MAINSTREAM BIO

MAINSTREAMING SMALL-SCALE BIO-BASED SOLUTIONS ACROSS RURAL EUROPE

D2.7

MainstreamBIO digital toolkit – final version

DRAXIS

29/8/2025

Funded by the European Union

PROJECT INFORMATION

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DISSEMINATION LEVEL

PU	Public, fully open	x
SEN	Sensitive, limited under the conditions of the Grant Agreement	
Classified R-UE/EU-R	EU RESTRICTED under the Commission Decision No2015/444	
Classified C-UE/EU-C	EU CONFIDENTIAL under the Commission Decision No2015/444	
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DOCUMENT HISTORY

Version	Date	Changes	Responsible partner
v0.1	21/7/2025	Initial version	DRAXIS
v0.2	19/8/2025	1st peer review	WR; IUNG
v0.3	25/8/2025	2nd peer review	All partners
v1	29/8/2025	Final version	DRAXIS

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Table of Contents

TABLE OF FIGURES

LIST OF TABLES

ABBREVIATIONS

CSA	Coordination and Support Action
DSS	Decision Support System
EU	European Union
GDPR	General Data Protection Regulation
MIPs	Multi-Actor Innovation Platform
UI	User Interface
UX	User Experience
WR	Wageningen Research

Executive summary

MainstreamBIO is a HORIZON Coordination and Support Action (CSA) project funded by the European Union under grant agreement No. 101059420. The project began in September 2022 and runs for a duration of 36 months, concluding in August 2025. Its overarching aim is to co-develop innovation support services and digital tools that build awareness, understanding, and capacity for the uptake of small-scale bio-based solutions, aligned with regional contexts and market needs.

This report presents the outcomes of activities related to the development of the MainstreamBIO digital toolkit, carried out under Work Package 2. The current deliverable, D2.7 – MainstreamBIO Digital Toolkit – final version, summarizes the final version of the toolkit as developed and coordinated by DRAXIS. The toolkit is available to the public at: https://mainstreambio-digital-toolkit.eu/.

The toolkit has been envisioned as a comprehensive, user-friendly online platform that serves individuals interested in bioeconomy, whether they are newcomers seeking to learn or experienced professionals looking to expand their knowledge and impact. It provides a dynamic digital environment that integrates education, decision support, collaboration, and access to resources that can help users implement real-world bio-based solutions.

Designed to support the adoption of small-scale bio-based innovations across rural Europe, the digital toolkit comprises nine (9) core components:

- A Catalogue of small-scale bio-based technologies, business models, and social innovations, allowing for cross-case comparison and opportunity assessment.
- A Collection of Best Practices for improved nutrient recycling and sustainable organic matter management.
- A curated set of MainstreamBIO Resources, including audiovisual educational materials and profiles of the bioeconomy landscape in seven EU rural regions.
- A Decision Support System (DSS) to help match available biomass and waste streams with relevant technologies, business models, and social innovations.
- The BioForum, a communication space for exchanging ideas, solutions, and good practices with other members of Multi-Actor Innovation Platforms (MIPs).
- A Bioeconomy Repository that aggregates educational content from related bioeconomy projects to raise awareness and promote knowledge sharing.
- A Tool Library, providing access to bioeconomy tools from other EU-funded projects (e.g. knowledge hubs, online encyclopedias, digital tools, and similar platforms)
- A comprehensive Instructions section with video and text-based guidance to support optimal use of the platform.
- A Webinars section featuring audiovisual learning content and further insights into the bioeconomy profiles of the seven focus regions.

This document also details the fully functional pages of the digital toolkit, alongside the initial wireframes and mockups that guided their development. It explains the purpose and intended functionality of each page and outlines the objectives they aim to support. The development process followed an iterative design methodology: beginning with wireframes, progressing to mockups, and integrating feedback and visual design elements to enhance usability, interactivity, and user experience.

Main Changes between D2.5 and D2.7

Section / Component	D2.5 (Initial Version – Feb 2024)	D2.7 (Final Version – Aug 2025)	Major Change
Improved UI/UX	First version of the Toolkit	Visual overhaul with UI/UX with refined visuals, accessibility features, and optimized navigation	Improved UI/UX, better usability and accessibility.
Toolkit Components	8 main components (Catalogue, Nutrient Practices, Resources, DSS, Bioeconomy Repository, Tool Library, BioForum, Instructions).	Expanded to 9 core components (added Webinars)	+1 functionalities (Webinars, renamed and expanded Other MainstreamBIO Resources)
Homepage Structure	4 pillars: Sustainable Solutions, Information Platforms, Innovation Resources, Learning Center. Includes a welcome pop-up.	Navigation reorganized into 4 headers: Catalogue & Resources, Decision Support & BioForum, Repository & Tool Library, Instructions & Webinars. No pop-up.	Removed pop-up; renamed/restructured headers and streamlined homepage.
Decision Support System	3-step process: Matching Table → Scoring Table → Radar Chart.	Expanded 6-step DSS: Matching Table → Social Impact → Economic Impact → Environmental Impact → Implementation Requirements → Radar Chart. Added popups with info/arguments, updated PDF export.	Extended DSS from 3 to 6 steps, more detailed impact assessment.
Resources	Included audiovisual materials and 7	Structured subsections for audiovisuals and	More audio-visual material and better

	regional bioeconomy profiles.	bioeconomy profiles; detailed country profiles (e.g. Netherlands).	navigation between the countries.
BioForum	Basic forum: users can post, comment, share PDFs/images, logged-in required.	Enhanced: structured communities (6 groups), thematic tags, advanced rich-text editor, search/filtering.	Expanded functionality and usability.
Repository	Audiovisual + documents, filterable. Content volume unspecified.	Audiovisual (15 videos) + documents (561 items) with advanced filters.	Content significantly expanded & quantified.
Tool Library	Collection of external bioeconomy tools.	Same function, but broader selection of planning/monitoring tools.	Expanded content.
Instructions / Learning	Instructions page only.	Instructions (with transcript + video) + Webinars section (10 webinars).	Addition of Webinars, updated and improved instructions.
Account Section	Basic account functions: profile, email/username, delete, password, privacy policy.	Expanded: added Rate Us feature, feedback questions, profile picture upload, privacy tabs.	Enhanced account features.
Annexes	Included user requirements questionnaire and wireframes/mockups.	No annexes; streamlined final version.	Removed annexes, focused on final content.
Action Plan	Up to delivery of first version (M18).	Extended through final delivery (M36), including translation, testing, and updates.	Extended timeline to full project lifecycle.

1. Introduction

One of the key objectives of MainstreamBIO was to develop and implement a digital toolkit that effectively connects bio-based technologies, social innovations, and sustainable nutrient recycling practices with existing biomass resources and market trends. In addition, the toolkit aims to strengthen understanding of the bioeconomy by providing educational resources built on existing research findings and available tools.

1.1 Description of Task 2.5 in Grant Agreement

The development and maintenance of MainstreamBIO digital toolkit is included in *Task 2.5: Development, upgrade and integration of digital tools in the MainstreamBIO digital toolkit* led by DRAXIS and supported by the entire consortium of the project.

The description of the task as described in the Grant Agreement is:

"DRAXIS will develop and maintain the MainstreamBIO digital toolkit during the project. WR will be responsible for providing the necessary material for the implementation of the decision support system developed under Task 2.4 with support from INNV (for available business models), IUNG (for nutrients recycling practices), WHITE (for social innovations) and MTU (for education and awareness raising practices). Q-PLAN will be responsible for collecting the material for the Bioeconomy Repository and Tool Library, using as a starting point the respective TRANSITION2BIO awareness, communication and education toolkits. The digital toolkit (D2.4) will be fine-tuned based on data collected from its practical use across each of the project's two innovation support rounds."

The MainstreamBIO digital toolkit played a pivotal role in the project's overall progress and represented a key milestone. To ensure its timely and efficient development, DRAXIS worked in close collaboration with all partners, developed a clear plan and timeline to guide its delivery.

1.2 Approach and methodology

As outlined in detail in Deliverable D2.5, our development journey followed a structured three-step methodology, beginning with an analysis phase built on insights gathered through a 50-question user survey. This helped us define user needs and informed every stage of the process.

We kicked off the design work by creating mockups in Whimsical, which allowed us to map out early concepts and structure the user flow. These drafts were reviewed extensively, incorporating feedback based on user stories and supporting resources such as visual catalogues and feature references.

To move from wireframes to a more polished and interactive design, we transitioned to Figma, a widely adopted tool in the design community. Figma enabled us to visualize the look and feel of the toolkit, including its layout, content structure, and user navigation across different pages and functionalities.

Once the visual design was complete, we used Figma's import feature to bring the layouts into Bubble.io, marking the start of development. Bubble.io, a powerful no-code platform, was chosen for its speed, flexibility, and scalability. It allowed us to turn designs into a working application quickly

while maintaining control over both functionality and aesthetics, ensuring that the toolkit is user-friendly, adaptable, and ready for real-world use.

1.3 Action Plan

The action plan in Table 1 was initially presented during the kick-off meeting in Thessaloniki and subsequently updated at each project meeting: the 2nd in Cork, the 3rd in Almere, the 4th in Viborg, the 5th in Madrid, the 6th held online, and the final update during the 7th project meeting in Brussels.

Table 1: Action plan for Task 2.5 was presented at kick-off meeting and updated at each project meeting.

No.	Action point	Who	By When	Month
1	Align with sister projects on synergies and avoiding overlaps regarding the toolkits	DRAXIS, WR, Q-PLAN	15/4/23	M8
2	Receive catalogue of small-scale bio-based technologies, business models and social innovations	WR, WHITE, INVV	30/4/23	M8
3	Receive catalogue of the collected nutrient recycling practices	IUNG	30/4/23	M8
4	Online meetings with material providers for the design and functionality of the toolkit	DRAXIS, WR, INVV, WHITE, MTU, Q-PLAN, IUNG	20/6/23	M10
5	Receive material for Bioeconomy Repository	Q-PLAN	30/6/23	M10
6	Results from the questionnaire for user requirements	DRAXIS	30/6/23	M10
7	Discuss implementation of multi-criteria decision model in Toolkit	WR, INNV	30/6/23	M10
8	Receive results for the MainstreamBIO digital toolkit functionality from the participants in the co – creation workshops	INVV	15/7/23	M11
9	Delivery of 1st design multi-criteria decision model	WR, INNV	20/7/23	M11
10	Receive outcomes from WP1, which will be included in the toolkit	MTU, WHITE	31/7/23	M11
11	Creation of 1st MainstreamBIO digital toolkit's functional design	DRAXIS	31/7/23	M11
12	MainstreamBIO digital toolkit's development – 1st prototype	DRAXIS	30/11/23	M15

13	1st innovation support round	All partners	31/12/23	M16
14	Delivery of toolkit's 1st version	DRAXIS	29/2/24	M18
15	Feedback analysis from Capacity Building Workshops	DRAXIS	30/6/24	M22
16	Finalization of Nutrient Recycling Practices	DRAXIS	31/7/24	M23
17	Finalization of Content (Descriptions, Features)	DRAXIS, WR	31/8/24	M24
19	Finalization of BioForum	DRAXIS	31/10/24	M26
20	Update of Toolkit's Decision Support System	WR, DRAXIS	30/11/24	M27
21	Integration of feedback from partners	All partners, DRAXIS	31/12/24	M28
22	Finalization of Translation in all EU languages	DRAXIS	31/12/24	M28
23	Quality testing of the Toolkit	All partners	28/2/25	M30
24	Updating the User Interface/User Experience	DRAXIS	30/4/25	M32
25	Finalization of Decision Support System	WR, DRAXIS	30/6/25	M34
26	Finalization of Instructions	All partners, DRAXIS	29/8/25	M36
27	Delivery of digital toolkit final version (Deliverable 2.7)	DRAXIS	29/8/25	M36

1.4 Content of deliverable

This deliverable provides an overview of how the MainstreamBIO digital toolkit was created, from gathering requirements and developing the platform to producing content, launching it, and rolling out updates. The toolkit is available to the public at: https://mainstreambio-digital-toolkit.eu/

2. MainstreamBIO digital toolkit

2.1 Home Page

Upon landing on the homepage, visitors are welcomed with an animation featuring the MainstreamBIO logo and with its core message. The header section provides key navigation options, including language selection using Google Translate and direct access to the toolkit's four main thematic categories of pages: Catalogue & Resources, Decision Support & BioForum, Repository & Tool Library, and Instructions & Webinars. These categories serve as structured entry points to the toolkit's nine (9) core functionalities. A login and signup feature are also available, enabling users to create customized Decision Support Systems (DSS) or actively engage in discussions via the BioForum.

Further down the page, a prominent "Find Out More" button is located, allowing users to scroll or click to access detailed descriptions of each available functionality. In addition, an accessibility support widget from UserWay is positioned at the bottom right corner of the interface. This feature enhances inclusivity by offering customizable options to accommodate a diverse range of user needs.

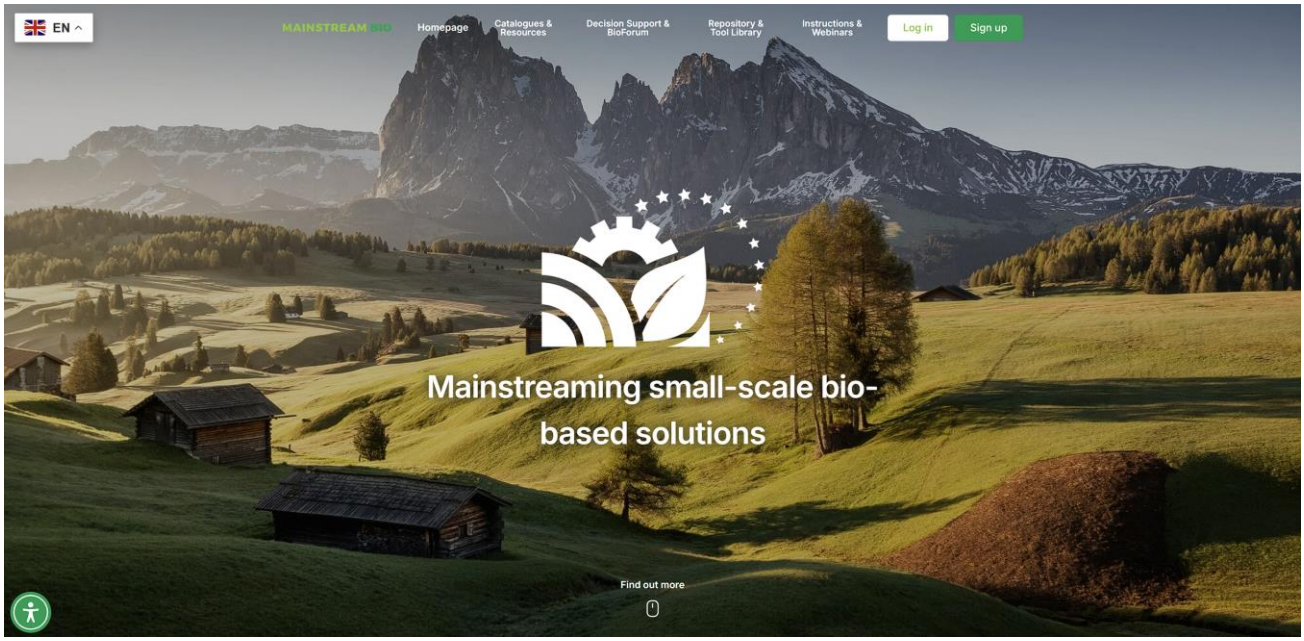


Figure 1: Homepage

2.2 Header (Catalogue & Resources)

The Catalogue & Resources section of the toolkit comprises three core functionalities: the Catalogue of Small-Scale Bio-Based Solutions, Nutrient Recycling Best Practices, and Other MainstreamBIO Resources. Each functionality is supported by a concise description that outlines its purpose, scope, and relevance within the broader context of the toolkit. This section aims to provide users with structured access to practical knowledge, case studies, and reference materials that support the uptake and replication of bio-based solutions across regions.

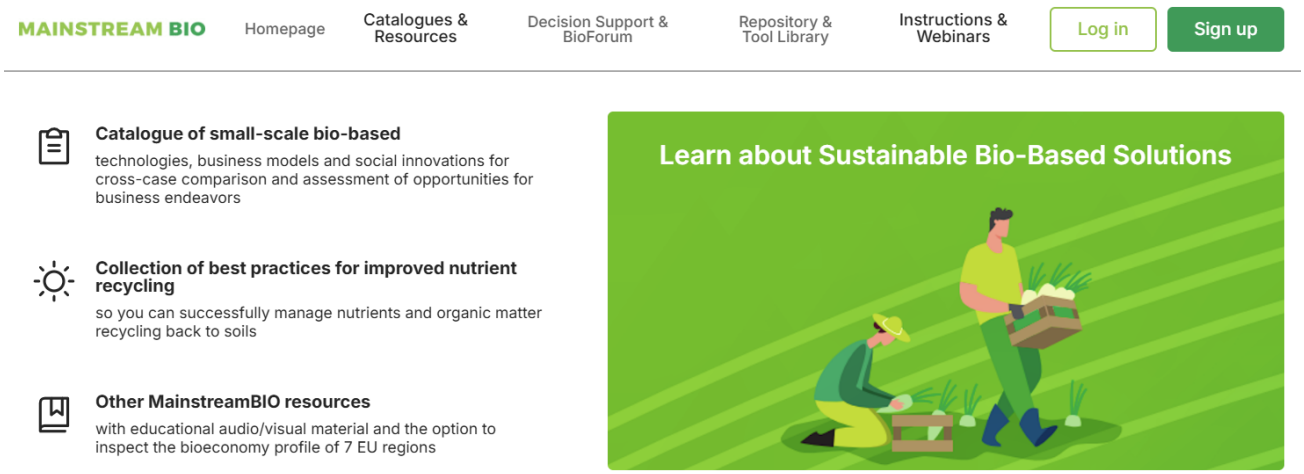


Figure 2: Catalogues & Resources (Header)

2.3 Header (Decision Support & BioForum)

The Decision Support & BioForum section contains two key functionalities of the toolkit: the Decision Support System (DSS) and the BioForum. These components are designed to support evidence-based decision-making and foster collaborative dialogue among stakeholders in the bioeconomy sector. The DSS enables users to develop tailored support systems based on specific parameters and regional contexts, while the BioForum facilitates knowledge exchange, peer-to-peer interaction, and community building around bio-based initiatives.

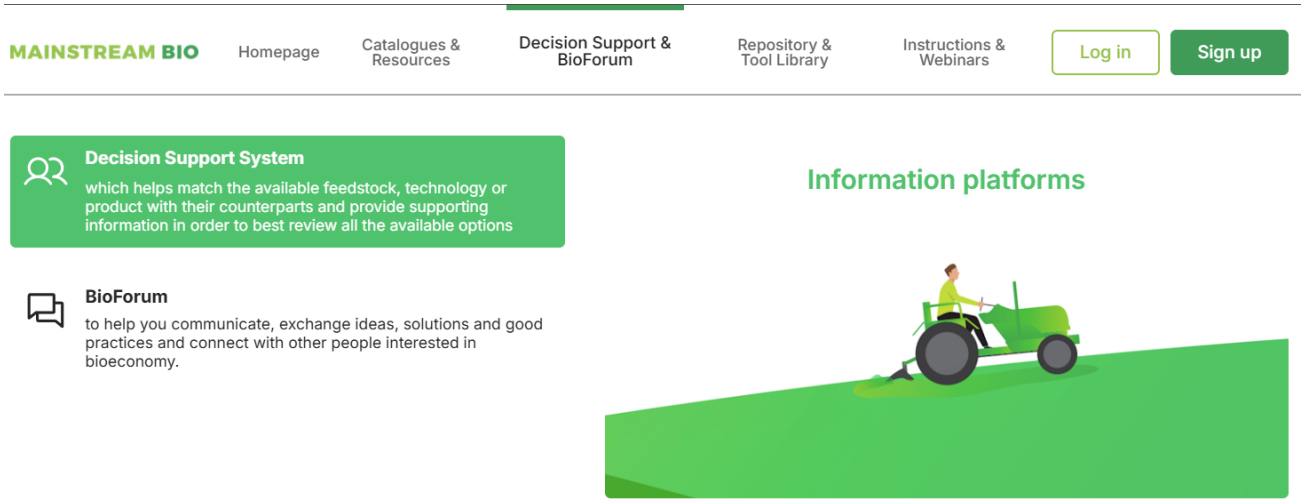


Figure 3: Decision Support & BioForum (Header)

2.4 Header (Repository & Tool Library)

The Repository & Tool Library section includes two distinct functionalities: the Bioeconomy Repository and the Tool Library. This section offers users access to a curated collection of key documents, methodologies, instruments, and digital tools that support innovation and informed decision-making in the bioeconomy sector. The content is intended to serve as a practical reference for stakeholders seeking to adopt, adapt, or scale up bio-based practices and solutions across various regional and thematic contexts.

Figure 4: Repository & Tool Library (Header)

2.5 Header (Instructions & Webinars)

The Instructions & Webinars section serves as a central hub for user support and instructional content. It includes the Instructions page, which offers step-by-step guidance on how to navigate and utilize the toolkit's functionalities. This guidance is provided through an integrated audio-visual tutorial accompanied by a full transcript to ensure accessibility for all users.

In addition, the section features a dedicated Webinars page, which hosts all webinar content produced within the framework of the MainstreamBIO project. This includes recordings of live training sessions delivered by project partners and external experts. Collectively, these resources aim to facilitate user engagement, promote knowledge transfer, and support the effective adoption of the toolkit across diverse stakeholder groups.

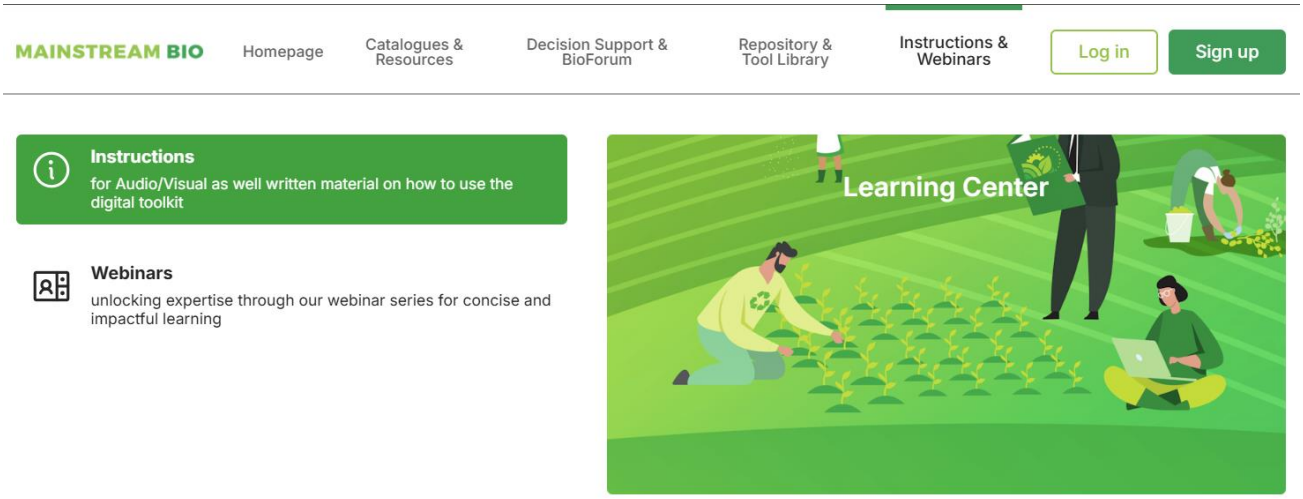


Figure 5: Instructions & Webinars (Header)

2.6 MainstreamBIO Login/Signup Page

Users can access the toolkit by logging in with their registered email address and password. In cases where login credentials are forgotten, a password recovery option is available through the "Forgot your password?" functionality. New users can create an account by completing a straightforward registration process, which requires the submission of a username, email address, password, and password confirmation.

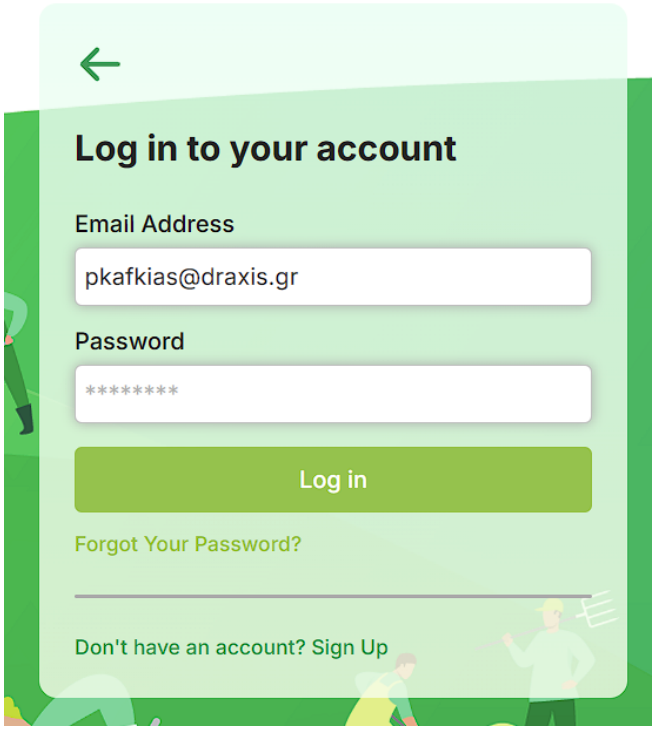


Figure 6: MainstreamBIO Log in Page

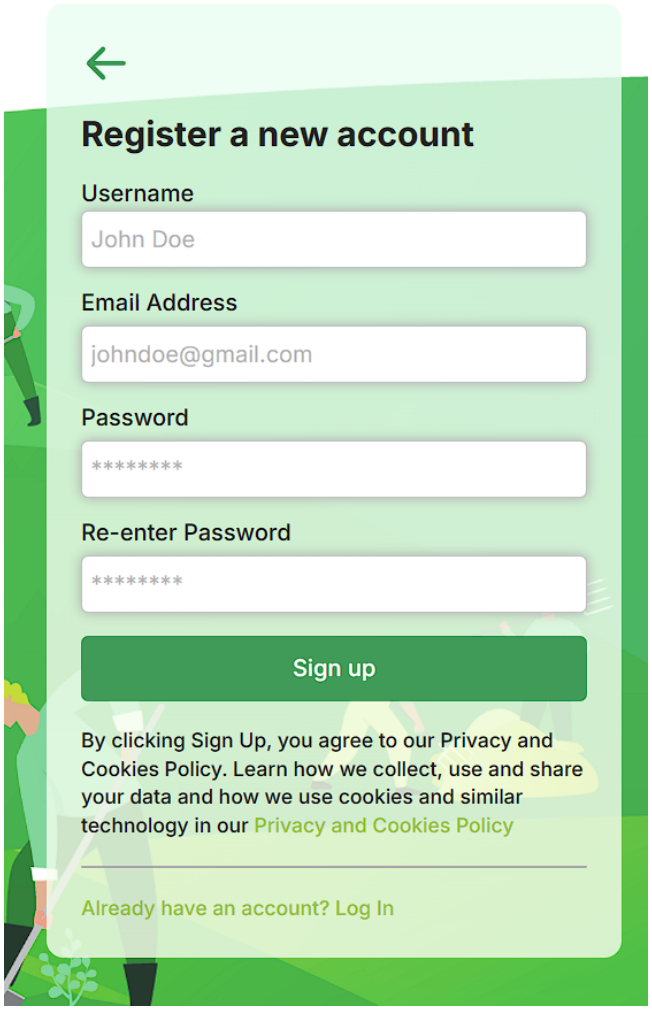


Figure 7: MainstreamBIO Sign up Page

2.7 Home page (Feature Selector)

By clicking the "Find Out More" button or scrolling down on the homepage, users are presented with a concise overview of the toolkit's structure, offering direct access to all nine (9) core functionalities. This section enables users to quickly identify and navigate to the specific functionality that aligns with their interests or needs.

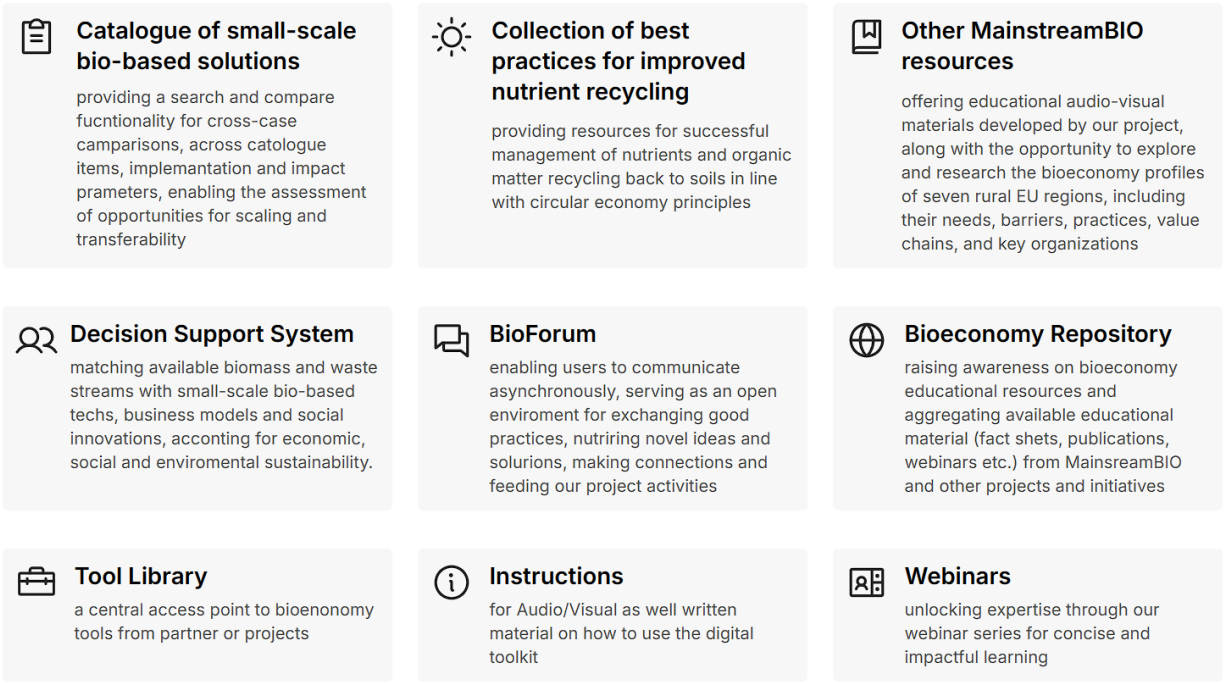


Figure 8: Home Page (Sustainable solutions)

2.8 Home page (Partners)

Beneath the feature selection area, the homepage includes a dedicated section displaying interactive partner logos, allowing users to navigate directly to the official webpages of each MainstreamBIO partner organization by clicking on the corresponding logo.

Figure 9: Home Page (Partners)

2.9 Footer

The footer of the digital toolkit includes several key elements designed to ensure transparency, accessibility, and user engagement. The MainstreamBIO project logo is positioned prominently at the left hand side and functions as a hyperlink redirecting users to the official MainstreamBIO project website. Centrally positioned within the footer is the official European Union funding disclaimer, acknowledging the financial support provided for the implementation of the project and including the appropriate legal notice.

On the right hand side of the footer, users can access the project's social media links along with a dedicated feedback section. This feature allows users to submit comments, suggestions, or issue reports, contributing to the ongoing enhancement, expansion, and refinement of the toolkit. Beneath the feedback section, links to the MainstreamBIO Privacy Policy and Toolkit Usage Instructions are provided, offering transparency regarding data protection and user guidance. At the bottom of these elements, a disclaimer regarding the use of the Google Translate plugin is included, informing users that content may be automatically translated and could contain inaccuracies. Finally, at the bottom of the footer, the copyright notice states that the toolkit is developed and hosted by DRAXIS Environmental SA, providing the necessary legal and ownership information.

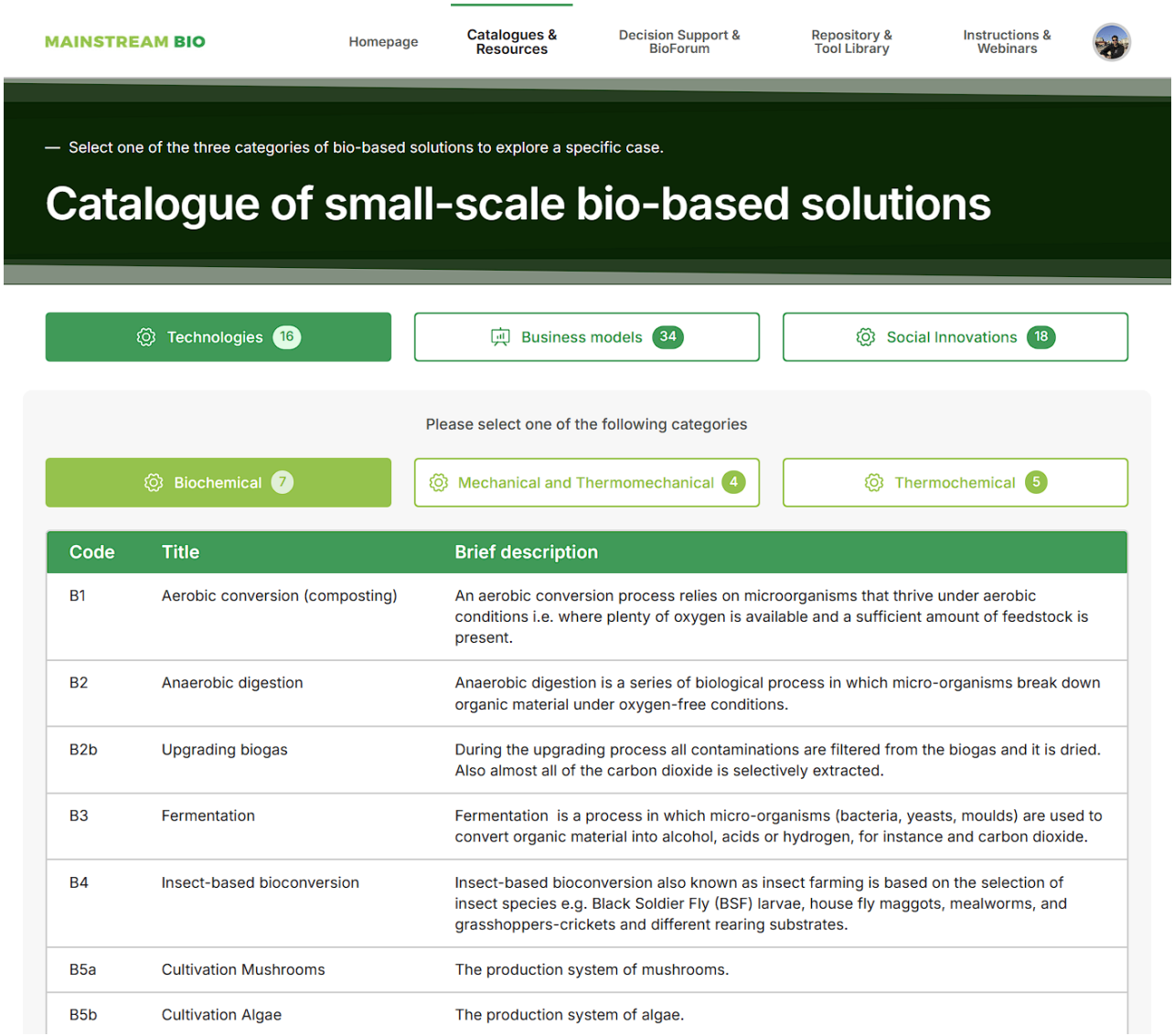
Figure 10: Footer

2.10 Catalogue of small-scale bio-based solutions (Selection Table)

The Catalogue of small-scale bio-based solutions page functions as a structured repository of bio-based technologies, systematically classified into three main categories: biochemical (7), mechanical and thermomechanical (4) and thermochemical (5) processes. It comprises sixteen (16) distinct small-scale technological solutions, including aerobic digestion, blending or mixing, and combustion, among others. These solutions are presented to support the dissemination of sustainable practices, raise awareness of environmentally responsible approaches, and illustrate technological diversity across the bioeconomy sector.

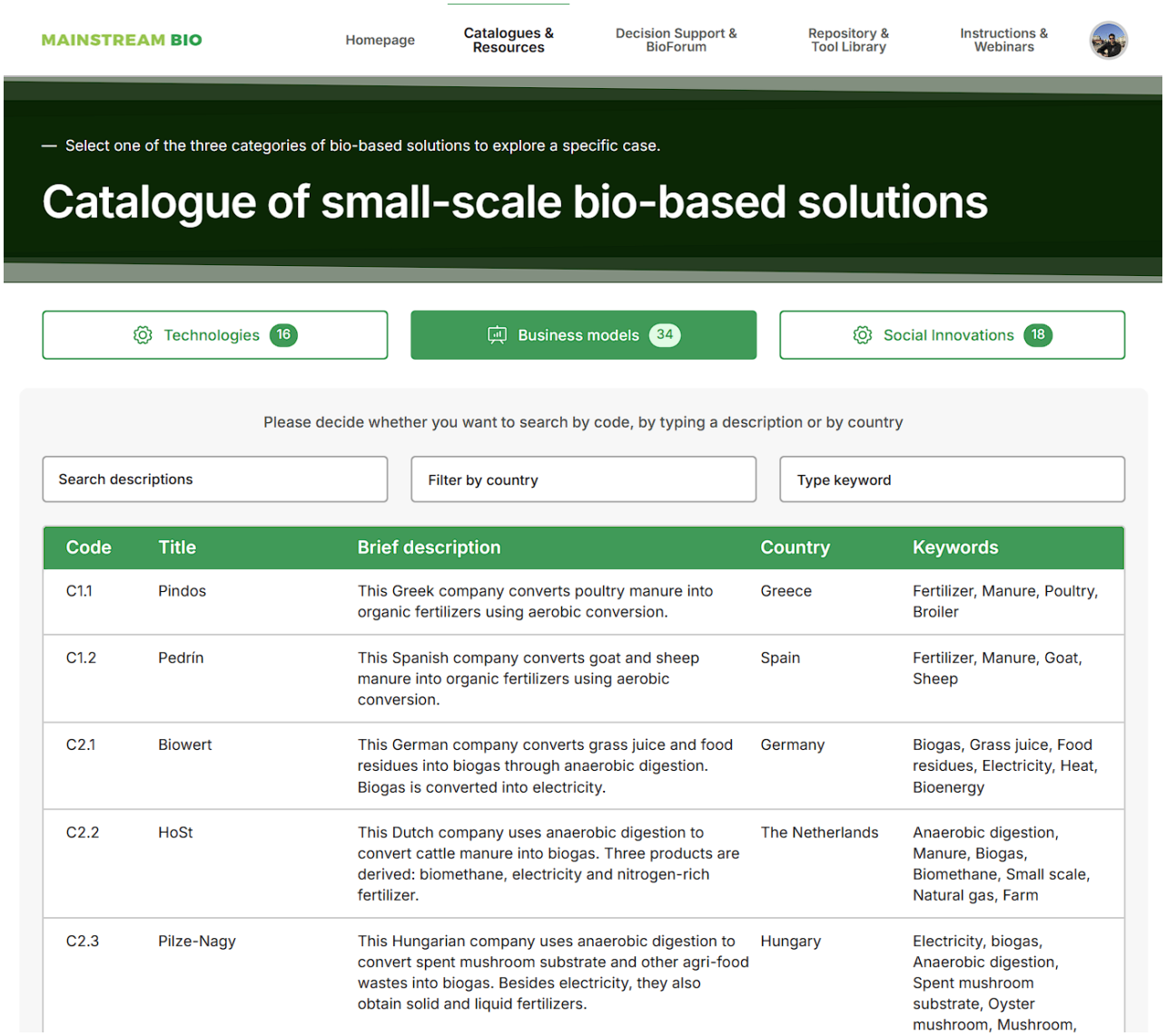
In parallel, the Catalogue section includes a set of thirty-four (34) business models originating from eighteen (18) countries, offering a broad overview of international market strategies. This collection enables users to gain insights into diverse implementation contexts and innovation pathways within the bioeconomy. To support targeted exploration and improve usability, filtering options are available based on description, country, and/or keyword.

Additionally, eighteen (18) social innovations from fourteen (14) countries are made available within the Catalogue. These examples reflect community-based approaches that integrate environmental and social objectives. Users are able to conduct comparative assessments of the innovations, with filtering capabilities based on description, country, and/or keyword supporting contextual analysis and user-driven exploration.



Code	Title	Brief description
B1	Aerobic conversion (composting)	An aerobic conversion process relies on microorganisms that thrive under aerobic conditions i.e. where plenty of oxygen is available and a sufficient amount of feedstock is present.
B2	Anaerobic digestion	Anaerobic digestion is a series of biological process in which micro-organisms break down organic material under oxygen-free conditions.
B2b	Upgrading biogas	During the upgrading process all contaminations are filtered from the biogas and it is dried. Also almost all of the carbon dioxide is selectively extracted.
B3	Fermentation	Fermentation is a process in which micro-organisms (bacteria, yeasts, moulds) are used to convert organic material into alcohol, acids or hydrogen, for instance and carbon dioxide.
B4	Insect-based bioconversion	Insect-based bioconversion also known as insect farming is based on the selection of insect species e.g. Black Soldier Fly (BSF) larvae, house fly maggots, mealworms, and grasshoppers-crickets and different rearing substrates.
B5a	Cultivation Mushrooms	The production system of mushrooms.
B5b	Cultivation Algae	The production system of algae.

Figure 11: Catalogue of small-scale bio-based solutions (Selection Table – Technologies)



Code	Title	Brief description	Country	Keywords
C1.1	Pindos	This Greek company converts poultry manure into organic fertilizers using aerobic conversion.	Greece	Fertilizer, Manure, Poultry, Broiler
C1.2	Pedrín	This Spanish company converts goat and sheep manure into organic fertilizers using aerobic conversion.	Spain	Fertilizer, Manure, Goat, Sheep
C2.1	Biowert	This German company converts grass juice and food residues into biogas through anaerobic digestion. Biogas is converted into electricity.	Germany	Biogas, Grass juice, Food residues, Electricity, Heat, Bioenergy
C2.2	HoSt	This Dutch company uses anaerobic digestion to convert cattle manure into biogas. Three products are derived: biomethane, electricity and nitrogen-rich fertilizer.	The Netherlands	Anaerobic digestion, Manure, Biogas, Biomethane, Small scale, Natural gas, Farm
C2.3	Pilze-Nagy	This Hungarian company uses anaerobic digestion to convert spent mushroom substrate and other agri-food wastes into biogas. Besides electricity, they also obtain solid and liquid fertilizers.	Hungary	Electricity, biogas, Anaerobic digestion, Spent mushroom substrate, Oyster mushroom, Mushroom,

Figure 12: Catalogue of small-scale bio-based solutions (Selection Table – Business models)

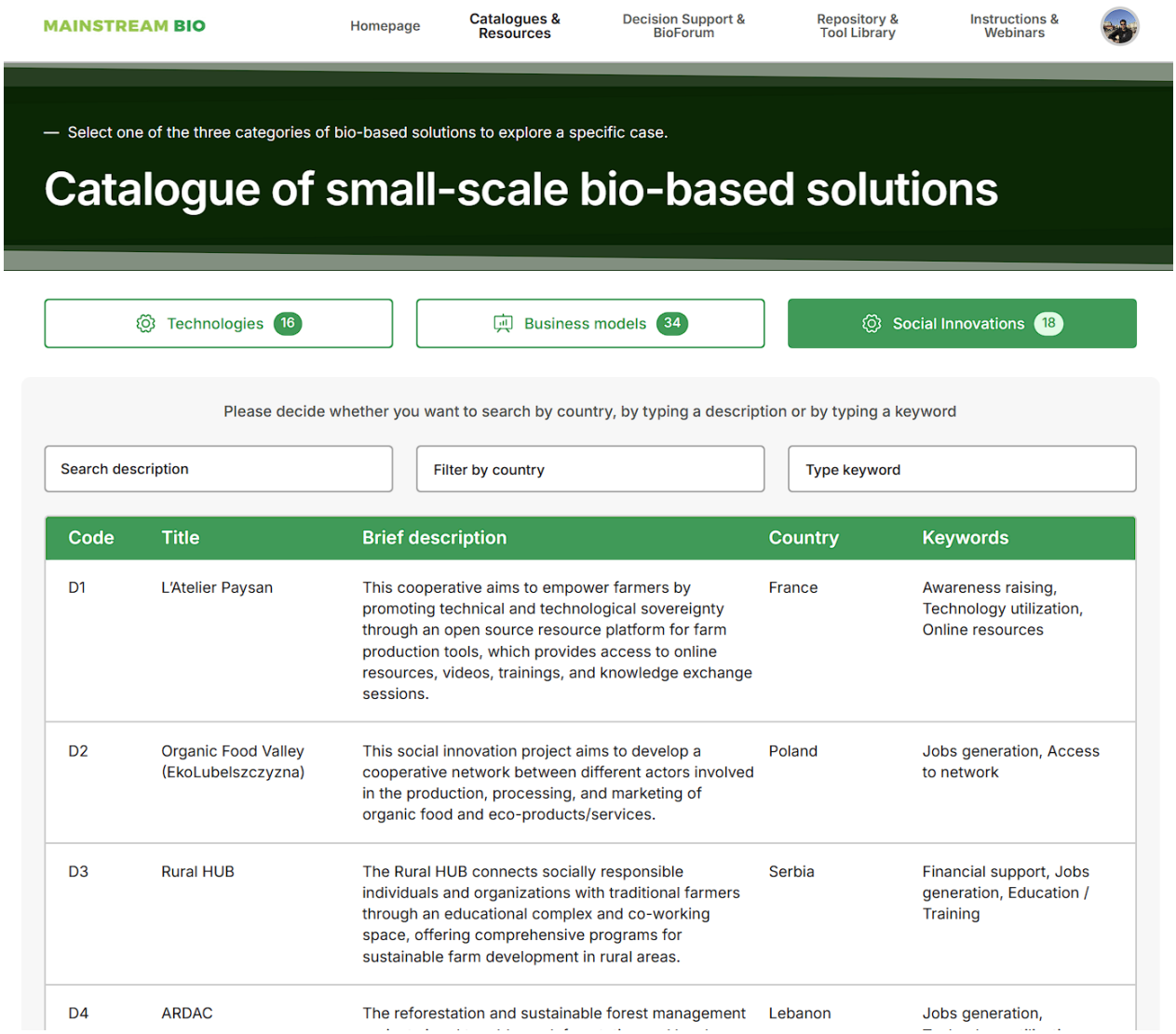


Figure 13: Catalogue of small-scale bio-based solutions (Selection Table – Social innovations)

2.11 Catalogue of small-scale bio-based solutions (Specific)

Once a user selects a specific technology, a dedicated page will open where they'll find a clear overview of the technology, along with detailed information on suitable feedstock, technical specifications, related products, and helpful references for further reading. All of this content can also be easily downloaded as a PDF using the download button.

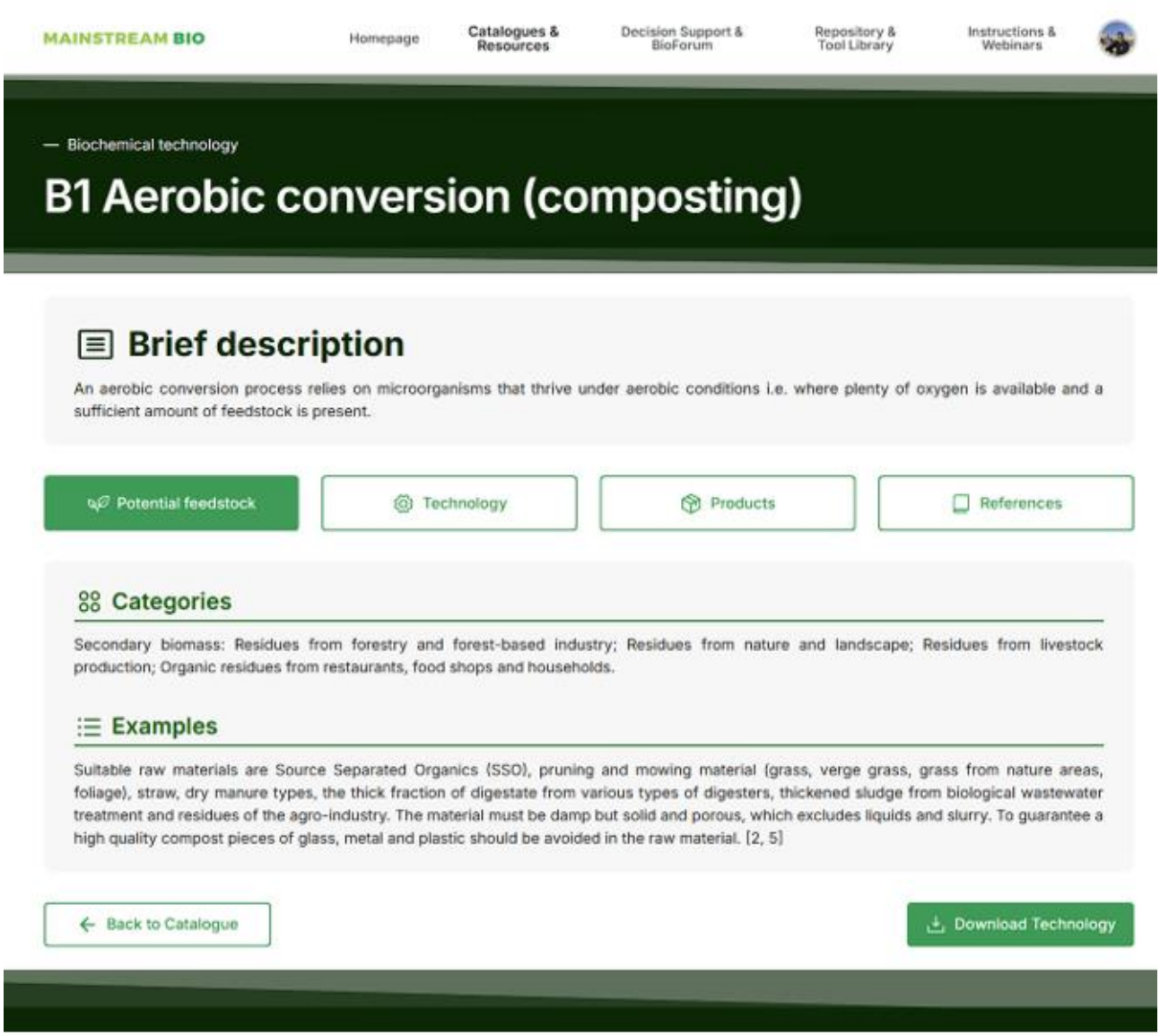


Figure 14: Catalogue of small-scaled bio-based solutions (Specific - Technology)

When a user selects a specific business, a dedicated page will open where they'll be able to explore detailed information such as feedstock analysis, technological specifications, impact assessments, and relevant reference materials. All of this content can also be easily downloaded as a PDF using the download button.

MAINSTREAM BIO Small scaled bio-based technologies

B1. Aerobic conversion

An aerobic conversion process relies on microorganisms that thrive under aerobic conditions i.e. where plenty of oxygen is available and a sufficient amount of feedstock is present.

A. Potential feedstock

Categories

Secondary biomass: Residues from forestry and forest-based industry; Residues from nature and landscape; Residues from livestock production; Organic residues from restaurants, food shops and households.

Examples

Suitable raw materials are Source Separated Organics (SSO), pruning and mowing material (grass, verge grass, grass from nature areas, foliage), straw, dry manure types, the thick fraction of digestate from various types of digesters, thickened sludge from biological wastewater treatment and residues of the agro-industry. The material must be damp but solid and porous, which excludes liquids and slurry. To guarantee a high quality compost pieces of glass, metal and plastic should be avoided in the raw material. [2, 5]

B. Technology

Technology name

Aerobic conversion

TRL

9

Description of technology

An aerobic conversion process relies on microorganisms that thrive under aerobic conditions i.e. where plenty of oxygen is available and a sufficient amount of feedstock is present [1].

An example is composting which is a microbiological process in which heterogeneous organic material is oxidised and broken down into compost, CO2, H2O and heat in a set-up where air passes through a heap (pile, mound) of porous, solid material. Although composting can occur spontaneously in the field (for example in mown verge grass), the process referred to here is controlled composting. It is often carried out with forced ventilation (through a ventilator) in a container, hall or in the open air. [2]

The aim of composting is to produce a final product that is stable, free of pathogens and germinable weed seeds. The composting process proceeds through three phases: i) mesophilic 10-45°C, ii) thermophilic 45-70°C and iii) maturation (curing). [3]

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Figure 15: Catalogue of small-scaled bio-based solutions (Specific – PDF Downloaded)

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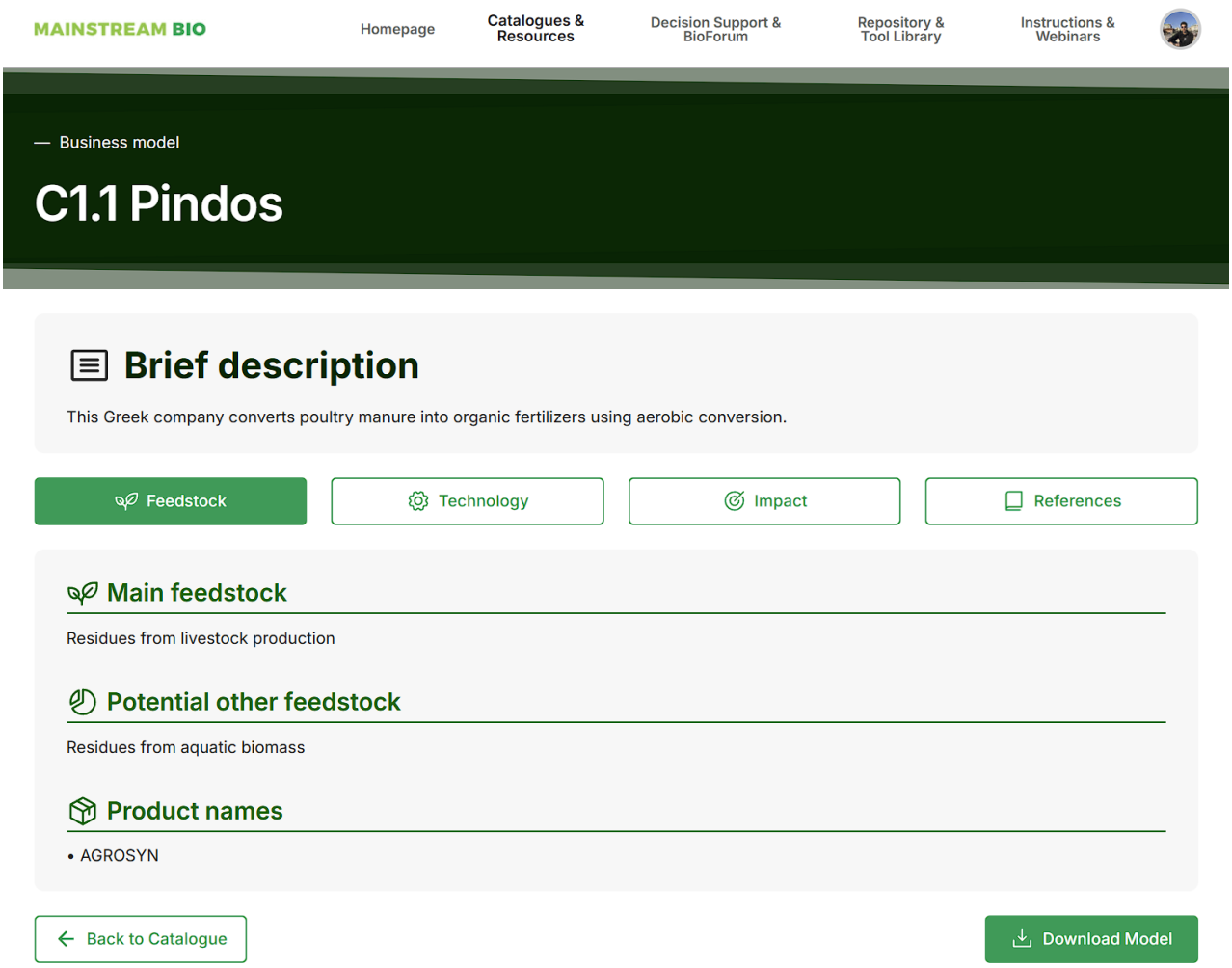


Figure 16: Catalogue of small-scaled bio-based solutions (Specific – Business model)

Finally, users have the opportunity to explore each social innovation in detail — gaining insights into its activities, key stakeholders, contribution to the bioeconomy, and wider social impact. All related information can also be conveniently downloaded in PDF format via the designated download button.

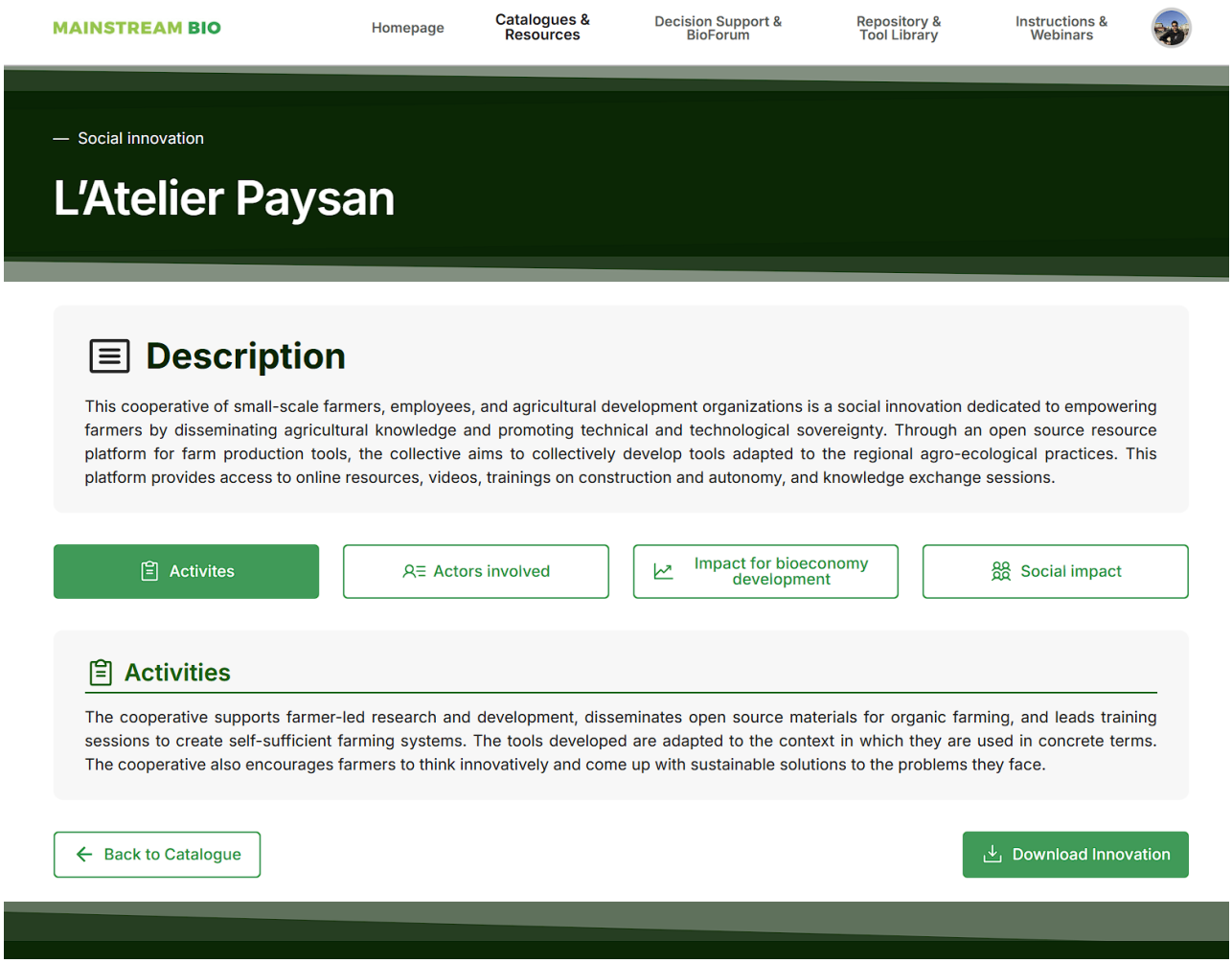
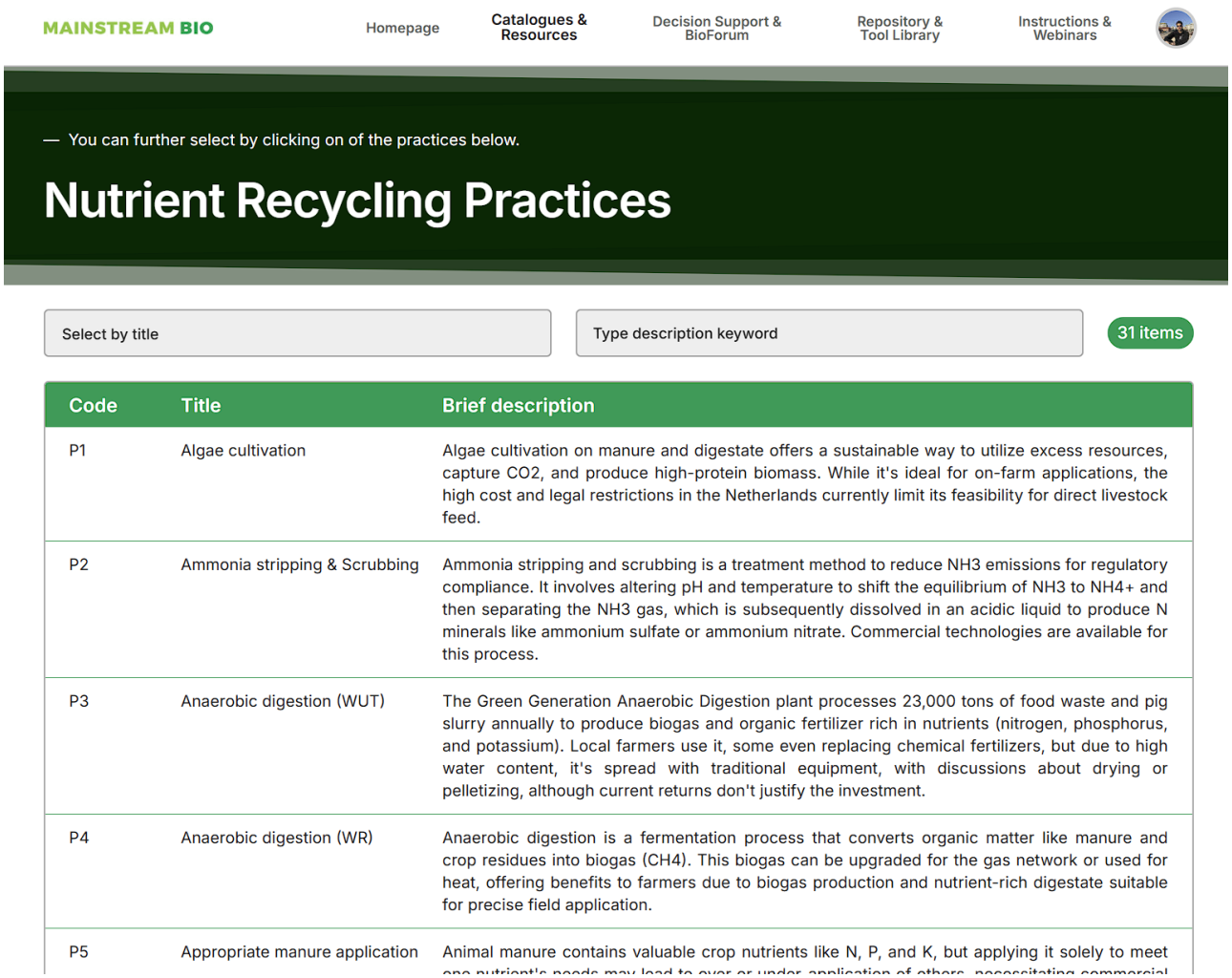


Figure 17: Catalogue of small-scaled bio-based solutions (Specific – Social innovation)

2.12 Nutrient Recycling Practices (Selection Table)

The Nutrient Recycling Practices page presents a carefully curated selection of thirty-one (31) agricultural practices, each strategically designed to promote sustainable agricultural and environmental methodologies. This comprehensive collection consolidates proven strategies, providing valuable insights into optimizing nutrient management, minimizing waste, and enhancing resource efficiency. It is specifically tailored to meet the needs of farmers, environmentalists, and policymakers, offering a detailed roadmap for the adoption of practices that not only increase crop yields but also reduce environmental impacts. By emphasizing innovation and leveraging successful implementations, this compilation serves as a knowledge repository, facilitating the dissemination of effective strategies to address global challenges in nutrient cycling within agriculture. The page's ultimate goal is to contribute to the development of a more resilient and environmentally sustainable food production system. Users can filter practices by title or by entering keywords from the practice descriptions, enabling easy access to relevant content.

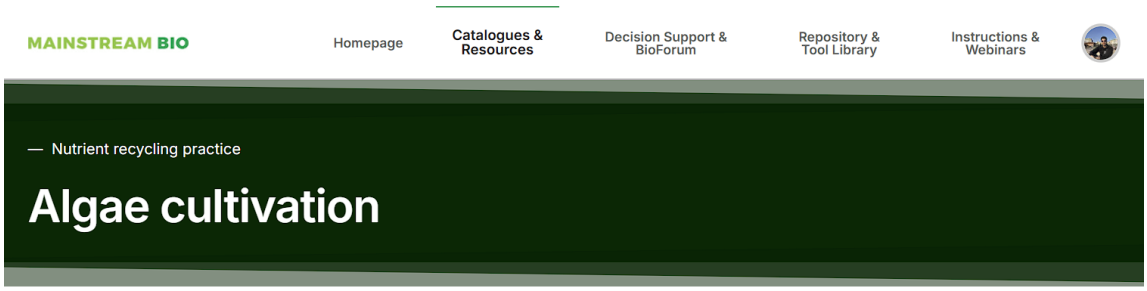


Code	Title	Brief description
P1	Algae cultivation	Algae cultivation on manure and digestate offers a sustainable way to utilize excess resources, capture CO2, and produce high-protein biomass. While it's ideal for on-farm applications, the high cost and legal restrictions in the Netherlands currently limit its feasibility for direct livestock feed.
P2	Ammonia stripping & Scrubbing	Ammonia stripping and scrubbing is a treatment method to reduce NH3 emissions for regulatory compliance. It involves altering pH and temperature to shift the equilibrium of NH3 to NH4+ and then separating the NH3 gas, which is subsequently dissolved in an acidic liquid to produce N minerals like ammonium sulfate or ammonium nitrate. Commercial technologies are available for this process.
P3	Anaerobic digestion (WUT)	The Green Generation Anaerobic Digestion plant processes 23,000 tons of food waste and pig slurry annually to produce biogas and organic fertilizer rich in nutrients (nitrogen, phosphorus, and potassium). Local farmers use it, some even replacing chemical fertilizers, but due to high water content, it's spread with traditional equipment, with discussions about drying or pelletizing, although current returns don't justify the investment.
P4	Anaerobic digestion (WR)	Anaerobic digestion is a fermentation process that converts organic matter like manure and crop residues into biogas (CH4). This biogas can be upgraded for the gas network or used for heat, offering benefits to farmers due to biogas production and nutrient-rich digestate suitable for precise field application.
P5	Appropriate manure application	Animal manure contains valuable crop nutrients like N, P, and K, but applying it solely to meet

Figure 18: Nutrient Recycling Practices (Selection Table)

2.13 Nutrient Recycling Practices (Specific)

By selecting a specific nutrient recycling practice, users are presented with a comprehensive overview that includes its description, objectives, contextual relevance, key components, and processes. They can also explore details on implementation, relevant legislation, and a curated list of references for further reading and verification. All information is available for download in PDF format via the provided download button.



Summary for stakeholders

Algae cultivation is one technique or way of valorizing manure and digestate. Algae are cultivated worldwide and can grow in all kinds of reactors (open pond raceway, cascade systems or closed tubular systems). The algae need light, CO2 and nutrients, such as N, P and K. They produce biomass and O2. Algae can also be grown on other C sources (other than CO2), for example organic carbon sources such as sugars. The first mentioned systems whereas light and CO2 are the input feedstocks is called heterotrophic. Autotrophic is a system wherein the algae are grown on other organic carbon sources, and light is not necessary. A combination of those systems is also possible, which is called mixotrophy. The algae are first cultivated in the presence of light and CO2 as carbon source. After a while, the algae are switched sugar as the main carbon sources, which can be done in the dark or with light. The advantage of this systems is the allowance of different cultivation methods, such as a 'regular' dark reactor instead of a systems which allows a lot of natural or led lights. Digestate can be used as a source of nutrients for the algae. The benefit of growing algae on digestate or the liquid fraction of manure is to valorize a small part of the excess manure in the Netherlands and secondly CO2 is captured by the algae. Cultivation of algae on manure or digestate would be best suitable as an on farm technique or installation. Part of the manure can be used for the algae and the algae produce biomass with a high protein concentration. The algae can be fed directly to cows, pigs or poultry. This would be an ideal situation, however algae installations are costly for a farmer. So, price and ease of operating would be crucial factors before an algae reactor can be operated on a farm. Furthermore, it is not possible to grow algae on manure or digestate and feed it directly to livestock. This is forbidden by law in the Netherlands for now.

Objective and context | Key elements and processes

Practice objective and context

Algae can be grown on the liquid fraction of cattle manure or on digestate from anaerobic digestion. In these feed streams there are (still) nutrients and sugars, which can be used by the algae. These nutrients and sugars are valuable so that retrieving them is worthwhile. Thereby, the amount of waste is reduced. A lot of protein is tilled on the field for cattle feed (grass for example), using land which could also be used to till food for humans (feed/food topic). Cultivating proteins in algae can contribute to reducing the land needed for feeding animals.
Some algae species are on the lists of approved animal feeds. However there can be still a problem with the legislation within Europe, in case particles of the manure are harvested together with the algae. Within Europe the process of production should be safe. Algae sold abroad Europe are only tested as product. A farmer in Belgium with a cattle farm is an example of a farmer producing algae. He however does not use digestate as a fertilizer for the algae, but he uses a feed safe medium. In this way, he is able to sell his products as food. He makes algae ice cream, cheeses and many other products

Practice description

Algae can be grown in multiple ways. See the short practice summary in the previous page. A two phase reactor is one of the possibilities already used on a small pilot scale, whereas digestate is used as a nutrient source in the culture. This work is done in the scope of ALG-AD, a European project who uses digestate to produce algae, in order to make the livestock industry more circular https://www.alg-ad-dst.com/. The liquid fraction of cattle manure or digestate is used as substrate. In the first phase algae are grown phototrophical autotrophically. Light is used as an energy source, CO2 is used as carbon source and nutrients (mainly nitrogen (N) and phosphorous (P)) are used to grow algae (Fuentes-Grünewald et al., 2021). After this phase the algae are concentrated using membrane technology. During the second phase the algae are grown mixotrophically. During this phase microalgae use inorganic CO2 as well as organic carbon sources in the presence of light to increase the biomass (Fuentes-Grünewald et al., 2021).
During these experiments, only a small percentage of the media is digestate, around 2%. The difficulty with digestate is it's dark color. Algae were grown in tubular closed loop reactors in the presence of light, a too dark medium blocks the light. Filtration of the digestate or a different cultivation method could be a possible solution for this problem. Van der Weide et al (2014) did experiments to cultivate algae with digestate. The digestate should be diluted but although still a bit dark the algae were able to grow on these diluted streams.

Environmental effects

CO2 (from air or concentrated) is used to let the algae grow. However, when the protein rich algae are used as feed for cattle than the cattle will produce methane (with a much higher GWP), so basically CO2 is converted into CH4 in the air. This is an environmental risk.
On the other hand, if feed for animals remains a must, then the alternative is tilling feed on the land. Here diesel is used for growing the crop, and in this case cattle also produces CH4. So in this case the greenhouse gas emissions are higher than when the feed is produced with algae cultivation.
Furthermore in case of using the manure of the cattle to produce green gas to increase on sustainability, smoke gas or other CO2 gas streams in this process can be used for the algae cultivation.

Back to Catalogue | Download Practice

Figure 19: Nutrient Recycling Practices (Specific)

2.14 MainstreamBIO Resources (Audio/Visual Material)

Upon accessing the MainstreamBIO Resources page, users are presented with two distinct categories: audio/visual materials and bioeconomy profiles of seven EU rural communities. The first section, dedicated to audio/visual materials, features a collection of educational and promotional videos produced by project partners as part of the MainstreamBIO initiative. This content aims to provide valuable insights and raise awareness about the project's objectives, showcasing key developments and successes within the bioeconomy sector.

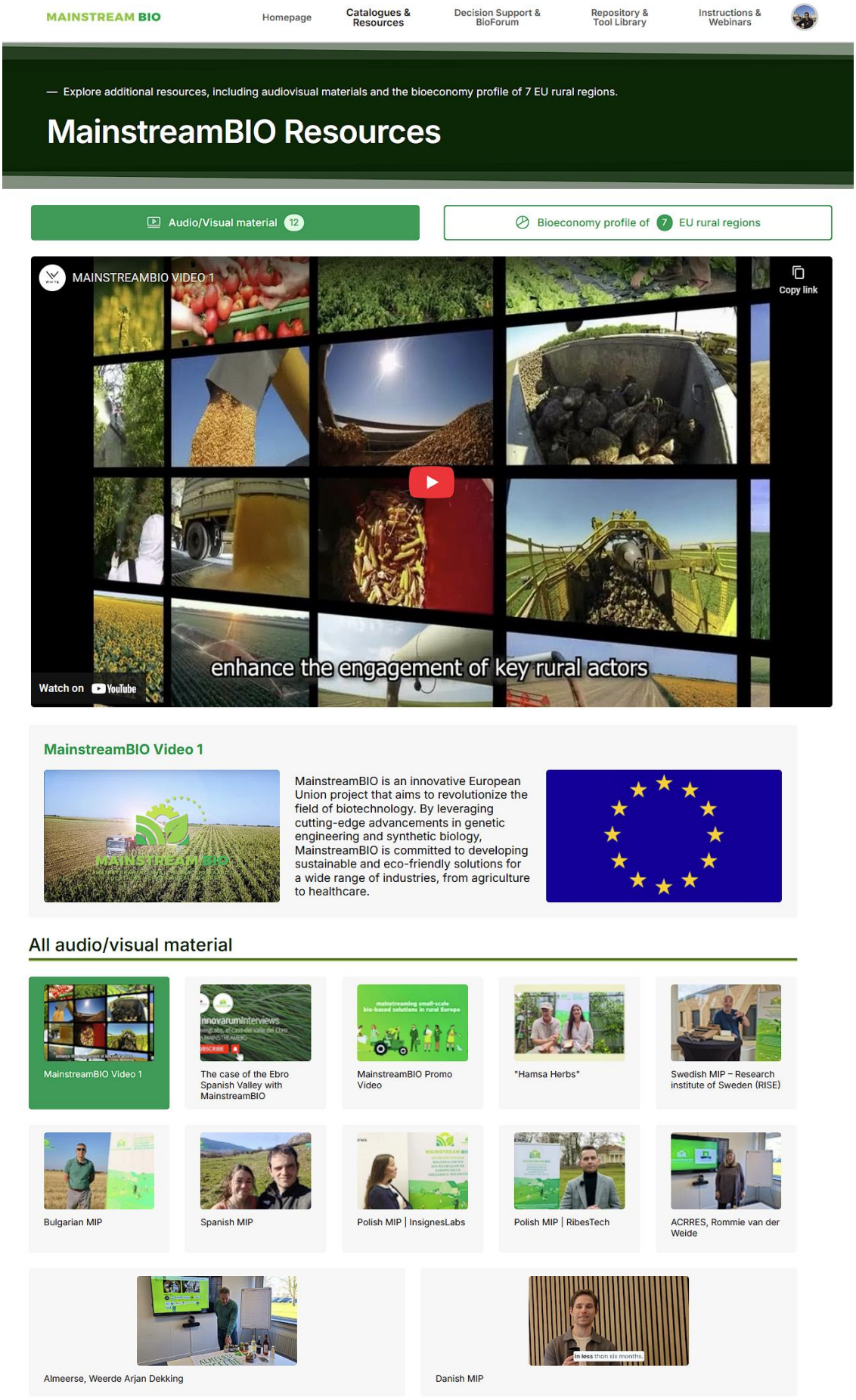

MAINSTREAM BIO
Homepage
Catalogues & Resources
Decision Support & BioForum
Repository & Tool Library
Instructions & Webinars
— Explore additional resources, including audiovisual materials and the bioeconomy profile of 7 EU rural regions.
MainstreamBIO Resources
Audio/Visual material 12
Bioeconomy profile of 7 EU rural regions
MAINSTREAMBIO VIDEO 1
Copy link
enhance the engagement of key rural actors
Watch on YouTube
MainstreamBIO Video 1
MainstreamBIO is an innovative European Union project that aims to revolutionize the field of biotechnology. By leveraging cutting-edge advancements in genetic engineering and synthetic biology, MainstreamBIO is committed to developing sustainable and eco-friendly solutions for a wide range of industries, from agriculture to healthcare.
All audio/visual material
MainstreamBIO Video 1
The case of the Ebro Spanish Valley with MainstreamBIO
MainstreamBIO Promo Video
"Hamsa Herbs"
Swedish MIP – Research institute of Sweden (RISE)
Bulgarian MIP
Spanish MIP
Polish MIP | InsignesLabs
Polish MIP | RibesTech
ACRRES, Rommie van der Weide
Almeerse, Weerde Arjan Dekking
Danish MIP

Figure 20: MainstreamBIO Resources (Audio/Visual Material)

2.15 MainstreamBIO Resources (Bioeconomy profile of 7 EU rural communities)

The Bioeconomy profile of 7 EU rural regions page offers a rich collection of carefully curated resources designed to support bio-based initiatives, including detailed guidelines and instructional videos. Users can also explore in-depth bioeconomy profiles of seven rural communities across the EU — the Netherlands, Poland, Denmark, Sweden, Bulgaria, Spain, and Ireland. These profiles provide valuable insights into regional characteristics, focus areas, resource use, and exemplary value chain models involving materials such as grass, manure, and pumpkin. Altogether, this resource hub serves as a practical and inspiring reference for those involved in bio-based projects.

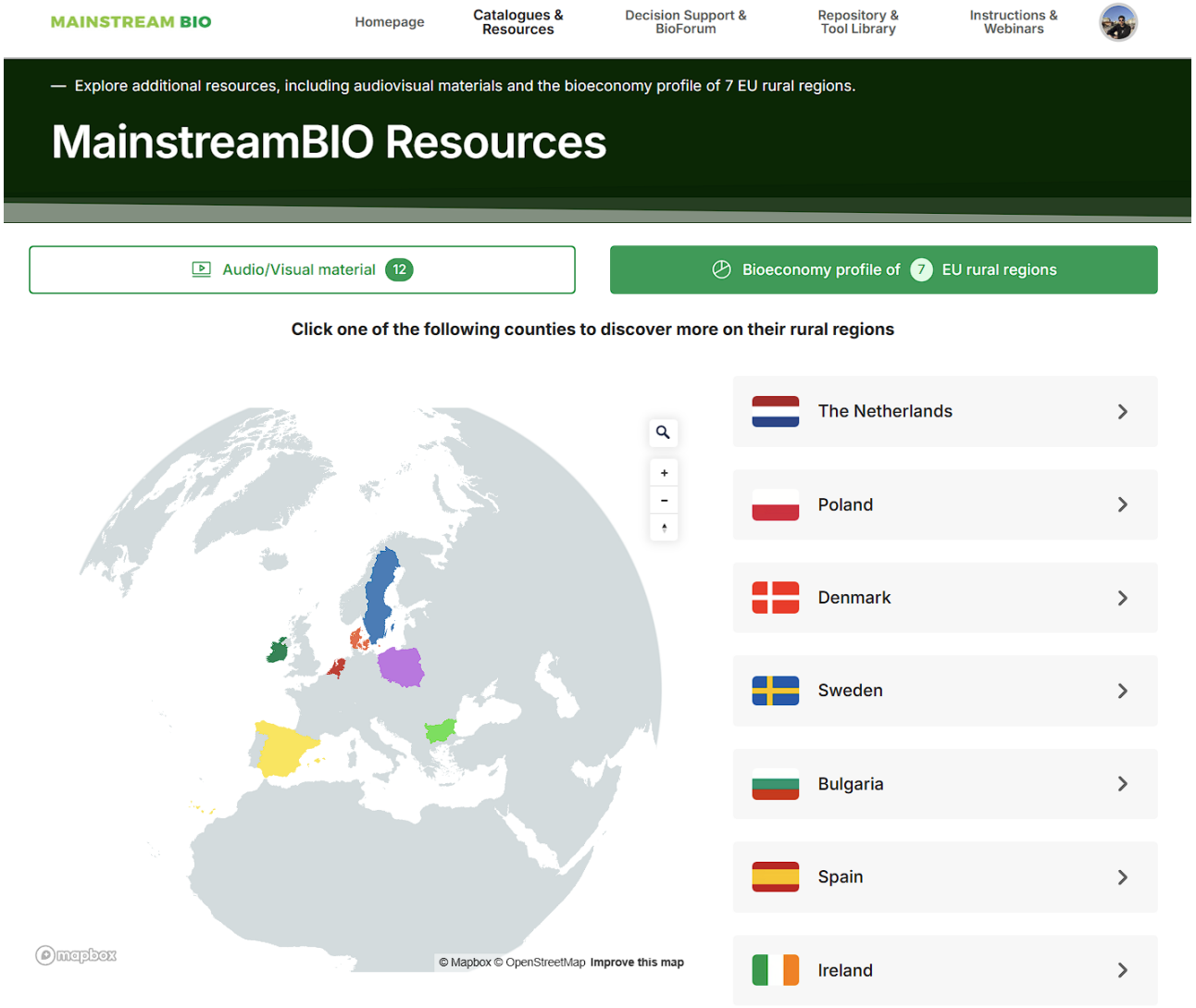


Figure 21: MainstreamBIO Resources (Bioeconomy profile of 7 EU rural communities)

Figure 22: MainstreamBIO Resources (Bioeconomy profile of The Netherlands)

2.16 Decision Support System

The Decision Support System (DSS), developed in close collaboration with Wageningen Research (WR) through iterative feedback rounds, is a user-friendly, six-step tool designed to help users effectively plan and optimize the implementation of their bioeconomy projects.The process begins with logging in (Figure 23). The user starts with the Matching Table (Figure 24), which enables the effective pairing of feedstock types with suitable technologies and end-products. Subsequent steps include assessments of Social Impact (Figure 25), Economic Impact (Figure 26), Environmental Impact (Figure 27), and Implementation Requirements (Figure 28). At each stage, users are supported by contextual information accessible via an info button located above the rating dropdown, facilitating informed and evidence-based evaluations.

Additionally, users are encouraged to consult the provided arguments situated above the multiline input fields and contribute comments that clarify the anticipated influence of each criterion on their specific project pathway. The final step culminates in the presentation of a Radar Chart (Figure 29), offering a clear and visually engaging summary of the assessment outcomes. This chart enables users to quickly identify key strengths and potential areas for improvement across dimensions such as social impact, economic impact, environmental impact and requirements for implementation. All

user inputs can be exported and downloaded in PDF format (Figure 30), ensuring ease of documentation and further analysis.

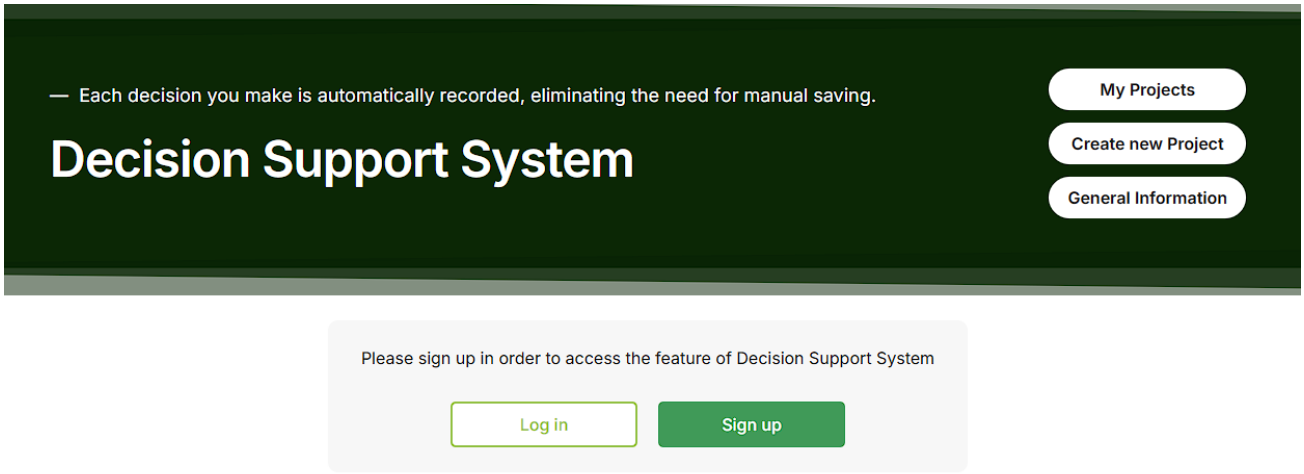
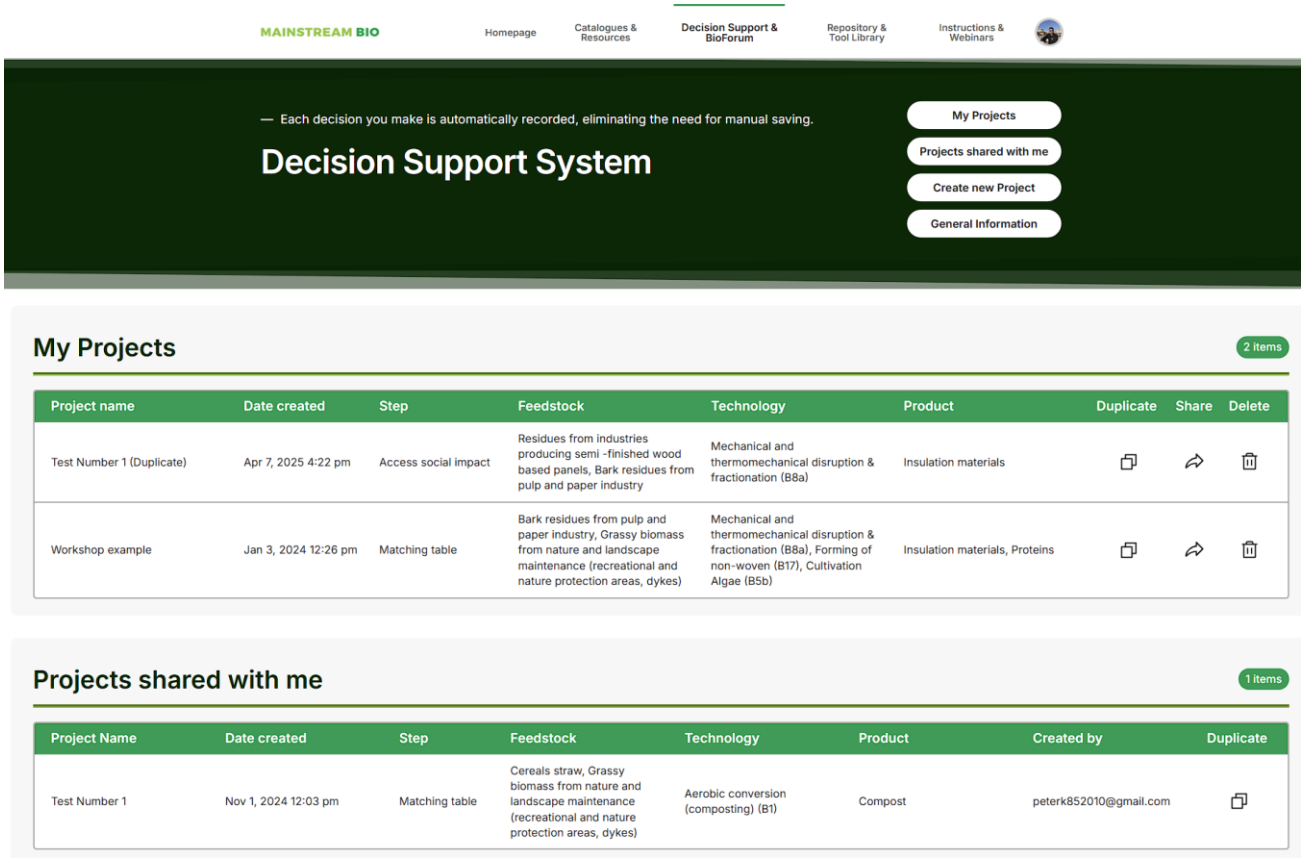


Figure 23: Decision Support System (User Not Logged In)



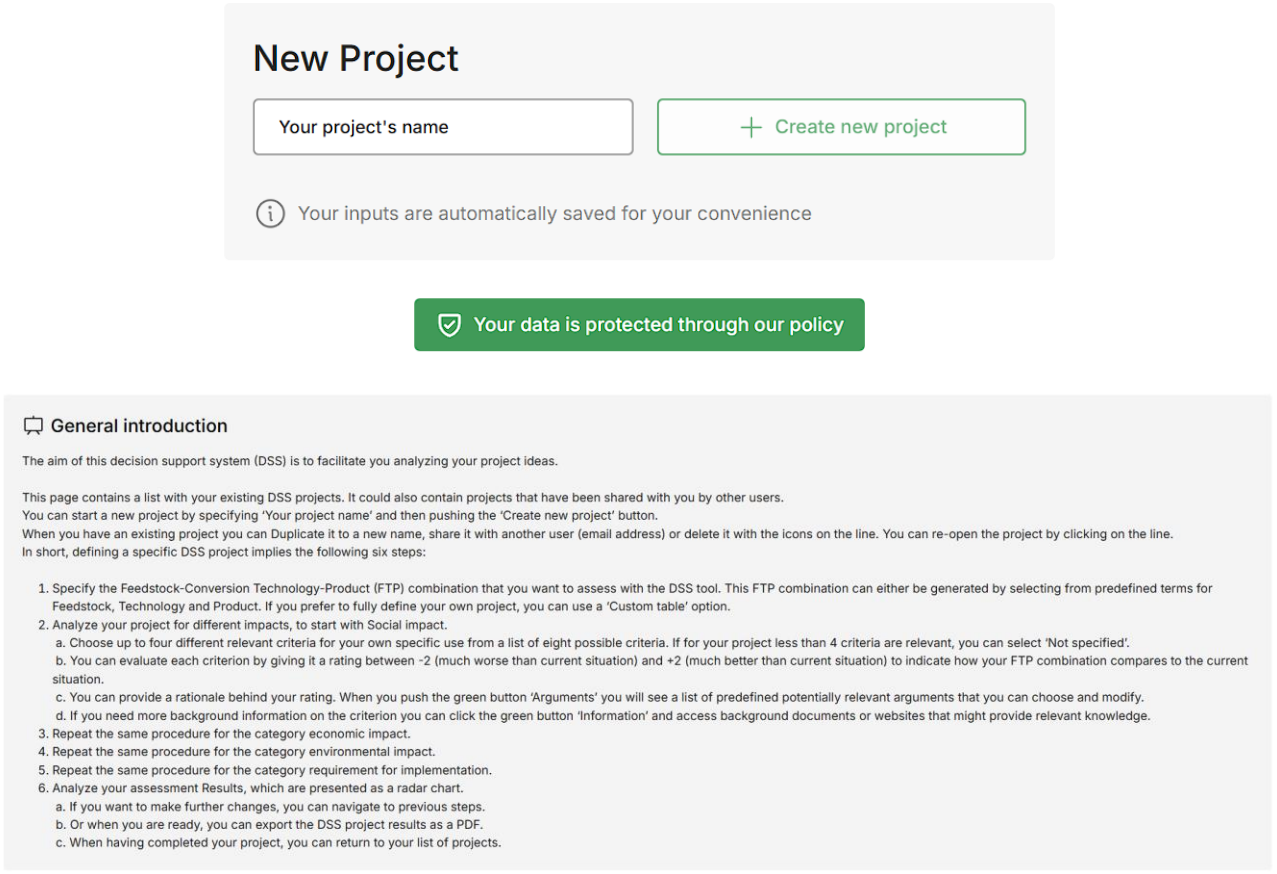


Figure 24: Decision Support System (User is Logged In and has made 2 previous DSS and another user has shared 1 DSS with him)

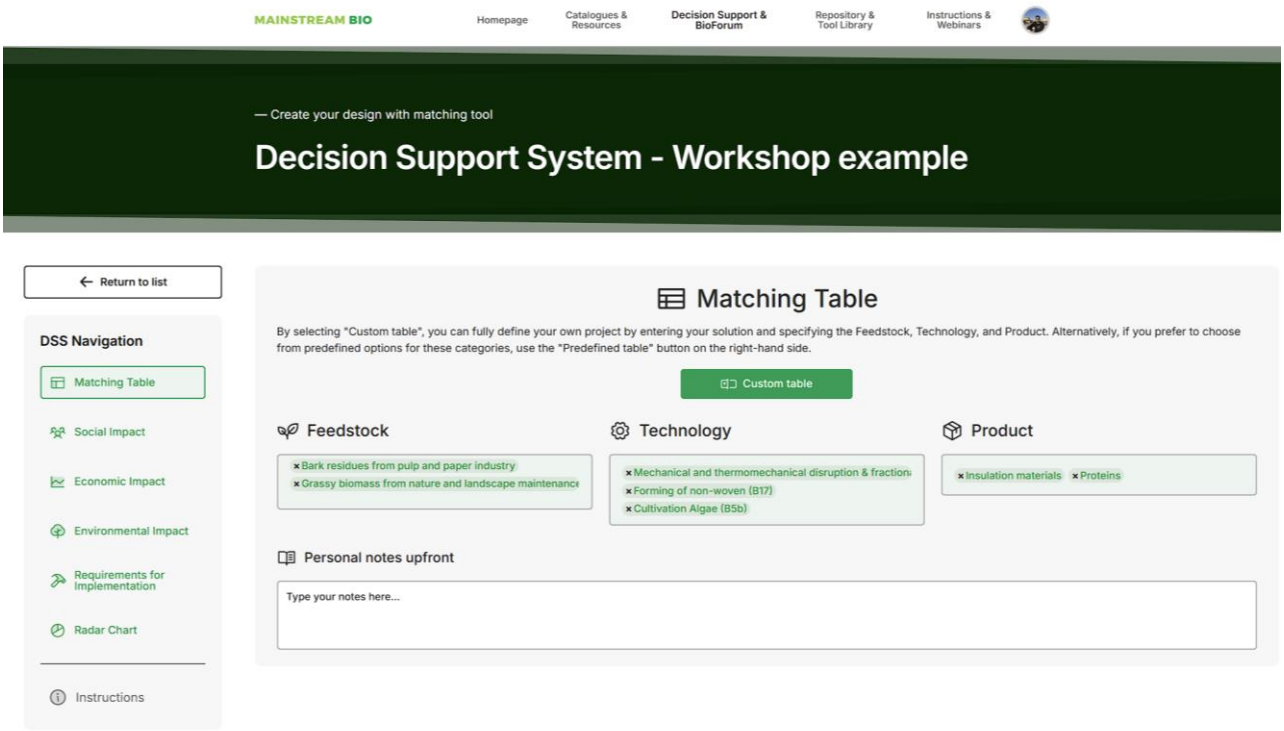


Figure 25: Decision Support System (Step 1: Matching Table)

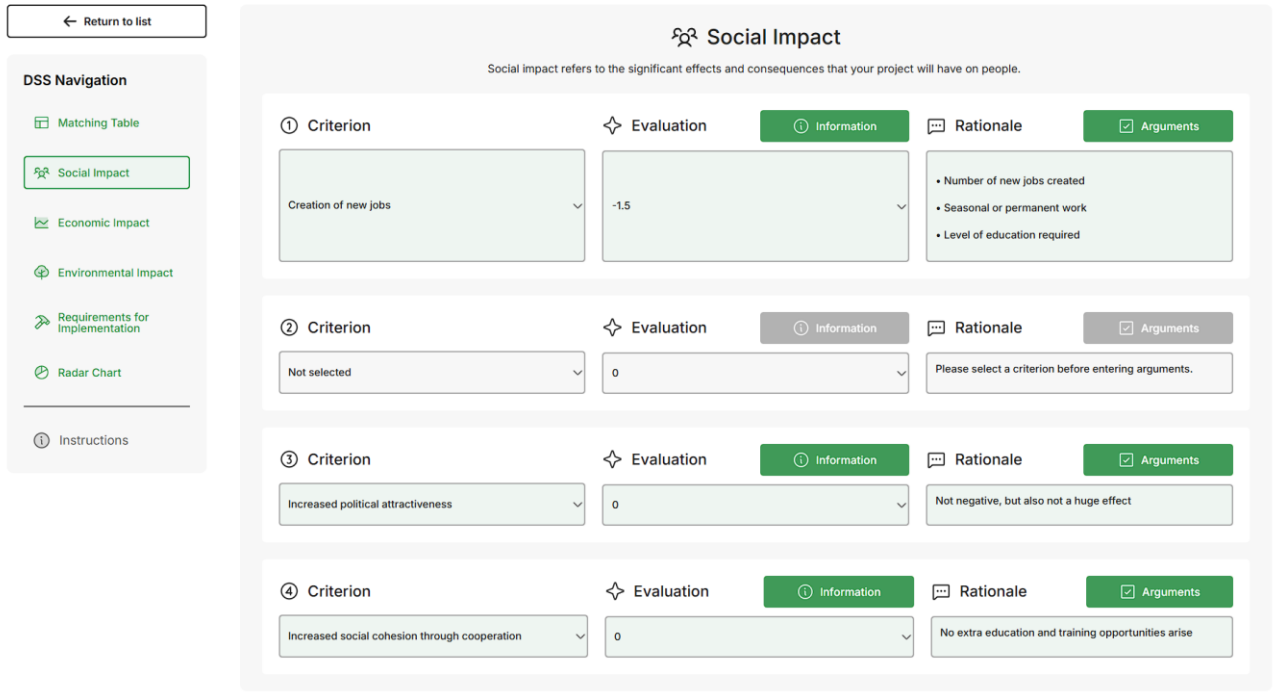


Figure 26: Decision Support System (Step 2: Social Impact Assessment)

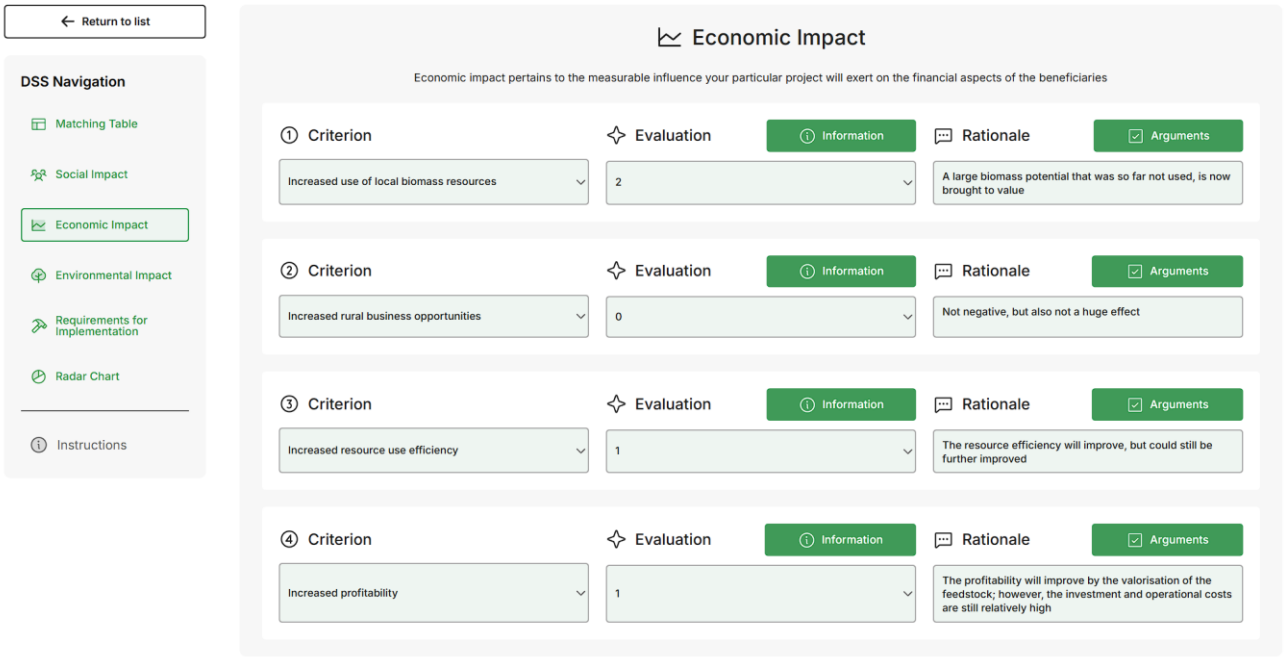


Figure 27: Decision Support System (Step 3: Economic Impact Assessment)

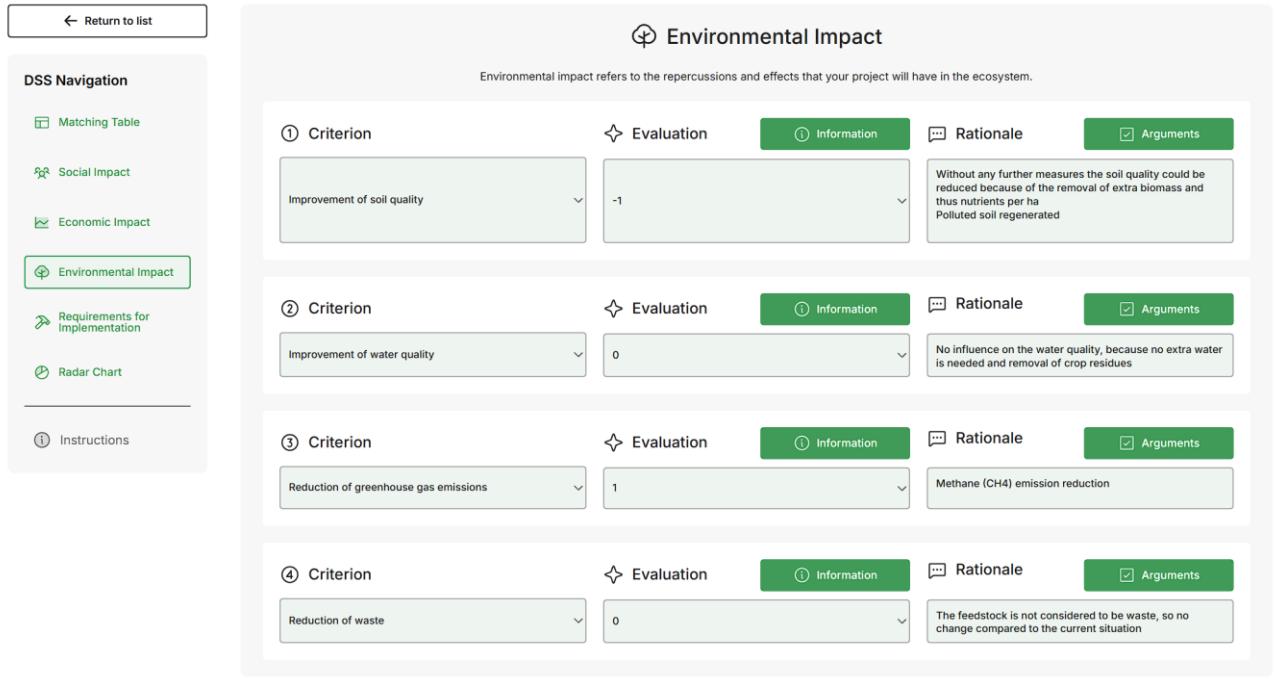


Figure 28: Decision Support System (Step 4: Environmental Impact Assessment)

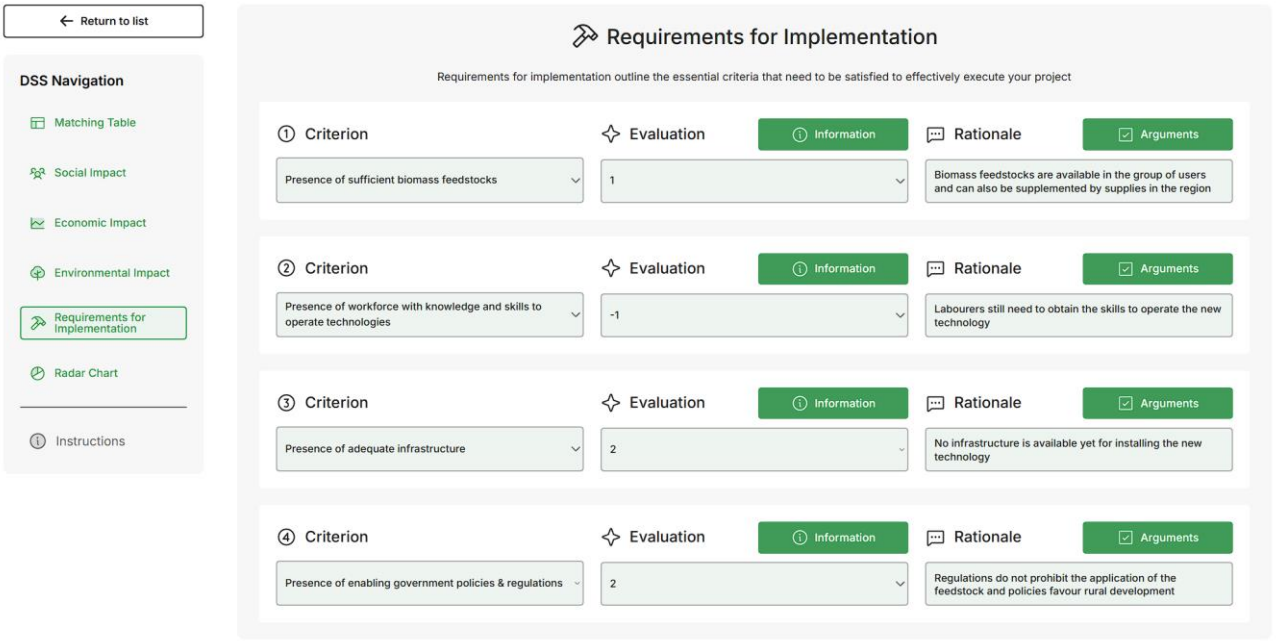


Figure 29: Decision Support System (Step 5: Requirements for Implementation Assessment)

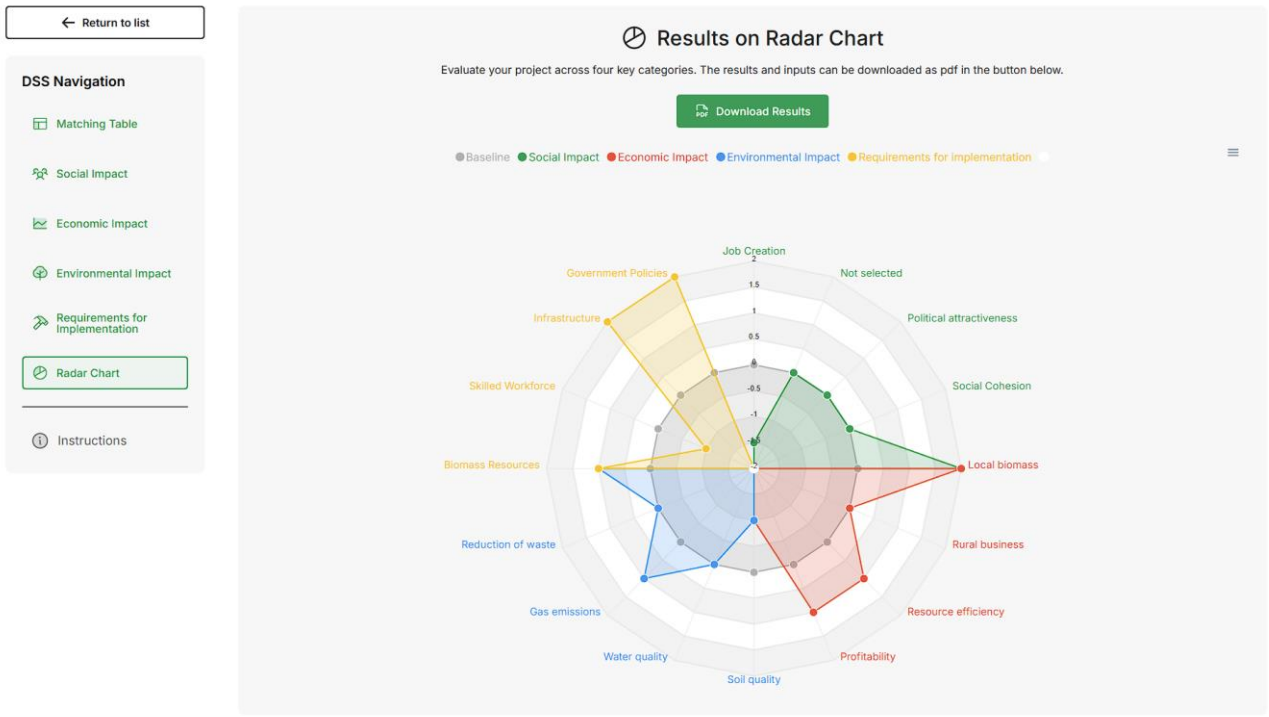


Figure 30: Decision Support System (Step 6: Radar Chart)

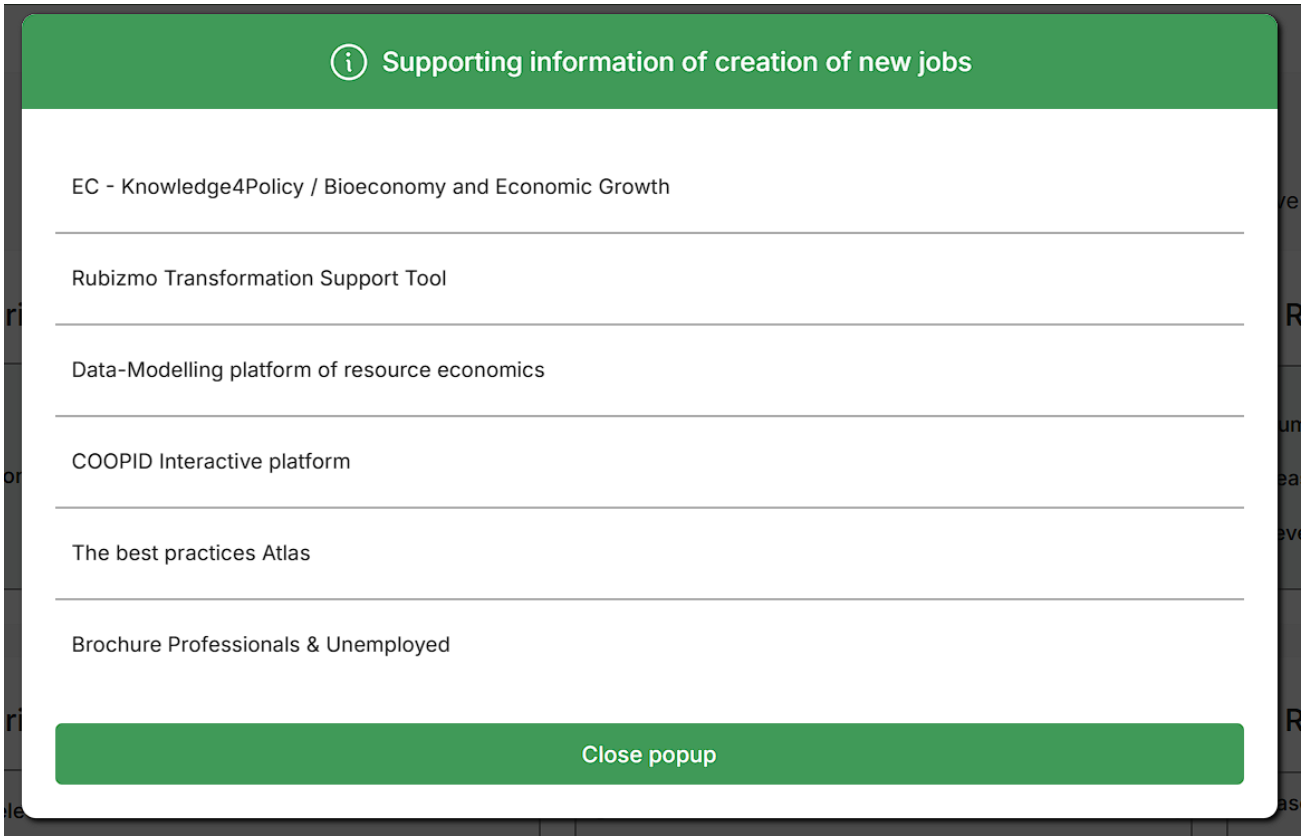


Figure 31: Decision Support System (Popup: Supporting Information)

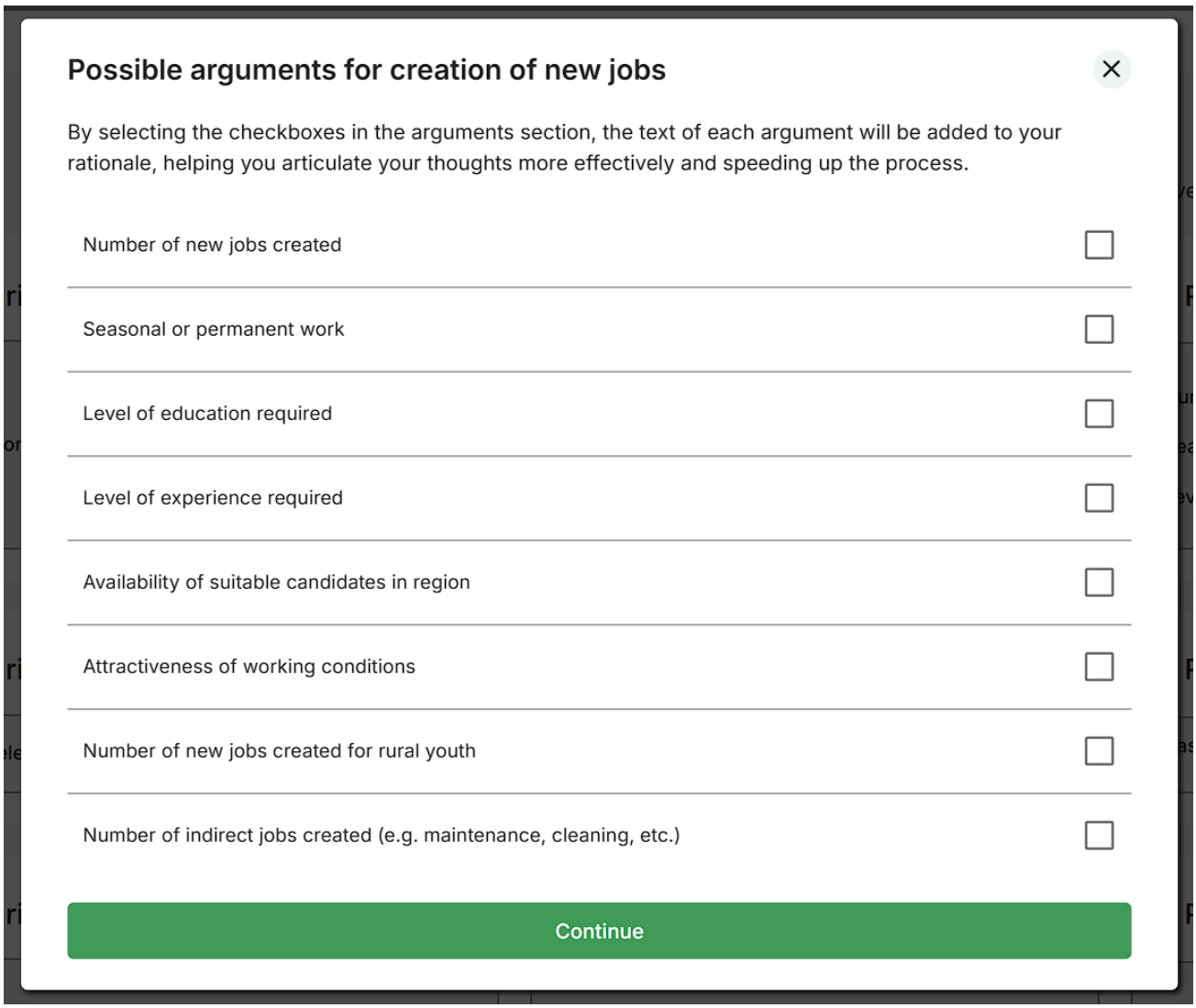
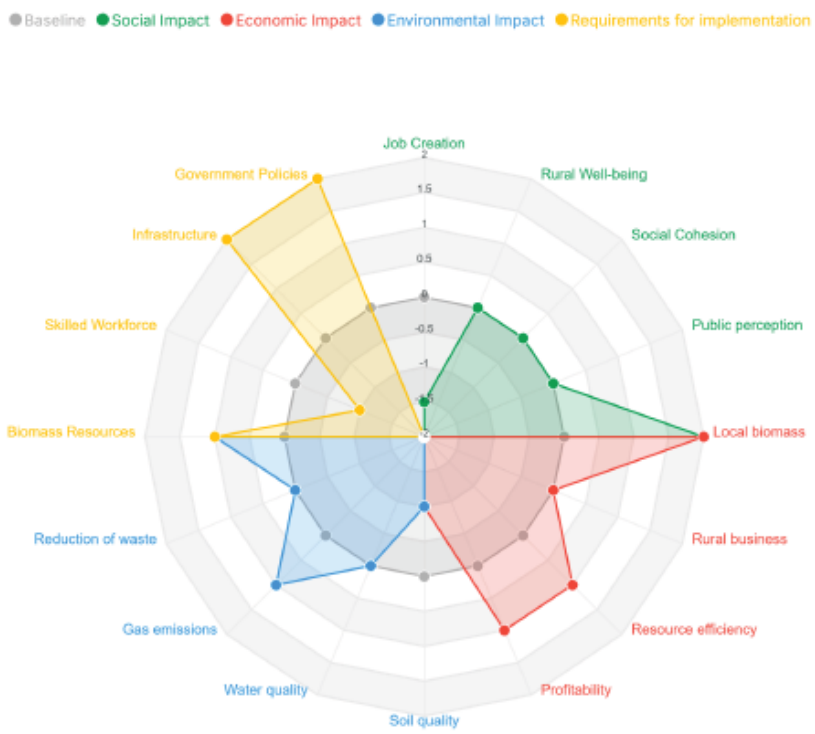


Figure 32: Decision Support System (Popup: Possible Arguments)

MAINSTREAM BIO

Decision Support System (Peter Kafkias)



Criteria in graph are selected by designer, so criteria in graph may be different from graphs of other project designs. This means that graphs cannot be simply compared.

Feedstock

Bark residues from pulp and paper industry, Grassy biomass from nature and landscape maintenance (recreational and nature protection areas, dykes)

Technology

Mechanical and thermomechanical disruption & fractionation (B8a), Forming of non-woven (B17), Cultivation Algae (B5b)

Product

Insulation materials, Proteins

Personal notes upfront

Funded by the European Union

1

Figure 33: Decision Support System (PDF Results)

2.17 BioForum

The BioForum serves as an interactive platform designed to facilitate collaboration among users and experts engaged in the development and application of bio-based solutions. While all content within the toolkit is publicly visible, interactive functionalities within the BioForum—such as posting, commenting, or uploading content—are accessible exclusively to logged-in users.

Once authenticated, users can actively participate in discussions, pose questions, share insights, and upload multimedia content including images and PDFs. They can also access relevant tools such as decision support systems and provide constructive feedback. To accommodate this wide range of contributions, the BioForum incorporates a rich text editor resembling standard word processing tools. This editor supports advanced formatting features, including headings, bold text, code blocks, bullet and numbered lists, indentation, hyperlinks, embedded images and videos, and more, thereby enhancing the clarity and expressiveness of user-generated content.

To support effective knowledge exchange and ensure streamlined access to relevant discussions, the platform includes robust and user-friendly search functionality. Users can locate content by performing keyword searches or by filtering results based on community categories and thematic tags.

The BioForum organizes discussions around six predefined communities of interest:

- Biomass Producers
- Business
- Civil Society
- General
- Policy Makers
- Researchers

In addition, contributions are categorized using a structured set of thematic tags that reflect critical focus areas within the bioeconomy, including:

- Bioeconomy Profile
- Business Model
- Decision Support System (DSS)
- LCA (Life Cycle Assessment)
- Nutrient Recycling
- Social Innovation
- Technology
- Tool
- Tutorial
- Value Chain

The search engine indexes all posts and comments, enabling the retrieval of content through matches with keywords, assigned tags, and community identifiers. This approach enhances content

discoverability and encourages cross-sectoral dialogue, fostering a dynamic and integrated knowledge-sharing environment across the bioeconomy ecosystem.

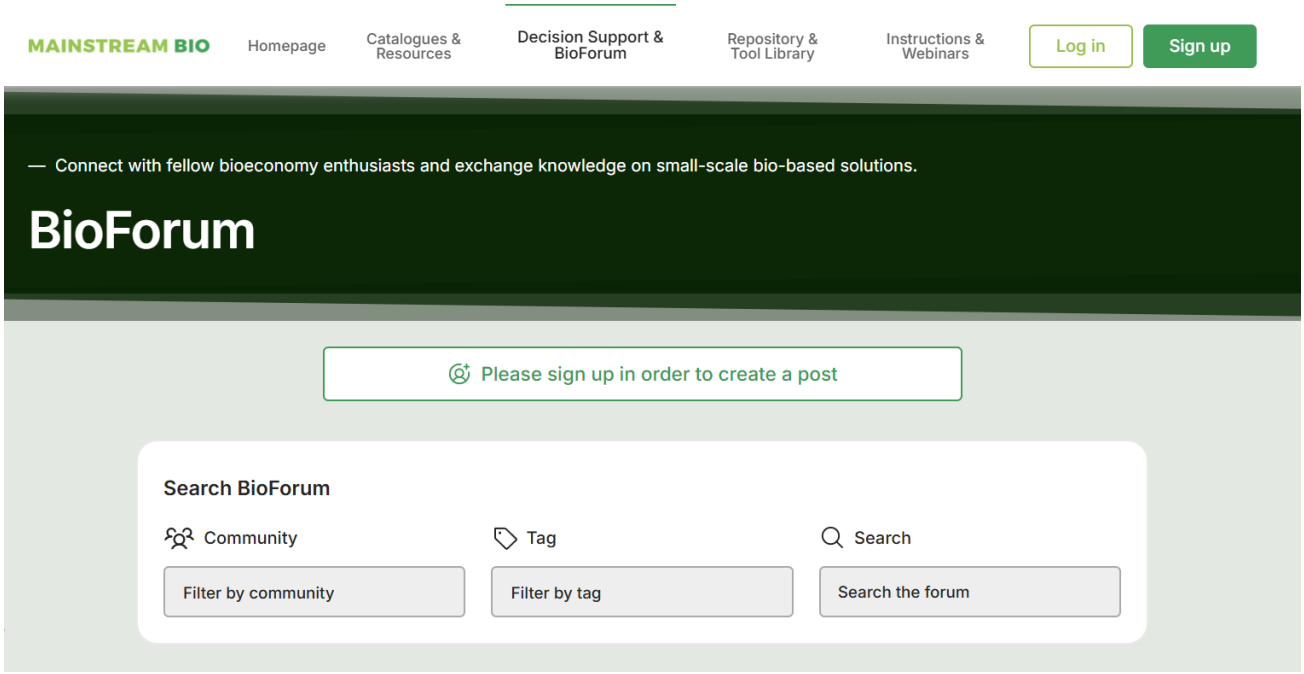


Figure 34: BioForum (User Not Logged In)

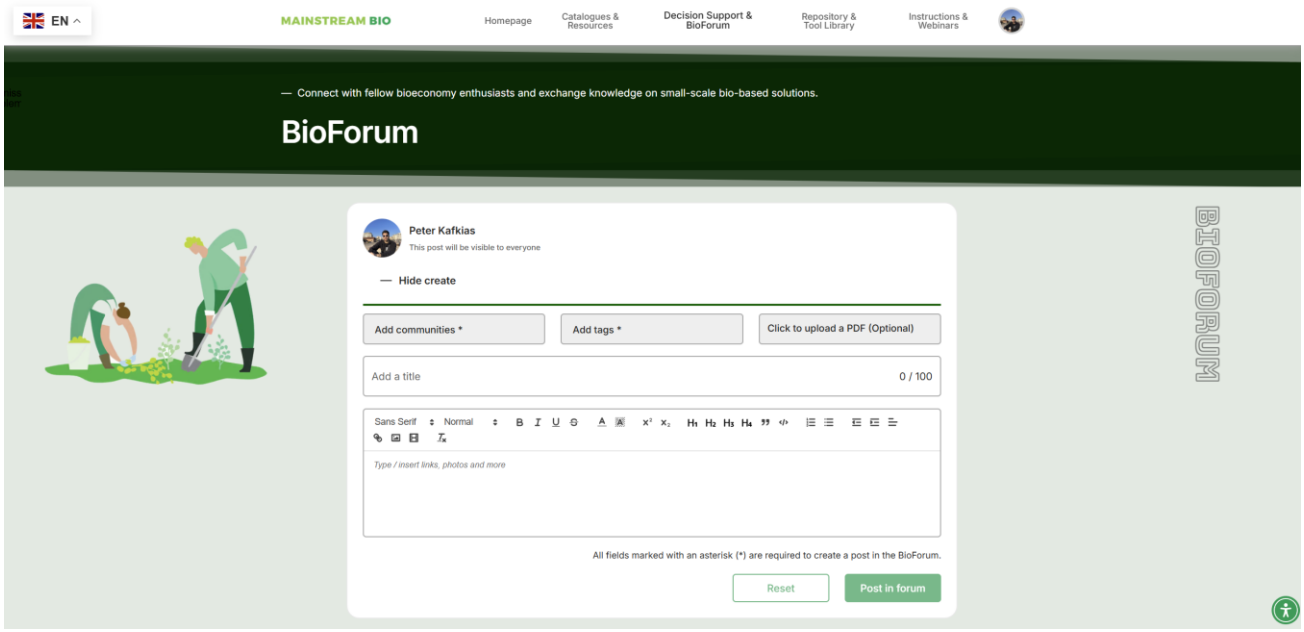


Figure 35: BioForum (Create Post)

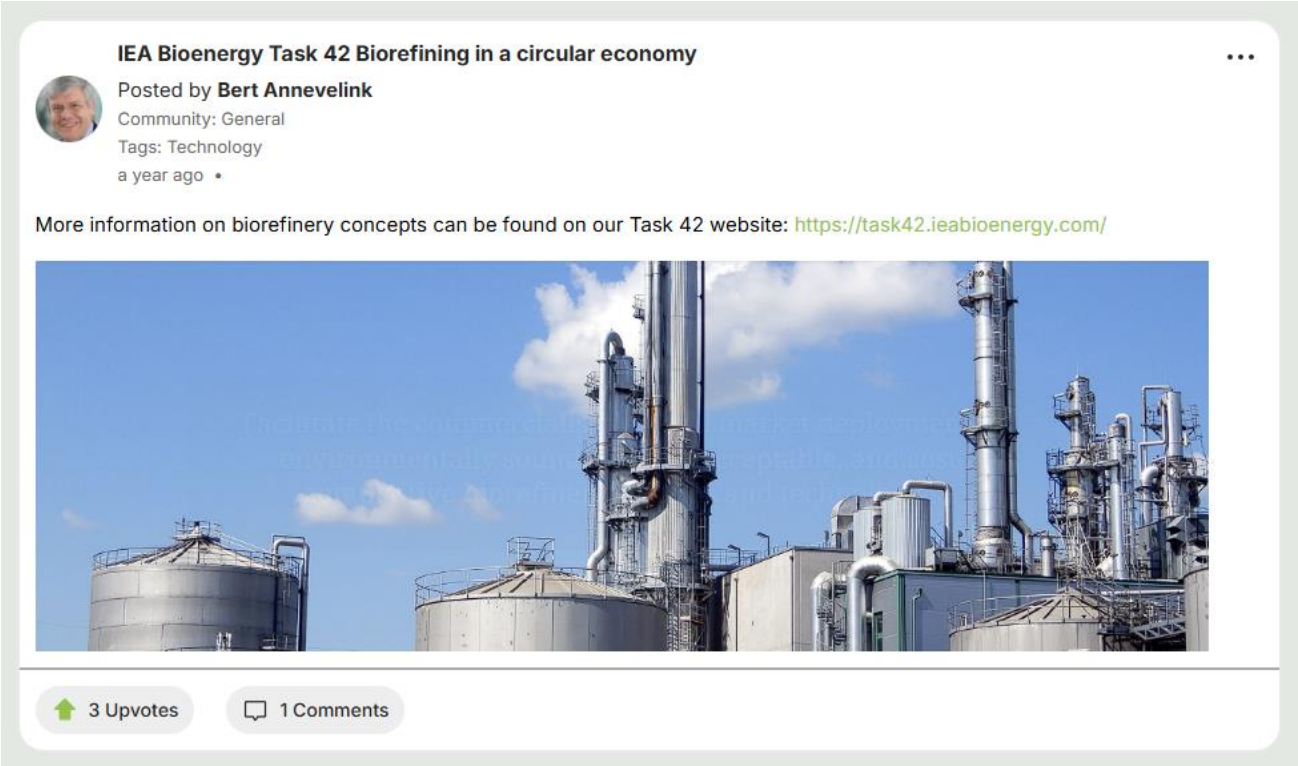


Figure 36: BioForum (User Logged In)

2.18 Bioeconomy Repository

The Bioeconomy Repository page offers users access to a comprehensive collection of resources covering a wide range of topics within the bioeconomy. The repository is structured into two main sections: audiovisual materials and supporting documentation.

The audiovisual section features a curated selection of fifteen (15) videos encompassing a variety of formats, including webinars, instructional content, and educational materials. These videos span diverse topics, stakeholder types, source initiatives, and publication years, offering users a multifaceted view of bioeconomy-related developments.

Complementing this is a substantial body of supporting documentation, comprising a total of five hundred and sixty-one (561) documents. Together, these materials provide in-depth knowledge and practical insights relevant to the bioeconomy landscape. To enhance usability, the repository includes a flexible filtering system that allows users to refine their searches based on category, stakeholder type, description, language, year, or keyword. This functionality ensures efficient navigation and access to targeted content. Serving as a dynamic knowledge hub, the Bioeconomy Repository equips users with the tools and information necessary to stay informed and engaged across multiple dimensions of bioeconomy.

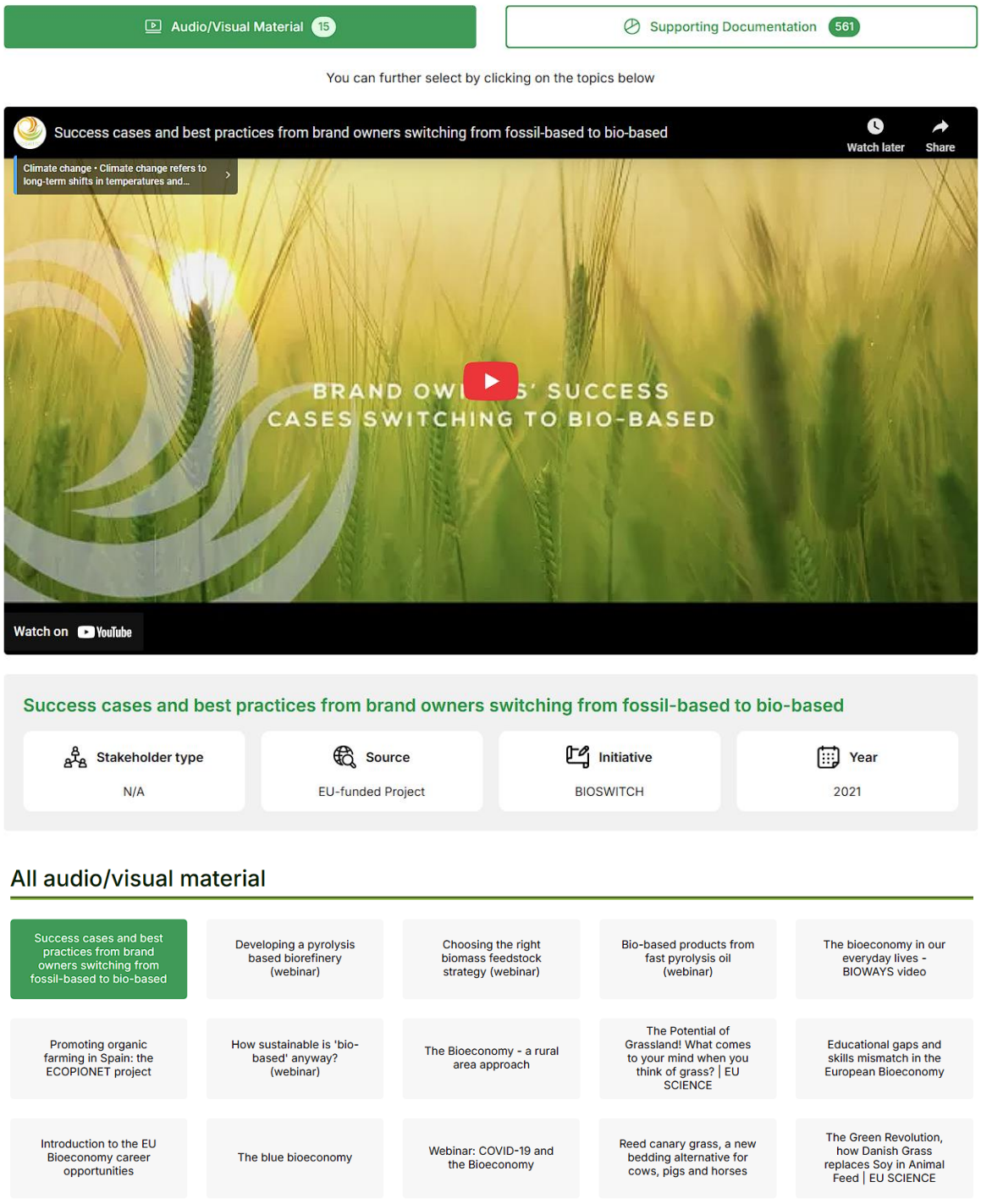


Figure 37: Bioeconomy Repository (Audio/Visual Material)

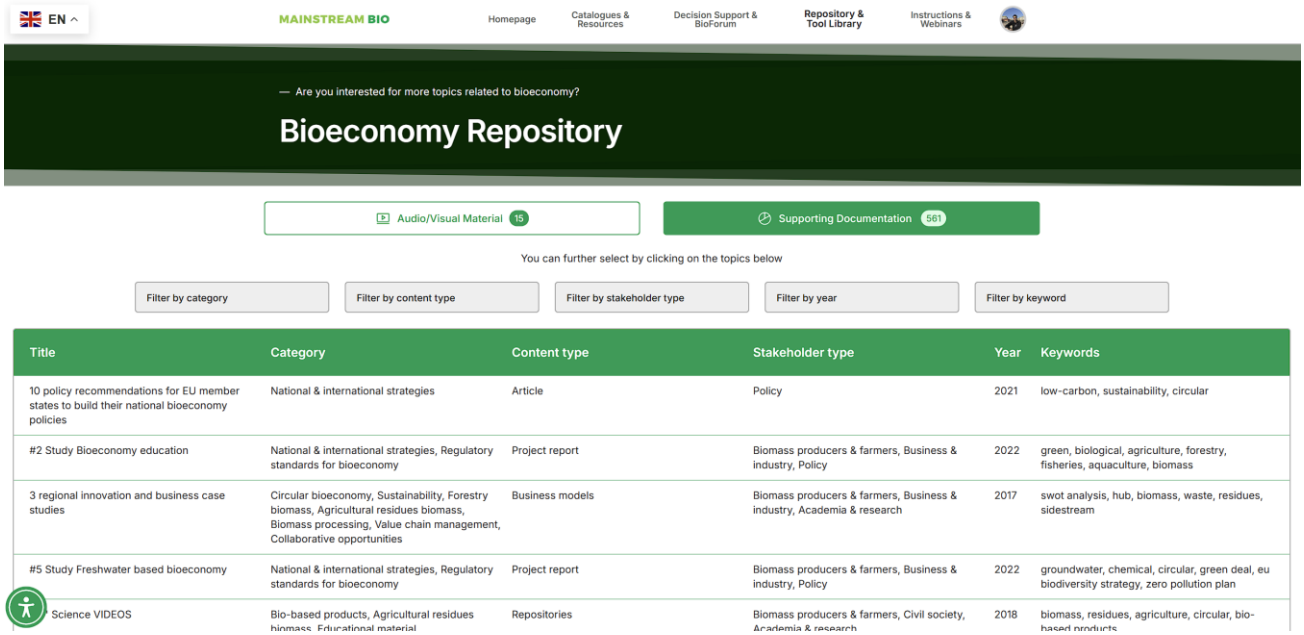


Figure 38: Bioeconomy Repository (Documentation)

2.19 Tool Library

The Tool Library page offers users access to a diverse selection of tools specifically designed to support the planning, implementation, and monitoring of bio-based projects. These tools aim to enhance decision-making and promote optimal sustainability throughout the project lifecycle, providing practical support for stakeholders across the bioeconomy value chain.

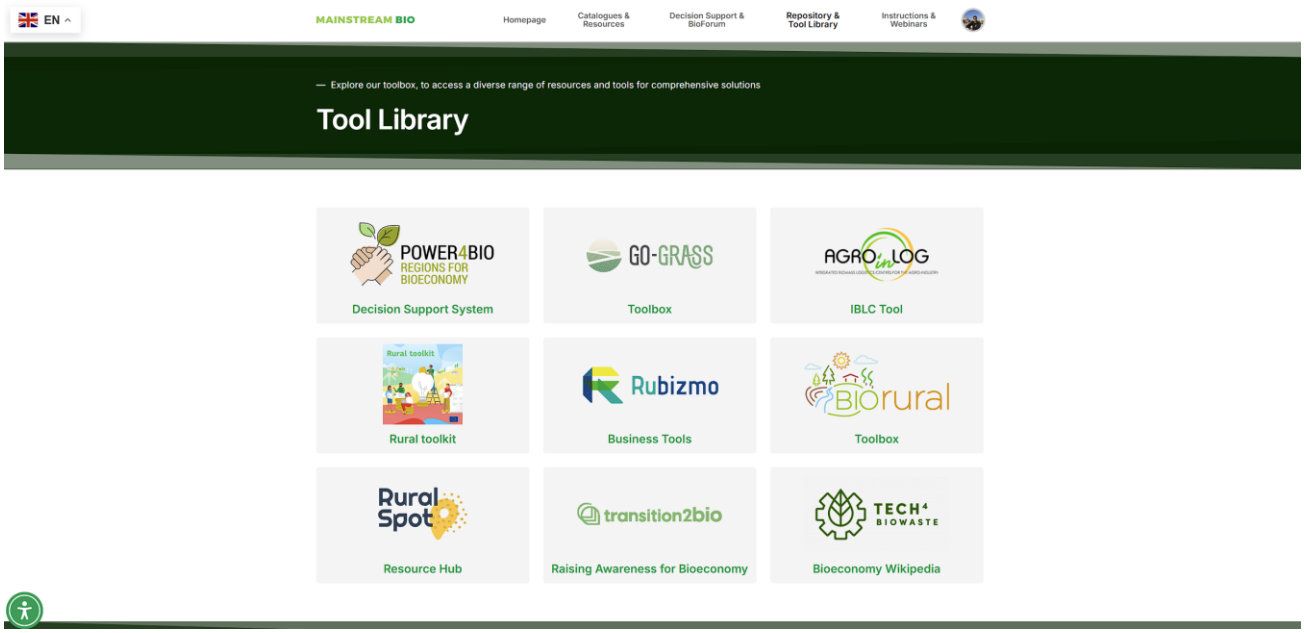


Figure 39: Tool Library

2.20 Instructions

The Instructions page provides users with a comprehensive overview of the functionalities and navigation of the digital toolkit. It features both audiovisual material and written guidelines, ensuring that users can easily understand and engage with the platform's tools and resources, regardless of their preferred learning style.

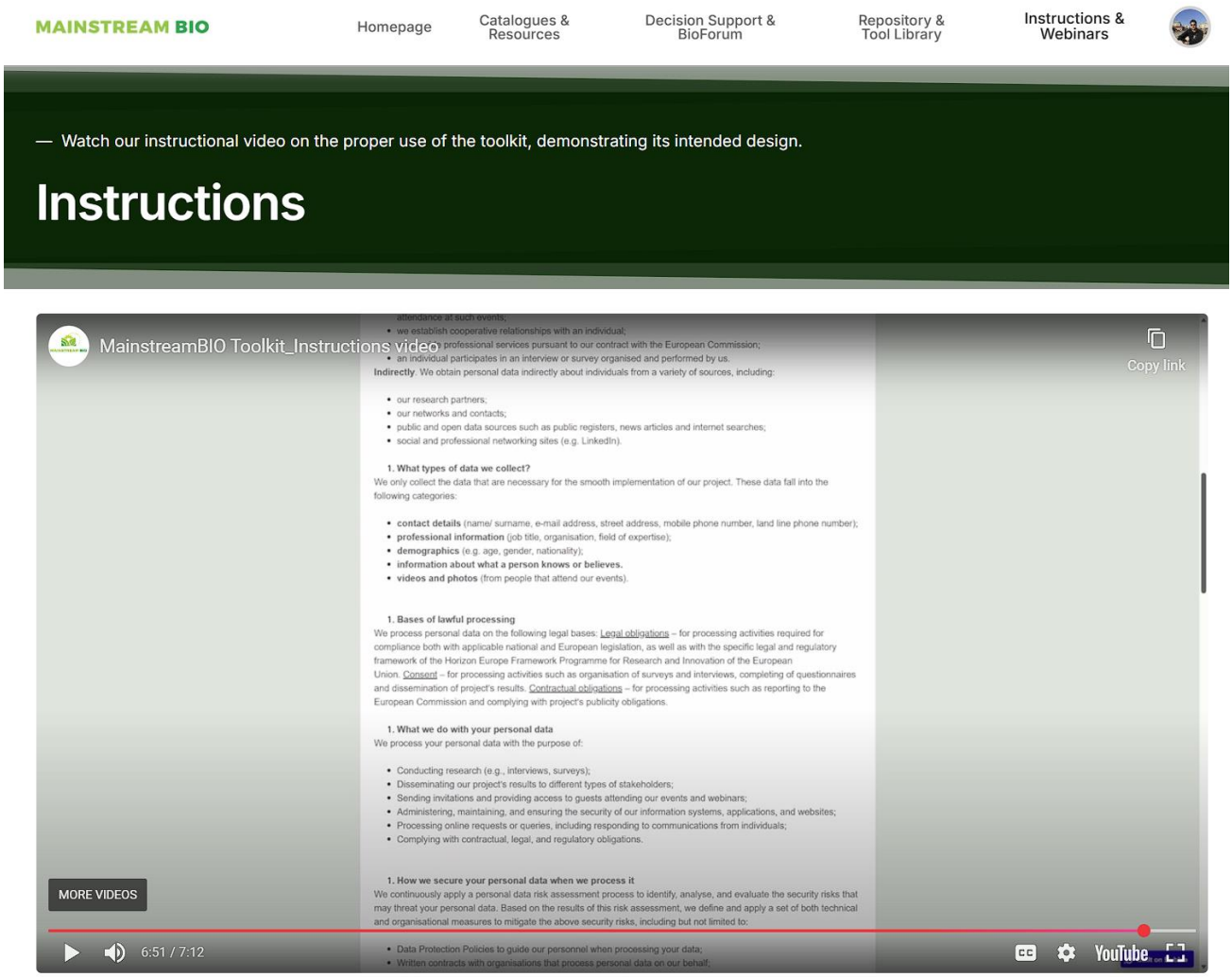


Figure 40: Instructions

2.21 Webinars

The Webinars page provides users with access to a comprehensive collection of webinars hosted within the framework of the MainstreamBIO project. A total of ten (10) webinars were conducted, each focusing on a distinct topic relevant to the bioeconomy. For each webinar, the digital toolkit includes the title, a detailed description, and an accompanying information sheet, offering users valuable insights and context for further exploration.

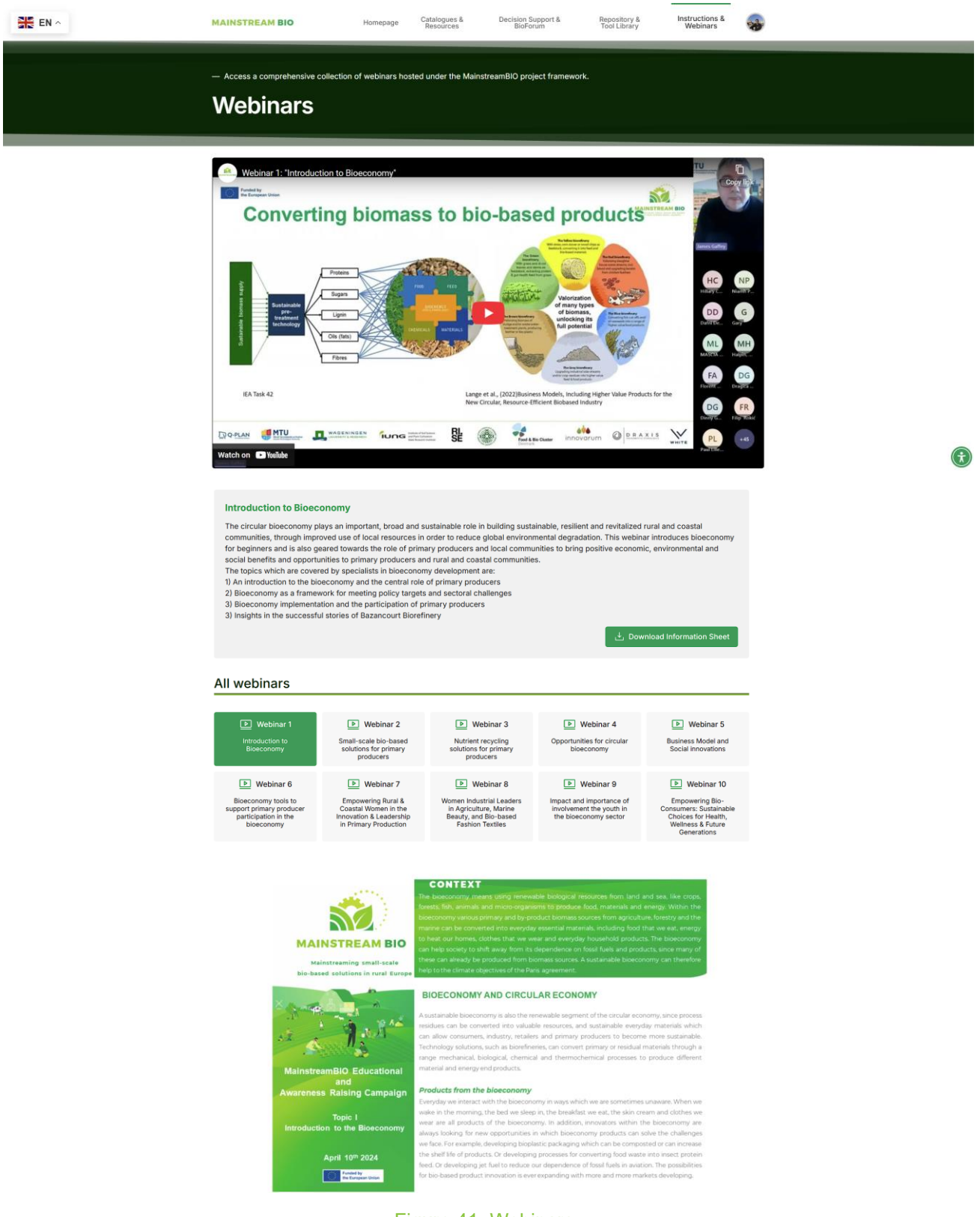


Figure 41: Webinars

2.22 Account

The Account page, accessible exclusively to logged-in users via the profile icon on the right side of the header, serves as the central hub for managing personal settings and preferences. Within this section, users can update various aspects of their profile and account.

By hovering and clicking over their current profile picture, users can upload a new image. In the "My Account" tab, they can modify their email address and username. The "Account Security" tab provides options to change the account password or permanently delete the account. Additionally, the "Privacy Policy" tab offers direct access to the platform's privacy policy for user review.

The "Rate Us" tab invites users to provide feedback on their experience with the digital toolkit. Users can rate the toolkit from one (1) to five (5) stars in response to the following three (3) questions:

- How likely are you to recommend our toolkit to others?
- How satisfied are you with the toolkit and its features?
- How easy was it to navigate our toolkit?

A free-text input field is also available for users to submit additional comments or suggestions, contributing to the ongoing enhancement of the toolkit's usability and effectiveness.

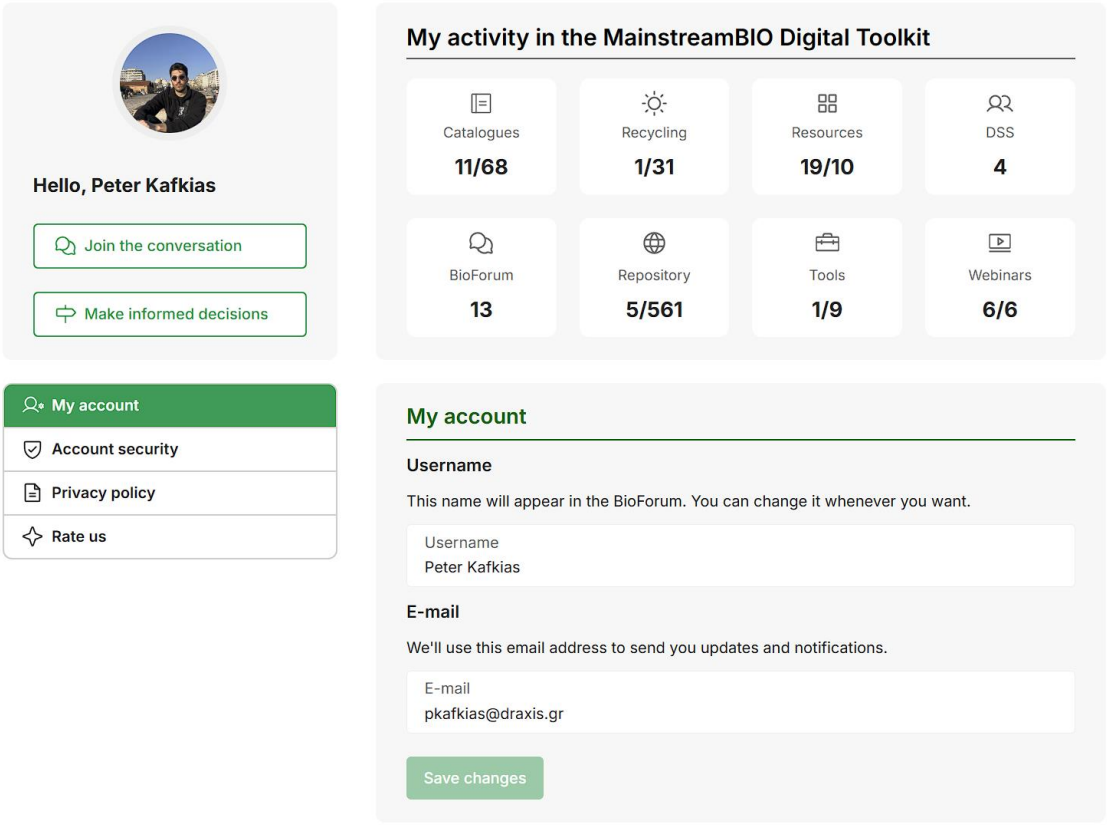


Figure 42: Account My account Tab

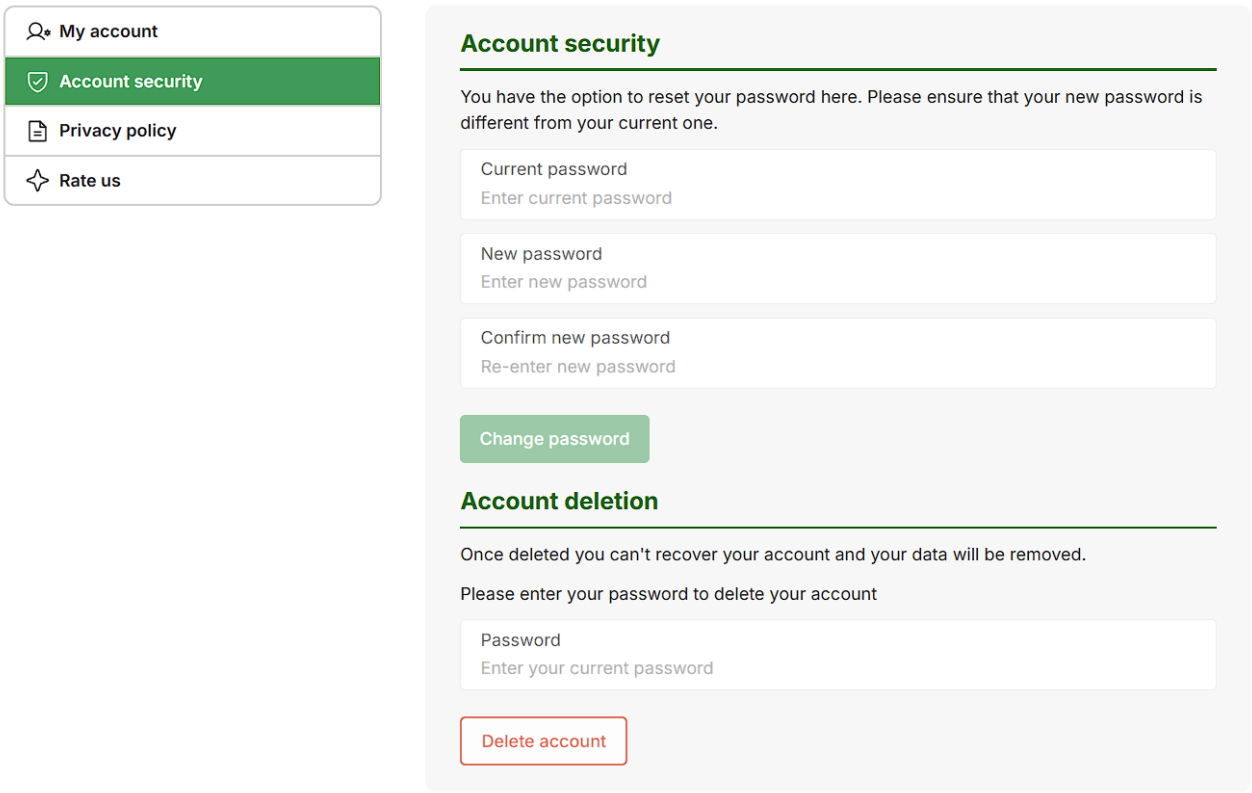


Figure 43: Account Security Tab

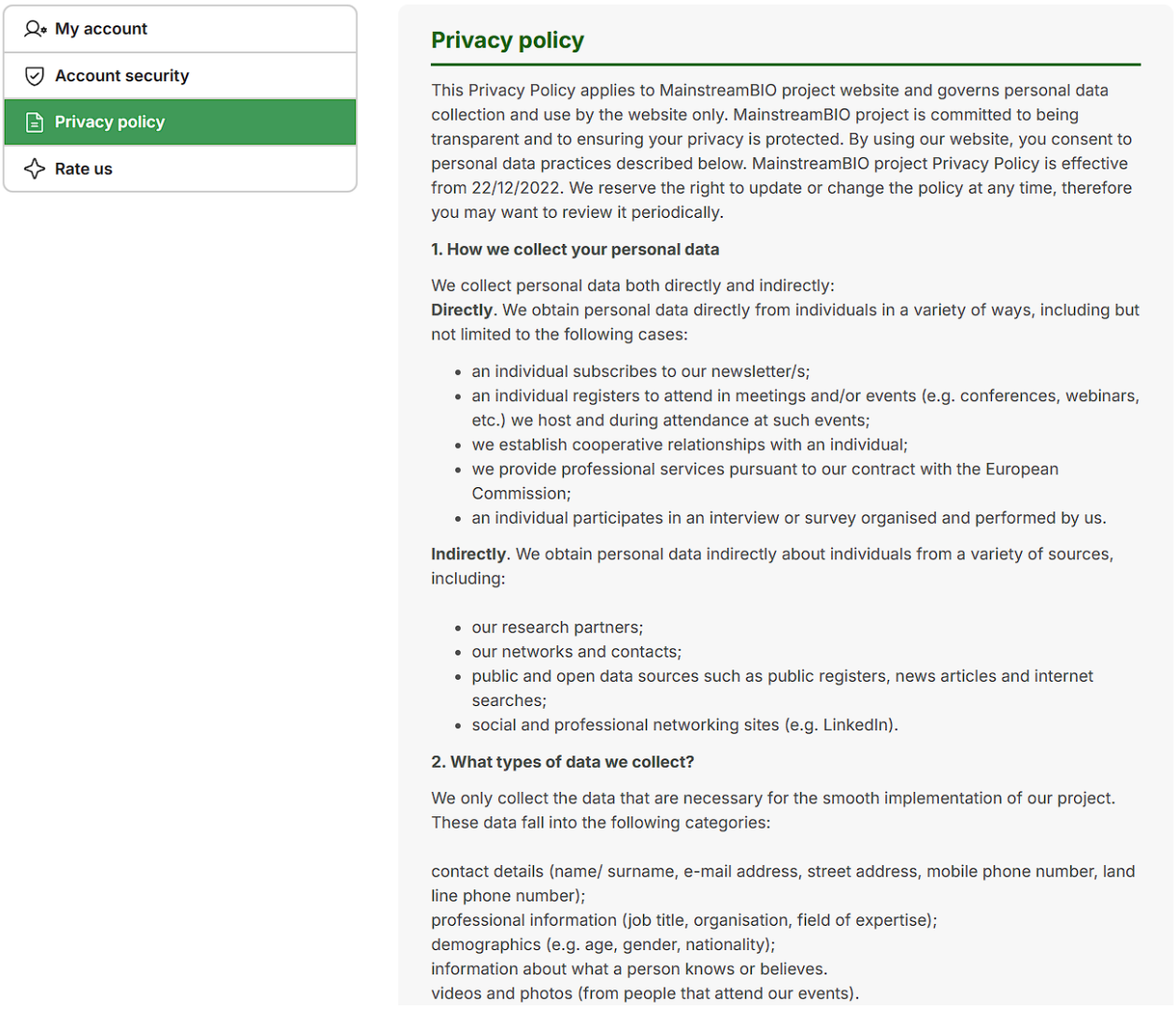


Figure 44: Account Privacy policy Tab

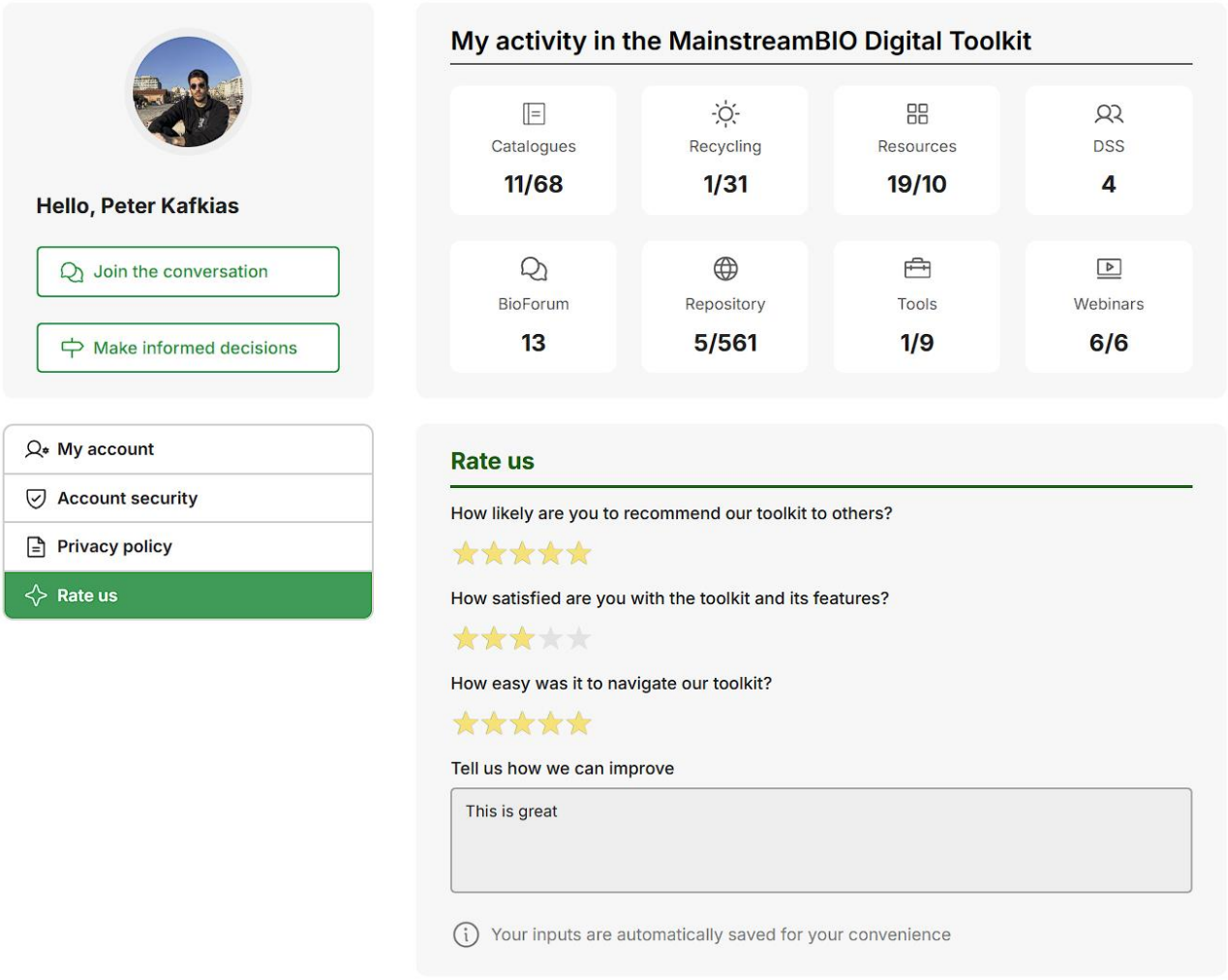


Figure 45: Account Rate us Tab

3. Conclusion

The development and deployment of the MainstreamBIO digital toolkit marked a significant milestone in the project's efforts to promote the uptake of small-scale bio-based solutions across rural Europe. Designed as an integrated and user-centric platform, the toolkit brought together nine core components including a Catalogue of Technologies, Business Models and Social Innovations, a Decision Support System (DSS), the BioForum, a Bioeconomy Repository, and others, to support stakeholders in exploring, understanding, and implementing circular bioeconomy practices adapted to their local contexts.

Throughout its development, the project generated valuable insights into collaborative digital innovation within a multi-partner Horizon Europe setting. One of the most impactful lessons was the strategic advantage of using no-code platforms. Leveraging Bubble.io allowed the team to rapidly prototype, test, and iterate functional versions of the toolkit without relying on heavy software development resources. This approach accelerated delivery timelines and enabled participation from both technical and non-technical contributors.

The inclusion of embedded educational content also played a crucial role in enhancing user engagement. Webinars, tutorial videos, step-by-step guides, and downloadable resources made the platform more dynamic, accessible, and useful to a diverse set of users, accommodating different learning preferences and levels of familiarity with bioeconomy topics.

Strong cross-partner coordination proved essential for the success of the toolkit. Given its wide-ranging content and technical components, the project required clear role definitions, close collaboration among content providers and developers, and alignment through regular review cycles. Structured co-design sessions and iterative planning ensured coherence across all components.

User feedback was another critical driver of improvement. Initial user requirements were collected through a detailed survey, and the insights gathered were directly incorporated into the toolkit's design and functionality. This early engagement with end users ensured that the toolkit was tailored to their real-world needs and priorities.

Collaborative design tools such as Figma and Whimsical further enhanced coordination across the consortium. These tools improved communication between technical and non-technical team members by providing a shared visual language for discussing layouts, wireframes, and user flows, thereby reducing the potential for misunderstandings and delays.

Ensuring consistency in user interface (UI) and user experience (UX) design was also a key focus. The toolkit's visual and functional alignment with the broader MainstreamBIO project identity contributed to a seamless, intuitive experience. Modern design choices, such as reduced visual clutter, clearer page hierarchy, and more structured alerts, improved both usability and visual appeal.

During the final phase, the project team launched a targeted improvement initiative based on feedback collected through co-creation workshops, pilot cases such as Sakana, and the "Helpful Feedback" feature embedded in the platform. Enhancements included a redesigned homepage, clarification of instructional content (especially within the DSS), new video tutorials, and additional curated content in the BioForum to stimulate meaningful discussion and peer exchange.

By combining stakeholder-driven design with iterative development, the final version of the MainstreamBIO digital toolkit delivered a robust, inclusive, and engaging digital environment. It played a central role in supporting rural actors in identifying and implementing small-scale bio-based innovations and contributed to the emergence of sustainable and circular bioeconomies at local and

regional levels. The knowledge and practices gained through its development offer a replicable model for similar EU-funded digital initiatives in the future.

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
AGRICULTURAL 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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