't know]



Q#24: How useful do you consider the following business support services for supporting investments in the biobased market? [1=Not useful at all; 2=Less useful;3=Somewhat useful; 4=Very useful; 5=I don't know]

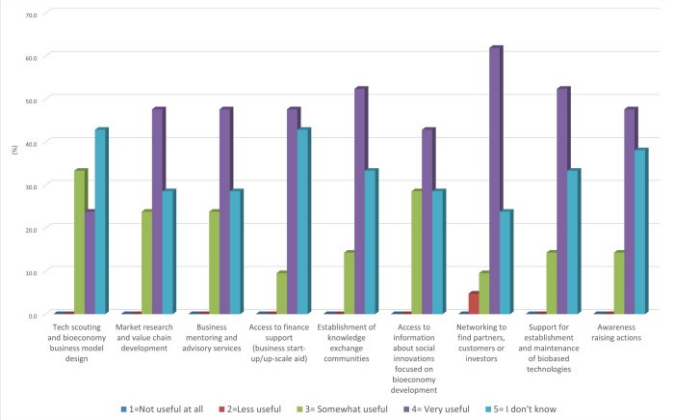


Figure 72. Other stakeholders responses analysis

5.5 Cross-category comparison

The largest percentage of the participated stakeholder groups considers that the main benefits (Table 9. Regional bioeconomy benefits - target groups' responses comparisonTable 9) from the application of the bioeconomy are of an environmental and social nature. Specifically, **waste reduction, less dependence on fossil fuels and business development** emerged as key advantages. Although these advantages were supported by the participants there are others, such as **public health improvement**, which also received many votes and are equally important. It is also important to note that **biodiversity protection** was not sufficiently supported as beneficial for each region despite the fact that the changes in biodiversity attributed to the use of natural resources have proven to be damaging.

Table 9. Regional bioeconomy benefits - target groups' responses comparison

	Biodiversity protection	Waste reduction	Improved public health	Less dependence upon fossil fuels	Business development	Job opportunities
BIOMASS PRODUCERS						
BUSINESS						
ACADEMIA/RESEARCH						
GOVERNMENT						
CIVIL SOCIETY						
OTHER						

Regarding the needs stated by the various stakeholder groups when it comes to the uptake of bio-based solutions, the largest percentage of participants pointed out as the main needs **the information about the opportunities in the biobased products market** and **access to finance** (Table 10). Nevertheless, some more needs are also considered important and linked to the background and shortcomings of each group. A typical example is the comparison of responses between biomass producers, academia and government. Supportive regulatory framework is a need that was highlighted mainly by the first two stakeholder groups. In addition to this, academia and government stakeholders claimed that another important need is the **public & private investments in R&D**. It seems that although at first sight some groups do not seem to be directly connected, their needs in certain issues coincide, showing that the filling of certain gaps can support more than one target group activities in terms of bioeconomy.

Table 10. Regional need for bioeconomy development - target groups' responses comparison

	Awareness raising actions	Supportive regulatory framework	Information about emerging market opportunities	Access to finance	Public & private investments in R&D	Demonstration sites	Increased availability of scientific information for the public	Infrastructure
BIOMASS PRODUCERS								
BUSINESS								
ACADEMIA/ RESEARCH								
GOVERNMENT								
CIVIL SOCIETY								
OTHER								

Moving on to the obstacles that appear in terms of the development of the bioeconomy (Table 11), all stakeholder groups argued that the main obstacle is the **high costs on investments, processing, certification and distribution**. In addition to these, there are other obstacles that the participants recognize and focus mainly on **the lack of policy incentives, lack of infrastructures and limited access to finance**. As can be seen, there is a connection between the needs and the obstacles and it is concluded that the main gap and the corresponding difficulty that exists regarding the bioeconomy is focused on the search for financial resources.

Table 11. Barriers hindering the uptake of biobased solutions - target groups' responses comparison

	Lack of policy incentives	Limited cooperation among different stakeholders	Lack of infrastructure – immature conversion technologies	High costs (investment, processing, certification, distribution, etc.)	Limited feedstock availability	Lack of awareness	Limited access to finance	Insufficient information regarding relevant market opportunities
BIOMASS PRODUCERS								
BUSINESS								
ACADEMIA/ RESEARCH								
GOVERNMENT								
CIVIL SOCIETY								
OTHER								

Regarding the extend of groups' familiarity with biobased products (Table 12), most groups state that they know them. Nevertheless, they harbor doubts as to whether these products are easily available on the market, have affordable prices and whether they meet specific standards and certifications. Furthermore, most of the participants from each stakeholder group state that they are aware of specific nutrient recycling practices (Table 13), e.g. **composting and anaerobic digestion**. However, a knowledge gap is observed regarding the rest of the practices included in the question.

Table 12. Bio-based products awareness levels - target groups' responses comparison

	I am familiar with biobased products.	Bio-based products are easily available in the market.	Biobased products are fairly priced.	Bio-based products meet all applicable standards and certifications.
BIOMASS PRODUCERS		Netiher agree or disagree	Netiher agree or disagree	Netiher agree or disagree
BUSINESS		Netiher agree or disagree	Netiher agree or disagree	Netiher agree or disagree
ACADEMIA/RESEARCH		Netiher agree or disagree	Netiher agree or disagree	Netiher agree or disagree
GOVERNMENT		Netiher agree or disagree	Netiher agree or disagree	Netiher agree or disagree
CIVIL SOCIETY	Netiher agree or disagree			
OTHER	Netiher agree or disagree	Netiher agree or disagree		Netiher agree or disagree

Table 13. Nutrient recycling practices - target groups' responses comparison

	Composting	Anaerobic digestion	Biological treatment	Pyrolysis	Manure drying	Phosphorus precipitation	Wastewater nutrients recycling
BIOMASS PRODUCERS							
BUSINESS							
ACADEMIA/RESEARCH							
GOVERNMENT							
CIVIL SOCIETY							
OTHER							

Moreover, as can be expected from the results regarding needs and obstacles, access to finance support (business start-up/up-scale aid.) was highlighted by all as the most useful business support service (Table 14). Thus, participants claim that financial resources from public and private investments/funds are the most important for the development of the biobased market. Other supporting services that are also considered useful are **business mentoring and advisory**, **networking to find partners**, **customers or investors** and **Support for establishment and maintenance of biobased technologies**.

Table 14. Stakeholders' perceptions on business support services - target groups' responses comparison

	Tech scouting and bioeconomy business model design	Market research	Business mentoring and advisory	Access to finance support	Exchange communities	Access to information	Networking	Support for establishment and maintenance of biobased technologies	Awareness raising actions
BIOMASS PRODUCERS									
BUSINESS									
ACADEMIA/ RESEARCH									
GOVERNMENT									
CIVIL SOCIETY									
OTHER									

Finally in terms of MainstreamBIO's **technical supporting services** (Table 15), as shown by the responses of the participants, there are differences as to which **are considered useful** depending on the background of each stakeholder group. For instance, biomass producers, business and academia stakeholders claim that a useful technical service would be the **project design and development**. Furthermore, despite the fact that these stakeholder groups have narrow knowledge when it comes to nutrient recycling practices, the results do not unanimously show that **training on the available nutrient recycling practices** is useful. In contrast, stakeholders from government and civil society state that this service would be beneficial for supporting investment in the biobased market. Moreover, other suggested services such as **consultancy on the implementation and monitoring of biobased solutions** and **field & lab testing** are considered useful by specific target groups.

Table 15. Stakeholders' perceptions on technical support services - target groups' responses comparison

	Project design and development	Pilot project implementation advice	Consultancy on the implementation and monitoring of biobased solutions	Training on the available nutrient recycling practices	Field and lab testing	Scale-up and optimization for increased efficiency and yields	Soil nutrient management & recycling monitoring
BIOMASS PRODUCERS							
BUSINESS							
ACADEMIA/RESEARCH							
GOVERNMENT							
CIVIL SOCIETY							
OTHER							

6. Conclusion

6.1 Country profiles

Country profile: Netherlands

Bioeconomy development progress and public perceptions on bioeconomy's benefits	Awareness levels and perceptions on biobased products/solutions	Regional needs	Regulatory landscape and support measures
• Significant progress has been made in the development of the bioeconomy in the Netherlands • High importance benefits: Decreased dependence upon fossil fuels and waste reduction are considered the most significant benefits • Limited recognition of health benefits	• Majority of participants have some degree of familiarity with biobased products • Medium awareness levels in relation to biobased products • High cost and lack of consumers' awareness • Uncertain about the affordability, market availability and certification of biobased products	• Access to finance • Public and private investments in R&D • Investments in infrastructure	• There is a bioeconomy strategy in force • Governmental support (subsidies) dedicated to bioeconomy development

Nutrient recycling practices applied in the region	Perceptions on the necessity of digital tools for bioeconomy development
• Composting, manure drying, and anaerobic digestion • In general, farmers are highly engaged with biobased solutions	• The majority supported the use of digital tools to support bioeconomy development

Factors facilitating the uptake of biobased solutions and bioeconomy development in the region	Technical support services needed
• Many subsidized projects between agricultural colleges and regional associations • A highly productive agricultural sector and motivated entrepreneurs • Active research institutions	• Field lab and testing • Scale-up and optimization for increased efficiency and yields

Country profile: Netherlands

Factors hindering the uptake of biobased solutions and bioeconomy development in the region

- Farmers are willing to innovative, but legislation is a barrier
- High costs of implementing nutrient recycling practices is considered the major barrier
- Limited quality standards for biobased products in place
- Ineffective cooperation between value chain actors
- Lack of clear and consistent policy on biobased products
- National laws and regulations not tailored to local needs

Measures recommended

- Governmental financial support (e.g. subsidies)

Business support services needed

- Access to finance
- High support of the use of digital tools to support bioeconomy development

Country profile: Bulgaria

Bioeconomy development progress and public perceptions on bioeconomy's benefits

- Slow progress, high amounts of unutilized biomass
- Positive community attitude towards the term biobased
- High importance benefits: Job creation and improved public health are considered significant benefits
- Less importance benefits: environmental benefits (e.g. minimized dependence upon fossil fuels)

Awareness levels and perceptions on biobased products/solutions

- Fairly priced
- Uncertain about the market availability and certification of biobased products

Regional needs

- More research and infrastructure, pilot projects, investments in R&D and living/labs – study cases
- Qualified employees, equipment and technologies
- Governmental support needed (e.g. subsidies)
- Improved access to finance
- Awareness raising actions

Regulatory landscape and support measures

- No dedicated bioeconomy strategy
- Regional support measures in rural areas to support bioeconomy development (e.g. Rural Development Program, initiatives/funding from EIT, Interreg Program)

Nutrient recycling practices applied in the region

- Composting, manure drying, and biological treatment
- In general, farmers are not actively engaged with biobased solutions

Perceptions on the necessity of digital tools for bioeconomy development

- High support of the use of digital tools to support bioeconomy development

Factors facilitating the uptake of biobased solutions and bioeconomy development in the region in the region in the region

- Local action groups vital for bioeconomy development in rural areas

Technical support services needed

- Soil nutrient management and monitoring
- Field and lab testing
- Training on nutrient recycling practices

Factors hindering the uptake of biobased solutions and bioeconomy development in the region in the region

- Inflation, economic stagnation and war in Ukraine
- Lack of cooperation between actors in the biobased value chain
- Large amounts of underutilized biomass
- Farmers resist to innovative solutions

Business support services needed

- Awareness raising actions are mostly needed
- Note: all of the listed business support services are considered equally important

Country profile: Bulgaria

Measures recommended	
• Free economic zones for bio-based products • Protective measures for local business to use local bio-based products • Governmental support needed (e.g. subsidies)	

Country profile: Denmark

Bioeconomy development progress and public perceptions on bioeconomy's benefits

- Rapid progress
- High public acceptance
- High importance benefits: business development, job creation, decreased dependence on fossil fuels
- Less important benefits: Improved public health

Awareness levels and perceptions on biobased products/solutions

- High familiarity with biobased products
- Medium awareness levels on biobased products origin and biodegradability
- Fairly priced
- Medium market accessibility
- High uncertainty around certification of biobased products

Regional needs

- Investments in R&D
- Demonstration sites

Regulatory landscape and support measures

- No dedicated bioeconomy strategy
- CO2 neutrality plan
- Regulation focused on organic food, electric cars
- Strategies for biodiversity and environmental protection
- Measures prohibiting the excessive use of pesticides

Nutrient recycling practices applied in the region

- Composting, anaerobic digestion and biological treatment
- Farmers are actively engaged with such practices

Perceptions on the necessity of digital tools for bioeconomy development

- High support of the use of digital tools to support bioeconomy development

Factors facilitating the uptake of biobased solutions and bioeconomy development in the region

- Strong cooperation among key players of the value chain

Technical support services needed

- Scale-up and optimization for increased efficiency and yields
- Training on nutrient recycling practices

Factors hindering the uptake of biobased solutions and bioeconomy development in the region

- Strict requirements for manure management and storage
- Farmers are willing to implement innovative solutions, however, there are many barriers including regulations, financial and geographical constraints
- Lack of policy incentives
- Lack of cooperation among stakeholders in the value chain
- High investment costs
- High costs of biomass transportation
- Lack of motivation to invest
- Challenges in logistics, transport and access to biomass

Business support services needed

- Access to finance
- Market research and value chain development

Country profile: Denmark

Measures recommended	
• Need for further governmental support	

Country profile: Spain

Bioeconomy development progress and public perceptions on bioeconomy's benefits

- Slow progress
- Growing positive attitude towards the biobased sector
- High importance benefits: biodiversity protection, job opportunities

Awareness levels and perceptions on biobased products/solutions

- Medium-low awareness levels in relation to biobased products content and biodegradability
- High trust levels on the certification and quality standards of biobased products
- No clear stance on the market accessibility and the cost of biobased products

Regional needs and challenges

- Further research and innovation
- The majority of the listed needs and challenges are considered important

Regulatory landscape and support measures

- Catalonia has a dedicated Bioeconomy Strategy and Action Plan, while Aragon and Navarre have included bioeconomy in their circular economy strategies

Nutrient recycling practices applied in the region

- Composting, manure drying and anaerobic digestion
- Farmers not active with biobased solutions

Perceptions on the necessity of digital tools for bioeconomy development

- High support on the use of digital tools to support bioeconomy development

Factors facilitating the uptake of biobased solutions and bioeconomy development in the region

N/A

Technical support services needed

- Pilot project implementation advice
- Overall, the rest of the services received similar levels of support

Factors hindering the uptake of biobased solutions and bioeconomy development in the region

- Lack of awareness and knowledge transfer
- Bureaucratic processes
- Lack of a ban on synthetic fertilizers
- Lack of farmers' understanding about the technologies involved
- Lack of communication and dialogue between stakeholders
- High costs, insufficient knowledge of market opportunities, low awareness

Business support services needed

- Support for establishing and maintaining biobased technologies
- Access to information about social innovations in bioeconomy development

Country profile: Spain

Measures recommended • Targeted funding • Specific strategies to address regional challenges	

Country profile: Poland

Bioeconomy development progress and public perceptions on bioeconomy's benefits

- Underdeveloped bioeconomy
- Untapped potential for renewable energy and raw material acquisition
- Lack of social acceptance due to negative media messages
- High importance benefit: Biodiversity protection
- Low importance benefit: job creation

Awareness levels and perceptions on biobased products

- Increased awareness levels about depletion of natural resources and need for alternative raw materials sources
- The majority of respondents considered the biobased products fairly priced
- Medium uncertainty around biobased products certification
- Hard to find biobased products in the market
- The majority of the participants were familiar with biobased products
- Medium awareness levels about biobased products content and biodegradability

Regional needs

- Access to finance
- Awareness-raising actions
- A supportive regulatory framework

Regulatory landscape and support measures

- A dedicated bioeconomy strategy not currently in force
- Development Strategy for the Lublin Voivodship until 2030
- Funding opportunities available through the National Fund for Environmental Protection and Water Management
- The Agroenergy program
- The regional Operational Program for the Lubelskie Voivodeship

Nutrient recycling practices applied in the region

- Composting, biological treatment and anaerobic digestion
- The number of farmers adopting nutrient recycling practices is growing due to legal requirements and increasing fertilizers' cost
- Low relevant awareness of the farmers

Perceptions on the necessity of digital tools for bioeconomy development

- High support on the use of digital tools to support bioeconomy development

Factors facilitating the uptake of biobased solutions and bioeconomy development in the region

- Large fragmentation of farms
- Small share of livestock production

Technical support services needed

- Field and laboratory testing
- Advice on pilot project implementation
- Scale-up and optimization for increased efficiency and yields

Country profile: Poland

Factors hindering the uptake of biobased solutions and bioeconomy development in the region

- Financial issues and lack of stable regulation
- Weak cooperation among key players of the value chain
- Ineffective cooperation with public administration
- Lack of infrastructure
- Limited feedstock availability

Measures recommended

- Financial support required
- National-wide measures required
- Measures to strengthen stakeholders cooperation

Business support services needed

- Access to information about social innovations related to bioeconomy
- Overall, all of the business support services listed are considered important

Country profile: Ireland

Bioeconomy development progress and public perceptions on bioeconomy's benefits

- Slow progress
- The region holds a great potential in to become a leader in the bioeconomy sector
- Medium public acceptance levels
- High significance benefits: waste reduction and decreased dependence upon fossil fuels
- Less significance benefit: improved public health

Awareness levels and perceptions on biobased products

- High levels of familiarity and awareness of biobased products
- High uncertainty around biobased products certification
- Mixed opinions on the market accessibility and the pricing of biobased products, with the majority being uncertain about that notions

Regional needs

- Address social resistance and increase education efforts
- Further financial support
- Need for knowledge transfer groups and demonstration plants to educate farmers

Regulatory landscape and support measures

- There is no dedicated bioeconomy strategy
- National policies connected to the EU Green Deal
- Financial support options: Local Enterprise Office grants, Enterprise Ireland, the LEADER fund and EIB Funding

Nutrient recycling practices applied in the region

- Composting, anaerobic digestion, and wastewater nutrients recycling
- Low awareness about the extent of farmers' engagement with nutrient recycling practices
- Farmers hold low awareness relevant to nutrient recycling practices

Perceptions on the necessity of digital tools for bioeconomy development

- The majority of the respondents agree on the high importance of digital tools use to assist the transition towards bioeconomy development, however, a big part of respondents appears to be uncertain

Factors facilitating the uptake of biobased solutions and bioeconomy development in the region

- High availability of renewable feedstocks (e.g. seaweed, manure, and other agricultural feedstocks)
- Many world-renowned research and educational institutions that are actively engaged in researching and developing the bioeconomy sector

Technical support services needed

- Pilot project implementation advice
- Field and lab testing

Country profile: Ireland

Factors hindering the uptake of biobased solutions and bioeconomy development in the region

- Lack of awareness and feasibility issues in implementing biobased projects
- Lack of access to finance
- High manure transportation costs
- Absence of policy incentives
- High costs
- Lack of infrastructure

Measures recommended

- Further governmental support (e.g. subsidies)

Business support services needed

- Access to finance
- Networking

Country profile: Sweden

Bioeconomy development progress and public perceptions on bioeconomy's benefits

- Significant progress in bioeconomy development
- Positive public attitude towards the transition
- Main public concerns are focused on deforestation issues, due to highly active forest industry
- High importance benefits: business development, job creation and decreased dependence upon fossil fuels
- Less importance benefits: improved public health

Awareness levels and perceptions on biobased products

- High familiarity and awareness of biobased products origin and biodegradability
- Mixed opinions on the certification and pricing of biobased products
- Medium market availability

Regional needs

- Access to finance
- Investments in R&D
- Demonstration sites

Regulatory landscape and support measures

- There is no regional strategy dedicated to bioeconomy growth
- Focus on foodtech, renewable energy, and the forest-based bioeconomy in Västernorrland's Innovation Strategy for Smart Specialization
- Lack of long-term political commitment to sustainable forestry

Nutrient recycling practices applied in the region

- Composting, anaerobic digestion, and wastewater nutrient recycling
- Minimal forest fertilization
- Medium involvement and awareness of farmers in relation to nutrient recycling practices

Perceptions on the necessity of digital tools for bioeconomy development

- Mixed opinions on the use of digital tools for bioeconomy development, the majority considered them highly important, however, another important proportion considered them unnecessary

Factors facilitating the uptake of biobased solutions and bioeconomy development in the region

- Abundant supply of forest products
- High level of expertise in the biobased sector
- Effective regulation of forest residue management

Technical support services needed

- Soil nutrient management and monitoring
- Project design and development
- Consultancy services
- Training on nutrient recycling practices

Country profile: Sweden

Factors hindering the uptake of biobased solutions and bioeconomy development in the region

- Lack of funding for large-scale production
- Lack of expertise
- Lack of governmental support
- Risk capital for biorefineries
- Absence of policy incentives
- High costs
- Strict regulation on feedstock and biobased commodities

Measures recommended

- Grants for large investments in full-scale production facilities
- National and structural investments in the regional geography

Business support services needed

- Business mentoring and advisory
- All of the services are considered important

6.2 Observations and considerations

Below is the summary of the results obtained by synthesizing the knowledge gained from all three research activities (literature review, interviews, survey).

Bioeconomy development progress and public perceptions on bioeconomy's benefits

As can be seen from the analysis and synthesis of the results, there are differences between the countries regarding the bioeconomy progress, perceptions and benefits in each of these. Specifically, countries such as the Netherlands, Denmark and Sweden appear to have **high to significant bioeconomy development**. However, areas were observed in which bioeconomy has a **slow growth rate** such as Bulgaria and Spain, even countries that are **underdeveloped** e.g. Poland. Regarding the community and stakeholders' perceptions of the bioeconomy, most of the countries involved state that there is **high acceptance and positive attitude**. Exceptions to this are Poland and Ireland, for which it seems that there is respectively **medium or even lack acceptance**.

Moving on to the benefits that the application of the bioeconomy is considered to have in each area, there is a relative matching between the countries. The main benefits stand out to be **less dependence on fossil fuels**, **business development** and **job creation**. In addition, other environmental benefits that resulted are **biodiversity protection** and **waste reduction**. Furthermore, it appears that **public health improvement** is primarily considered as a lower importance benefit.

Awareness levels and perceptions on biobased products

Regarding the involvement of stakeholders in targeted areas on the biobased products, the results obtained vary by area. In countries such as the Netherlands, Denmark, Poland, Ireland and Sweden there is a **high level of familiarity** with this kind of products. In contrast to this, the rest of the countries examined declare **medium to low awareness**. Regarding the availability of biobased products in the market, their price and the certifications they meet, the **results differ from country to country**. While in Bulgaria, Denmark and Poland biobased products are considered to be **fairly priced**, there are countries (e.g. Netherlands, Spain, Ireland and Sweden) where these products are considered **either to be high in price or that there is no clear view** of stakeholders about it.

Moreover, moving on to perceptions on certification and availability, the results show that **each country has its own characteristics**. Specifically, there are countries such as the Netherlands, Bulgaria and Denmark which declare **highly uncertain on the certifications and ease-to-access** issues. On the other hand, Spain does **not claim to have a clear view on market accessibility**, having at the same time **high trust on biobased products certification**. Also, the results concerning Poland show that there is **no trust in the certifications of biobased products**, **without a clear view on market accessibility**. Finally, countries such as Ireland and Sweden have **mixed opinions on certification and accessibility issues**.

Regional needs

From the analysis of the results concerning the needs per targeted area, it appears that there is a relative uniformity. The stakeholders mainly state that **their needs are financial** (e.g. access to finance, investments in R&D and infrastructures) for most of the countries examined. Other needs that emerge are the **development of supporting regulatory frameworks** and the promotion of **awareness raising actions**.

Regulatory landscape and support measures

Regarding the existence of bioeconomy strategies, **most of the examined areas do not have a certain plan on this topic**. An exception to this is Spain, in which it appears that **Catalonia** had a **dedicated Bioeconomy Strategy Plan** and the regions of **Aragon & Navarre** have integrated the **bioeconomy in their circular economy** planning. However, in countries such as **Denmark and Ireland** there are **local regulatory frameworks** on issues such as food, electric cars, biodiversity & environment and certain financial support options which are **aligned to the EU Green Deal**.

Nutrient recycling practices applied in the region

Moving on to the awareness and application of regional recycling practices, the most basic technique with which the stakeholders are familiar is that of **composting**. Regarding the rest of the listed practices, the results differ from country to country. The next best known are **anaerobic digestion** (most of countries except Bulgaria), **manure drying** (Netherlands, Spain), **biological treatment** (Bulgaria, Denmark) and **wastewater nutrient recycling** (Ireland, Sweden).

Regarding the level of awareness of farmers on these kind of practices, in countries such as the Netherlands, Denmark and Poland, farmers are **aware of these or highly engaged**. In contrast, in Bulgaria, Spain and Ireland it seems that there is **no active engagement** of stakeholders to nutrient recycling practiced or that there is **low awareness**.

Perceptions on the necessity of digital tools for bioeconomy development

From the analysis of the results it appears that **almost all countries highly support the use of digital tools**. The exception is Sweden, which is characterized by mixed opinions as it has a good percentage on considering digital tools both as highly important and unnecessary.

Factors facilitating the uptake of biobased solutions and bioeconomy development in the focal regions

Regarding the factors that facilitate the adoption of biobased solutions by region, the results differ and directly depend on the current state in each region. For this reason, the results obtained per country are summarized in the table below.

Table 16. Factors facilitating the uptake of biobased solutions and bioeconomy development in the focal regions

NL	• Subsidized projects between agricultural colleges and regional associations • Highly productive agricultural sector • Motivated entrepreneurs • Active research institutions
BG	• Local action groups vital for bioeconomy development in rural areas
DK	• Strong cooperation among key players of the value chain
ES	N/A
PL	• Large fragmentation of farms • Small share of livestock production

IE	• High availability of renewable feedstocks • Many world-renowned research and educational institutions are actively engaged
SE	• Abundant supply of forest products • High level of expertise in the biobased sector • Effective regulation of forest residue management

Factors hindering the uptake of biobased solutions and bioeconomy development in the region

Moving on to the factors that prevent the use of biobased solutions and the development of the bioeconomy in each region, it is observed that the main factors are of an economic nature. Specifically, in countries such as the Netherlands, Denmark, Spain, Poland, Ireland and Sweden, the results show that obstacles such as high costs on investment & biomass transportation, lack of funding for large-scale production and lack of access to finance significantly influence the development of the sector. Furthermore, in most of the countries (except for Bulgaria and Spain) the non-existence of a legislative framework or the inadequacy of the existing frameworks for the development of the bioeconomy emerges as an important obstacle. To be more specific, typical examples of these difficulties are the lack of clear policy, lack of policy incentives, lack of regulation, lack of governmental support and strict regulation on feedstock. Another obstacle that emerges directly from the analysis and seems to be of particular importance in almost all targeted areas, both in the promotion and adoption of biobased solutions and in the development of the bioeconomy, is the lack or ineffective cooperation between value chain and lack of communication among stakeholders. Finally, the absence of quality standards and lack of knowledge & awareness are considered special obstacles.

Technical support services needed

As can be seen from the analysis of the results, most of the listed support services are considered important in the participating countries. The most useful technical support services turn out to be **field and lab testing** (NL, BG, PL, IE) and **training on nutrient recycling practices** (BG, DK, SE). Furthermore, services such as **soil nutrient management and monitoring** as well as **advisory services on pilot project implementation** are also claimed as helpful for bioeconomy development regionally.

Business support services needed

Regarding business support services, most of the listed ones are considered useful. Those that stand out in terms of their importance are of an economic nature, such as access to finance for the Netherlands, Denmark and Ireland, while access to information about social innovations is considered particularly helpful for countries such as Spain and Poland. Also, for the results regarding Ireland and Sweden, networking support and business mentoring & advisory are highlighted as important services respectively.

Measures recommended

The table below includes proposed measures to overcome the obstacles in each area and support according to bioeconomy development.

Table 17. Measures recommended to overcome the obstacles

NL	• Governmental financial support (e.g. subsidies)
BG	• Free economic zones for bio-based products • Protective measures for local business to use local bio-based products • Governmental support needed (e.g. subsidies)
DK	• Need for further governmental support
ES	• Targeted funding • Specific strategies to address regional challenges
PL	• Financial support required • National-wide measures required • Measures to strengthen stakeholders cooperation
IE	• Further governmental support (e.g. subsidies)
SE	• Grants for large investments in full-scale production facilities • National and structural investments in the regional geography

Annexes

Annex I – Exploratory research additional results

Examples of bioeconomy development in targeted areas

Country	Example	Short Description
Netherlands	**"ECORAS"**	Ecoras' mission is to create circular value chains by recognizing and working with environmental, technical and economic opportunities in the circular economy.
	CHEMPORTEUROPE	This ecosystem of companies is dedicated to speed up the transformation to sustainable chemistry, supporting the growth of the chemical industry in the Northern Netherlands. One o CHEMPORT's activities is the production of PHA for plastics in Friesland
Poland	"Pustelnia"	PUSTELNIA faced two main problems: it is located far from retail market (large retailers, processing plants) and the retail market, especially of carp, is unpredictable (extremely changing prices, seasonal sale). The idea was to create local, stable, all year round market for the species they farm.
Denmark	Biogas	Pyrolysis of the digested fibers followed by Carbon sequestration in the soils and green biorefinery of proteins from grass.
Sweden	Biorefinery Testbed	RISE (Research institute of Sweden) is establishing a world-class centre with test beds for biorefinery helping companies to set up their own pilot equipment with staff in a dynamic innovation environment consisting of labs, pilots, offices, and meeting places.[161].
	Liquid wind	The investment of 550 MSEK, to develop a commercial-scale facility FlagshipONE in Örnsköldsvik, is to be finally decided upon in November 2022. The concept is about producing green electrofuel for the shipping industry.[162]
Bulgaria	Cupffee	An Eco-friendly type of coffee cup created by the Bulgarian startup in 2010. It is made from natural grains which makes it consumable. It can be used for both hot and cold drinks.

[161] https://www.ri.se/en/what-we-do/projects/biorefinery-test-bed

[162] https://www.liquidwind.se/emethanol

		Cupffee is a combination of a cup and food and the product is reaching more and more countries. It is available in different cup sizes and stirrers as well and preserve best its properties before 9 months from the date of production. The production of Cupffee is patented and received copyright in 2015. The innovation in the process is that it offers an alternative usage of grain and grain residues (https://www.cupffee.me).

Bioeconomy case-study in targeted areas

Country	Name	Short description
Netherlands	Friesland Campina	Royal FrieslandCampina N.V. is a Dutch multinational dairy cooperative which is based in Amersfoort, Netherlands. It is the result of a merger between Friesland Foods and Campina on 30 December 2008.
Poland	Podlaskie Gorzelnie "SURWIN" Sp. z o.o	The company carried out a thorough modernization of the technological line for the production of bioethanol. This investment was co-financed by the Minister of Economy (http://www.surwin.pl/kontakt.html).
	REBREAD Kraków, Małopolskie voivodeship	Processing of unsold bread into distillate, beer, food and beverages, cosmetics, dishes and packaging, substrates for growing mushrooms, fertilizers (https://www.rebread.com/).
Denmark	Grass biorefinery at Ausumgaard	A plant concept for locally Danish-produced grass protein as an alternative to imported soya protein and thus contribute to a more environmentally and climate-friendly agriculture.
	REBREAD Kraków, Małopolskie voivodeship	Processing of unsold bread into distillate, beer, food and beverages, cosmetics, dishes and packaging, substrates for growing mushrooms, fertilizers (https://www.rebread.com/).
Sweden	Cinis Fertilizer	Is currently investing in an industrial plant for production of a circular, fossil free, water-soluble Sulfate of Potash (SOP) fertilizer using a zero emission and zero pollution production process, by revitalizing discarded material from for example the regional pulp and paper industry. Key factors of successful scalling-up: • good biorefinery idea. • dedicated entrepreneur. • well-functioning biorefinery cluster in this case with RISE Processum as its coordinating hub with available public funding, research, and laboratory resources. well-functioning innovation system and network including incubators, investors and both regional and the municipality governmental stakeholders.

Spain	Josenea Bio	A non-profit association that was born as a centre for social and labour insertion of people at risk of social exclusion, through the creation of small business projects related to gardening, reforestation, recovery of areas of ecological value, agrotourism, composting and the ecological cultivation of aromatic and medicinal plants. In 2022, Josenea Bio has presented a project to create the Circular Economy Park of Navarre[163], with a budget of 500,000€. The first phase of the creation of this park is planned for the end of 2023[164].
Ireland	AgriChemWhey	Aiming to build a first of its kind biorefinery in the region, based at Lisheen Co. Tipperary, AgriChemWhey a BBI-JU Flagship project will build an industrial scale biorefinery to valorise dairy waste. The project will develop commercial operation of a biorefinery to convert dairy wastes, whey permeate and delactosed whey into the bioplastic building block chemical lactic acid, with the co-production of products for food and fertiliser application (https://www.agrichemwhey.com/).

Small-scale bio-based solutions in targeted areas

Country	Title	Short description	Link
Netherlands	VOF Hanenberg-Vogels	Farms which also became biogas producers and develop fertilizer products	https://www.hanenberg.nu/Over%20ons/index.htm
	Jouregio	Production of composts on waste streams grass from nature areas or road site and usage at farms, sometimes also composting at farms	https://www.jouregio.nl/friese-melkveebedrijven-composteren-groenafval/
Poland	Koczergi	The biogas plant uses the cavitation process, which allows both the management of excessive plant biomass and waste plant materials. Waste generated after fermentation is used as a natural fertilizer BIO-EKO2.	http://dmg.net.pl/
	GWDA Sp. z o.o. / Piła, Wielkopolskie voivodeship	The GWDA Limited Liability Company processes biodegradable waste, and cooperates with farms and other enterprises interested in purchasing compost products for agricultural use.	http://gwda.pl/pl/oferta-kompostowni

[163] Propuesta Parque de la Economía Circular de Navarra. Available here

[164] La primera fase del parque de la economía circular de Navarra, para finales de 2023 (link)

Denmark	Stiesdal pyrolysis at Green Lab Skive	A green technology business, has opted to locate its first 2 MW SkyClean facility at GreenLab, near Skive. The company's ground-breaking pyrolysis technology converts straw and other agricultural waste into green fuel while also capturing and storing CO2.	https://www.greenlab.dk/
	DONG	Ørsted has been undergoing a huge biomass conversion initiative since 2006, constructing and upgrading our coal-fired combined heat and power (CHP) units to run on sustainable biomass[165].	https://orsted.com/en/our-business/bioenergy
Sweden	EcoHelix	A biotechnology company that produces sustainable materials from side streams from the pulp and paper industries. When producing cellulose pulp from wood, the hemicellulose and lignin need to be separated from the wood matrix. By their technology Ecohelix can utilize the hemicellulose and lignin that end up in the side streams throughout the pulp process to produce their material.	https://ecohelix.se//
Bulgaria	"GERMI" Ltd.	A proven manufacturer of mulch for decoration of gardens, playgrounds, inter-block spaces, parks. Mulch is a protective layer of organic or inorganic material that is placed around the stems of plants to protect them from weeds, excessive soil drying during hot summer days, or frost damage to the plantings during winter. The process of placing this protective layer around the plants is called mulching, which results in soil moisture regulation and continuous fertilization.	www. http://mulchbg.com/
Spain	INtercamBIOM network	Generated as a result of the H2020 project BRANCHES, is an information tool that compiles innovative practices that are already being applied in the field of biomass supply, bioenergy and value-added uses in Spain. Among them, there are two examples applied on a small scale: • Cooperativa Agrària de Miralcamp (cooperative dryer) Pirenaicasccl (livestock manure as fertiliser)	https://intercambio.org/

[165]Catalogue with bio-based solutions; Deliverable 3.3; POWER4BIO (2019). Available here

Ireland	*Biorefinery Glas*	An EIP-Agri Operational group funded by Department of Agriculture, Food, and the Marine under the Rural Development Program 2014 – 2020 led by MTU, in a collaboration involving fellow university UCD, Dutch company GRASSA and two Irish co-operatives Carbery Group (representing dairy farmers) and Barryroe Co-operative (representing a mixture of cattle, pig and other farmers).	https://biorefineryglas.eu/

Annex II – Interviews material

Interview Questionnaire

Interviewee	*[First Name] [Last Name]*	Title	
Date	[Date]		
Interviewer	[First Name] [Last Name]	*Region*	

Introduction: You have been invited to represent you regional area regarding the bioeconomy development in your region. The aim of this interview is to assess the degree to which you are familiar with the concept of bioeconomy and bio-based solutions, while identifying the potential needs and challenges, as well as, the regulatory framework and market conditions, of your region. An additional aim of this process is to provide profound information in relation to the status of the societal discussion on bioeconomy and the social acceptance of bio-based solutions, in your region.

Total estimated duration: 35'-40'

Part 1 : Background Information | Est. Duration 1'

1) Which of the following stakeholder groups do you associate with?
   - ❑ Biomass producer (farmers, forestry, aquaculture, unions, associations, etc.)
   - ❑ Business (agri-food & bio-based industry, logistics, financing)
   - ❑ Academic/Researcher
   - ❑ Government/policy-maker/public authority
   - ❑ Civil Society
   - ❑ Other, specify _____

2) Your Gender:
   - ❑ Female
   - ❑ Male
   - ❑ Diverse / Non-binary
   - ❑ Rather not to say

3) Your region: _____

4) What is your highest educational degree achieved?
   - ❑ Less than high school diploma
   - ❑ High school diploma
   - ❑ Some college, but no degree

- ❑ Bachelor's degree or equivalent
- ❑ Master's degree or equivalent
- ❑ Doctorate or Professional degree
- ❑

Note: Write down your notes in a way that ensures that information is recorded in a comprehensive and distinct way. Always make sure that the answer provided by the interviewee, fully responds to the respective question. Please, include interesting quotations, if possible.

Part 2: Bioeconomy development and social acceptance | Est. duration 9'-12'

Bioeconomy development in your region | Est. Duration 5-7'	
Question:	**Answer:**
1. How would you evaluate the progress in the bioeconomy field in your region? • What example of Bioeconomy can you think of in your region? • Which factors do you believe that might hold back bioeconomy growth in your region? • What are, in your opinion important factors for bioeconomy growth, in your region?	

Social acceptance of bioeconomy development in your region | Est. Duration 4-5'	
Question:	**Answer:**
2. How would you characterise the community's attitude towards biobased products/solutions, in your area (in terms of development, production and as market products)? • Are there any factors hindering the social acceptance of biobased products/solutions, in your region? • How could biobased products/solutions become more widely accepted?	

Part 3: Framework conditions | Est. duration 16-20'

Regulation and bioeconomy development in your region | Est. Duration 8-10'

Question:	Answer:
3. Does you region have a bioeconomy strategy? Please elaborate. • What kind of regional support measures encouraging the deployment of biobased solutions, are provided in your area (e.g. financial support measures, etc.)? • Do you believe the support is sufficient to stimulate investments in the respective field? • What policy and/or financial measures would you recommend for boosting the bioeconomy, in your region?	

Needs, challenges and market conditions in your region | Est. Duration 8-10'

Question:	Answer:
4. What opportunities exist in your region related to bioeconomy, or the production of novel or biobased products? • What do you think is required to help those opportunities develop into projects/solutions? • Which of the bioeconomy related fields do you believe that requires investments in research and innovation (e.g. policy, logistics, etc.)? • How would you evaluate the cooperation amongst the value chain actors, in your region? Do you believe it's effective? If not, how could this be improved? (e.g. events, workshops, campaigns, a communication platform, etc.)	

Part 4: Nutrient recycling practices | Est. duration 4-5'

Nutrient recycling practices in your region | Est. Duration 4-5'	
Question:	**Answer:**
5. Are you aware if nutrient circularity practices are applied by the farmers, in your region? • Which do you think is the main barrier preventing their adoption? • What actions could have a positive impact on farmers' willingness to adopt these practices?	

Part 5: Final thoughts | Est. duration 2-3'

➢ "Would you like to share any final thoughts? Anything you consider important to highlight?"

Interview Guidelines

Interview Methodology

The methodology applied for investigating the awareness, needs & perception of stakeholders, as well as, their acceptance levels in reference to bio-economy & bio-based solutions, is comprised by the following elements:

1. Interview and Sampling Methodology
2. Participant target groups
3. Procedure to be followed
4. Interview Questionnaires Overview

The following sections provide a comprehensive description of each one of the elements embodied in the methodology applied.

Sampling Methodology

The interview data will be collected in accordance with a semi-structured, in-depth questionnaire consisting of a set of open-ended questions. The sampling frame should consist of various stakeholder groups, and is thoroughly clarified within the following section.

Target groups

The targeted stakeholders for the MainstreamBIO interviews are divided into the five categories based on the basis of Quadruple Helix:

- **Category 1: Industry** (Biomass producers, Farmers**,** Agri-food and bio-based industry, rural entrepreneurs, tech providers, etc.),
- **Category 2: Academic and research institutions** (experts, researchers, etc.)
- **Category 3: Government agencies & public bodies** (political decision-makers, policy makers, etc.)
- **Category 4: Civil society** (non-governmental organisations, consumer associations, etc.)

The consortium partners have agreed on a minimum number of 5 interviewees per MIP region, hence 35 in total, in accordance with the agreed PM effort for this task. All of the MIP Leaders will be totally accountable for performing 5 interviews per MIP, in which the participants should eventually be one or more of the aforementioned domains.

In particular, at least 2 of the interviewees should belong to the Category 2 (experts, researchers, etc.) or Category 3 (authorities, policy makers, etc.), whereas the remaining 3 interviewees should come from any of the rest categories[166]. Accordingly, the interview areas, the number of interviewees and the corresponding leading partner are included in the table below:

Table 1: Number of interviews per MIP

	WR	IUNG	FBCD	PROC	AUP	INNV	MTU
Category 1, 4	3	3	3	3	3	3	3
Category 2, 3	2	2	2	2	2	2	2
TOTAL	5 (NL)	5 (PL)	5 (DK)	5 (SE)	5 (BG)	5 (ES)	5 (IE)

[166] Note: The remaining 3 interviewees should not necessarily come from each of the respective categories (farmers/ agri-food and bio-based industry /civil society/academics). They could also belong to one solely category. Ideally, at least one of the 3 interviewees should belong to the agri-food/bio-based industry.

Procedure to follow

As discussed in the previous section, the sampling frame should include stakeholders across various specializations and domains, particularly from the following sectors: biomass producers, agri-food and bio-based industry, academic and research institutions, as well as, civil society. Consequently, each of the MIP Leaders is fully responsible for identifying the potential interviewees, get in touch with them and explain thoroughly the scope of this project and the interview, and eventually, invite them to participate either to a face-to-face, or over the phone/skype interview, depending on the availability and convenience of the respective participant. The following tables[167] outline thoroughly the entire interview process.

Phase I: Identify potential interview participants, contact them and try to involve them in the interview process. Estimated time: 1-week (28/10/2022 – 04/11/2022)

Table 2: Interview Phase I - Instructions

Phase I	Step 1	Identify potential participants from the stakeholder groups depending on the availability and network of your organization by tracing a minimum number of five contacts for your target region. In addition, one or two contacts must be found as substitute participants in the event that a contact is unwilling or unavailable to participate. Also, in case the project members find contacts belonging to one of the other target areas then they are expected to contact the respective responsible bodies and recommend these to them.
	Step 2	Send the Invitation Letter to potential interviewees, inviting them to participate in interviews' process, either in person or remotely. Make sure to inform them that the interviewee will remain anonymous throughout the process in order to protect their identity.
	Step 3	To those who respond positively, provide the "Consent Form" prior to their participation in the interview. Participants are expected to sign and send back the Consent Form, before participating, so that the personal data protection laws and regulations are fully implemented.
	Step 4	When the participants return the consent form filled-in and signed, contact them to schedule the date and time of the interview. Clarify from the beginning the time required to complete the interview (expected time: 40'-45'). Before the interview, you can share with the interviewees the questionnaire that will be used, emphasizing the type of answers you expect and indicating which questions may need preparation for answering.
		Prepare for the interview by reading the questions, so that you are fully familiar with them and the interview gets the flow of a natural conversation.

[167] Table 2, Table 3, Table 4

	Step 5	This will help the participants feel more comfortable during the interview and thus get better results. To have the style of a natural dialogue as much as possible you must be able to move from one question to another when the interviewee answers something that can be a trigger.

Phase II: Carrying out the interviews .Estimated time: 2-weeks (04/11/2022 – 18/11/2022)

Table 3: Interview Phase II - Instructions

Phase II	Step 6	Make sure you have all the necessary materials for the interview and note-taking.
	Step 7	Inform the interviewee about the content and objectives of the project, the organizations and countries involved in it as well as interview's purpose, so that they feel as familiar as possible.
	Step 8	Proceed through the interview process using the questionnaire. The interview should last between 40-45 minutes. When the interviewee answers a question, repeat the answer by summarizing it to make sure you fully understand the answer and thus giving the participant an opportunity to expand their thinking and give more details.
	Step 9	Conclude the interview by asking the interviewees to give their impressions and explaining to them that their contribution to the project's evolution is of particular importance and plays a decisive role in its results. Let them know that they will get feedback on the results so that they feel welcome to participate in upcoming activities that they will be informed about if they wish. Also, ask if they'd mind contacting them via a quick e-mail or phone call in case you have a quick question to answer.

Phase III: Share the reporting templates with White Research for analysis and send the consent forms to the project coordinator for safekeeping. Share the reporting templates by 21/11/2022.

Table 4: Interview Phase III - Instructions

Phase III	Step 10	Include your notes in the Reporting Template, in the form of a coherent text, making sure that your notes are complete and clear so that a non-interviewer can understand their content.
	Step 11	Submit the completed template to White Research for its data analysis by 15th of November 2022.

Note: The total time for the realization of all the above actions is more than three weeks, taking into account the overlap of actions from one phase to the next. Therefore, we are led to the completion of the process on **November 21, 2022** where the partners are expected to submit the completed templates. The study and conduct of interviewers as well as the integrity and privacy of the participants must be assured at all stages of the study, in compliance with the principles of GDPR.

Interview Questionnaire Overview

To identify the current situation regarding the stakeholders' perception of the bio-economy, what are the regional needs and challenges, as well as, the social acceptance of the bio-economy and the bio-based solutions a questionnaire will be used. WHITE is responsible for the preparation and distribution of the questionnaire to the MIP Leaders, while the contribution of all partners is expected for its proper development.

Interview Questionnaire Guidelines | Estimated total duration : 40'-45'

Introduction of ourselves, project and interview process. Random questions to make interview feel comfortable and break the ice. The goal is to create rapport.

- Introduction to the interview process: You have been invited to represent you regional area regarding the bioeconomy development in your region. The aim of this interview is to assess the degree to which you are familiar with the concept of bioeconomy and bio-based solutions, while identifying the potential needs and challenges, as well as, the regulatory framework and market conditions, of your region. An additional aim of this process is to provide profound information in relation to the status of the societal discussion on bioeconomy and the social acceptance of bio-based solutions, in your region..".
- Make sure that you make clear to the interviewee that there are no wrong or correct answers, and that he/she should freely express his/her opinion. In case the interviewee does not understand the question, you should make sure to elaborate on the question.

Interview Questionnaire Structure

Part 1 || Background Information | Est. duration 1'

1) Which of the following stakeholder groups do you associate with?

- ❑ Biomass producer (farmers, forestry, aquaculture, unions, associations, etc.)
- ❑ Business (agri-food & bio-based industry, logistics, financing)
- ❑ Academic/Researcher

- ❑ Government/policy-maker/public authority
- ❑ Civil Society
- ❑ Other, specify _____

2) Your Gender:

- ❑ Female
- ❑ Male
- ❑ Diverse / Non-binary
- ❑ Rather not to say

3) Your region: _____

4) What is your highest educational degree achieved?

- ❑ Less than high school diploma
- ❑ High school diploma
- ❑ Some college, but no degree
- ❑ Bachelor's degree or equivalent
- ❑ Master's degree or equivalent
- ❑ Doctorate or Professional degree

Part 2 || Bioeconomy development and social acceptance, Estimated Duration 9' - 12'

Bioeconomy development in interviewee's region. | Est. Duration: 5' – 7'

Question 1: How would you evaluate the progress in the bioeconomy field in your region?

- What example of Bioeconomy can you think of in your region?
- Which factors do you believe that might hold back bioeconomy growth in your region?
- What are, in your opinion important factors for bioeconomy growth, in your region?

Social acceptance of bioeconomy development in interviewee's region. | Est. Duration: 4 - 5'

Question 2: How would you characterise the community's attitude towards biobased products/solutions, in your area (in terms of development, production and as market products)?

- Are there any factors hindering the social acceptance of biobased products/solutions, in your region?
- How could biobased products/solutions become more widely accepted?

Part 3 || Framework conditions | Est. duration 16-20'

Regulation and bioeconomy development in interviewee's region. | Est. Duration: 8' – 10'

Question 3: Does you region have a bioeconomy strategy? Please elaborate.

- What kind of regional support measures encouraging the deployment of biobased solutions, are provided in your area (e.g. financial support measures, etc.)?
- Do you believe the support is sufficient to stimulate investments in the respective field? What policy and/or financial measures would you recommend for boosting the bioeconomy, in your region?
- What policy and/or financial measures would you recommend for boosting the bioeconomy, in your region?

Needs, challenges and market conditions in your region | Est. Duration 7'

Question 4: What opportunities exist in your region related to bioeconomy, or the production of novel or biobased products?

- What do you think is required to help those opportunities develop into projects/solutions?
- Which of the bioeconomy related fields do you believe that requires investments in research and innovation (e.g. policy, logistics, etc.)?
- How would you evaluate the cooperation amongst the value chain actors, in your region? Do you believe it's effective? If not, how could this be improved? (e.g. events, workshops, campaigns, a communication platform, etc.)

Part 4 || Nutrient recycling practices | Est. duration 4-5'

Nutrient recycling practices in your region | Est. Duration 5'

Question 5: Are you aware if nutrient circularity practices are applied by the farmers, in your region?

- Which do you think is the main barrier preventing their adoption?

- What actions could have a positive impact on farmers' willingness to adopt these practices?

Part 5 || Final Thoughts | Est. duration 2-3'

At this point the interviewee is free to share his/her final thoughts, provide any comments or recommendations, and highlight anything important.

"I would like to thank you for taking your time for providing valuable insights in your perspective"

Interviews invitation letter

Consent form

Text in red colour contains guidelines for adjusting this template and should be deleted.

Text included in < > and/or highlighted with yellow should be replaced with content that is suitable to the context of each activity & project as well as to the organisation seeking to obtain the consent.

Before using this template take the time to carefully read and adjust it to the needs of the activity at hand as well as to any relevant regulations and particularities applicable to your country and organisation.

INFORMED CONSENT FORM

Who we are:

We are < Insert Partner Name > and we are contacting you in the framework of MainstreamBIO a project funded by the European Union under the Horizon Europe Framework Programme for Research and Innovation. A detailed description on how MainstreamBIO handles personal data is presented in the project's Privacy Policy available through the project's web page / that accompanies this Consent Form.

Project:

MainstreamBIO – MAINSTREAMing small-scale BIO-based solutions across rural Europe via regional Multi-actor Innovation Platforms and tailored innovation support (GA Number 101059420).

Partner:

Organisation name: < Insert Partner Name >

Address: < Insert Partner Address >.

Phone: < Insert Partner Phone >.

E-mail: <Insert Partner Generic E-mail Address >

Responsible persons:

You may delete the line referring to the Data Protection Officer if your organisation does not have one.

#	Role	Name	E-mail
1	Mainstr amBIO Project Manager	<Insert name of project manager from your organisation>	<Insert e-mail of project manager from your organisation >
2	Interviewer	<Insert name of interviewer from your organisation >	<Insert e-mail of interviewer from your organisation >
3	Data Protection Officer	<Insert name of DPO from your organisation >	<Insert e-mail of DPO from your organisation >

What do we need from you?

We need you to provide us with information about your professional and demographic status in order to: assess this information, contact and invite you to participate as a member in the Multi-actor Innovation Platform of your country.

Moreover, we might need you to participate in online surveys and/or interviews conducted under MainstreamBIO project for the analysis of current situation on small-scale biobased solutions in your region.

To effectively conduct this interview, we need to process some of your personal data:

Your contact details (full name, email, phone number);

Some basic demographics (age, gender, region, country);

Your professional info (organization, job position, field of expertise);

Your experience info relative to bioeconomy;

Your opinions on the subject matter.

Why do we need your data & what will we do with them?

We need your data to contact you, in order to invite you to participate as a member in the Multi-actor Innovation Platform in <country>, to plan and carry out the aforementioned interviews and/or surveys and to resolve any ambiguities, questions and other issues that may arise after and as a result of the interviews and/or surveys. We also need to record your data to keep track of the interview process. The project's deliverables that will be derived by the interviews and/or surveys will not include your personal data or any other information that could identify you. Your personal data will remain on our written notes (interview's transcript).

We will share your data with a few other MainstreamBIO project partners that are also involved in this task and will participate in the drafting of the relevant deliverables. We are also obliged to grant access to your data to:

EU officials such as our Project Officer for purposes related to project's evaluation;

EU agencies and other authorities for project's auditing purposes.

We would also be very happy if you gave us your consent to contact you in the future to ask you to participate in other project's activities (e.g. project workshops, events etc.) and also to inform you about the project's progress (e.g. by sending you a newsletter or similar messages).

How can you withdraw your consent?

You should know that you can withdraw your consent at any time by communicating either on the phone or by email with the responsible persons listed in the previous page. With regards to the informational messages and newsletters you can always opt out by simply clicking the link "Unsubscribe" or something similar included at the end of all the relevant messages.

I hereby give my consent to the processing of my personal data needed for:

*(Please, tick the boxes below to confirm that you give us your consent for the respective subject. Any boxes left unticked mean that **you do not consent to the relevant subject**.)*

#	Consent Subject	Tick box
1	My participation as a member in the Multi-actor Innovation Platform in <country> in my individual capacity	
2	My participation in an interview/survey that will be carried out by MainstreamBIO to study the current situation on small-scale biobased solutions in my region	
3	My participation in future activities of MainstreamBIO	
4	Receiving newsletters and messages regarding MainstreamBIO activities	

_____ _____

Name of participant Date Signature

Annex III – Survey material

Survey Questionnaire

Part I: Background Information

1. ***Which of the following stakeholder groups do you associate with?***
   - Biomass producer (farmers, forestry, aquaculture, unions, associations, etc.)
   - Business (agrifood & biobased industry, logistics, financing)
   - Government/Policy Maker
   - Public Authority
   - Academic/Researcher
   - Organization/Company
   - Civil Society/Individual
   - Other, specify _____

2. ***Gender: How do you identify?***
   - Female
   - Male
   - Non-binary
   - Rather not to say

3. ***Please indicate your age***: ……

4. ***Please indicate your area of residence***:
   - Urban
   - Semi-urban
   - Rural

5. ***What is the highest level of education you have completed?***
   - Less than high school diploma
   - High school diploma
   - Some college, but no degree
   - Bachelor's degree or equivalent
   - Master's degree or equivalent
   - Doctorate or Professional Degree

6. ***What is your Net Annual Household Income (in Euros)?***
   - €5.000 or less
   - €5.001 - €15.000
   - €15.001 - €25.000
   - €25.001 - 35.000
   - €45.001 - €55.000
   - €55.001 - €65.000
   - €65.001 - €75.000
   - €75.001 or more

7. ***Please indicate the extend of your familiarity with biobased products/solutions. [1=Not familiar at all; 2=Somewhat familiar; 3=Neutral; 4=Familiar;5=Highly familiar]***1

   - 2
   - 3
   - 4
   - 5

8. ***Biobased products are:***
   - Products derived wholly from biomass
   - Products derived partly from biomass
   - Both
   - I do not know

9. ***Biobased products are:***
   - All biodegradable
   - Some biodegradable and some non-biodegradable
   - All non-biodegradable
   - I do not know

Part II: Bioeconomy development

10. ***Please indicate your agreement with the following statements:[1=Strongly disagree; 2=Disagree; 3=Neither agree nor disagree/No opinion; 4=Agree; 5=Strongly agree; 6=I don't know]***

Bioeconomy can provide to my region:	1	2	3	4	5	6
Biodiversity protection	☐	☐	☐	☐	☐	☐
Waste reduction	☐	☐	☐	☐	☐	☐
Improved public health	☐	☐	☐	☐	☐	☐
Less dependence upon fossil fuels	☐	☐	☐	☐	☐	☐
Business development	☐	☐	☐	☐	☐	☐
Job opportunities	☐	☐	☐	☐	☐	☐

11. ***How important do you find the following areas for promoting entrepreneurship in bioeconomy, in your region?[1=Not important at all; 2=Low importance;3=Neutral; 4=Important; 5=Very important;]***

	1	2	3	4	5
Access to finance	☐	☐	☐	☐	☐
Access to knowledge	☐	☐	☐	☐	☐

Access to skilled workforce	☐	☐	☐	☐	☐
Access to R&D and testing infrastructures	☐	☐	☐	☐	☐
Access to information about relevant market opportunities	☐	☐	☐	☐	☐

12. How important do you find the following drivers for the development of bioeconomy and biobased products?[1=Not important at all; 2=Low importance;3=Neutral; 4=Important; 5=Very important;]

	1	2	3	4	5
Product competitiveness	☐	☐	☐	☐	☐
Improved profitability	☐	☐	☐	☐	☐
Sales growth potential	☐	☐	☐	☐	☐
Development of innovative products	☐	☐	☐	☐	☐
Increased access to knowledge	☐	☐	☐	☐	☐
Changes in consumer preferences	☐	☐	☐	☐	☐
Improved product's environmental performance	☐	☐	☐	☐	☐
Regulation compliance	☐	☐	☐	☐	☐
Availability of smart technologies & digital solutions	☐	☐	☐	☐	☐

Part III: Needs & Barriers

13. Which of the following do you consider as important needs of your region when it comes to the uptake of biobased solutions? [1=Not important at all; 2=Low importance;

	1	2	3	4	5
Awareness raising actions	☐	☐	☐	☐	☐
Supportive regulatory framework	☐	☐	☐	☐	☐
Information about emerging market opportunities	☐	☐	☐	☐	☐
Access to finance	☐	☐	☐	☐	☐
Public & private investments in R&D	☐	☐	☐	☐	☐
Demonstration sites	☐	☐	☐	☐	☐
Increased availability of scientific information for the public	☐	☐	☐	☐	☐
Infrastructure	☐	☐	☐	☐	☐

3=Neutral; 4=Important; 5=Highly important;]

14. Which of the following barrier(s) do you consider as important for your region to overcome when it comes to bioeconomy development? [1=Not important at all; 2=Low importance; 3=Neutral; 4=Important; 5=Highly important]

	1	2	3	4	5
Lack of policy incentives	□	□	□	□	□
Limited cooperation among different stakeholders	□	□	□	□	□
Lack of infrastructure – immature conversion technologies	□	□	□	□	□
High costs (investment, processing, certification, distribution, etc.)	□	□	□	□	□
Limited feedstock availability	□	□	□	□	□
Lack of awareness	□	□	□	□	□
Limited access to finance	□	□	□	□	□
Insufficient information regarding relevant market opportunities	□	□	□	□	□

Part IV: Biobased products

15. How often do you use bio-based products:

- Daily
- Often
- Not so often
- Rarely
- Never

16. Please indicate your agreement with the following statements: [1=Strongly disagree; 2=Disagree; 3=Neither agree nor disagree/No opinion; 4=Agree; 5=Strongly agree;]

	1	2	3	4	5
I am familiar with biobased products.	□	□	□	□	□
Bio-based products are easily available in the market.	□	□	□	□	□
Biobased products are fairly priced.	□	□	□	□	□
Bio-based products meet all applicable standards and certifications.	□	□	□	□	□

17. How strong are the following assets for you to buy biobased products?[1=Not strong at all; 2=Less strong; 3=Neutral; 4=Strong; 5=Highly strong;]

	1	2	3	4	5
Wide range of branded products	□	□	□	□	□
Labelling: bio-based	□	□	□	□	□
Priceto quantity ratio	□	□	□	□	□
Accuracy of product's information	□	□	□	□	□
Environmental footprint	□	□	□	□	□
Sustainable packaging	□	□	□	□	□
Origin of the product (e.g. local production)	□	□	□	□	□
Advertised on social media	□	□	□	□	□

18. How much more (in percentage) would you be willing to pay for the following bio-based products compared to the same fossil-based products?

	0%	**5%**	**10%**	**15%**	**20%**	**25%**	**30%, or more**
Construction materials	□	□	□	□	□	□	□
Vehicles and mobility	□	□	□	□	□	□	□
Clothes and textiles	□	□	□	□	□	□	□
Sports equipment	□	□	□	□	□	□	□
Disposable products (e.g. dishes, cups, straws, etc.)	□	□	□	□	□	□	□
Packaging products	□	□	□	□	□	□	□
Furniture and home decoration	□	□	□	□	□	□	□
Children's toys	□	□	□	□	□	□	□
Gardening products	□	□	□	□	□	□	□
Cleaning, hygiene and sanitary products	□	□	□	□	□	□	□
Cosmetics and personal care	□	□	□	□	□	□	□
Home office supplies	□	□	□	□	□	□	□

19. Are you aware if any of the following nutrient recycling practices is applied in your region?

	Yes	No	I don't know
Composting	☐	☐	☐
Anaerobic digestion	☐	☐	☐
Biological treatment (nitrification-denitrification)	☐	☐	☐
Pyrolysis	☐	☐	☐
Manure drying	☐	☐	☐
Phosphorus precipitation	☐	☐	☐
Wastewater nutrients recycling (e.g. microalgal bioremediation, omega-3s, biofuel)	☐	☐	☐

Part VI: Support services

20. Do you believe that digital tools are crucial for enhancing the actors' involvement in bioeconomy development?

- Yes
- No
- I don't know

21. How useful do you considerthe following technicalsupport services for supporting investments in the biobased market? [1=Not useful at all; 2=Less useful;3=Somewhat useful; 4=Very useful; 5=I don't know]

☐

	1	2	3	4	5
Project design and development	☐	☐	☐	☐	☐
Pilot project implementation advice	☐	☐	☐	☐	☐
Consultancy on the implementation and monitoring of biobased solutions	☐	☐	☐	☐	☐
Training on the available nutrient recycling practices	☐	☐	☐	☐	☐
Field and lab testing	☐	☐	☐	☐	☐
Scale-up and optimization for increased efficiency and yields	☐	☐	☐	☐	☐
Soil nutrient management & recycling monitoring	☐	☐	☐	☐	☐

22. How useful do you consider the following <u>business</u> support services for supporting investments in the biobased market? [1=Not useful at all; 2=Less useful;3=Somewhat useful; 4=Very useful; 5=I don't know]

	1	2	3	4	5
Tech scouting and bioeconomy business model design	☐	☐	☐	☐	☐
Market research and value chain development	☐	☐	☐	☐	☐
Business mentoring and advisory services	☐	☐	☐	☐	☐
Access to finance support (business start-up/up-scale aid)	☐	☐	☐	☐	☐
Establishment of knowledge exchange communities	☐	☐	☐	☐	☐
Access to information about social innovations focused on bioeconomy development	☐	☐	☐	☐	☐
Networking to find partners, customers or investors	☐	☐	☐	☐	☐
Support for establishment and maintenance of biobased technologies	☐	☐	☐	☐	☐
Awareness raising actions	☐	☐	☐	☐	☐

The project

MainstreamBIO is an Horizon Europe EU funded project, which sets out to get small-scale bio-based solutions into mainstream practice across rural Europe, providing a broader range of rural actors with the opportunity to engage in and speed up the development of the bioeconomy. Recognizing the paramount importance of bioeconomy for addressing key global environmental and societal challenges, MainstreamBIO develops regional Multi-actor Innovation Platforms in 7 EU countries (PL, DK, SE, BG, ES, IE & NL). The project aims to enhance cooperation among key rural players towards co-creating sustainable business model pathways in line with regional potentials and policy initiatives. MainstreamBIO supports 35 multiactor partnerships to overcome barriers and get bio-based innovations to market with hands-on innovation support, accelerating the development of over 70 marketable bio-based products and services. Furthermore, the project develops and employs a digital toolkit to better match bio-based technologies, social innovations and good nutrient recycling practices with available biomass and market trends as well as to enhance understanding of the bioeconomy with a suite of educational resources building on existing research results and tools. To achieve these targets, MainstreamBIO involves 10 partners across Europe, coming from various fields. Thus, all partners combine their knowledge and experience to promote the growth of bioeconomy in a sustainable and inclusive manner.

Coordinator: Q-**PLAN INTERNATIONAL ADVISORS PC (Q-PLAN**)

Partner		Short Name
Q-PLAN INTERNATIONAL	Q-PLAN INTERNATIONAL ADVISORS PC	Q-PLAN
MTU Ollscoil Teicneolaíochta na Mumhan Munster Technological University	MUNSTER TECHNOLOGICAL UNIVERSITY	MTU
WAGENINGEN UNIVERSITY & RESEARCH	STICHTING WAGENINGEN RESEARCH	WR
IUNG Institute of Soil Science and Plant Cultivation State Research Institute	INSTYTUT UPRAWY NAWOZENIA I GLEBOZNAWSTWA, PANSTWOWY INSTYTUT BADAWCZY	IUNG
RI. SE	RISE PROCESSUM AB	PROC
AGRARIAN UNIVERSITY - PLOVDIV	AGRAREN UNIVERSITET - PLOVDIV	AUP
Food & Bio Cluster Denmark	FBCD AS	FBCD
innovarum	EURIZON SL	INNV
DRAXIS ENVIRONMENTAL TECHNOLOGIES	DRAXIS ENVIRONMENTAL SA	DRAXIS
WHITE	WHITE RESEARCH SPRL	WHITE

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