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D3.2 Draft Catalogue of biobased solutions

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Date: 27/05/2024

Funded by
the European Union

BIOLOC

DOCUMENT CONTROL SHEET

Deliverable name and number	3.2
Deliverable version	Final
WP number / name	Draft Catalogue of biobased solutions
Number of pages	140
Delivery due date	January 2024 (M15)
Actual date of submission	May 2024 (M20)
Dissemination level	Public
Lead beneficiary	WR
Main Authors	Lesly Garcia, Bert Annevelink, Martien van den Oever & Edwin Keijsers, Raymond Schrijver, Alwin Gerritsen & Remco Kranendonk (WR)
Contributors	

DISSEMINATION AND UPTAKE: PUBLIC

VERSIONS AND HISTORY OF CHANGES

Version	Due date	Author/Editor	Contributors	Description
V1.1	26/04/2024	WR	CIRCE, UHOH, ZSI, RCISD, BUAS, DOOR, BICK, CERTH	
V1.2	14/05/2024	WR	INCE	
FV	27/05/2024	WR		

Contents

1. Introduction

BIOLOC aims to support and inspire the communities of 12 participating European regions to unlock and propel local development potentials by fostering sustainable, innovative, tangible and participatory pathways to an inclusive Circular Bioeconomy (CBE).

The objectives of WP3 'Catalogue biobased solutions and good practice examples' within BIOLOC are to build a catalogue of relevant bio-based solutions that contribute to the revitalization of the selected European local communities. WP3 is composed of four different tasks and three deliverables as shown in Table 1. This document (D3.2) describes the result of Task 3.2: Development of the catalogue of biobased solutions according to the concepts established in Task 3.1. The catalogue will be finalized in deliverable D3.3 'Final catalogue of biobased solution including good practices'. The catalogue is built considering regional innovation concepts to support local biobased systems and revamp of European local communities, focussing on local/regional needs. The catalogue will be available for any party interested in local bioeconomy solutions, and the information is meant as an orientation point for users.

TABLE 1. WP3 TASKS AND DELIVERABLES.

Tasks	Deliverables
3.1 Development of the factsheet template, list of different concepts of the biobased catalogue	D3.1 Factsheet template for biobased catalogue
3.2 Development of the catalogue of biobased solutions according to the concepts established in task 3.1	D3.2 Draft catalogue of biobased solutions with an Annex on the development of the Societal Readiness Level (SRL) concept
3.3 Inclusion of good practices section to the catalogue	D3.3 Final catalogue of biobased solution including good practices
3.4 Presentation of final version of the catalogue.	PowerPoint presentation

During Task 3.1, key concepts were identified biobased solutions utilized in relevant projects, such as Horizon Europe projects like POWER4BIO, BE-RURAL, CityLoops, and MainstreamBIO, as well as other open sources to showcase biobased solutions. This initial step laid the groundwork for constructing the "Framework of Concepts" for the BIOLOC catalogue. However, to address the specific challenges and needs of the regions involved in this project comprehensively, it became clear that it is imperative to incorporate social aspects in connection to the technical biobased solutions. Therefore, concepts highlighting the social benefits achieved were added, as well as the actors involved in the initiative implementation, and when available, information on the governance structure.

In Task 3.2, we carefully reviewed the needs of the 12 BIOLOC regions connected to the SWOT analysis performed in WP2, and identified certain needs to be addressed using biobased technology solutions identified during our initial search. The aim was to contribute to enhance their local bioeconomy and, if feasible, support marginalized groups in those areas. Through this analysis, we recognized that inclusive social innovations and small-scale solutions, taking into account economic, environmental, and social factors, were better suited for addressing regional challenges than solely relying on large-scale technological solutions. These smaller-scale technological solutions and social innovations hold greater potential to address the needs of the regions effectively. In this report, we present two different types of biobased solutions: technical solutions and social innovations (for definitions see section 2.3), and match these solutions to the different BIOLOC region's needs.

In the biobased catalogue, we utilize the Technology Readiness Level (TRL) concept to indicate the maturity of technological solutions. However, to complement traditional technology readiness assessments, In the BIOLOC project developed the concept of Societal Readiness Level (SRL). The presentation and explanation of the SRL concept are detailed in Annex 6. Practical application of the SRL will occur in Task 3.3, with the results to be presented in D3.3.'Catalogue of Good Practices Toward the Revitalization of European Local Communities', together with good practices examples with more balanced technical and social approaches.

2. Methodology

2.1 Introduction

In the development of the biobased catalogue a stepwise approach was followed for the selection of relevant biobased solutions to be included in the catalogue. The approach consisted of the following steps:

- Identification of the needs of the BIOLOC regions;
- Drafting a long list of potentially relevant biobased solutions using as reference other relevant biobased catalogues and EU biobased projects.
- Matching the needs of the BIOLOC regions with the potentially relevant biobased solutions;
- Description of selected biobased solutions in factsheets, resulting in a catalogue.

Each of the steps is explained in more detail in the section below.

2.2 Identification of the needs of BIOLOC regions

The identification of the local needs of the BIOLOC regions to be addressed in WP3 was done by extracting the needs from talks to regional representatives, which are summarized in a one-page description presented in Annex 1, and from the information compiled in other WP deliverables, in particular BIOLOC D.2.3 'Report on the assessment of local needs, conditions, opportunities' and D.4.1 'Analysis of local context'.

The needs that are described in Annex 1 are summarized as a short concept in a list and a code number was assigned to each need using the country letters and a number (see Table 6 in the results section). In total 41 needs were identified.

2.3 Drafting the list of potentially relevant biobased solutions

A list of potentially relevant biobased solution was generated (see Tables 6 & 7) through a review of important biobased catalogues of Power4Bio, MainstreamBIO, CityLoops, AgriForValor, BE-Rural and other sources (OTH). For this review, and to facilitate the communication and understanding, it is necessary to agree on some concepts such as: waste, residues, side-stream, by-product, biobased technical solutions and biobased social innovations. Therefore these concepts are clarified in this section.

'Waste' is a commonly used term to refer to side streams, residues and byproducts that are generated and have no further use or application. Under specific conditions according to the European Waste Framework directive and the 'end-of-waste concept' certain waste ceases to be waste and becomes a product or a secondary raw material. Consequently, the term "waste" is no longer used.[1] Following this directive, within the BIOLOC context, biomass is seen as a potential feedstock, and it will not be referred to as waste. Instead of waste the terms **residue**, **side-stream** or **by-product** will be used.

During the outlining of the list of potentially relevant biobased solutions, two different types of **biobased solutions** were identified: Technical Solutions and Social Innovations. **Technical solutions** mainly focus on addressing practical problems using technology principles and scientific knowledge to improve efficiency, effectiveness and productivity. On the other hand, **Social Innovations** are initiatives that aim to address social, cultural, or educational challenges with an openness to share knowledge and ownership, in order to create a positive social impact. Social innovations do not necessarily imply the use of novel technology in bioeconomy or commercial scale biomass conversion. Social innovations can be small size (semi-public) organization in rural or urban areas, or small enterprises with a strong social goal.

[1] https://environment.ec.europa.eu/topics/waste-and-recycling/waste-framework-directive_en

For the social innovations, a new template was created instead of using the proposed template for technologies described in D 3.1 'Factsheet template for biobased catalogue'. The decision was made due to the different nature of the information available on the social innovation topics. Table 2 and Table 3 summarize the concepts included for the technical solutions and for social innovations, respectively. The two factsheet templates were used to build the catalogue. The templates are presented with a detailed description of the concepts in Annex 2 for technological solutions and in Annex 4 for social innovations.

TABLE 2. FACTSHEET TEMPLATE FOR TECHNICAL BIOBASED SOLUTIONS (OUTCOME OF TASK 3.1).

#. Solution Code -Name of the solution

A. General

Title
Location
Keywords
Example user / provider of technology

B. Feedstock

Main feedstock
Other potential feedstock
Required feedstock quality
Feedstock source, price, trade spot and location

C. Technology

Technology Name
TRL
Description of Technology
Capacity
Investment and Operational Costs

D. Product(s)

Product Name(s)
Price, trade spot and location

E. Environmental Impact

Environmental Benefits

F. Financial Aspects

Financial Support

G. Institutional and Organizational Aspects

Type of Organization and Governance Structure
Actors Involved

H. Public Perception and Social Impact

I. Challenges for Implementation

J. References

The template for biobased social innovation was developed with an emphasis on describing solutions from a social-participatory perspective. Drawing partially from the concepts outlined in the MainstreamBIO project, it has been extended to cover social aspects typically overlooked by conventional market economies, as well as the challenges these solutions may face during implementation. The social innovation template was internally established by the WR team responsible for this task.

TABLE 3. TEMPLATE FOR SOCIAL INNOVATION FOR SMALL SCALE BIO-BASED SOLUTIONS.

#. Solution Code - Name of the social innovation for small scale bio-based solution

A. Description

- Main objectives
- Social innovation's target
- Approach
- Location and Example user

B. Activities

C. Actors Involved

D. Impact for bioeconomy development

E. Social Impact

F. Challenges for implementation

G. References

2.4 Matching the needs of the BIOLOC regions with the potentially relevant biobased solutions

A matching table was used to link the biobased solutions from the literature review to the needs of the BIOLOC regions and to facilitate organization, comparison and analysis in a concise and accessible manner. The examination of the matching tables (Table 7, Table 8, Table 9) supports stakeholders to identify the technical solutions and social innovations that could be inspirational and suitable as partial solutions for their specific needs.

2.5 Description of selected biobased solutions in factsheets, resulting in a catalogue

Finally, the biobased solutions that are identified as most relevant to address the needs are further described in detail in Annex 3 for technical biobased solutions and in Annex 5 for social biobased innovations. These biobased solutions constitute the Catalogue of Biobased Solutions.

3. Results

3.1 List of potentially useful biobased solutions (technologies & social innovations)

The list of biobased solutions was reviewed and adapted to produce a compiled version with relevant examples addressing the specific needs of the BIOLOC regions. Table 5 presents the technical biobased solutions with a brief description, while Table 6 showcases the social innovations. The technical biobased solutions are classified within a general conversion technology concept according to the MainstreamBIO project and identified with the code MB-B-x, referring to the Annex numbering in MainstreamBIO report D2.1. For each technology concept, a more specific and detailed example of the biobased solution is provided, and a different source code is assigned to trace the reference from where this example was taken (see Table 4). For example The number in the first column of Table 5 and Table 6 corresponds to the biobased solutions in Annexes 3 (technical solutions) and 5 (social solutions).

It is important to mentioned that one of the main challenges when compiling information for the technical biobased solutions factsheet, was the scarcity of publicly available financial data and data on production capacity. Consequently, much of the technical biobased solutions are deficient in these aspects.

TABLE 4. SOLUTION CODING STRUCTURE.

Source	Location in source	BIOLOC code	Remarks
MainstreamBIO D2.1	Annex B1	MB-B-01	
	Annex C2.2	MB-C2.2	
	Annex D1	MB-D-01	
Power4Bio Catalogue	-	P4B-01	Factsheets in the catalogue (not online anymore) were not numbered. Therefore BIOLOC numbering starts from 1.
BeRural D2.1	-	MB-B-02	Factsheets in the report do not have simple number. Therefore BIOLOC numbering starts from 1.
Bio-based products- from idea to market - 15 EU successful studies	-	BPM-01	Solution descriptions in the report do not have clear numbers. Therefore BIOLOC numbering starts from 1.
CityLoops	-	CL-01	Solution descriptions in the report do not have clear numbers. Therefore BIOLOC numbering starts from 1.
AgriForValor	-	AFV-01	Solution descriptions in the report do not have clear numbers. Therefore BIOLOC numbering starts from 1.
Other open sources	-	OTH-01	Further solutions collected from open sources have been numbered consecutively.

TABLE 5. LIST OF TECHNICAL BIOBASED SOLUTIONS AND SHORT DESCRIPTIONS.

#	Solutions Name	Source code	Short description
	Aerobic conversion (composting)	MB-B-01	Aerobic conversion breaks down instable fractions of bio-based feedstock into carbon dioxide (CO_2) and water by microorganisms where plenty of oxygen is available, resulting in residual stable fraction of biomass which can be used e.g. as soil improver or nutrient rich compost.
1.	Aerobic digestion of bio residues (grass, leaves, food residues)	OTH-01	Aerobic digestion of grass, leaves and bio residues remove from waterways to produce compost.
	Anaerobic digestion	MB-B-02	Anaerobic digestion is a biological process in which micro-organisms break down organic material under oxygen-free conditions into useful compounds such as methane (biogas).
2.	Cattle manure based anaerobic digestion producing biogas (HoSt - NL)	MB-C2.2	uses anaerobic digestion to convert cattle manure into biogas. Three products are derived: biomethane, electricity and nitrogen-rich fertilizer.
3.	Spent mushroom substrate & other agricultural and food industrial residues based anaerobic digestion producing biogas & electricity (Pilze-Nagy - HU)	MB-C2.3	Use of anaerobic digestion to convert mushroom substrate and other agri-food residues into biogas for electricity production. Additionally solid and liquid fertilizers are obtained.
4.	Whey permeate based anaerobic digestion producing bioethanol, biogas and fertilizers (Carbery - IRL)	MB-C2.8	Use of anaerobic digestion dairy industry whey permeate into ethanol and biogas.
	Fermentation	MB-B-03	Fermentation is a process in which micro-organisms (bacteria, yeasts, moulds) are used to convert organic material into alcohol, acids or hydrogen, for instance, which can be used in food and chemical industry.
5.	Unsold bread-based fermentation producing beer (Toastale - UK)	MB-C3.1	Unsold bread to produce beer by fermentation.
	Insect-based bioconversion	MB-B-04	Insect-based bioconversion also known as insect farming is based on growing a selection of insect species like e.g. Black Soldier Fly (BSF) larvae, house fly maggots, mealworms, and grasshoppers-crickets and different rearing substrates to produce e.g. protein rich feed.
6.	Organic side streams-based bioconversion by black soldier fly larvae producing lipids and proteins for feed (Bestico - NL)	MB-C4.1	Revalorization of agri-food residues into feed and fertilizers by insect bioconversion.
	Mushroom cultivation	MB-B-05	The production system of mushrooms from residues.
7.	Coffee residues based growing producing mushrooms (Rotterzwam - NL)	MB-C5.1	Growing oyster mushrooms using coffee residues, straw and lime.

#	Solutions Name	Source code	Short description
	Blending or mixing	MB-B-06	Blending or mixing is used to modify the specification of biomass streams for different purposes, such as meeting the required emission, minimizing the ash production, obtaining the desired nutritional requirements for a specific animal or creating building materials.
8.	(Insulating) materials made of hemp & lime (Hempire - PL; Dunagro - NL)	P4B-01 & MB-C6.1	Mixing and curing of hemp shives with lime to make a building material suitable for semi-structural semi-insulating walls, both exterior and interior.
	Extraction & separation processes	MB-B-07	Extraction is a recovery and purification technology to extract impurities or valuable compounds. Separation is an important process for the conversion of biomass into components for use in chemicals, energy and materials.
9.	Fruit juice residue streams based pressing and solvent extraction producing specialty oils and additives for food, food supplements & cosmetics (Add Essens - BE)	MB-C7.1	Valorisation of waste from juice production to produce additives for food, food supplements & cosmetics by pressing and solvent extraction. Since 2021 part of Innovad Group.
10.	Olive oil industry by-products-based extraction producing food additives (Natac Group - ES)	MB-C7.2	Valorisation of olive oil industry by-products to produce food additives using extraction.
	Mechanical and thermomechanical disruption & fractionation	MB-B-08	Mechanical and thermomechanical disruption & fractionation are processes to modify the shape, particle size, bulk density and/or moisture of biomass.
11.	Meadow grass silage based mechanical treatment and compounding, producing grass fibre enhanced plastic granulates and natural insulation material (Biowert - DE)	P4B-02 & MB-C8.1	Making composites by extrusion compounding of grass fibre as reinforcement/filler in a thermoplastic like e.g. biobased polylactic acid (PLA). The composite is produced in the form of granules, suitable for further processing into (semi)products using injection moulding, compression moulding or profile extrusion.
12.	Wood residues based mechanical disruption producing pellets for energy applications (Biomassehof-Chiemgau - DE)	MB-C8.4	Use of wood residues to produce pellets for energy applications.
13.	Agricultural waste based mechanical disruption producing pellets (Pelletierungs Genossenschaft - AT)	MB-C8.6	Using agricultural waste from different sources to produce pellets for multiple applications (energy, cattle bedding) by mechanical disruption and subsequent pressing.
14.	Production of wide range of wood fuels (Biopel - SK)	OTH-03	Production and transportation and of pellets, briquettes, chipped firewood, dry wood chips from low-quality wood and wood residues, not useable as high-quality material in construction and furniture industry.
15.	Wheat bran disposable tableware (Biotrem, PL)	BPM-01	Fully bio-based tableware from compressed wheat bran by-product from the production of refined grains.
16.	Biofilter from tree bark chips (Bures, Pastorino, Odour balance - ES, IT, NL)	AFV-01	Specific porous lignocellulosic biomass can be chipped, purified, calibrated in size, treated and formed into a layer as filter for extracting (odorous and toxic) compounds from an air stream.

#	Solutions Name	Source code	Short description
17.	Straw based insulation blow-in, blocks, panels (NL,UK, DE)	OTH-02	Cereal straw can be milled to specific size and blown in cavities of building walls and roofing to provide thermal insulation. Alternatively, straw can be pressed into bales/blocks or glued into panels to provide semi-structural and insulating walls.
18.	Plant-based protein using pulse drying technology (FlavaPulse - BU)	OTH-04	Pulse dry technology can efficiently dehydrate food while preserving its quality and native functionality and high nutritional value. The technology can be applied to a wide range of agrifood products like fruits, vegetables and grains.
	Mechanical pulping	MB-B-09	Mechanical pulping is the process to open up the fibrous structure of plants or wood by grinding or refining. It frees fibre bundles, (partly) creating single fibres and fibril structures that can be used for the production of moulded fibre products, paper and fibre board materials.
19.	Agricultural residue to produce tableware and packaging material (Bio-Lutions - DE)	MB-C9.1	Agricultural residues treated via mechanical pulping, producing tableware and packaging material
	Combustion	MB-B-10	During combustion of biomass heat is released, which can be used to produce steam that drives a steam turbine to produce electricity. Efficient co-production of power and heat can be applied by using so called CHP-plants (part of the heat is used to produce power, the other part for producing heat).
20.	Biomass- CHP combustion plant (Bioenergy NEXTgarden - NL)	OTH-05	Using biomasses from low grade wood chips to generate heat and power by combustion.
	Gasification	MB-B-11	Gasification converts biomass into combustible gas at high temperatures (>600°C) with a controlled amount of oxygen (or air). Depending on the use of the gas is called fuel gas if it is used for energy (power and/or heat) applications, and syngas in case is being used for catalytically synthesis of bio-based products (transport fuels, chemicals). The material that is not converted into gas ends up in a remaining fraction called biochar, which has properties similar to activated carbon, and can be used as a soil enricher or as a fuel for heating the gasifier.
21.	Wood waste based gasification producing renewable hydrogen (Hynoca - FR)	MB-C11.1	Use of wood waste to produce producing renewable hydrogen via gasification.
	Pyrolysis	MB-B-13	In the pyrolysis process, the biomass is thermally cracked at temperatures between 400°C-600°C in an oxygen-free environment, producing a combustible gas, pyrolysis oil and char. Pyrolysis oil can be used as fuel and as a source for a naphtha-cracking process in which chemicals can be extracted. The gas by-product is usually burned in order to generate process heat for the pyrolysis reactor, and the biochar is a solid carbonaceous residue and it is suitable as soil improver or as solid fuel.
22.	The containerized-mobile pyrolysis unit (ETIA Biogreen - FR)	BR-01	This is a mobile pyrolysis unit in a container. Some can run in torrefaction (MB-B-14), pyrolysis or high temperature pyrolysis mode to produce biochar, bio-oil and syngas from any kind of biomass residues from wood, crops or other lignocellulosic residue material. Other type of mobile units can convert waste plastics into oil, syngas and char.
	Torrefaction & Carbonization	MB-B-14	Torrefaction & carbonization are thermal processes to convert biomass into a coallike material, with higher energy density and hydrophobic characteristics compared to the original biomass and

#	Solutions Name	Source code	Short description
			can withstand biodegradation. This delivers improved retention (stability), and reduced storage and transportation costs. The material is suitable for gasification and co-firing in coal-fired power stations.
23.	Sewage Sludge hydrothermal carbonization (HTC) producing bio-coal (TerraNova - DE)	MB-C12.1	Sewage Sludge based hydrothermal carbonization (HTC) producing bio-coal.
	Combined technologies		
24.	Grass-based insulation mats (Gramitherm Europe - BE)	OTH-06	Manufacture of insulating mats made with natural grass. These products can be used for new buildings as well as for renovations.
25.	Phytoextraction of Nickel with perennial plants to extract nickel from mining site's soil (Botanikel - FR)	OTH-07	Cultivation of perennial plants to extract nickel from abandoned mining sites or contaminated soil. Biomass is chopped to produce pellets and nickel is recovered and recycled via a combustion process (MB-B-10) where energy is produced and nickel is recovered from the ashes.
26.	Phytoremediation to produce bioenergy and biofuels (ES, LT, SB, FR, UK, SB, RO)	OTH-08	Soil remediation by cultivating energy crops (perennial or annual) in marginal soils contaminated with heavy metals or petroleum hydrocarbons. Biomass is pelletized and processed by thermo-catalytic technologies

TABLE 6. LIST OF SOCIAL INNOVATIONS AND SHORT DESCRIPTIONS

27.	Cooperative network in France of small-scale farmers, employees, and agricultural development organizations, providing a tool box of farmer-driven technologies and practices (L'Atelier Paysan - FR)	MB-D-01	This cooperative aims to empower farmers by promoting technical and technological sovereignty through an open source resource platform for farm production tools, which provides access to online resources, videos, trainings, and knowledge exchange sessions.
28.	Cooperative network Organic Food Valley in Poland (EkoLubelszczyzna - PL)	MB-D-02	This social innovation project aims to develop a cooperative network between different actors involved in the production, processing, and marketing of organic food and eco-products/services.
29.	Centre for Education and Personal Development in Nature, an innovative co-working space and educational complex in Serbia (Rural HUB)	MB-D-03	The Rural HUB connects socially responsible individuals and organizations with traditional farmers through an educational complex and co-working space, offering comprehensive programs for sustainable farm development in rural areas.
30.	Assessing Reforestation and Forest Development Activities in partnership with local communities in Lebanon (ARDAC - LBN)	MB-D-04	The reforestation and sustainable forest management project aimed to address deforestation and local development, with an innovative aspect being the management of non-wood forest products from the biggest laurel forest in Lebanon.
31.	Biological farm collaboratively run by employees and a group of around 300 consumers in Austria (Gela Ochsenherz - AT)	MB-D-05	The Demeter farm in Lower Austria is a partnership between employees and a group of around 300 consumers who collaboratively work together through an association.
32.	Federation Agriculture and Care - Network for Care Farming in The Netherlands (NL)	MB-D-06	The organization aims to professionalize agriculture and facilitate regional organizations of farmers, with consulting and training, networking activities for (future) social farmers in starting their business.

33.	Land Sharing for food and social good, a project promoting and preserving traditional farming techniques in Slovenia (SL)	MB-D-07	The Land Sharing for Food and Social Good project promotes sustainable farming by transferring knowledge through intergenerational cooperation.
34.	Regeneration of degraded farmland in Greece through sustainable agriculture practices (Mazi company - GR)	MB-D-08	Mazi leads the regeneration of degraded farmland in the Mediterranean through community-supported agroforestry, adopting the 'syntropic' model of agriculture that mimics nature's patterns for a diverse and resilient ecosystem benefiting the environment and the community.
35.	Fish farming in symbiosis with pulp mills in Sweden (Big Akwa - SE)	MB-D-10	Big Akwa is a social innovation company that combines fish farming with pulp mills through industrial symbiosis, to achieve sustainable and resource-efficient food production with lower costs and reduced environmental impact.
36.	Fish farming in symbiosis with Tomato farming in Sweden (Agtira - SE)	MB-D-11	Agtira's closed-cycle system is highly beneficial for resource and energy efficiency, reducing water consumption, waste disposal needs, and transportation, while increasing produce freshness and decreasing food waste.
37.	An innovative waste management system that prioritizes the recycling of food waste in Sweden (Örnsköldsvik municipality - SE)	MB-D-12	Örnsköldsvik municipality's innovative waste management system efficiently produces biogas and biofertilizer from food waste, contributing positively to the environment, society, and the agricultural sector.
38.	An educational community partnership Cloughjordan EcoVillage in Ireland (IR)	MB-D-13	Cloughjordan EcoVillage is a unique development that emphasizes sustainable living practices and community engagement.
39.	Shared composting approach for urban agriculture in Bulgaria (The Root - BU)	MB-D-14	The "Root" Foundation is promoting sustainable development through shared composting and collaboration with various agricultural and environmental organizations to restore and conserve biodiversity and natural resources, with a focus on soil.
40.	An organization for the promotion of sustainable forest management in Spain (Planeta Madera - ES)	MB-D-15	Planeta Mandera promotes sustainable forest management practices in Spain through information dissemination and encouraging the implementation of sustainable practices.
41.	Fight against depopulation, sponsorship of abandoned olive trees (Apadrina un olivo - ES)	MB-D-16	Apadrina un olivo is a successful initiative that recovers abandoned olive trees in Oliete, Teruel through sponsorship, creating job opportunities and attracting tourism.
42.	Promoting sustainability, food culture, and health among children and young people in Denmark (Haver til maver - DK)	MB-D-17	Haver til Maver is a non-profit organization that focuses on promoting sustainability, food culture, and health among children and young people in Denmark.
43.	Initiative to reduce food waste in Denmark (Too good to go - DK)	MB-D-18	Too Good To Go is a Danish success case in the fight against food waste.
44.	Community-based project in Northern Greece that collects used coffee grounds from cafes and converts them into clean biofuel (Kafsimo - GR)	MB-D-19	Kafsimo is a community-based project in Northern Greece that collects used coffee grounds from cafes and converts them into clean biofuel.
45.	Production of bokashi from leaves to improve soil quality (Gemeente Apeldoorn, NL)	CL-01	Local production of bokashi from bio-waste from green spaces and local use as soil improver promotes the connection of public servants and citizens with the quality of the green spaces in the city.

46.	Production of paper from grass (Gemeente Apeldoorn, NL)	CL-02	Local production of paper from grass and other non-wood residues can bring the biobased economy closer to citizens, paper factories may increase their position in relation to competing paper factories by increasing their portfolio.
47.	Production of 3D filament from Japanese Knotweed and PLA (Gemeente Apeldoorn, NL	CL-03	Local production and use of biodegradable biobased filament for 3D printing will connect citizens with the biobased economy and reduce plastic waste.
48.	Organizing a contest to encourage new bio-based initiatives (PT)	CL-04	Contest to invite people and new businesses to start up biobased industries with help from the city/region and experts.
49.	Redistributing of food residues to vulnerable groups (Zero Desperdicio - PT)	CL-05	City and volunteer initiative to redistribute food residues towards vulnerable groups.
50.	Combine Kitchen garden concept with food residue to produce meals by vulnerable groups (PT)	CL-06	A combination of day care/daily activities for vulnerable groups and production of food products/meals from a kitchen garden and food residue from local shops.
51.	Improve separate bio-residue collection for biogas production by digestion (ES)	CL-07	Reducing landfill by adding separated bio-residue as input material to existing digesters. Includes encouraging citizens to separate residue to obtain the right bio-residue quality.
52.	Create certified green spaces to improve general wellbeing (PT)	CL-08	City initiatives to improve the quality of green spaces by certification of green spaces that improve the social cohesion of the neighbourhood and the biological quality of the green space.
53.	Improve separate bio-residue collection for biogas production to fuel local busses (Mikkeli, FI)	CL-09	Increase of biogas production capacity by adding separated bio-residue as input material to existing digesters and reducing the amount of bio-residue in the municipal waste fraction that is burned for energy production. Includes encouraging citizens to separate waste to obtain the right bio-residue quality.
54.	Urban Vertical Farms (NL)	OTH-09	Vertical farms. Advanced food cultivation in an environmental and sustainable way and close to the communities.
55.	Wooden bicycle and fitness frames (ES, DE)	OTH-10	bicycles frames made out of natural fibres and hardwood.
56.	Farm machine Cooperatives (CUMA, FR)	OTH-11	Farmers cooperatives for the collective investment and joint use of machinery, building, workers for tasks directly linked to production cycles.
57.	Recycling wood from local building sites (Usefulwood, UK)	OTH-12	Organization that collects unwanted wood from local building sites, recycle the wood, by selling the wood for do it yourself projects (DIY) and making wood products in a workshops. The used wood that can’t be used is chipped for bio-fuel.

Explanation of source codes: P4B = Power4Bio, MB-C = MainstreamBIO - Small-scale technologies (D2.1 Annex C), MB-D = MainstreamBIO - Social innovations related to small-scale bio-based solutions (D2.1 Annex D), CL = CityLoops, AFV = AgriForValor, BR = BE-Rural, BPM = Bio-based products-from idea to market*15 EU successful studies, OTH = Other solutions identified during BIOLOC project.

3.2 List of needs of BIOLOC regions matched with potential solutions

The needs that are described in Annex 1 are summarized in Table 7 and the solutions from Table 5 and Table 6 were selected to address to the need of the 12 BIOLOC regions.

TABLE 7. MATCHING BIOLOC REGIONS NEEDS TO BIOBASED SOLUTIONS.

#	Country (code) & Region	Need code	Regional Needs[2]	Most Relevant Solutions (brief explanation)
1.	Bulgaria (BU) - Region Plovdiv	BU-1	Increasing the knowledge level and active participation of local minorities, including unemployed people and or people with low education background towards bioeconomy and recycling.	- MB-D-03: The rural hub connects individuals and organisations with farmers. - MB-D-05: The biological farm is a partnership between employees and consumers. - MB-D-07: The land sharing initiative is targeting young people. - MB-D-08: The regeneration of degraded farmland is a community supported initiative. - MB-D-13: This Irish ecovillage involves community engagement. - CL-04: This contest invites people to produce ideas and helps them to start a company. - CL-08: The certification of green spaces improves social cohesion and participation. - OTH-12: Local recycling of unwanted wood and wood workshop helping unemployed people to get new skills
2.		BU-2	Valorisation of agricultural residues and food chain residues - towards soil improvement to reduce use of fertilisers and pesticides	- MB-B-01 (OTH-01): Anaerobic conversion results in producing compost, which is a product higher on the residue valorisation ladder as landfill and burning. - MB-B-02 (MB-C2.3, MB-C-2.2): Anaerobic digestion produces digestate, which can be turned into compost for soil improvement. - MB-B-04 (MB-C4.1): Insect based bioconversion, conversion of agricultural residues and food chain residues to animal feed. - MB-B-05 (MB-C5.1): Mushroom cultivation, because the spend material can be used as compost. - MB-B-13 (BR-01): Pyrolysis creates biochar, which can be used as soil improver. - MB-D-12: This innovative waste management system produces bio-fertilizer. - MB-D-14: The Root foundation promotes composting. - CL-01: The bokashi produced can be used for soil improvement.
3.		BU-3	Improving the-recycling value chain	- MB-B-05(MB-C5.1): Revalorization of coffee residues as media to produce food. - MB-D-19: Recycling: collecting and using coffee grounds. - CL-05/CL06: Recycling: Food residue distribution preventing landfill. - CL-07: Improving the recycling value chain by improving separate collection of bio-residue by citizens. - CL-09: Improving the recycling value chain by improving separation of bio-residue by citizens. - OTH-12: local recycling of unwanted wood and wood workshop helping unemployed people to get new skills

[2] As reported in Annex 1. one- pagers ‘WP3-Initial information for the selection of relevant biobased solutions’

#	Country (code) & Region	Need code	Regional Needs[2]	Most Relevant Solutions (brief explanation)
4.	Croatia (HR) - Region Adriatic Croatia	HR-1	Promote the diversification of forestry-agricultural activities to improve rural local services through the circular bio-based economy	- MB-B-06 (P4B-01 & MB-C6.1): Blending or mixing of agricultural residues at a regional biohub could be used to produce materials. - MB-B-08 (MB-C8.4, OTH-03 & AFV-01): Mechanical and thermochemical disruption and fractionation for the same reason (biocommodities). - OTH-10: use of hardwood to produce bicycle and fitness frames. - OTH-12: Local recycling of unwanted wood and wood workshop helping unemployed people to get new skills.
5.		HR-2	Encourage the development of new products, services, or industries which can create employment opportunities in rural areas	- MB-B-01 (OTH-01): In this solution compost is produced, which is a product higher on the residue valorisation ladder as landfill and burning. - MB-D-03: A rural biohub will create new employment. - MB-D-04: Reforestation and sustainable forest management are essential to keep the values of the forest. - MB-D-15: Sustainable forest management is essential. - MB-D-16: This solution recovers abandoned forest or rural area through sponsorship, creating job opportunities and attracting tourism.
6.		HR-3	Adopt and utilize new business models and advanced technologies for agroforestry systems to increase productivity, efficiency and overall competitiveness	- MB-B-10 (OTH-05): A small-scale combustion installation will enable the region to generate a local bioenergy supply based on forestry residues. - MB-B-11 (MB-C11.1): Gasification of woody residues could be an option. - MB-B-13 (BR-01): From forestry residues the pyrolysis process will produce i) pyrolysis oil that can be sold as an intermediate product to biofuel production sites (e.g., SAF) and ii) char that can be used for soil improvement locally. - MB-B-14 (MB-C12.1): Torrefaction of forestry residues will produce pellets that can either be used locally or sold (inter)nationally. - MB-B-08 (AFV-01): Biofilters from tree bark chips could also be an option to utilize the forestry residues. - MB-D-10: Fish cultivation in combination with wood industry could be an option. - OTH-11: The collective investment to boost productivity and modernize agro-forestry can be done sharing resources.
7.	Czechia (CZ) - Region Moravian-Silesian	CZ-1	Creating job opportunities for young people in bioeconomy (e.g., small medium enterprise to use of agricultural residues, use of biomass as heating source)	- MB-B-08 (MB-C8.6): Conversion of agricultural residues to produce pellets for heat production. - MB-B-10 (OTH-05): Small scale combustion of dry solid biomass into renewable heat and power using lower grade wood and agri-residues. - MB-D-03: A Rural HUB connecting individuals and organizations with traditional farmers through an educational and co-working program in rural areas.

#	Country (code) & Region	Need code	Regional Needs[2]	Most Relevant Solutions (brief explanation)
8.		CZ-2	Revitalization of contaminated sites (brownfields from coal mining and steel industry) through bioeconomy	- OTH-07: Use of perennial plants to extract nickel, produce energy and valorise metal recovered from the ashes in the steel industry. - OTH-08: Revitalize areas with small-medium concentration of contaminant. Harvested contaminated biomass can be used to produce biofuels using MB-B-13 technology.
9.		CZ-3	Develop bio-based solutions that stimulate the circular economy of agricultural residues (cereals, wheat straw, oil crops, sugar beet)	- MB-B-02 (MB-C2.3): Anaerobic digestion can also use sugar beet by-products (sugar beet pulp) to produce biogas. More specific examples con be found at [3] - MB-B-05(MB-C5.1): Use of residues like straw to promote circular economy and generate different products (food-mushrooms, energy). - MB-B-13 (BR-01): Use of crops residues to produce bio-combustible gas, bio-oil and biochar. - MB-B-08(OTH-02): Use of cereal straw to produce insulation material. - MB-B-08 (BPM-01): Use of cereals by-products (wheat brand) to produce materials.
10.		CZ-4	Modern technologies for clean bioenergy production and biofuel production to reduce coal and gas consumption	- MB-B-02 (MB-C2.3): Conversion of agri-food residues via anaerobic digestion to produce electricity and fertilizers. - MB-B-13 (BR-01): Use of residual materials from crops or other lignocellulosic material to produce gas (heat), pyrolysis oil (fuel) and biochar (soil improver). - MB-B-14 (MB-C12.1): Use of diverse type of biomass to produce a coallike material that can be used locally but also exported to produce bioenergy.
11.	Germany (DE) - Region of Baden-Württemberg	DE-1	Motivate young people not engaged in education, employment, or training (NEET) aged 16 to 24 to participate in the develop CBE in the region.	- MB-D-3: This rural hub connects people with farmers, which may result in motivating young people. - MB-D-17: An organisation that promotes sustainability among young people. - CL-03: 3D printing could be a suitable and attractive technology for young people. - CL-04: This contest motivates people and start-ups to develop the circular biobased economy. - OTH-10: use of hardwood to produce bicycle and fitness frames. - OTH-12: social innovation to locally recycling of unwanted wood and wood workshop helping unemployed people to get new skills in different fields.
12.		DE-2	Inspire young people towards Urban circular biobased solutions (urban farming-gardening)	- OTH-06: Conversion of grass clipping to biobased insulation materials. - MB-D-02: Marketing of organic food and eco-products/services. - MB-D-13: Establishing an Ecovillage, an educational community partnership. - MB-D-19: Community-based project showing an urban circular solution. - Cl-01: Local bokashi production. - CL-04: Young people may be triggered by a contest towards setting up a circular biobased company. - CL-08: Certification of green spaces invites people towards urban gardening.

[3] Anaerobic Digestion at Bury St Edmunds | Case study (britishsugar.co.uk), Green energy | Cosun Beet Company

#	Country (code) & Region	Need code	Regional Needs[2]	Most Relevant Solutions (brief explanation)
				- OTH-09: Vertical Garden in urban areas.
13.		DE-3	Overview of Urban innovative business models for young people	- See DE-2.
14.	Greece (GR) - Region Western Macedonia	GR-1	Develop bio-based solutions that stimulate the circular economy of wood with low commercial value by repairing, reusing, reprocessing and repurposing of wood products	- MB-B-06 (P4B-01 & MB-C6.1): Blending or mixing of wood with low commercial value at a regional biohub could be used to produce materials. - MB-B-08 (MB-C8.4, OTH-03 & AFV-01): Mechanical and thermochemical disruption and fractionation for the same reason (biocommodities). - MB-B-10 (OTH-05): A small-scale combustion installation will enable the region to generate a local bioenergy supply based on woody residues. - MB-B-11 (MB-C11.1): Gasification of woody residues could be an option. - MB-B-13 (BR-01): From woody residues the pyrolysis process will produce i) pyrolysis oil that can be sold as an intermediate product to biofuel production sites (e.g., SAF) and ii) char that can be used for soil improvement locally. - MB-B-14 (MB-C12.1): Torrefaction of woody residues will produce pellets that can either be used locally or sold (inter)nationally. - OTH-12: Local recycling of unwanted wood and wood workshop helping unemployed people to get new skills.
15.		GR-2	Design operational schemes like a community workshop or fabrication lab where marginal groups find opportunities	- MB-D-03: A rural biohub will create new employment. - MB-D-13: An educational community partnership can support marginal groups. - CL-03: Local production and use of biodegradable biobased filament 3D printing. - CL-07: A contest can be focussed specifically to regional needs. - OTH-12: Local recycling of unwanted wood and wood workshop helping unemployed people to get new skills.
16.	Hungary (HU) - North Hungary	HU-1	Address energy poverty condition for rural population	*All of the solutions mentioned here below may be implemented at relatively small scale.* - MB-B-02: Anaerobic digestion to convert organic biomass into biogas for heating and potentially power+heat. In combination with encouraging people to separate well digestible organic residue streams (CL-07 and CL-09). - MB-B-10 (OTH-05): Combustion of dry solid biomass into heat and potentially power and heat. - MB-D-12: Municipal anaerobic digestion of food residue into biogas (and fertilizer). - MB-B-13 (BR-01): Mobile pyrolysis unit to convert biomass into combustible gas, bio-oil and biochar. - OTH-03: Pressing woody biomass into pellets or briquettes for easy feeding and proper incineration.
17.		HU-2	Valorisation of side streams and by-products from forestry	- MB-B-06: Blending or mixing of forestry residues at a regional biohub could be used to produce biocommodities, an intermediate product.

#	Country (code) & Region	Need code	Regional Needs[2]	Most Relevant Solutions (brief explanation)
				- MB-B-07: Extraction & separation for the valorisation of extractives from wood taking as example olive tree (biocommodities). - MB-B-08 (MB-C8.4; MB-C8.6): Mechanical and thermochemical disruption and fractionation, followed by production off energy pellets. - MB-B-08 (AFV-01): Converting tree bark into biofilter chips to extract odorous and toxic compounds from industrial air streams or to prevent N and P to reach ditches and keep waterways healthy; example in Hungary and other countries. - MB-B-08 (OTH-03): Pressing woody biomass into pellets or briquettes for easy feeding and proper incineration. - MB-B-10 (OTH-05): Combustion of dry solid biomass into heat and potentially power+heat. - MB-B-11(MB-C11.1): Gasification to convert dry biomass into combustible gas for energy or into syngas for further conversion into e.g. transportation fuels and chemicals. - MB-B-14 (MB-C12.1): Torrefaction is a thermal process to convert biomass into coal-like material with high energy density and hydrophobic character; thus reducing transportation and storage costs. - MB-B-13(BR-01): Mobile pyrolysis unit to convert biomass into combustible gas, bio-oil and biochar. A further solution may be considered, not being a small scale, solution, yet potentially feasible when targeting the market of the entire country: Typically, residues of forestry sector are used for making particle board and MDF. Conventional scale is up to 500,000 m^3/annum and more. For dedicated purposes, a smaller production scale could be feasible.
18.		HU-3	Small scale farming & other bioeconomy solutions to revitalize local communities	- MB-B-02: Anaerobic digestion to convert organic biomass into biogas for heating and potentially power+heating. Multiple farmers and also citizens may collaborate in separating and collecting well digestible organic residue streams (CL-07 and CL-09). - MB-B-04: Insect-based bioconversion (insect farming) of (perishable) organic residue streams into e.g. Black Soldier Fly (BSF) larvae, house fly maggots, mealworms, and grasshoppers-crickets to produce e.g. protein rich feed. - MB-B-05 (MB-C5.1): The production of mushrooms on organic residues such as cereal straw. - MB-D-01: Cooperative to empower farmers by promoting technical and technological sovereignty through an open source platform for farm production tools: resources, videos, trainings, and knowledge exchange sessions. - MB-D-02: Cooperative network between different actors involved in the production, processing, and marketing of organic food and eco-products/services; example project. - MB-D-03: A Rural HUB connecting socially responsible individuals and organizations with traditional farmers through an educational complex and co-working space, offering comprehensive programs for sustainable farm development in rural areas.

#	Country (code) & Region	Need code	Regional Needs[2]	Most Relevant Solutions (brief explanation)
				- MB-D-05: Farm being a partnership between its owner/employees and a group of around 300 consumers ('harvest sharers') who collaboratively work together through an association; example from Lower Austria. - MB-D-07: Intergenerational collaboration to promote sustainable farming by transferring knowledge; example project. - MB-D-11: Closed-cycle system for symbiosis of tomato and fish farming: resource and energy efficient, reducing water consumption, (food) residue disposal, while increasing produce; Agtira example.
19.		HU-4	Solution to promote the use of abandoned & underutilized land	- MB-D-04: Reforestation and sustainable forest management to address deforestation and local development; an innovative example of non-wood forest products from the biggest laurel forest in Lebanon; example project. - MB-D-08: Community-supported agroforestry to regenerate degraded farmland, adopting the 'syntropic' model of agriculture that mimics nature's patterns for a diverse and resilient ecosystems; Mazi is an example project in Mediterranean area. - MB-D-15: Promotion of sustainable forest management practices; Planeta Mandera example in Spain. - MB-D-16: Recovering the abandoned olive grove, through sponsorship to preserve the biodiversity of the area while generating a sustainable and social economy for the people in Oliete so that they can survive in the long-term.OTH-06 grass clippings to materials - For outlets/applications of reforestation yield, also see HU-2.
20.	Italy (IT) - Campania	IT-1	Creating opportunities for agro-forestry workers & livestock farmers (young generations, in particular women)	- MB-B-06 (P4B-01): Blending or mixing of forestry residues at a regional biohub could be used to produce biocommodities, an intermediate product. - MB-B-07 (MB-C7.1): Extraction & separation to produce biocommodities, an intermediate product. - MB-B-08 (AFV-01, OTH-02): Mechanical and thermochemical disruption and fractionation to produce biocommodities, an intermediate product. - MB-B-10: small scale combustion of dry solid biomass into heat and potentially power and heat. - MB-D-03: A Rural HUB connecting individuals and organizations with traditional farmers through an educational and co-working programs for sustainable farm development in rural areas. - MB-D-04: Reforestation and sustainable forest management to address deforestation and local development; an innovative example of non-wood forest products from the biggest laurel forest in Lebanon; example project. - MB-D-17: Promoting sustainability, food culture and health among children and young people.

#	Country (code) & Region	Need code	Regional Needs[2]	Most Relevant Solutions (brief explanation)
				- OTH-02: Using milled (cereal) straw to insulate buildings by blowing in dry wall and roof cavities. - OTH-03: Pressing woody biomass into pellets or briquettes for easy feeding and proper incineration.
21.		IT-2	Agroforestry services to combat abandonment of agricultural land	- See all solutions at HU-4.
22.		IT-3	Valorisation of by-products from cheese production (whey, manure)	- MB-B-02 (MB-C2.8): Anaerobic digestion of dairy industry residue (whey permeate) into ethanol and biogas. - MB-B-02: Anaerobic digestion to convert manure (and other organic biomass) into biogas for heating and potentially power+heat. Multiple farmers and also citizens may collaborate in separating and collecting well digestible organic residue streams (CL-07 and CL-09). Additional examples can be found at [4]
23.		IT-4	Create awareness about circular bioeconomy to exploit local resources	- MB-D-01: Cooperative to empower farmers by promoting technical and technological sovereignty through an open source platform for farm production tools: resources, videos, trainings, and knowledge exchange sessions. - MB-D-02: Cooperative network between different actors involved in the production, processing, and marketing of organic food and eco-products/services. - MB-D-03: A Rural HUB connecting individuals and organizations with traditional farmers through an educational and co-working programs for sustainable farm development in rural areas. - MB-D-05: Farm being a partnership between its owner/employees and a group of around 300 consumers ('harvest sharers') who collaboratively work together through an association; example from Lower Austria - MB-D-13: An educational community partnership; Cloughjordan ecovillage (IE) example project. - MB-D-17: Promoting sustainability, food culture and health among children and young people; Haver til Maver (DK) example initiative. - CL-04: Contest to invite (young) people to come up with ideas and help them to start a company; Porto (PT) example project.
24.	Netherlands (NL) - Apeldoorn	NL-1	Improving the kitchen garden concept, aimed at helping people with social and	- MB-D-01: An open-source network for farm production tools. - MB-D-02: Development of a cooperative network.

[4] Conversion of discarded milk into casein textile fibres, Q-Milk (Germany), www.qmilkfiber.eu , High protein level drink from milk whey, by Meotis (Romania), page 47-48 of https://be-rural.eu/wp-content/uploads/2019/10/BE-Rural_D2.1_Small-scale_technology_options.pdf

#	Country (code) & Region	Need code	Regional Needs[2]	Most Relevant Solutions (brief explanation)
			addiction problems, to become more resilient and completely biobased.	- MB-D-13: Setting up an ecovillage emphasizing community engagement. - CL-06: A kitchen garden concept combined with day care. - OTH-09: Setup of Urban vertical farms.
25.		NL-2	Establishing the farmer to biobased building materials concept	- MB-C8.1(P4B-01): The production of building materials by profile extrusion of hemp containing materials. - MB-B-08 (OTH-02): Mechanical preparation of (farm-) residues towards building materials. - MB-B-09 (MB-C9.1): Mechanical preparation of (farm-) residues towards materials. - OTH-06: Production of grass-based insulation products
26.		NL-3	Establishing the biobased crops for energy and heating concept	- MB-B-10: Combustion results in electricity and heat. - MB-B-11: Gasification includes producing energy and heat. - MB-D-01: An open-source platform with information about farm production tools sill help establishing this concept. - MB-B-13 (BR-01): Pyrolysis will result in heat. - OTH-03: Producing pellets and briquettes from energy crops, a necessary step to transport crops for energy and heating over long distances.
27.	Romania (RO) - Western Romania & Transilvania	RO-1	Support local communities to stop or improve food cultivation in contaminated areas close to brownfields (chemical-energy producing industries). Safe cultivation of local food.	- MB-D-02: Social innovation project to develop a cooperative network involved in the production, processing, and marketing of organic food and eco-products/services. - MB-D-07: Promotion of traditional organic farming to promote sustainable farming by transferring knowledge to younger unemployed generations. - OTH-09: The concept of vertical garden can be used to produce safe food in contaminated areas.
28.		RO-2	Create biobased jobs to prevent migration of young generations (e.g. energy production using energy crops or uses for residues from agriculture, forestry and food industry)	- MB-B-08 (MB-C8.6): Using agricultural to produce pellets for multiple applications (energy, cattle bedding) by mechanical disruption. - MB-B-08 (OTH-03): Use of forestry and agricultural residues to produce pellets for energy and cattle bedding. - MB-B-14: This technology uses biomass to produce a coallike material to produce bioenergy. - MB-D-07:Intergenerational collaboration to promote sustainable farming by transferring knowledge to younger unemployed generations. - MB-B-13(BR-01): Use of residual materials from crops or other lignocellulosic material to produce gas (heat), pyrolysis oil (fuel) and biochar (soil improver).
29.		RO-3	Revitalization of contaminated soils (metallurgy, mining and coal power plants) connecting with bioeconomy	- OTH-07: Use of perennial plants are used to extract nickel, produce energy and valorise metal recovered from the ashes in the steel industry. - OTH-08: Revitalize areas with small-medium concentration of contaminant. Harvested contaminated biomass can be used to produce biofuels using MB-B-13 technology.

#	Country (code) & Region	Need code	Regional Needs[2]	Most Relevant Solutions (brief explanation)
30.	Slovakia (SK) - Nitra Region	SK-1	Local food processing (of locally cultivated crops)	Potential solutions are mature and common practice. For this reason, they were not included in previous projects like Power4Bio, MainstreamBIO, etc. Examples of established solutions have been listed at [5]. Some potential solutions identified are: - MB-B-08(OTH-04): Relative recent technology to dehydrate food, preserving native functionality and high nutritional value, the technology can be applied to a wide range of agrifood products like fruits, vegetables, and grains. - MB-D-02: Development of a cooperative network between different actors involved in the production, processing, and marketing of organic food and eco-products/services in Poland. - MB-D-05: The Demeter farm is a partnership between employees and a group of around 300 consumers who collaboratively work together through an association; example from Lower Austria.
31.		SK-2	Local processing of residues from households (food), farms and forestry	*Many of the solutions mentioned here below may be implemented at relatively small scale. Forces can be joined e.g. in the form of a collaborative*. - MB-B-02 (MB-C2.2): Anaerobic digestion to convert organic biomass into biogas for heating and potentially power+heat. Multiple farmers and also citizens may collaborate in separating and collecting well digestible organic residue streams (CL-07 and CL-09). - MB-B-03 (MB-C3.1): Beer production from unsold bread. - MB-B-05 (MB-C5.1): Production of mushrooms on organic residues such as cereal straw. - MB-B-08 (AFV-01): Converting tree bark into biofilter chips to extract odorous and toxic compounds from industrial air streams or to prevent N and P to reach ditches and keep waterways healthy; example in Hungary and other countries. - MB-B-08 (OTH-02): Using milled (cereal) straw to insulate buildings by blowing in dry wall and roof cavities and OTH-03: Pressing woody biomass into pellets or briquettes for easy feeding and proper incineration. - MB-B-10 (OTH-05): Combustion of dry solid biomass into heat and potentially power+heat. - MB-B-11 (MB-C11.1): Gasification to convert dry biomass into combustible gas for energy or into syngas for further conversion into e.g. transportation fuels and chemicals. - MB-B-13(BR-01): Mobile pyrolysis unit to convert biomass into combustible gas, bio-oil and biochar.

[5] Aviko (potatoes), https://www.avikofoodservice.com/, Cosun (sugar beets), https://www.cosunbeetcompany.com/, Südzucker (sugar beets, potatoes, corn, wheat), https://www.suedzuckergroup.com/en, Südzucker Polska (sugar beets), https://www.suedzucker.pl/en/, Agrana ((sugar beets, potatoes, corn, wheat), https://www.agrana.com/en/, Koopmans (cereals), https://www.royalkoopmans.com/en, Limagrain (cereals), https://www.limagrain.com/en/agri-food-chains

#	Country (code) & Region	Need code	Regional Needs[2]	Most Relevant Solutions (brief explanation)
				- MB-D-11: Closed-cycle system for symbiosis of tomato and fish farming: resource and energy efficient, reducing water consumption, (food) residue disposal, while increasing produce; Agtira example. - MB-D-12: Municipal anaerobic digestion of food residue into biogas (and fertilizer).
32.		SK-3	Increasing productivity of small farmers through mechanisation (technification)	- MB-D-01: A cooperative aiming to empower farmer by promoting technical and technological sovereignty through an open source resource platform for farm processing tools. - MB-D-06: A cooperative aiming to professionalize agriculture and facilitate regional organisation of farmers. - OTH-11: Farmers cooperatives for the collective investment and joint use of machinery, building, workers for tasks directly linked to production cycles. Effectively introduce mechanisation for small scale farmers may involve actual combination of small plots to large plots in order to efficiently use (large) mechanisation equipment.
33.	Slovenia (SL) - Whole country	SL-1	Valorisation of agricultural value chains including residues (vegetables, straw, corn steams, oil crops, green cuttings from vine and fruit plants)	- MB-B-02 (MB-C2.3): Conversion of agricultural residues to produce gas and bioethanol. - MB-B-08, (MB-C8.1, OTH-03, C 8.6,BMP-01, AFV-01, OTH-02): Use of grass and agricultural residue to produce materials and/or energy carriers. - MB-B-09(MB-C.9.1): Use of fibrous agricultural residues to produce materials. - CL-02: Valorisation of local grass for the production of paper. - OTH-06: Use of grass clipping to produce biobased insulation materials.
34.		SL-2	Valorisation of forestry value chains including residues (efficient energy production, increase hardwood potential, develop of new construction materials, good forestry management practices)	- MB-B-08(AFV-01): Use of lignocellulosic biomass to produce biofilters. - MB-B-08(OTH-03): Production of pellets, briquettes, chipped firewood, dry wood chips from low-quality wood and wood residues. - MB-B-13 (BR-01): Use of forestry residues to produce pyrolysis oil (an intermediate product to large-scale biofuel production sites and char used for soil improvement locally. - MB-D-15: Promoting sustainable forest management, disseminates information of utilizing forest resources in a sustainable manner and encourages the implementation of practices.
35.		SL-3	Promote circular use of wood and discarded wood products	- MB-B-08(MB-C8.4): Use of wood residues to produce pellets for energy applications - MB-B-08(OTH-3): Production of pellets, briquettes, chipped firewood, dry wood chips from low-quality wood and wood residues - MB-B-08(AFV-01): Use of lignocellulosic biomass to produce biofilters. - MB-B-10 (OTH-05): Combustion of low-grade woody biomass into power and heat. - OTH-10: Use of hardwood to produce bicycle and fitness frames. - OTH-12: Recycling unwanted wood from local construction sites.
36.		SL-4	Valorisation of side-streams and residues in processing sectors e.g. dairy and brewing industries.	- MB-B-02 (C2.8): Conversion of dairy industry residues (whey) to produce bioethanol and biogas via anaerobic digestion. - MB-B-03 (C3.1): Fermentation of unused bread to produce beer.

#	Country (code) & Region	Need code	Regional Needs[2]	Most Relevant Solutions (brief explanation)
				- MB-B-08(BPM-01): Use of cereals processing byproducts in the production of materials.
37.		SL-5	Implementation of lignocellulosic biorefineries	- MB-B-11(C11.1): Use of wood residue to produce renewable hydrogen by gasification.
38.	Spain (ES) - Region Aragon	ES-1	Create new biobased jobs in rural areas to avoid migration to cities and therefore depopulation	- MB-D-16: Initiative that recovers abandoned olive trees in Oliete, Teruel through sponsorship, creating job opportunities and attracting tourism.
39.		ES-2	Valorisation of residues and by-products from the primary sector (cereals, fruits, vineyards)	- MB-B-02 (MB-C2.2 & MB-C2.3): Agricultural residues can be (co)digested anaerobically to produce electricity & heat for a local market. - MB-B-03 (MB-C3.1): Agricultural residues can be a feedstock for fermentation. - MB-B-07 (MB-C7.1 & MB-C7.2): The extraction of valuable components could be an option. - MB-B-08 (MB-C8.6, OTH-02): The production of pellets using agricultural residues through mechanical and thermochemical disruption could be an option. - MB-B-08 (BPM-01): The use of cereals' byproducts in the production of bio-materials. - OTH-02: Straw can be used as insulation material.
40.		ES-3	Develop bio-based initiatives in rural areas to modernize the primary sector, to foster socio-economic development and to include socially disadvantaged groups	- MB-D-01: The cooperative approach can empower farmers to modernize their company. - MB-D-06: A Network Care Farming can support farmers. - MB-D-08: Regeneration of degraded farmland might be necessary. - OTH-11: Farmers cooperatives for the collective investment and joint use of machinery, building, workers for tasks directly linked to production cycles.

In Table 8 and Table 9, the identified solutions for the different BIOLOC regions are summarize. An "X" indicates that the solution matches at least one of the need of the region . The symbol "-" indicates that the solution does not match the needs of the region.

TABLE 8.MATCHING TABLE OF REGIONS WITH TECHNICAL BIOBASED SOLUTIONS.

	Solution source Code	Bulgaria	Croatia	Czech Republic	Germany	Greece	Hungary	Italy	The Netherlands	Romania	Slovakia	Slovenia	Spain
	MB-B-01	X	X	-	-	-	-	-	-	-	-	-	-
1.	OTH-01	X	X	-	-	-	-	-	-	-	-	-	-
	MB-B-02	X	-	X	-	-	X	-	-	-	X	X	X
2.	MB-C2.2	X	-		-	-	X	X	-	-	X	-	X
3.	MB-C2.3	X	-	X	-	-	X	-	-	-	-	-	X
4.	MB-C2.8	-	-	-	-	-	-	X	-	-	-	X	-
	MB-B-03	-	-	X	-	-	-	-	-	-	X	X	X
5.	MB-C3.1	-	-	-	-	-	-	-	-	-	X	X	X
	MB-B-04	X	-	-	-	-	X	-	-	-	-	-	X
6.	MB-C4.1	X	-	-	-	-	X	-	-	-	X	-	X
	MB-B-05	X	-	X	-	-	X	-	-	-	X	-	X
7.	MB-C5.1	X	-	X	-	-	X	-	-	-	X	-	X
	MB-B-06	-	X	-	-	X	X	X	X	-	-	-	-
8.	(P4B-01)	-	X	-	-	X	X	X	X	-	-	-	-
	MB-B-07	X	-	-	-	X	X	X	-	-	-	-	X
9.	MB-C7.1	-	-	-	-	-	-	X	-	-	-	-	X
10.	MB-C7.2	X	-	-	-	-	-	-	-	-	-	-	X
	MB-B-08	-	X	X	-	X	X	X	X	X	X	X	X
11.	MB-C8.1 (P4B-02)	-	-	-	-	-	-	-	-	-	-	X	-
12.	MB-C8.4	-	X	-	-	X	X	-	-	-	-	X	-
13.	MB-C8.6	-	-	X	-	-	X	-	-	X	-	X	X
14.	OTH-03	-	X	-	-	X	X	-	X	X	-	X	-
15.	BPM-01	-	-	X	-	-		-	-	-	-	X	X
16.	AFV-01	-	X	-	-	X	X	X	-	-	X	X	-
17.	OTH-02	-	-	X	-	-	X	X	X	-	X	X	X
18.	OTH-04	-	-	-	-	-	-	-	-	-	X	-	-
	MB-B-09	-	-	-	-	-	-	-	X	-	-	X	-
19.	MB-C9.1	-	-	-	-	-	-	-	X	-	-	X	-
	MB-B-10	-	X	X	-	X	X	X	X	-	X	X	-
20.	OTH-05	-	X	X	-	X	X	X	X	-	X	X	-
	MB-B-11	-	X	-	-	X	X	-	X	-	X	X	-
21.	MB-C11.1	-	X	-	-	X	X	-	X	-	X	X	-
	MB-B-13	X	X	X	-	X	X	-	X	X	X	X	-
22.	BR-01	X	X	X	-	X	X	-	X	X	X	X	-
	MB-B-14	-	X	X	-	X	X	-	-	X	-	-	-
23.	MB-C12.1	-	X	X	-	X	X	-	-	X	-	-	-
24.	OTH-06	-	-	-	X	-	X	X	X		-	X	-
25.	OTH-07	-	-	X	-	-	-	-	-	X	-	-	-
26.	OTH-08	-	-	X	-	-	-	-	-	X	-	-	-

TABLE 9.MATCHING TABLE OF REGIONS WITH BIOBASED SOCIAL INNOVATIONS.

	Solution source Code	Bulgaria	Croatia	Czech Republic	Germany	Greece	Hungary	Italy	The Netherlands	Romania	Slovakia	Slovenia	Spain
27.	MB-D-01	-	-	-	-	-	X	X	X	-	X	-	X
28.	MB-D-02	-	-	-	X	-	X	X	X	X	X	-	-
29.	MB-D-03	X	X	-	X	X	X	X	-	-	-	-	-
30.	MB-D-04	-	X	-	-	-	X	X	-	-	-	-	-
31.	MB-D-05	X	-	-		-	X	X	-	-	-	-	-
32.	MB-D-06	-	-	-	-	-	-	-	-	-	-	-	X
33.	MB-D-07	X	-	-	-	-	X	-	-	X	-	-	-
34.	MB-D-08	X	-	X		-	X	X	-	-	-	-	X
35.	MB-D-10	-	X	-	-	-	-	-	-	-	-	-	-
36.	MB-D-11	-	-	-	-	-	X	-	-	-	X	-	-
37.	MB-D-12	X	-	-	-	-	X	-	-	-	X	-	-
38.	MB-D-13	X	-	-	X	X	-	X	X	-	-	-	-
39.	MB-D-14	X	-	-	-	-	-	-	-	-	-	-	-
40.	MB-D-15	-	X	-	-	-	X	X	-	-	-	X	-
41.	MB-D-16	-	X	-	-	-	X	X	-	-	-	-	-
42.	MB-D-17	X	-	-	X	-	-	X	-	-	-	-	-
43.	MB-D-18	-	-	-		-	-	-	-	-	-	-	-
44.	MB-D-19	X	-	X	X	-	-	-	-	-	-	-	-
45.	CL-01	X	-	-	X	-	-	-	-	-	-	-	-
46.	CL-02	-	-	-	-	-	-	-	-	-	-	X	-
47.	CL-03	-	-	-	-	X	-	-	-	-	-	-	-
48.	CL-04	X	-	-	X	X	-	X	-	-	-	-	-
49.	CL-05	X	-	-	-	-	-	-	-	-	-	-	-
50.	CL-06	X	-	-	-	-	-	-	X	X	-	-	-
51.	CL-07	X	-	-	-	-	X	-	-	-	-	-	-
52.	CL-08	X	-	-	X	-	-	-	-	-	-	-	-
53.	CL-09	X	-	-	-	-	X	-	-	-	-	-	-
54.	OTH-09	-	-	-	X	-	-		X	X	--	-	-
55.	OTH-10	-	X	-	X	-	-	-	-	-	-	X	-
56.	OTH-11	-	-	-		-	-	-	X	-	X	-	-
57.	OTH-12	X	X	-	X	X	-	-	-	-	-	X	-

4. Conclusions

The biobased solutions catalogue serves as a resource for the 12 BIOLOC regions to visualize the current landscape of biobased innovations in Europe. These solutions may address some of their local needs and inspire individuals such as potential entrepreneurs and communities to initiate their own innovative projects. It is good to know that examples of biobased solutions exist and that they are empowering people in other regions. Additionally, the biobased solutions catalogue aims to facilitate networking and collaboration among social innovators, researchers, practitioners, and policymakers. It does this by facilitating the connection of individuals and organizations with similar interests or complementary expertise to tackle social challenges and barriers that hinder the deployment of bio-based value chains in the region.

The biobased solutions catalogue showcases a wide range of biobased solutions (technical solutions and social innovations) across various industries and sectors, highlighting the diversity and versatility of biobased technologies and products. Many of the listed solutions offer significant environmental benefits, such as reducing carbon footprint, lessening dependence on finite resources, minimizing pollution, and promoting circular economy principles. The catalogue also reveals opportunities associated with biobased solutions, including job creation, innovation in renewable resources and social implications. Additionally, it contributes to raising awareness among local communities regarding how biobased solutions can improve community resilience and integration, health outcome, education and enhanced access to sustainable products and technologies.

While analysing the biobased solutions catalogue, it becomes apparent that certain gaps or challenges still exist in the adoption and implementation of biobased solutions. These may include technological limitations, regulatory hurdles, or market barriers that require attention. For instance, there are opportunities for developing solutions that utilize contaminated biomass containing heavy metals, which could spur innovation in the biobased market or lead to the creation of new business models.

Furthermore, the analysis of the catalogue might reveal emerging consumer preferences and trends in biobased products and technologies. However, it is essential to recognize that the catalogue mainly serves as an informative and inspirational tool. Not every solution will perfectly match the specific needs of each region, and various political, economic, and cultural factors may affect the replicability of these solutions in different regions. Therefore, a nuanced approach is necessary when considering the applicability of the described biobased innovations in different contexts.

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Annex 1. WP3 Initial information to start search of relevant biobased solutions for the BIOLOC regions

Bulgaria

Region: Region of Plovdiv, rural municipalities of Brezovo and Rakovski.
Marginal group to be supported: Local minorities, including unemployed people and or people with low education background.

Description of priorities-needs to be cover by WP3:
This region will focus on the following areas: the sustainable processing and valorisation of agricultural residues from the regional agri-food chains (e.g. winery industry, aromatic plant oil industry, food processing, animal manure and waste, etc.) into added-value products and biobased solutions for soil improvement thus addressing the soil contamination caused by the excessive applications of pesticides and fertilizers in the area.

Additionally, the region is looking for solutions for the recycling of PET as the current recycling scheme is not working properly because the incentive given to the population is not attractive enough (0.1 euro per 10 PET bottles). Policy makers and companies involved in the recycling value chain of PET need to create more attractive recycling schemes in the region.

The target population group in this region has shown lack of motivation and involvement towards bioeconomy and recycling topics. It is cause mainly by the limited knowledge and understanding of the importance of the regional environment and sustainability. Therefore, informative campaigns and Vocational Education and Training (VET) are required in collaboration between academia (Agricultural University Plovdiv) with the Local Action Groups (LAGs) and the municipality management.

Croatia

Region: Adriatic Croatia (Primorje-Gorski Kotar County)
Marginal group to be supported: Students and young people interested in the wood sector

Description of priorities-needs to be cover by WP3:
During the BIOLOC project, Croatia will focus on practical biobased solutions to improve rural local services through circular biobased economy. This will be done by promoting the diversification of forestry-agricultural activities and by encouraging the development of new products, services, or industries which can also create employment opportunities in rural areas. Croatia's approach includes the valorisation of resources, raw materials from forestry which mainly consist of saw log and wood pulp, followed by other forestry extractions and forestry residues and by-products to produce renewable energy and other added value products.

Additionally, Croatia is looking for the increase of productivity and competitiveness in agriculture and forestry through the adoption and utilization of new business models and advanced technologies for agroforestry systems to increase productivity, efficiency, and overall competitiveness. Therefore, knowledge on the financial aspects and the participation of the different stakeholders of existing biobased solutions is needed to visualize and support the transition and implementation of sustainable practices. The rural population lacks adequate knowledge and skills to initiate the pre-development stage and expert assistance is required to navigate the process of initiating a project and accessing subsidies.

Czech Republic

Region: Northeast region (Moravian-Silesian Region)
Marginal group to be supported: Young unemployed people (under 44 years), looking for a job.

Description of priorities-needs to be cover by WP3:

The Moravian-Silesian Region is in the northeast area of Czech Republic and borders with Poland and Slovakia. This is an industrial region dependent on large, traditional companies in the fields of metallurgy, mining and engineering. The decline of these industries and the outflow of talented young people causes a decrease of inhabitants by an average of 5000-10000 per year. Currently, the region is slowly starting to prepare for the transformation of the economy. The Just Transformation Operational Program is a new program (2021-2027) that aims at solving the negative impacts of the shift away from coal in the most affected regions (Karlovy Vary, Moravian-Silesian and Ústí regions). The support aims to enable regions and people to address the social, economic and environmental impacts of the transformation, and achieve the Union's energy and climate goals for 2030 and a climate-neutral Union economy by 2050. A wide range of topics towards Bioeconomy can be supported, such as:

- small and medium enterprises,
- research and innovation,
- digitization,
- clean energy and energy savings,
- circular economy,
- reclamation and new use of land,
- retraining and assistance in finding a job.

The region is looking for a transformation process to deal with the end of coal mining, regenerate brownfiels[1] and to low-carbon economy. There is interested in biobased solutions for the bioremediation and revitalization of contaminated sites that have been heavily polluted by the coal-mining region and heavy industry (e.g. steel plants and other metallurgical production).

Bioeconomy is still not a very well-known term in the Czech Republic. BIOEAST HUB CZ uses the connection of bioeconomy and financial subsidies to convince stakeholders that the bioeconomy concept can be interesting, and that it does not only concern waste management or agriculture, but that it is a broader perspective for the future of the region.

According to the Ministry of Labor and Social Affairs by the end of 2023, unemployment increased and currently there is almost 43,000 unemployed people registered. For young people it is very complicated to find a job. The demand does not correspond to the current vacant positions, which are often only seasonal. The successful transformation process of the Moravian-Silesian Region cannot be done without those who will shape its near and distant future. The main goal is to involve active young people from the region in the discussion. A group of young job seekers is willing to undergo retraining and change their field of employment (or the field they graduated from).

Germany

Region: Region of Baden-Württemberg. (Stuttgart, Karlsruhe, Freiburg, Tübingen)
Marginal group to be supported: Young people (15-25 years) without employment and/or outside educational programs in urban areas (so-called NEETS)

Description of priorities-needs to be cover by WP3:
Baden-Württemberg's primary goal is to recover "valuable raw materials and returning them to the economic cycle" (https://um.baden-wuerttemberg.de/en/topics/bioeconomy). This is due to the fact that we focus in Baden-Württemberg on the industrial and urban areas. At the same time, Baden-Württemberg aims to create and use resource-saving and climate-friendly bio-based alternatives. While these aspects mainly highlight the economic and environmental aspects, especially with regard to the BIOLOC project, the social perspective is very important: Urban areas in the region are looking for circular biobased solutions that inspire and involve the selected marginal group (NEETS) to help them find education, work, or even inspire them to set up their own start-ups that could create new markets for circular biobased products. Biobased solutions applicable to industrial and urban areas, such as urban farming, urban gardening, etc. are of interest in the region.
The main social benefit of the desired solutions is to the creation of training and employment opportunities for the young population (e.g., NEETS) in the circular bioeconomy sector. For Baden-Württemberg, innovative business models and finding the right communication strategy to reach the young population, and especially NEETS, are key, as these groups are not easily accessible and communication via the standard channels most likely will not reach them. Communicating the opportunities could become e.g. part of the training for people that are in contact with the target group.

Greece

Region: Western Macedonia
Marginal group to be supported: Local people abled differently (this can be with mental or physical impairment)

Description of priorities-needs to be cover by WP3:
Western Macedonia has some forestry activities focused on low value products/commodities. Approximately 190.000 m^3 of wood is harvested each year of which 70% is used as firewood. This region is seeking for biobased solutions to stimulate the circular economy of wood with low commercial value by repairing, reusing, reprocessing and repurposing of wood products. This could involve the physical transformation of the material. One suggested idea is to consider an operational scheme such as community workshop or fabrication lab where marginal groups can find opportunities.

A second approach is to explore for more technological solutions. The Region is interested in developing biobased materials for 3D printing to engage young people with higher education or more technical skills in the biobased economy.

Hungary

Region: North Hungary
Marginal group to be supported: Rural population (population under energy poverty condition). [1]

Description of priorities-needs to be cover by WP3:
The North Hungary Region possess the potential of a high developed bio-based sector, especially concerning the traditional forestry sector. Therefore, there is a significant potential of biomass available, and knowledge related to this area. However, there is an unutilized potential based on side streams and by-products valorisation that would be interesting to assess. The region is also looking for biobased solutions that promote the use of abandoned and underutilised lands. The abandonment comes from the relatively low-quality level of the soil; however, it is also due to the elimination of communal farms in the 1990s as well as a massive land concentration and extensive development throughout the region afterwards. The region is also interested in biobased solutions that provide new alternatives for housing heating which is currently provided by natural gas which high price is promoting the use of illegal wood and gardening residue to cover this need.
Activities such as small-scale farming or dedicated energy crops and trees cultivation (such as: willow, sallow, aspen, locust; maize, hemp, etc) could be a good approach to support the local people, generate economic development and enhance employment opportunities in these rural while contributing to European climate and energy objectives.

Italy

Region: Campania (Irpinia, Salerno, Caserta)
Marginal group to be supported: People living in internal areas with unstable development trajectories and demographic problems, but nevertheless endowed with resources and a strong potential. We will focus on agro-forestry workers and livestock farmers.

Description of priorities-needs to be cover by WP3:
This region is focusing on the development of two different biobased value chains. The first one is related to agroforestry services in internal areas to combat the abandonment of agricultural land and production, hence environmental degradation, and to encourage generational change in agriculture by focusing on innovation and sustainability.
The second value chain is related to reuse of by-products and residues (e.g. whey, livestock manure) generated for example during the cheese production (Mozzarella di Bufala) to generate added value products, such as biomethane and contribute to the implementation of biorefinery solutions. The social benefit they are looking for is to increase awareness about the opportunities generated by the circular bioeconomy to exploit all the resources present in the region by involvement of rural populations, more precisely forestry workers and small farmers.

The Netherlands

Region: Municipality Apeldoorn.
Marginal group to be supported: refugees, elderly people, poor people and people with addiction or mental problems.

Description of priorities-needs to be cover by WP3:
The Municipality Apeldoorn is looking for biobased solutions that can contribute to local food production and organic waste management. The main priority of the municipality is to reduce the residual waste per person per year (from 61 to 30kg), close the local cycle of organic residue and to create markets for circular products from organic residue with social inclusiveness.

The information that could be helpful for Apeldoorn can be split into two groups, one based on the selected hub, the other one based on other activities in Apeldoorn concerning bio-based initiatives.
The selected hub “Kitchen Garden Havenpark”

- Examples of the use of bio-based solutions that can be used inside a kitchen garden.
- Options to grow non-food crops and use or sell the products in a kitchen garden. (Bamboo or willow stakes etc.).
- Options to create a financial stable structure around a kitchen garden.
- Examples of initiatives to support marginal groups in a garden/kitchen garden/urban farming -like concept, without focussing on the production of food, but aiming at bio-based.
- Examples of solutions that allow people with physical impairment to work safely in a kitchen garden concept.

Other bio-based initiatives

- Overview of crops that can be grown by farmers and used without too much processing as building materials.
- Overview of dual/multi-purpose crops to combine food/feed and bio-based production.
- New building bio-based materials from crops.
- Financial strategies to support the value chain from farmer towards building materials.
- Strategies to reduce nitrogen emissions from farmers.
- Strategies to reduce energy use in producing bio-based products.
- Examples for using crops/residues to produce heat and energy.

Romania

Region: Western Romanian and Transylvanian peri-urban and rural settlements located in proximity of closed chemical and energy industry
Marginal group to be supported: Local community living in areas contaminated by chemical and fossil energy industry (currently closed), producing crops and vegetables for subsistence or for food trade.

Description of priorities-needs to be cover by WP3:
Polluted regions are looking for circular biobased solutions that use local resources to improve qualities of the soil affected by chemical and fossil energy industries (metallurgy, mining, coal powered power plants) that currently have ceased activities, negatively affecting social life and local economies. These regions became unattractive for young generation, causing high rates of emigration; the soil is contaminated with heavy metals (especially cadmium and lead) and is being used to grow food contaminated with pollutants, which are causing health problems in the local population already affected by economic constrains caused by closed industry. Pollution-affected communities from this area can improve their social, economic and environmental situation (the three pillars of sustainable growth) and safely cultivate crops to produce healthy food if (bio)-remediation of soils is made. These local communities need solutions that connect circular bioeconomy and soil remediation to reduce the negative effects of pollution. It is very important to inform the local community about the safety issues of growing their own food in areas with contaminated soil in the region as there is a general belief that food produced in own garden is safer than the food from the stores.

Slovakia

Region: Nitra Self-Governing Region
Marginal group to be supported: Roma population, small farmers (in rural areas) and increasing number of homeless people (in urban areas).

Description of priorities-needs to be cover by WP3:
Currently, this region has not developed a diverse-strong bioeconomy strategy (only paper and pulp industry are relevant) and has been strongly nesting the automotive industry.
Forest Importance> wood processing
Slovakia imports up to 60% of processed food consumed in the region while exporting important raw materials mostly inside Europe, e. g. wheat, rape and other products such as wheat, barley, grain maize, peas, sugar beet, rape, sunflower and grapes. Therefore, the region is interested in biobased solution related to food processing, food residue and organic residue management from households, farms and forestry that could support the selected marginal groups. Small farmers (in rural areas) are facing problems like low productivity compared to larger producers for this reason there is a need to increase the technification of the current value chains and to suggest new ones.

Slovenia

Region: All, 12 administrative entities
Marginal group to be supported: marginalized youngsters – school dropouts, more difficult to employ, pushed into social exclusion.

Description of priorities-needs to be cover by WP3:
Slovenia is looking for biobased and circular solutions that promote carbon capture and storage in soils and products while strengthening its forestry and agricultural value chains, such as:

- Provide local and sustainable production of energy from agricultural, forestry and organic residue origin biomass.
- Prevention and reduction of waste in different forestry and agricultural value chains.
- Provide added value of side-streams and residues in primary production and in processing sectors e.g. side streams of the food processing industry, e.g. dairy and brewing industries.
- Promote the use of less commonly tree species (increase of hardwood potential) for the development of new timber construction materials (new engineering wood products) applying good forestry management practices.
- Circular use of wood and discarded wood products
- Enhance digitalization and automation of forestry and agricultural value chains.

For the country is important to ensure the right balance between of the use of biomass for energy production and development of new biobased materials and products.
One of the most vital challenges to further expand bio-based industry is the implementation of bio-refining, which is presently lacking.

Spain

Region: Aragon
Marginal group to be supported: Population in rural areas especially women and people over 40 years, who have problems finding jobs seeking to avoid migration to the cities and therefore depopulation. (*Preliminary identification of disadvantaged group*)

Description of priorities-needs to be cover by WP3:
Aragón is characterized by a strong depopulation of rural areas (97% of municipalities have less than 5,000 inhabitants) and significant unemployment rate of 9.4%. Agriculture (cereals, fruits, vineyards) and agroindustry (meat, milk, and their derivatives) are the main rural activities and forestland is growing but is negatively affected by extreme climate events such as drought and fires.
The primary sector is quite relevant in the region, producing a significant volume of residues and by-products, thus, there is high potential for valorising such streams in new bio-based value chains. The main challenges faced at regional level are the rural migration, forest fire prevention and aging of rural population. Moreover, there is not a bioeconomy

strategy in place, but there is a social economy promotion plan and a circularity certification scheme that could set the baseline for promoting bio-based initiatives. Importantly, many industries have established ambitious decarbonisation goals locally and nationally, bringing an interesting opportunity to promote the circular bioeconomy and involve different stakeholders. Finally, the development of bio-based initiatives in rural areas could help the primary sector to modernize their exploitations, foster socio-economic development and help to include socially disadvantaged groups via job creations and knowledge building.

Annex 2. Format catalogue biobased solutions

#. Solution Code-Name of the solution

A. General

Title

Concise description of the innovation, including feedstock, technology/ies and product(s). Acronym between brackets at end, if available.

Location

Country, region

Keywords:

To facilitate finding related innovations with similar aspects. E.g. Urban areas, rural areas, industrial scale.

Example user / provider of technology

Relevant website(s)regarding the users or providers of the technology.

B. Feedstock

Main feedstock

Main feedstock that is converted by the example user of the innovation.

Other potential feedstock

Often technologies can handle a range of feedstocks. Mention if there are several feedstocks that can/could be used.

Required feedstock quality

Technologies may require specific feedstock quality, e.g. achieved by pre-treatment.

Feedstock source, price, trade spot and location

General information on feedstocks' origin (imported or produced locally) and price (if available) to facilitate translation of useful cost-benefit data from elsewhere to own situation.

C. Technology

Technology Name

To facilitate quick discrimination of technology applied.

TRL

TRL scale of the solution from 1 (the basic principles are documented) to 9 (the technology is released, and industrial production is started).

Description of Technology

Short description of the main applied technology/ies in short but full sentences. Attention for the following topics:

- Process steps (conversion processes: Biochemical, Chemical, Mechanical and thermomechanical, thermochemical. E.g. milling, hydrolysis, fermentation, purification), the conditions (temperature, time, additives needed), what is converted into what, conversion yields and purity.
- Feedstock flexibility: Elaboration on which type of feedstocks may be used and their limitations.
- For which applications and sectors can they be used.
- Innovativeness: Including patents filed or granted

Capacity

Feedstock input and product output, in ton/annum, at given dry matter content.

Investment and Operational Costs

Give an indication of capital Investment and/or operational cost. By proving these information is relevant to make a quick assessment for potentially interested stakeholders, entrepreneurs/investors.

D. Product(s)

Product Name(s)

List main products and side products and its application/purpose. Eventually also indicate residual streams which need to be disposed.

Price, trade spot and location

To facilitate translation of useful cost-benefit data from elsewhere to own situation.

E. Environmental Impact

Environmental Benefits

Indicate quantitative or qualitative benefits e.g. impact to the ecosystems (e.g. promote sustainable forest management, protection to biodiversity, sustainable use of resources), contribution to the reduction of GHG emissions, substitution of fossil based raw materials or fossil based products, promote good air quality.

F. Financial Aspects

Financial Support

Provide info on the type of funding or public support for establishing the solution. For example: Private investment, self-investment of agricultural cooperative, tax reduction during first some years, loan for 50% of investment costs from Regional Investment Fund (with 0% interest), project supported by crowdfunding.

G. Institutional and Organizational Aspects

Type of Organization and Governance Structure

Describe the type of organization and provide a general information on the governance structure associated to the biobased solution or innovation.

Actors Involved

What are the main actors involved in the biobased solution. E.g. from business, government, research and broader society (NGOs), local farmers, regional authorities, volunteers, companies, civil society.

H. Public Perception and Social Impact

Indicate the local societal impact and public perception of the solution. For example: improved health outcomes, reduced crime rates, increased educational attainment, enhanced social cohesion, enhance job creation, social inclusion, provides an alternative business-economic model for a group of people that has decrease/stop with a current economic activity or supporting asylum seeker and new commers in the region to facilitate their adaptation.

I. Challenges for Implementation

Indicate potential hurdles when setting up the solution. These ones could be environmental, social, legal or economic. For example: (waste) legislation, market readiness level, weakness of value chain (e.g. transportability), farmers not willing to guarantee multi annual supply, etc.

J. References

Numbered references ([1], [2], etc.) that can be mentioned in the description above. Each technology starts numbering at [1] again.

Funded by the European Union

BIOLOC

Annex 3. Catalogue biobased technical solutions

1. (OTH-01) Aerobic digestion of bio-residues (Van der Wiel - NL)

A. General

Title: Aerobic digestion of bio-residues
Location: Ny Beets, Friesland, the Netherlands
Keywords: Bio-residues, Industrial composition, aerobic digestion
Example user / provider of technology: Van der Wiel, Composting plant at sand pit Nij Beets

B. Feedstock

Main feedstock
Grass, leaves, bio-residues removed from waterways.

Other potential feedstock
Food-residues, Collected bio-residues from households, side/residues-streams from crops, manure.

Required feedstock quality
Feedstock should not contain pollutants which include e.g., non-biological materials. The quality and value of the produced compost depends on the input quality.

Feedstock source, price, trade spot and location

Typically, the bio-residues owner pays a fee to the composting plant. The bio-residues is delivered at the plant, acceptance depends on the amount of pollutants.

C. Technology

Technology Name
Aerobic digestion of bio-residues, composting

TRL 9

Description of Technology
The process consists of several stages, firstly larger non-soil materials are removed. Tree stubs are removed, tree branches are shredded. The rest of the material is placed in long rows and turned regularly. Because micro-organisms (bacteria/fungi) digest the green residues, decomposition takes place and compost is created. The activity of the microorganisms creates heat. The temperature in the 'heap' of green residues to be composted should be about 60-70 degrees for a longer period of time, because then the weed seeds and germs are killed. Final stage is the sieving of the compost.

Capacity
45 kton of fresh bio-residues per year

Investment and Operational Costs
Unknown, costs of composting are typically covered by a gate fee of 25-50 euro per ton and a selling price of high-quality compost of 30 euro per m^3.

D. Product(s)

Product Name(s)
Tested and certified “Keur” compost

Price, trade spot and location
Price of compost can be about 30 euro, without handling and shipment.

E. Environmental Impact

Environmental Benefits

Composting reduces waste and saves landfill space. Compost improves the quality of the soil. Industrial composting prevents the spreading of unwanted plant seeds.

F. Financial Aspects

Financial Support

Composting is typically performed by waste recycling companies supported by the cities.

G. Institutional and Organizational Aspects

Type of Organization and Governance Structure

Van der Wiel is one of the largest and most versatile civil engineering companies in the north and central Netherlands.

H. Public Perception and Social Impact

Industrial composting is performed in at least ninety-five locations in the Netherlands, the process fits in with agricultural activities. Control of odour emission is regulated by the government.

I. Challenges for Implementation

The EU is actively promoting composting of bio-residues as alternative for landfill (Landfill directive, 1999)

J. References

[1] Composteerinrichting op zandput Nij Beets - Van der Wiel
[2] Compost: waardevol voor bodem en klimaat - BVOR-Factsheet - BVOR
[3] Bestel Keurcompost in BigBag of los gestort - Otte Lisse
[4] EUR-Lex - 01999L0031-20180704 - EN - EUR-Lex (europa.eu)

2. (MB-C2.2) Cattle manure based anaerobic digestion producing biogas (HoSt - NL)

A. General

Title: Cattle manure based anaerobic digestion producing biogas (HoSt - NL)
Location: Enschede / The Netherlands
Keywords: Anaerobic digestion, manure, biogas, biomethane, small scale, natural gas, farm
Example user / provider of technology: Provider: https://www.host.nl, Example users: https://www.bioenergyfarm.eu/en/,, https://www.europeanbiogas.eu/, https://geniaglobal.com/en/

B. Feedstock

Main feedstock
Fresh cattle manure
Other potential feedstock
Sewage sludges, poultry manure, grass, cereal straw, agricultural residues
Required feedstock quality
Dry matter content typically 9 w-%
Feedstock source, price, trade spot and location:
111 €/tonne dry matter in The Netherlands

C. Technology

Technology Name
Anaerobic digestion
TRL
TRL 9 actual system proved and in operation.
Description of Technology
The main processing steps include:

- The manure is anaerobically digested in the digester and converted into biogas (57 % v/ v CH_4).
- In the biogas upgrading system, it is upgraded to biomethane (green gas or renewable gas, 89 % v/v CH_4).
- Subsequently, the product gas with natural gas quality is fed directly into the natural gas network.
- In order to reduce the production costs, the company generates its own electrical energy and sells the surplus energy.
- One of the by-products of the process is digestate. This material, being rich in nitrogen, is used as fertilizer by local farmers.

Capacity
15,000 tonne/year
Investment Costs and Operational Costs
0.239 million €

D. Product(s)

Product Name(s)
Methane, Digestate which can be used as fertilizer as a side-product
Price, trade spot and location
Biomethane 130 €/MWh

E. Environmental Impact

Environmental Benefits
GHG emissions can be reduced when shifting from natural gas to biogas or green gas (renewable energy). The digestate is used as a fertilizer, which gives less methane emissions in the field compared to adding manure directly to the field. At the same time, using the digestate as fertilizer saves chemical fertilizers.

F. Financial Aspects

Financial Support

In several countries, investment in digesters for production of biogas receive subsidy through specific regulations.

G. Institutional and Organizational Aspects

Type of Organization and Governance Structure

HoSt is a family owned company established in 1991 and has global reach in 5 continents, 45 countries.

Actors Involved

Technology supplier, farmer, eventually suppliers of other feedstock, power grid company, natural gas grid company

H. Public Perception and Social Impact

Micro-scale digesters (MSD) do not require many man-hours for operation. Farmers can operate and maintain them themselves. This means more work for farmers, but according to those who operate such plants, it is manageable. On the other hand, new workplaces can be created in other areas, i.e. technology providers, plant developers, and technical support.

HoSt works with local resources and local companies to perform maintenance of installations. Therefore, the capital remains in the region.
MSD are usually built on farms, near houses. The proximity is much closer than in the case of large-scale installations. The distance from other buildings should be enough to make the noise level acceptable.

Farmers who have neighbours with animal farms can launch a biogas project together or make an agreement to utilize also their manure. This type of cooperation can tighten social cohesion.

Decentralized energy production in plants with MSD improves the security of energy supply for households through reducing grid loads. Furthermore, the significant costs for the grid losses and for the grid stabilization can be avoided.

Producing energy for the farm may be profitable mostly due to the avoided cost of energy purchase. The income from surplus energy sales may be an additional advantage and shorten the payback time of the investment.

I. Challenges for implementation

Information about microscale digestion, and appropriate support is needed.

G. References

[1] Catalogue MainstreamBIO, Annex C2.2
[2] https://www.host.nl/en/biogas-plants/agricultural-biogas-plants/
[3] Cornelissen Consulting Services B.V. www.cocos.nl
[4] DCA Multimedia B.V. www.boerenbusiness.nl
[5] www.bio-up.nl
[6] https://www.host.nl/en/biogas-plants/agricultural-biogas-plants/
[7] Power4Bio Catalogue - HoSt factsheet
[8] https://www.biogas-e.be/sites/default/files/attachments/pocketdigestion_brochure.pdf

3. (MB-C2.3) Spent mushroom substrate & other agricultural and food industrial residues based anaerobic digestion producing biogas & electricity (Pilze-Nagy - HU)

A. General

Title: Spent mushroom substrate & other agricultural and food industrial residues based anaerobic digestion producing biogas and electricity (Pilze-Nagy)
Location: Kecskemét / Hungary
Keywords: Spent mushroom substrate, agricultural residues, food industry residues, anaerobic digestion, biogas, electricity, bioenergy, biofertiliser
Example user / provider of technology: http://pleurotus.hu/biogaz

B. Feedstock

Main feedstock

Spent mushroom substrate (SMS)

Other potential feedstock

(Industrial) food (processing) residues, expired food, marc and other by-products of distillery process, sludge from slaughterhouse, poultry manure

Required feedstock quality

-

Feedstock source, price, trade spot and location

Conform market conditions.

C. Technology

Technology Name

Anaerobic digestion

TRL

TRL 9 actual system proved and in operation.

Description of Technology [1]

The main processing steps include:

- Spent mushroom substrate (SMS) is transported into the biogas plant and mixed with other residues (e.g. food residues, expired food, poultry manure, marc, oil based mud, etc.).
- 110 m^3 biogas can be produced per tonne of input material (dry matter content: 50-60%).
- The plant can process maximum 10 thousand tonnes of biomass per year, 1-1.2 million m^3 biogas is produced per year from this amount of biomass.
- Biogas is converted into electrical energy (2,000-2,400 MWh/year) by burning it in a gas engine CHP (combined heat and power).
- Biogas digestate, the by-product of the anaerobic digestion process, is separated: the solid phase (containing 3 w % nitrogen) is used as biofertilizer by local farmers and the liquid phase is stored in an open digestate storage pond.
- A part of this liquid material is used for wetting the input material of the biogas plant and the rest is placed on agricultural fields as a liquid biofertilizer.

Capacity

Maximum 10,000 tonne/year (5,000 tonne dry matter). Typical: 4,000 tonne dry matter/year. [1]

Investment Costs and Operational Costs

1.340 million € investment. [1]

D. Product(s)

Product Name(s)

Electrical energy delivered to grid

Price, trade spot and location

Electricity generated from renewable energy sources and residues is promoted through feed-in tariffs in Hungary. [1]

E. Environmental Impact

Environmental Benefits

Waste reduction and producing green energy by utilising agricultural and food industrial residues; renewable energy replaces fossil fuels. Fertiliser part of the residue streams remains virtually intact, and can replace conventional fertilizer.

F. Financial Aspects

Financial Support

70% private, partly bank loan + 30% public funding, by the Environment Protection and Infrastructure Operative Program. [1]

G. Institutional and Organizational Aspects

Type of Organization and Governance Structure

Biowert was founded in 2007 and is a limited liability company. [2]

Actors Involved

Feedstock providers, Converters, Operation technicians, Logistics company

H. Public Perception and Social Impact

A plant of the same sizes as operated by Pilze-Nagy Ltd can employ 3 persons.

Biogas systems can support rural development and mitigate the negative effects of general economic fluctuations by local energy and fertiliser production. Biogas reduces the dependence of local communities on imported fuels and increases the local energy supply. Farmers can get a new social function as energy producers or waste managers.

I. Challenges for implementation

The most important challenges identified are related to:

- Malfunction or failure in the technical infrastructure (e.g. gas engine).
- Optimization steps needed when starting the implementation.

G. References

[1] Catalogue MainstreamBIO, Annex C2.3
[2] http://pleurotus.hu/biogas
[3] Larisa Lovrencec, 2010. Highlights of socio- economic impacts from biogas in 28 target regions. D.2.4. of IEE Project ‘BiogasIN’ (Contract No. IEE/09/848 SI2.558364)
[4] Power4Bio Catalogue – Pilze-Nagy factsheet
[5] https://www.biogas-e.be/sites/default/files/attachments/pocketdigestion_brochure.pdf

4. (MB-C2.8) Whey permeate based anaerobic digestion producing bioethanol, biogas and fertilizers (Carbery - IR)

A. General

Title: Whey permeate based anaerobic digestion producing bioethanol, biogas and fertilizers (Carbery)
Location: Ballineen, Cork / Ireland
Keywords: Dairy, milk, whey, bioethanol, biogas, biofuel, fertilizer
Example user / provider of technology: https://www.carbery.com/

B. Feedstock

Main feedstock
Residues from milk production (whey permeate)
Other potential feedstock
-
Required feedstock quality
-
Feedstock source, price, trade spot and location
Conform market conditions.

C. Technology

Technology Name
Anaerobic digestion
TRL
TRL 9 actual system proved and in operation.
Description of Technology [1]
The main processing steps include:

- Milk from farmer shareholders is processed to remove milk fat (derived to butter production).
- Skimmed milk is used to produce cheese and whey.
- Whey proteins are stripped from whey and sold for nutritional ingredients purposes.
- The derived residue, whey permeate, is fermented into bioethanol (12 million L/year).
- A co-product of said fermentation is stillage residue. This is the feedstock for anaerobic digestion, which produces biogas.
- The solid residue from the digester is converted into an organic fertilizer.

Capacity
-
Investment Costs and Operational Costs
-

D. Product(s)

Product Name(s)
Bioethanol; biogas; heat; electrical power; organic fertilisers
Price, trade spot and location
-

E. Environmental Impact

Environmental Benefits
The biogas produced at Carbery's Ballineen facility provides 9% of its steam power requirements. [2]
Carbery has also installed reverse osmosis systems to recover and recycle water contained in whey permeate, reducing water waste. [2] They also create project towards a climate-neutral dairy farm by undertaking an interdisciplinary programme of work, targeting several areas: soil carbon, animal diet and breeding, biodiversity.

F. Financial Aspects

Financial Support

-

G. Institutional and Organizational Aspects

Type of Organization and Governance Structure

Carbery was founded in 1965 as a joint venture between four West Cork diary co-operatives and Express Dairies, UK. In 1992, the company becomes 100% owned by West Cork farmers. [3]

Actors Involved

Farmers; customers,research organisations.

H. Public Perception and Social Impact

The company is owned by the 1220 farmer suppliers who supply milk, with an average herd size of 90 cows which are outdoors for 240 days per year. [4] Carbery is closely connected to the local communities supporting farmer shareholders with specific farm development programmes, sustainability initiatives and quality improvement schemes.

I. Challenges for implementation

-

G. References

[1] Catalogue MainstreamBIO, Annex C2.8
[2] https://www.carbery.com/sustainability/our-environment/
[3] https://www.carbery.com/about/heritage/
[4] https://www.carbery.com/about/our-farmers/
[5] https://www.biogas-e.be/sites/default/files/attachments/pocketdigestion_brochure.pdf

5. (MB-C3.1) Unsold bread based fermentation producing beer (Toastale - UK)

A. General

Title: Unsold bread based fermentation producing beer (Toastale)
Location: Southwark, London / UK
Keywords: Fermentation, bakery residue, food residues, starch, beer, bread, brewery, barley malt
Example user / provider of technology: https://www.toastbrewing.com/ ; https://www.beerproject.be/ ; https://www.instock.nl/en/

B. Feedstock

Main feedstock
Unsold bread and malted barley
Other potential feedstock
Wheat grain, bread & rolls losses (surplus product retail, processing, bread crusts, dough)
Required feedstock quality
Food grade
Feedstock source, price, trade spot and location
-

C. Technology

Technology Name
Fermentation
TRL
TRL 9 actual system proved and in operation.
Description of Technology [1]
The main processing steps include:

- Process - Barley is malted (germination, release of starch and enzymes), add bread (1/3 of the mass of barley malt), mashing (conversion starch into sugars), lautering (separation into clear wort and residual grain), add hop, boiling the wort (sterilisation, create flavour), cooling, add yeast, fermenting (conversion sugars into ethanol and carbon dioxide), conditioning (aging, better taste) and filtering.
- Feedstock flexibility - Wheat, other bakery products, other materials that contain starch can be used to produce beer.
- Products - 11 litre of beer is produced from 1 kg bread.
- Innovativeness - Making beer from bread is a century old technology, but creating a good taste is an art. It can be adopted by any operational brewery.
- Investment costs are estimated using the Bridgewater method with 8 unit operations and 30 tonnes barley plus bread per year. This is the investment for a complete and new brewery.
- Other Input Materials are water, hop, barley and yeast.

Capacity
-

Investment Costs and Operational Costs
6 million € Investment.

D. Product(s)

Product Name(s)
Beer; Brewer's spent grains
Price, trade spot and location
Beer: 7.5 €/l

E. Environmental Impact

Environmental Benefits
Avoiding GHG emission from landfilling bread, preventing environmental effects of barley cultivation.

F. Financial Aspects

Financial Support

-

G. Institutional and Organizational Aspects

Type of Organization and Governance Structure

The company was founded in 2015/2016.

Actors Involved

Suppliers of old bread; own webshop; pubs; supermarkets.

H. Public Perception and Social Impact

The brewery provides 3 direct jobs and 4 indirect jobs. More interaction (cohesion) in a local community that collects unsold bread and transfers it to a local brewery. Part of the profit is donated for charity.

I. Challenges for implementation

Finding right conditions to brew optimum beer quality.

G. References

[1] Catalogue MainstreamBIO, Annex C3.1
[2] www.toastale.com
[3] www.beerproject.be

6. (MB-C4.1) Organic side streams based bioconversion by Black Soldier Fly larvae producing lipids & proteins for feed (Bestico - NL)

A. General

Title: Organic side streams based bioconversion by Black Soldier Fly larvae producing lipids & proteins for feed (Bestico)
Location: Berkel en Rodenrijs / Netherlands
Keywords: Agricultural residues; food residues; bioconversion; black soldier fly; lipids; proteins; feed
Example user / provider of technology: https://www.bestico.nl , https://www.insectsforpeace.org/

B. Feedstock

Main feedstock
Agricultural and food residues
Other potential feedstock
-
Required feedstock quality
GMP+; insecticide free
Feedstock source, price, trade spot and location
100 - 200 €/ton on-site in Netherlands [1]

C. Technology

Technology Name
Bioconversion by insects.
TRL
TRL 8
Description of Technology [1]
The main processing steps include:

- Black soldier fly larvae are grown in crates on rack cupboards and fed with agricultural and food residue streams.
    - Technology is simply scalable to the amounts of vegetable residue streams available, whether smaller or larger quantities.
- Larvae are harvested, dried & used as feed (when grown on GMP + side streams) or further refined to a protein rich fraction and lipids. Larvae and protein fraction contain essential amino acids which are low in feeds produced from plants [2].
- During harvesting the insects are sieved out of their remaining feed medium, the fine fraction (left-overs, debris, etc.) is sold as fertilizer (compost). Also the substrate residue (skins of worms) remaining after pressing of the worms can be used as fertilizer.

Capacity
400 – 600 ton/year fresh. 10 ton/year Black soldier fly larvae; 90 ton/year proteins; 45 ton/year lipids.
Investment Costs and Operational Costs
3 million €. [1]

D. Product(s)

Product Name(s)
Black soldier fly larvae; proteins; lipids.
Price, trade spot and location
2,000 – 2,500 €/ton for Black soldier fly larvae as pet food and feed; 3,000 – 3,750 €/ton for proteins as pet food and feed; 1,500 €/ton for lipids as feed. [1]

E. Environmental Impact

Environmental Benefits
High quality feed can be produced at scalable scale, thus avoiding transportation from centralized specialized feed producers to remote areas.

F. Financial Aspects

Financial Support

Own investment.

G. Institutional and Organizational Aspects

Type of Organization and Governance Structure

The company was established as a subsidiary of Koppert, a company supplying insects for natural control of agricultural pests.

Actors Involved

The company sources feedstock from various providers.

H. Public Perception and Social Impact

The technology allows to convert perishable food and agro-industrial residue streams into nutritious feed having a much longer shelf life [3]. Rural communities can thus produce their own high quality feed. A so called air washer reduces smell around the building to basically zero.

The initiative has created 20-25 jobs. [1]

I. Challenges for implementation

-

G. References

[1] Catalogue MainstreamBIO, Annex C4.1
[2] https://dokumen.tips/documents/bsf-bioconversion-by-bestico-bv-abstract-bsf-bioconversion-by-bestico-bv.html
[3] https://power4bio.eu/wp-content/uploads/2020/04/POWER4BIO_D3.4_Best_practices_of_bio-based_solutions.pdf
[4] https://www.insectsforpeace.org/

7. (MB-C5.1) Coffee residues as a substrate to grow mushrooms (Rotterzwam - NL)

A. General

Title: Coffee residues as substrate to grow mushrooms.
Location: Netherlands, South Holland, Rotterdam
Keywords: Reuse, coffee grounds, mushroom, oyster mushroom, food, urban areas.
Example user / provider of technology: https://www.rotterzwam.nl, https://grocycle.com

B. Feedstock

Main feedstock
Coffee grounds
Other potential feedstock
Wheat straw; however other pasteurized/sterilized cellulosic material e.g. (sawdust, seed hulls ,leaves) could be used and lime.
Required feedstock quality
-
Feedstock source, price, trade spot and location
Coffee grounds: 0 €/ton is a residue.

C. Technology

Technology Name
Cultivation of mushrooms from organic residues (coffee grounds).
TRL
TRL 9 actual system proved and in operation.
Description of Technology [3,4]

- The main processing steps include:
- Coffee grounds are mixed with straw (20 wt.% of coffee ground weight) and lime, and then mixed with Oyster mushroom spawn (10 wt.% of coffee ground weight). The mixture is put in growing bags and incubated at 20-24 °C in the dark for 2-3 weeks. White mycelium is formed. To produce the mushroom the bags are placed under fruiting conditions (with indirect light) and after 10-17 days the mushrooms are harvested. 1 Ton of coffee grounds (40 wt.% dry matter) yields 200 kg of oyster mushrooms.
- The production consists of multiple technology steps: chopping and composting straw, solid- state fermentation, inoculating the bags of straw, ensuring growing conditions and harvesting oyster mushrooms after 5-8 weeks of growing period. Moisture content of the feedstock has to be under 14% otherwise the storage can be problematic. 3 tonnes of straw produced on one hectare can be converted into 1,8-2,0 tonnes oyster mushroom.
- The technology is no covered by patents, but specific know-how is required.

Capacity
The nursery consists of 8 climate growing units (containers), a substrate preparation room and a cooling and frozen storage room. The nursery can accommodate a total of 12 tonne of substrate that required 80 tonnes of coffee grounds are converted into 13 tonnes of mushrooms per annum. [2]
Investment Costs and Operational Costs
Investment cost around 260 k€ [1].

D. Product(s)

Product Name(s)
Oyster mushrooms that are further processed to a wide range of products (e.g. supply to local restaurants, supply for processed food production) and services around mushroom production.
Price, trade spot and location
Local coffee collection and local selling of mushrooms in Rotterdam area.

E. Environmental Impact

Environmental Benefits

The solution provides a high-quality reuse of coffee grounds and production of oyster mushrooms and food snacks. The solution contributes to close local loops by producing mushrooms from local residual flows and promote renewable energy (solar panels) to cover its utilities and avoids land use conversion for food production, as well as reduction of waste management.

F. Financial Aspects

Financial Support

This solution used the crowdfunding scheme to start operations and received subsidy from the province of South Holland and the European Union via POP3 scheme. The POP3 is a grant programme for agricultural development, sustainability and innovation in the Netherlands. The company's revenue is generated from coffee grounds collection services and sales of Oyster mushrooms, cultivation kits, training workshops and educational and inspirational talks.

G. Institutional and Organizational Aspects

Type of Organization and Governance Structure

Rotterzwam was founded by two young entrepreneurs with backgrounds in financial services and the energy sector with interest in sustainability. The goal of Rotterzwam is to establish and then replicate a business model that has an economic, environmental and social revenue model.

Actors Involved

The solution contributes to job creation locally and to stimulate the implementation of circular bioeconomy at local level. The company Rotterzwam worked together with farmers (Maatschap den Ouden) and research institutes (Wageningen University, Louis Bolk Institute and Ecochain) to investigate the effect of organic residual flows from the production process to be used as soil improver in arable farming and avoid waste generation. They also have enabling partners such as the Municipality of Rotterdam, Triodos Foundation and Sylvan Inc. and volunteers.

H. Public Perception and Social Impact

The solution creates awareness about sustainability and the circular economy at local level. During the implementation of this solution, it was possible to change the status of waste for the coffee grounds. Waste classification does not permit the use of coffee grounds to grow food. However, with the *administrative legal judgment of 'continued use of coffee grounds'*, Rotterzwam has contribute to change public perception and achieved an important step towards the circular economy.

The company was also involved in the research project 'Back to soil'[5] which provided background scientific information to evaluate the possibility to use organic residual flows from the production process as soil improver in arable farming and avoid waste generation.

I. Challenges for implementation

The most important challenges identified are related to:

- Legislation: An important barrier to enhance circular economy for this solution was within the Laws and Regulations. In this specific case overcoming legal barriers, regarding the use of organic residual flows which should no longer be burned but should be used as substrates for food production or as soil improvers.
- Stable raw materials supply: during the COVID 19 pandemic, when the solution was ready to be scale up, the supply of coffee grounds was limited as a lot of raw material normally comes from working places (offices).

G. References

[1] Power4Bio Catalogue - Rotterzwam factsheet.

[2] https://www.rotterzwam.nl/pages/geschiedenis-van-rotterzwam

[3]https://power4bio.eu/wpcontent/uploads/2020/04/POWER4BIO_D3.4_Best_practices_of_bio-based_solutions.pdf

[4] Catalogue MainstreamBIO Annex C5.1

[5] https://www.rotterzwam.nl/blogs/news/blogserie-terug-naar-de-bodem-organische-reststromen-afvalwetgeving-en-bodemonderzoek

8. (P4B-01 & MB-C6.1) (Insulating) building materials made of hemp shives & lime (Hempire - PL)

A. General

Title: (Insulating) building materials made of hemp shives & lime (Hempire)
Location: Rzeszów / Poland
Keywords: Hemp; limestone; insulation material; construction material; biomaterial
Example user / provider of technology: https://hempire.tech ; https://dunagrohempgroup.com/hemp-construction/

B. Feedstock

Main feedstock
Hemp hurds; and lime
Other potential feedstock
Coconut shell fibre; rice fibre; palm tree fibre; straw; other locally produced feedstock can be suitable as well
Required feedstock quality
Hurd length preferrable ranges between 10-40 mm. Mouldy and wet feedstock is not suitable.
Feedstock source, price, trade spot and location
About 120 €/ton in Ukraine in 2020 [3].

C. Technology

Technology Name
Mixing hemp, lime water and natural additive.
TRL
TRL 9 actual system proved and in operation.
Description of Technology [1,2]
The main processing steps include:

- At the construction site, the ingredients are mixed: Hemp hurds, water and the so called 'fifth element', consisting of lime and natural additive.
- Mixing is performed for about 5 minutes and needs to be done above 0 °C.
- The mixture can be cast in the wood timber frame construction of a house to provide insulating walls using a mould system [4]. Alternatively, premanufactured plates or blocks can be moulded. Or it can be sprayed [5].
- It can be applied for: (non-load bearing) walls, roof, ceiling, floor, attic and basement.
- Exterior coating would have to contain no hemp hurds [6].

Capacity
Typically 3,000 ton/year
Investment Costs and Operational Costs
Investment Costs ca 1.5 million €

D. Product(s)

Product Name(s)
Hemp-lime based building blocks
Price, trade spot and location
180 €/m^3 on site in Ukraine in 2020 at a density of 260 kg/m^3 Hempire Mix insulation material.
480 €/ton in Ukraine in 2020 for lime based binder [3].
Cost calculation tool can be found here: https://hempire.tech/products/fifth-element-binder

E. Environmental Impact

Environmental Benefits
Lower CO_2 emissions compared to the more commonly used construction materials are claimed; CO_2 emissions of lime production and absorption during hardening are not mentioned. Because of the insulation performance and heat capacity of the material, less heating in winter and air conditioning in summer is required.

F. Financial Aspects

Financial Support

-

G. Institutional and Organizational Aspects

Type of Organization and Governance Structure

The company was founded in Ukraine in 2015, now having its headquarters in Poland.

Actors Involved

Technology provider, logistics, commissioner for construction of the building

H. Public Perception and Social Impact

The binder production facility employs 4 persons, another 4 jobs on the construction site.
Hempire Mix provides a natural insulation material, absorbing moisture during humid seasons and releasing moisture during winter season, thus improving indoor air quality (issue for so called passive houses).
The technology is quite simple to implement (low investment costs, standard mixing equipment suffices) and easily scalable.

I. Challenges for implementation

Lack of knowledge on the side of construction industry leaders as well as practical construction sector (conservative industry). Producing good quality hemp hurds (or similar) requires knowledge and know-how which is not yet broadly available. Price of plant based building materials like hempcrete is still higher compared with conventional mainstream materials.

G. References

[1] Catalogue MainstreamBIO, Annex C6.1
[2] https://hempire.tech/about
[3] Power4Bio Catalogue - Hempire factsheet.
[4] https://www.hempirebuilding.net/index.php/hemplime-videos/how-to-pack-hemp-insulation
[5] https://urbannext.net/hemp-concrete/
[6] https://hempirebuilding.net/index.php/hemplime-videos/types-of-hempire-plaster
[7] https://power4bio.eu/wp-content/uploads/2020/04/POWER4BIO_D3.4_Best_practices_of_bio-based_solutions.pdf

9. (MB-C7.1) Fruit juice residue streams based pressing and solvent extraction producing specialty oils and additives for food, food supplements & cosmetics (Add Essens - BE)

A. General

Title: Fruit juice residue streams based pressing and solvent extraction producing specialty oils and additives for food, food supplements & cosmetics (Add Essens)
Location: Belgium
Keywords: Extraction; biorefinery; grape marc; grape seed oil; food supplement; natural colorant; pilot plant; Toll manufacturing
Example user / provider of technology: https://addessens.com

B. Feedstock

Main feedstock
Juice pressing residue (pits, seeds, pulp, grape lees, peel)
Other potential feedstock
Vegetables
Required feedstock quality
Food grade compatible
Feedstock source, price, trade spot and location
5 – 50 €/ton at factory gate in Belgium in 2020

C. Technology

Technology Name
Solvent extraction (Aqueous, ethanolic, supercritical CO_2)
TRL
8
Description of Technology

- Juice pulp is dried and seeds are sieved out.
- Seeds are pressed to obtain the oil.
- Seed free dried pulp is solvent extracted (aqueous, ethanolic or super critical CO2) for colorants and other functional components.
    - Otherwise, the seed free dried pulp is directly released to feed.
- A schematic representation of the processing and application options is given in [1].

Capacity
300 – 900 ton/year [2]
Investment and Operational Costs
1.5 million € [2].

D. Product(s)

Product Name(s)
Fruit seed oil; fruit fibre; fruit seed flour; fruit juice pulp extracts (e.g. colorants) for application in food (supplements), feed, cosmetics.
Price, trade spot and location
-

E. Environmental Impact

Environmental Benefits
-

F. Financial Aspects

Financial Support

-

G. Institutional and Organizational Aspects

Type of Organization and Governance Structure

-

Actors Involved

Feedstock providers, converters , operation technicians, logistics company

H. Public Perception and Social Impact

Creation of 6-15 jobs and facilitate the upgrading food residue streams

I. Challenges for Implementation

Transportability, farmers not willing to guarantee multi annual supply, etc.

J. References

[1] https://addessens.com/en/fruiticals-2/
[2] Power4Bio Catalogue - EcoTreasures factsheet

10. (MB-C7.2) Olive oil industry by-products based extraction producing food additives (Natac Group - ES)

A. General

Title: Olive oil industry by-products based extraction producing food additives (Natac Group - ES)
Location: Spain
Keywords: Olive leaves, olive stones, olive pomace, extraction, tri-terpenes polyphenol
Example user / provider of technology: https://natacgroup.com/products/olive-extracts/ , https://oleaf4value.eu/

B. Feedstock

Main feedstock
Olive pomace
Other potential feedstock
Olive leaves; olive stones
Required feedstock quality
-
Feedstock source, price, trade spot and location
-

C. Technology

Technology Name
Extraction
TRL
9
Description of Technology

- The process involves several extraction techniques and the exact technique depends on the feedstock. The plant in Hervas (Spain) is a multi-product and multi-feedstock extraction plant. [1]
- Extracts can be made from olive pomace, olive stones, olive leaves and even from grape residue.
- About 100 kg of products (polyphenols, triterpenes) can be made from one tonne of feedstock (with high dry matter content). [2]

Capacity
2,500 ton/year dry matter [1].
Investment and Operational Costs
7,700 k€ [1]

D. Product(s)

Product Name(s)
Polyphenols and triterpenes (food additives)
Price, trade spot and location
750 €/ton for polyphenols [1]

E. Environmental Impact

Environmental Benefits
Application of olive-industry by-products as food additive is a more circular destination than landfilling (soil contamination and water-bodies pollution) or eventually application as feed (development continues). [2]

F. Financial Aspects

Financial Support
-

G. Institutional and Organizational Aspects

Type of Organization and Governance Structure

-

Actors Involved

- Feedstock providers
- Converters
- Operation technicians
- Logistics company

H. Public Perception and Social Impact

- 10 direct jobs [1].
- The solution can be operated in areas where olives are grown and processed. Farmers could set up a cooperation to establish such a plant and achieve higher value for their olive production, while reducing environmental impact. Operating the extraction plant requires educated and specialized personnel, so this solution offers opportunities for young people to stay in or return to rural areas.
- Similar technology may be used for extraction of specific compounds from several other crops: Lupin, Crambe and Camelina for oil; Cardoon for chemicals; Camomile for aroma's and medicinal compounds; Rosemary for essential oils. An extraction plant flexible in its feedstock would offer farmers more rotation options to select crops for cultivation.

I. Challenges for Implementation

Legal barriers had to be overcome when it comes to convert residues into food (additive) products.
To establish such an innovative solution, it is key to align the several actors from different sectors: farmers, industrial technology providers, R&D, innovators, entrepreneurs. All of them from different backgrounds and economical areas makes it challenging.

J. References

[1] Power4Bio Catalogue - Natac factsheet.
[2] https://power4bio.eu/wp-content/uploads/2020/04/POWER4BIO_D3.4_Best_practices_of_bio-based_solutions.pdf (Innovaoleo)

11. (P4B-02 & MB-C8.1) Meadow grass silage biorefinery producing grass fibre enhanced plastic granules (Biowert - DE)

A. General

Title: Meadow grass silage biorefinery producing grass fibre enhanced plastic granules
Location: Brensbach, Germany
Keywords: biorefinery, meadow grass, insulation material , grass fibre , plastic , bioplastic
Example user / provider of technology: https://biowert.com/agriplast/

B. Feedstock

Main feedstock
Meadow grass silage
Other potential feedstock
-
Required feedstock quality
The grass should be harvested before the panicle is pushed and ensiled at a dry matter content of 25-30 %.
Feedstock source, price, trade spot and location
Negotiated directly with the suppliers. Typical value: 140 €/tonne dry matter at factory gate in Germany [1,2].

C. Technology

Technology Name
Mechanical treatment and hot pressing of fibres. Subsequent compounding in thermoplastic.
TRL
TRL 9 actual system proved and in operation.
Description of Technology [1,2]
The main processing steps include:

- The cellulose fibres are separated from the grass using mechanical processing (presses, macerators) and warm water, heated by the waste heat from the company's combined heat and power biogas plant, which is directly connected to the facility (see also solution entitled "Biogas plant producing electrical energy from grass juice and food residues"). The waste heat is also used for fibre drying.
- The fibres are compounded together with recycled plastic with the addition of a coupling agent into a fibre-reinforced composite material.
- Meadow grass in Europe grows in spring and early summer, it can be harvested up to 4 times a year. At the usual 2 cuts per year about 50 tonnes fresh mass per ha are harvested.
- The ensiling makes it durable, so that it is available for processing all year round. The seasonal characters can be different with other types of grasses and/ or in other geographic area and/ or under other climatic conditions.
- An average of 500 kg of fibres can be obtained from one tonne of dry matter.
- An integrated biogas plant helps the biorefinery system to be circular by converting the output material of the biorefinery other than the grass fibres, the grass juice, into nutrients that can be brought back to the land and CO_2 and water which is then used by fresh growing plants again, thus closing the circle. The biogas is used in a combined heat and power facilities. The heat and electricity derived from the biogas facility is used to satisfy the energy demand in the biorefinery and excess electricity is exported to the electricity grid.

Capacity
2500 tonne fibres/year. [1,2]
Investment Costs and Operational Costs
Investment costs of a similar grass processing plant would be 10 million € (by the estimation of Biowert). [1]

D. Product(s)

Product Name(s)
Grass fibre enhanced plastic granulates, called AgriPlast for injection moulding and extrusion. Biogas from grass juice.

Price, trade spot and location
2.75 €/kg in Germany

E. Environmental Impact

Environmental Benefits

Raw materials are used as efficiently as possible in a closed-loop recycling process, generating no wastewater or waste products and minimising the resources used. Replacing plastic content by natural fibres reduces plastic use. If the plastic is fossil based, using grass fibres allows to significantly reduce CO_2 footprint.
The production of AgriPlast uses recycled materials (recycled HDPE, PP, etc), further decreasing environmental impact. Products made of AgriPlast can also be recycled several times with limited losses in performance.

F. Financial Aspects

Financial Support

Own investment; revenues generated.

G. Institutional and Organizational Aspects

Type of Organization and Governance Structure

Biowert was founded in 2007 and is a limited liability company. [3]

Actors Involved

The company sources meadow grass from local farmers and delivers composite granules to industry. Excess power is supplied to the grid. Fertilizer is supplied to regional farmers.

H. Public Perception and Social Impact

This solution is a business-to-business service. The composite granules, AgriPlast, must meet the technical requirements of customer applications.

The company endeavours to have a production process that is ecologically, regionally and socially responsible. It is regional because meadow grass processed is a raw material from the Odenwald region where livestock farming is declining and new ways of exploiting grassland are being sought.

Social impacts can arise if facilities and industrial jobs are created in structurally weak regions, that usually are agricultural heavy. The feedstock production and the operation of the biorefinery and the biogas plant require several types of employees, both agricultural jobs industrial jobs (production manager,
engineers, etc.).

Public perception of the technology and its attractiveness for entrepreneurs in the bio-based industry lies in the circular economy model, its low environmental impact and positive environmental effect by the reduction of fossil raw material consumption. At the same time, own biogas production reduces the dependence of local communities on (imported) fuels and increases the local energy supply.

Further development could be performed with regard to the use of other feedstock (types of grasses), biodegradable polymers and additives, and a more efficient use of side products and/or residues.

I. Challenges for implementation

The most important challenges identified are related to:

- Market development for fibre-reinforced materials.
- Injection moulding and extrusion processes need to be adapted to the specificities of the grass fibre enhanced granulates. It takes about 18-24 months to install and optimize the technology.

G. References

[1] Catalogue MainstreamBIO, Annex C8.1
[2] Power4Bio Catalogue - Biowert factsheet.
[3] https://biowert.com/unternehmen/

12. (MB-C8.4) Wood residues based mechanical disruption producing pellets energy applications (Biomassehof-Chiemgau - DE)

A. General

Title: Wood residues based mechanical disruption producing pellets energy applications (Biomassehof-Chiemgau)
Location: Chieming, Germany
Keywords: wood residues, sawing, forestry residues, pelletisation, chipping, heat, energy
Example user / provider of technology: https://www.biomassehof-chiemgau.de/

B. Feedstock

Main feedstock

Residues from forestry and forest-based industry and Industrial wood residue

Other potential feedstock

-

Required feedstock quality

-

Feedstock source, price, trade spot and location

-

C. Technology

Technology Name

Mechanical treatment

TRL

9

Description of Technology

- Residue wood products from industry, commerce and private households are collected, sorted, collated and sent for material and thermal recycling using the latest technology.
- Green residue is also used as feedstock. The woody component is filtered out via screening plants and chopped up. The remaining material components are intended for composting.
- Wood residues are mechanically disaggregated and reformed into pellets.

Capacity

-

Investment and Operational Costs

-

D. Product(s)

Product Name(s)

Wood pellets, compost

Price, trade spot and location

-

E. Environmental Impact

Environmental Benefits

70% of the feedstock is transformed into material recycling (primarily the Austrian chipboard industry), reducing the use of virgin materials and the environmental impact of their processing. The remaining 30% is used for thermal purposes, granting a bio-based substitute to petroleum-based technologies.

F. Financial Aspects

Financial Support

G. Institutional and Organizational Aspects

Type of Organization and Governance Structure

-

Actors Involved

- Feedstock providers
- Technology providers
- Operation technicians
- Logistics company

H. Public Perception and Social Impact

The company also produces green electricity (solar panels) and biogas (see anaerobic digestion) for the local citizens, boosting the overall sustainability of the surrounding area.

I. Challenges for Implementation

-

J. References

[1] https://www.biomassehof-chiemgau.de/

[2] https://www.arjes.de/

13. (MB-C8.6) Agricultural residue based mechanical disruption producing pellets (Pelletierungs Genossenschaft - AT)

A. General

Title: Agricultural residue based mechanical disruption producing pellets (Pelletierungs Genossenschaft)
Location: Austria
Keywords: meadow hay, corn cob, straw, husks, lucerne, pelletisation, heat
Example user / provider of technology: https://www.pelletierung.at/

B. Feedstock

Main feedstock
Residues from agriculture, Organic residues (corn cob from food consumption)
Other potential feedstock
- Other residues from agriculture and additives can be subjected to a pelleting test to address their suitability.

Required feedstock quality
-

Feedstock source, price, trade spot and location
-

C. Technology

Technology Name
Mechanical treatment
TRL
9
Description of Technology
- Metals and sand are separated from the interesting portion of the feedstock.
- Said portion is grinded in a hammer mill.
- Outcome is fed to the drying system.
- Dried material is mixed in the desired proportions and pressed.
- Pellets are cooled.
- Dust and pellets are sorted using a sieve.
- Pellets are ready to be stored or transported to the end user.

Capacity
1,500-2,000 kg pellets/hour
Investment and Operational Costs
-

D. Product(s)

Product Name(s)
Pellets for litter, fuel, or feed
Price, trade spot and location
Around 270€/1,000 kg pellets, depending on the composition

E. Environmental Impact

Environmental Benefits
Crop, feed and food residues are recycled and given a second useful life. The employment of non-renewable energy resources is diminished. If pellets are used as feed, arable land can be sown with other interesting crops.

F. Financial Aspects

Financial Support
-

G. Institutional and Organizational Aspects

Type of Organization and Governance Structure

BIOPEL, a. s. is a company established in 2012 by individuals and legal entities

Actors Involved

- Feedstock providers
- Technology providers
- Operation technicians
- Logistics company

H. Public Perception and Social Impact

The treatment of otherwise non-useful residues is turned into a profitable business.

I. Challenges for Implementation

-

J. References

[1] https://www.pelletierung.at/

14. (OTH-03) Production of wide range of wood fuels (Biopel - SK)

A. General

Title: Conversion of low-quality wood and wood residues, not useable as high-quality material in construction and furniture industry into wide range of wood fuels.
Location: Kysucký Lieskovec, Slovakia Slovakia
Keywords: Biomass Logistics Centre (BLC).low quality wood(sawdust), pelletisation, heat.
Example user / provider of technology: Biopel

B. Feedstock

Main feedstock
Byproducts from wood processing and low quality wood.

Required feedstock quality
-

Feedstock source, price, trade spot and location
Most of the biomass is purchase from local sawmills.

C. Technology

Technology Name
Mechanical and thermal treatment
TRL
TRL 9
Description of Technology
Wood pellets are a refined and densified biomass fuel that is formed when wood residues are compressed into a uniform diameter under high pressure. Wood pellets have a uniform shape, size and density and are ideal for automatic combustion heating systems such as pellet stoves and boilers.

Wood chips are made from wood residues, a chipper machine with a capacity to produce 200 m^3/h woodchips according to the Austrian Önorm 7M133chip standard, is used. Humidity is reached by natural desiccation if after natural drying the wood chips do not reach the required moisture a mobile dryer container is used. Wood chips are store on covered landfills (shelter, close storehouses).

Capacity
The expectation is yearly sales of 25,000 tons of fuel ready for final use.[2]

Investment and Operational Costs
-

D. Product(s)

Product Name(s)
Pellets (wood, industrial, alternative), briquettes (wood, alternative), chipped firewood, dry wood chips.
Price, trade spot and location
Around 300-400 €/1,000 kg pellets, depending on the composition. [5]

E. Environmental Impact

Environmental Benefits
Providing a renewable and eco-friendly source of energy for homes and businesses and contribute to Slovakia's goals for a CO_2-neutral future by increasing the share of renewable energy sources to the ambitious goal of 14% by 2020. Biopel's products can contribute to a circular economy by closing material loops and reducing the need for virgin materials.

F. Financial Aspects

Financial Support

Biomass logistics center project is funded by grants from Norway, the credit funds obtained from Tatra banka and own resources.

G. Institutional and Organizational Aspects

Type of Organization and Governance Structure

BIOPEL, a. s. is a company established in 2012 by individuals and legal entities. Biopel has a General meeting of shareholders which is the supreme body of the company. The board of directors which acts as a statutory body of the company and the supervisory board that is the supreme controlling body of the company.

Actors Involved

The business of BIOPEL is supporting domestic players in wood industry: forest owners and small processing enterprises as: associations of forest owners, saw-mills, carpenters, foresters, waterway administrators etc.

H. Public Perception and Social Impact

Locally produced -wood pellets mills provide jobs, support local economies and can lead to energy independence and appropriate ecologic fuels from domestic renewable energy sources for people.

I. Challenges for Implementation

-

J. References

[1] https://www.biopel.sk/en/about-us
[2] https://id-norway.com/project/biopel/
[3] https://issuu.com/biopel/docs/brozura_2017_en
[4] https://ec.europa.eu/enrd/sites/default/files/enrd_publications/bioeconomy_case_study-the_wood_biomass_sustainability_criteria_in_slovakia-v03.pdf
[5] https://pellets-trade.com/price/slovakia.html

15. (BPM-01) Wheat bran disposable tableware (Biotrem - PL)

A. General

Title: Valorisation of wheat bran (by product of cereal refining) by compression and heating to produce disposable and compostable tableware materials.

Location: Zambrow, Poland

Keywords: Wheat bran, i.e. the hard outer layer of the grain.

Example user / provider of technology: https://biotrem.pl/en/

B. Feedstock

Main feedstock

Wheat brand. Bran is the hard outer layer of the grain and is a by-product in the production of refined grains.

Other potential feedstock

The company is investigating the possibility of using alternative feedstocks, e.g. algae, cassava by-products, corn bran and other agri-food industry by-products.

Required feedstock quality

Stable access to high quality, GMO free, raw material (bran) from nearby mills.

Feedstock source, price, trade spot and location

The wheat bran is supplied by local mills in the North-Eastern Polish region of Podlasie. Wheat bran is the hard outer layer of the grain. It is part of the whole grain, and a by-product of milling in the production of refined grains.

C. Technology

Technology Name

To facilitate quick discrimination of technology applied.

TRL

TRL is considered to be 9.

Description of Technology

- The production process requires only bran and water. No further ingredients are used.
- The process of shaping Biotrem tableware involves using high temperature and high pressure. The bran is pressed and baked in a single production cycle.
- The manufacturing process is fully automated and designed to comply with food safety standards
- Feedstock flexibility: The majority of bran is used as animal feed and a smaller fraction as a source of dietary fibre by the food industry. According to Biotrem, the bran that is used would otherwise be unutilised or under-utilised. As such, the use of bran to produce tableware represents a value added component of this raw material.
- Innovativeness: Patented production technology.

Capacity

Feedstock input and product output, in ton/annum, at given dry matter content.

Investment and Operational Costs

Overall, the company estimates over 5 million euros on R&D, including 3.3 million in building the production plant by 2019.

D. Product(s)

Product Name(s)

Materials, disposable tableware.

Price, trade spot and location

Circa EUR 0.25/piece (wholesale packaging); EUR 0.4/ piece (retail packaging), about 5 times the price of plastic plates. The company has been expanding their network of distributors and engaging in efforts to support their expansion on promising international markets. The product is commercially available since 2016 and is sold in 40 countries.

E. Environmental Impact

Environmental Benefits

The product is biodegradable (30 days for them to decompose through composting). It is certified by DIN Certco as products made of compostable material, it use renewable agricultural side-products and it is free of chemical additives. According to company estimates, 1 kilogram of wheat bran plates or bowls generates around 1.3 kg of CO_2-equivalent, considering the whole wheat cultivation process, transportation, processing, and utilisation. This compares to about 8.5 kg of CO_2 generated for the production of 1 kg of polystyrene disposable plates or cups.[2]

F. Financial Aspects

Financial Support

Initially, Biotrem R&D activities were financed by the inventor's in-kind contribution. In the different stages of commercialisation, the company relied on EU-Horizon 2020 funding and in European Structural and Investment Funds (ESIF) to reach the current level of business and technology advancement. The company actively sought public and private financing. Currently, Biotrem is looking into new ways of funding. They are planning to launch a crowd funding campaign and are considering to become a publicly traded company.

G. Institutional and Organizational Aspects

Type of Organization and Governance Structure

Privately Held

Actors Involved

Companies, local farmers, regional authorities, companies, local mills from traditionally agricultural region. The company has been expanding their network of distributors and engaging in efforts to support their expansion on promising international markets.

H. Public Perception and Social Impact

Public perception is positive. Global demand is becoming more focused on sustainability. Waste-related legislation and initiatives aimed at reducing food losses along production chains and initiatives like the EU Strategy for Plastics, the EU Directive on Packaging Waste, and national and regional waste management plans like the French ban on plastic disposables and in New Delhi provide favourable conditions. The solution promotes the valorisation of agricultural raw materials and emphasise the need for reduction of food losses from the food processing sector.

I. Challenges for Implementation

Sustainability/acceptability of feedstock may be questioned in the future as the majority of bran is used as animal feed and a smaller fraction as a source of dietary fibre by the food industry. Price competitiveness with plastic or paper products is challenging, making the product at this moment suitable for consumers that are less driven by price considerations and willing to pay a 'green premium'. Further efforts are required to reduce costs through economies of scale.

J. References

[1] https://biotrem.pl/en/
[2] European Commission, Directorate-General for Research and Innovation, Bio-based products – From idea to market "15 EU success stories", Publications Office, 2019
[3] https://cordis.europa.eu/project/id/729781

16. (AFV-01) Biofilter from lignocellulosic biomass (Bures, Pastorino, Odour balance - ES,IT, NL)

A. General

Title: Chips from wood and other forestry residues as biofilter material.
Location: Spain, Italy, Netherlands, UK.
Keywords: Material, forestry and gardening residues, rural and urban areas.
Example user / provider of technology: Bures professional S.A[1], Pastorino S.R.L[2], Odour balance B.V. [3].

B. Feedstock

Main feedstock

Different wood chip particle sizes made from bark, leafless branches, shredded rots and heather from different pine tree species.

Other potential feedstock

Mesocarp of coconut, gardening and forest trimmings.

Required feedstock quality

The biomass that can be used is forestry biomass including residues.

Feedstock source, price, trade spot and location

Preferable local-European feedstocks

C. Technology

Technology Name

Mechanical fractionation

TRL 8-9

Description of Technology

Biofiltration is a very versatile technique, able to treat odours, toxic gas compounds and volatile organic compounds. Can be used is farms, factories, The filling materials is mainly forestry biomass and is processed as follow:

- Pre-treatment (crushing and screening) to increase the surface area and enables the microorganisms to more effectively colonise the medium.
- For rural areas there it is possible to find mobile wood chipping unit which can be fed with wood based raw material from forest industry, agriculture and municipalities.
- Drying process to reduce moisture content to the appropriate levels and get a consistent quality product and readily available supplies.

Capacity

-

Investment and Operational Costs

For the wood chips production, it is possible to use simple mobile woodchipper that requires a small investment of about EUR 17.000 (including trailer chassis, diesel engine, chipper, hydraulic engine, pump and pipes). The operational costs depend on influence factors like fuel costs for drying , labour force.[6] For the biofilter construction

D. Product(s)

Product Name(s)

Wood chip biofilter can absorb odoriferous compounds and other pollutants from the residual air stream.

Price, trade spot and location

Woodchips can be produced from locally sourced renewable timber and do not contain any metal, stones, raw bark, green or residue wood materials.

E. Environmental Impact

Environmental Benefits

The filling material is organic, non-toxic and biodegradable through composting once its useful life is over. High efficiency of volatile contaminants and odoriferous complexes control and elimination. Total decomposition of the contaminants without secondary products creation through the Biofiltering process. It may also be used as water biofilters to prevent N and P to reach ditches and keep waterways healthy.[4]

F. Financial Aspects

-

G. Institutional and Organizational Aspects

Type of Organization and Governance Structure

Companies

Actors Involved

Woodlot owners or local feedstock suppliers, local entrepreneurs and the local wood industry enabled successful implementation of the biomass plants.

H. Public Perception and Social Impact

Wood chipping can help to valorise unused and underused raw materials and thus create new jobs and income streams in the fields of harvesting, manufacturing, logistics. Since wood chipping is a very simple technology with a high replication potential, it is suitable for various locations including rural areas. Moreover, they can be used as materials but also for heating, making the costs per MWh lower for wood chips than for heating oil and natural gas.

I. Challenges for Implementation

Expertise is needed or to design and build the biofilters. If the objective is just to produce the filter material, keeping the right quality of the wood chips is important and storage has to be done preferably on dry, level ground close to the transport road. Handling mouldy chips can lead to the release of high concentration of spores to the air. Due to their small size, mold spores are easily inhalable and they can penetrate the respiratory system causing allergic reactions, respiratory protection is recommended during construction, maintenance, and media removal. [7]

J. References

[1]https://www.burespro.com/en/product/wood-chips-for-biofilter/
[2] https://www.pastorinosrl.com/en/
[3] https://www.odourbalance.nl/en/dienst/biofilter-material/
[4] https://thamesriver.on.ca/wp-content/uploads/Woodchip-Biofilters-Manual-UTRCA.pdf (prevent N and P reaching ditches/waterways)
[5] https://www.tmabark.co.uk/tma-biofilter-services/
[6] Colmorgen F., Khawaja C. Small-scale technology options for regional bioeconomies. BE-Rural , September 2019.
[7]https://www.solidstandards.eu/images/Training/Summary_reports/module_woodchips_public_eng_public.pdf

17. (OTH-02) Straw based insulation (NL, UK, DE)

A. General

Title: Milling (cereal) straw to specific size and blow-in dry cavities of building walls and roofing to provide thermal insulation.

Location: Any region producing (cereal) straw, hemp shives (hurds), Miscanthus, etc.

Keywords: Straw; Cereal straw; Hemp shives; Miscanthus; Thermal insulation; Energy consumption; Blow-in; Panels; Bales

Example user / provider of technology: https://buildingbalance.eu/ketenprojecten/keten-inblaasisolatie/ (in Dutch; straw based blow in insulation), https://ecococon.eu/gb/ (prefab panels with wood construction and straw based insulation), https://fasba.de/wp-content/uploads/2022/02/the_strawbale_building_guideline_2019.pdf (straw bale building guidelines)

B. Feedstock

Main feedstock

Cereal straw

Other potential feedstock

Miscanthus, Hemp shives

Required feedstock quality

Feedstock should be dry and free from any mould, etc.

Feedstock source, price, trade spot and location

Feedstock can be sourced directly from the farmer after harvesting season, or from dry stock.
Typical price range in North-western Europe is 100 €/tonne in bales.

C. Technology

Technology Name

There are 3 options:

1) Milling and blowing in dry cavities of walls and roof.
2) Milling and pressing into prefab building elements.
3) Pressing into bales for straw bale building.

TRL

TRL 9 (the technology is released, and industrial production has started).

Description of Technology

The main processing steps include:

- Drying to moisture contents of about 10 wt.% or lower, in order to avoid growth of mould, fungi, etc.
- Milling to particle size suitable for further processing. For blow in insulation this may be shorter than for pressing into prefab building elements or bales.
- Cleaning the straw to remove dust.
- Blowing in cavities or pressing into prefab elements or bales with a packing density of about 100 kg/m^3 [1]. Density should be such high that potential settlement does not lead to unfilled cavity space.
    - For image of direct blow-in in wall cavity see https://zerocarbon.wordpress.com/chopped-straw-blown-in-insulation/
- The installation of the insulation products has to be such that it remains dry throughout the service life of the building. It may be noted that the biobased insulation material is moisture permeable, yet it is often advised to apply a moisture barrier foil.
- Some patents have been filed regarding the use of straw for thermal insulation of buildings, however, the use of straw to insulate houses is a long known principle.

Capacity

Equipment for blowing straw directly into wall or roofing cavities is in the range 100 – 500 tonne/annum [2].
For blow-in of prefab building elements, capacity is in the range 480 – 1600 tonne/annum [3].

Investment and Operational Costs

-

D. Product(s)

Product Name(s)

Blow-in insulation based on cereal straw, Miscanthus, hemp shives, etc.

In principle, the enclosure of insulation material, i.e. the building system, is supposed to provide the required fire behaviour.Apart from dust, no further residue streams apply. The dust may be used as fertilizer.

Price, trade spot and location

Price involves cost of straw, milling, cleaning and conversion into final product: blow-in, bales, prefab elements.

E. Environmental Impact

Environmental Benefits

Application of thermal insulation in buildings largely reduces the heating demand in winter and potential cooling demand in summer, thus reducing the contribution to global warming. At the same time, insulation material based on sustainably produced annual crops like straw etc. stores biogenic carbon (CO_2 extracted from the atmosphere) for a long period of time, which can be regarded as a temporary yet long term negative CO_2-emission.[4]

F. Financial Aspects

Financial Support

Risks relate to market demand rather than to technology development. Setting up feedstock supply and investment in equipment for conversion into insulation products (milling, cleaning, pressing, blowing-in) will be mainly private investment.

G. Institutional and Organizational Aspects

Type of Organization and Governance Structure

Establishing the value chain requires the collaboration of farmers, constructors and building owners. The involved technologies are relatively small scale, meaning that scaling up can keep pace with market demand. There is a mutual benefit for farmers and constructors to establish a multi-annual collaboration: it provides the constructors with feedstock/material of required quality standards and it provides the farmers with a relevant market for their straw.

Actors Involved

The main actors include farmers, constructors and building owners. Also architects and governments may be considered relevant actors. Architects to adapt building designs to the opportunities and conditions for biobased construction; governments to stimulate and support the insulation of houses using biobased insulation material, thus addressing climate change while at the same time supporting regional economy.

H. Public Perception and Social Impact

In general, the public has a positive image of biobased materials. However, biobased building materials are new again (after they have been replaced by fossil building materials decades ago) and experience the disadvantage of doubt. Nevertheless, biobased building conforms high standards and allows very durable building and construction. Key is the proper installation of materials, like for traditional building materials. This requires education of architects, constructors as well building owners/commissioners. As long as biobased materials like wood, straw, Miscanthus and hemp shives allow (semi) damp open building and construction, indoor climate faces less issues with high moisture content, and as a consequence biobased building results in more healthy indoor climate. Also, the value chain can be organised locally/regionally, thus creating local/regional jobs and enhancing social cohesion.

I. Challenges for Implementation

When removing an increasing amount of straw from the land, it may be considered that straw is often ploughed under the soil to improve/maintain soil health. Bringing back the dust to the land may contribute to soil health as the leaves and other non-fibre plant parts are often comprising the largest amount of nutrients [5].

J. References

[1] Zoë circular building, ‘chopped straw blown-in insulation’, https://zerocarbon.wordpress.com/chopped-straw-blown-in-insulation/

[2] ThermoFloc, blow-in machines, https://www.thermofloc.com/en/blow-in-technology/thermoblow-blow-in-machines

[3] ThermoFloc, blow-in machines for prefab,
https://www.thermofloc.com/nl/inblaastechnologie/prefabinstallatietechniek
[4] A. Levasseur, M. Brandão, P. Lesage, M. Margni, D. Pennington, R. Clift & R. Samson (2012).
Valuing temporary carbon storage, Nature Climate Change volume 2, pages 6–8,
https://www.nature.com/articles/nclimate1335
[5] W. Elbersen, Manipulating biomass ash content and ash quality in herbaceous biomass, 3rd Biomass Trade and Power Conference, Brussels, 24 February 2012, https://edepot.wur.nl/282359

18. (OTH-04) Plant-based protein using drying technology (FlavaPulse - BU)

A. General

Title: Production of plant -based protein from yellow pea (protein concentrate, flour and fibre) using state of the art technologies to formulate natural, nutritious, functional food & beverages.
Location: Shumen, Bulgaria
Keywords: Food protein transition, plant-based protein, innovative food processing.
Example user / provider of technology: https://flavapulse.com/

B. Feedstock

Main feedstock

FlavaPulse partners with to ensure consistency of crop quality, traceability of the yellow peas and limited transportation. Their sustainable practices not only ensure quality of our peas, but they also foster a vibrant, productive, and profitable agriculture in the European Union.

Other potential feedstock

Grains, beans, and lentils

Required feedstock quality

-

Feedstock source, price, trade spot and location

Local production from farmers in Bulgaria and Romania.

C. Technology

Technology Name

Combination of Innovative mechanical processes

TRL

TRL 7-9

Description of Technology

Innovative dry protein extraction (Air fractionation + Electrostatic separation),The process is purely mechanic and it is an alternative to wet extraction methods that involve energy consuming steps (drying) and lead to the loss of native functional properties due to the use of solvents or alkaline conditions during the extraction. The dry extraction includes: milling, air classification, and electrostatic separation. The air classification removes starch, whereas the subsequent electrostatic separation removes fibre from the resulting protein concentrate.

- Air-classification (Air fractionation): is used to separate grains based on differences in size, shape, and density by blowing air through (including de-hulling). After milling a pulse seed particles with different sizes. Protein bodies (small) and starch granules (big).. The smaller, lighter particles get blown out via the top and heavier ones fall to the bottom.
- Electrostatic separation: is used to separate particles based on their electrical conductivity and charge properties. By adding electrostatic separation to air classification, a higher pea protein purity can be obtained, enhancing the quality of grains by removing contaminants and improving their appearance, texture, and nutritional value. This desirable for various food products and applications, leading to improved marketability and consumer acceptance.

The benefits of dry extraction are: Low CAPEX/OPEX, low production cost, no use of solvent and water, Preservation of native protein, good functional properties.

Capacity

-

Investment Costs and Operational Costs

Investment Costs -

D. Product(s)

Product Name(s)

Pea protein concentrate, pea flour, pea hulls, clean taste pea flour and concentrate.

Price, trade spot and location

-

E. Environmental Impact

Environmental Benefits

Meat production is very resource-intensive, causing deforestation and large amounts of CO_2 emissions. Customer preference is shifting towards plant proteins, especially among the young generation. Plant based alternatives are trendy, and the market for alternative proteins is just booming. Pea protein concentrates offer an attractive alternative to pea and soy protein isolates, thanks to their competitive price and low carbon footprint.

F. Financial Aspects

Financial Support

Bank credit for financing of the required CAPEX and OPEX was completed (January 2022).

G. Institutional and Organizational Aspects

Type of Organization and Governance Structure

Flava-Pulse was created in 2021 when 9 investors agreed on the amount of the equity and the terms of the shareholders' agreement. The shareholders are from Switzerland, France, USA and Bulgaria. Most of them have a background in trading agricultural commodities.

Actors Involved

Feedstock providers (local farmers in Southeast Europe); R&D and technological partners, food manufacturers.

H. Public Perception and Social Impact

Plant-based alternatives are trendy, and the market for alternative proteins is booming. Flava-Pulse support production of yellow peas in Southeastern EU directly from local farmers, and uses state of the art technologies and the latest innovations to turn yellow peas into natural, nutritious, functional pea products. Flava-pulse supports formulators of plant based ingredients in the meat and dairy analogue industries, bakery, and gluten-free and allergen-free applications by supplying healthy ingredients.

I. Challenges for implementation

- Introducing new food ingredients into the market can be challenging, especially if consumers are not familiar with them.
- The cost of Flava-Pulse products compared to alternative ingredients may influence their adoption by food manufacturers.
- Flava-Pulse products may face competition from other plant-based ingredients or alternative protein sources in the market.

G. References

[1] https://flavapulse.com/about-us/
[2] https://www.futureofproteinproduction.com/exhibitors/flavapulse
[3] https://www.youtube.com/watch?v=xAl87Zr3u_c
[4] Q. Xing, et al., Innovative Food Science and Emerging Technologies 66 (2020) 10248
[5]https://btpubs.co.uk/publication/?i=814341&p=52&view=issueViewer

19. (MB-C9.1) Agricultural residue to produce tableware and packaging material (Bio-Lutions - DE)

A. General

Title: Agricultural residue based mechanical treatment and hot pressing producing tableware and packaging material (Bio-Lutions)
Location: Schwedt a.d. Oder, Germany
Keywords: Agricultural residues; tableware; packaging material; plant fibres; biodegradable.
Example user / provider of technology: https://www.bio-lutions.com/

B. Feedstock

Main feedstock

Agricultural residues.

Other potential feedstock

Bagasse; Rice straw; Banana trunks; Sugarcane leaves; Tomato trunks; Cereal straw.

Required feedstock quality

Strong fibres, not too fine (hardwood leaves), not too much like wood. Moisture content preferably in the range 10-15 wt.%.

Feedstock source, price, trade spot and location

-

C. Technology

Technology Name

Mechanical treatment and hot pressing

TRL

TRL 9 actual system proved and in operation.

Description of Technology [1]

The main processing steps include:

- Collection, drying and shredding of plant residues. E.g. tomato trunks, different types of straw, silphy, hemp etc. in Germany. And e.g. banana trunks, sugarcane leaves and bagasse, rice straw in India.
- Mechanical refining (patented process), without using heat or chemicals, into 'self-binding' micro and nano fibrillated fibcro® natural fibres. No components are extracted. [2]
- The fibres are mixed with water and stirred into a pulp. The pulp is then pressed into shape (tableware or packaging material) and hot-pressed using bio-heat. The process requires 3.5 litres of water per 1 kg of product.

Capacity

1,500-2,000 ton/year input in India; dry matter content not specified [2]. 400 – 850 ton/year output in India [3]. Bio-Lutions and PulPac (Dry Molded Fiber pioneer) are setting up a production facility in Germany, aiming at 72,000 ton/year input [4].

Investment Costs and Operational Costs

Investment Costs 8.3 million €. [5]

D. Product(s)

Product Name(s)

Disposable tableware and packaging items. Also other products are mentioned: Sporting goods, car panels, furniture, insulation for building and construction.

Price, trade spot and location

-

E. Environmental Impact

Environmental Benefits

Sustainable alternative to e.g. single-use non-biodegradable plastic tableware.

F. Financial Aspects

Financial Support

-

G. Institutional and Organizational Aspects

Type of Organization and Governance Structure

Bio-Lutions aims to provide the technology to parties interested in setting up a production plant.

Actors Involved

Feedstock providers; logistics company; customers.

H. Public Perception and Social Impact

80 people work in the India facility; in Europe this would be significantly less.

Valorisation of agricultural residues. Decentralized production possible. Raw material can be formed and coloured according to the user's needs.

I. Challenges for implementation

The processing facility has to be close to the feedstock sources (<60 km). Need of qualified workforce (expert knowledge in paper industry). Adequate infrastructure needed.

G. References

[1] Catalogue MainstreamBIO, Annex C9.1

[2] https://www.bioplasticsmagazine.com/en/news/meldungen/10-05-2017-Bio-Lutions-wins-Biobased-Material-of-the-Year-award.php

[3] https://www.bio-lutions.com/to-tackle-indias-growing-waste-problem-some-companies-are-changing-the-way-they-package-products/

[4] Power4Bio Catalogue - Bio-Lutions factsheet

[5] https://www.bio-lutions.com/category/press/

20. (OTH-05) Biomass- Combined Heat and Power (CHP) plant (Bioenergy NEXTgarden - NL)

A. General

Title: Biomass- CHP combustion plant (Bioenergy NEXTgarden)
Location: Located in a thriving greenhouse region called NEXTgarden in Bemmel, The Netherlands
Keywords: Combustion, power and heat, wood residues.
Example user / provider of technology: HoSt bioenergy systems, info@host-bioenergy.com

B. Feedstock

Main feedstock

NTA8080-certified shredded wood waste (low-grade wood chips, shreds, sawdust from the timber industry)

Other potential feedstock

Agri residues from the food and beverage industry

Required feedstock quality

This multi- fuel plant is so robust that it can accept a great variety of moisture and ash content and size up to as large as 40 cm.

Feedstock source, price, trade spot and location

-

C. Technology

Technology Name

15 MWth biomass-fired boiler.

TRL

9

Description of Technology

- Biomass-fired heat and power plant, turnkey supplied and owned and operated by HoSt
- Commissioned in 2021, has achieved an uninterrupted operation in 2023 for an impressive 14 months without maintenance stops. This is due to:
  - Best available boiler design
  - Multi fuel biomass plant
  - Robust optimized fuel feeding design
  - Reliable high-quality components
  - Service & maintenance contract including preventive maintenance
  - Continuous improvements of the design based on input from construction, engineering, operations, and maintenance experience
- Technical highlights:
  - Fuel type - Woodchips from pruning
  - Wood storage - 250 m^2
  - Wood supply system - Moving floor with chain conveyor and hydraulic push feeder
  - Fuel capacity - 7 tons/hour
  - Furnace -16.5 MW
  - Water tube boiler - 15 MW
  - Steam turbine - 3.4 MWe on 70 °C
  - Steam condenser - 11.4 MWth
  - Bag house filter - Dust emission <2 mg/Nm^3
  - Flue gas cleaning - DeNOx-cleaning (NO-NOx™)
  - Flue gas condenser - 3.5 MW
  - Efficiency - Up to 118% through the use of a flue gas condenser

- The best available cleaning technology is applied. This results in the lowest emissions ever measured at these types of cogeneration plants.
- While maintaining very high efficiency and achieving ultra-low emissions, this operational achievement exemplifies the power of providing a reliable and sustainable energy source.

- In March 2024 it has been upgraded to a multi-fuel boiler plant. The primary objective was to enable the use of lower-grade, yet abundantly available fuel types while maintaining compliance with strict emission standards. By modifying the fuel transport and handling system, the plant now boasts the ability to fire a diverse array of biomass materials. This includes 100% shreds from composting systems, even those with ash contents as high as 25%, and agricultural residues like soya hulls. The upgrade has also equipped the CHP plant to handle larger particle sizes, seamlessly processing materials up to 400 mm.

Capacity

Annual uptime 8,400 hours

Investment and Operational Costs

-

D. Product(s)

Product Name(s)

Renewable heat and power

Price, trade spot and location

-

E. Environmental Impact

Environmental Benefits

This 15 MW biomass-fired boiler plant eliminates the need for the traditional natural gas boiler. The amount of natural gas saved is 23 million Nm^3 / year. By turning area-sourced shredded wood residues with a high ash content into renewable heat and power, local growers meet their energy demands and reach their sustainability goals. The plant reaches a high efficiency rate due to the integration of a flue gas condenser. It is a clean biomass boiler plant due to NO-NOx cleaning technology.

F. Financial Aspects

Financial Support

Subsidies have been received from the Dutch Government within the so-called SDE++ framework (for both CAPEX and OPEX).

G. Institutional and Organizational Aspects

Type of Organization and Governance Structure

The technology supplier remains the owner of the power plant.

Actors Involved

Horticultural growers using the energy in their glasshouses in the NEXTgarden area, feedstock providers and the technology provider and owner Host.

H. Public Perception and Social Impact

Although there was some opposition by the public the installation is now fully operational.

I. Challenges for Implementation

- Acquiring subsidies for the project
- Getting and keeping the correct permits
- Coping with local opposition of environmentalist and local inhabitants

J. References

[1] https://www.host-bioenergy.com/project/netherlands-biomass-fired-chp-plant/
[2] https://www.host-bioenergy.com/chp-plant-evolution-upgrade-from-biomass-to-multifuel/
[3] https://twitter.com/HoSt_bioenergy/status/1666761686559125504
[4] https://www.nextgarden.nl/
[5] https://youtu.be/wonxpXpnLNE
[6] https://youtu.be/Ce4WSSP7PCU

21. (MB-C-11.1) Wood residue based thermolysis (gasification) producing renewable hydrogen (Hynoca - FR)

A. General

Title: Wood residue based thermolysis (gasification) producing renewable hydrogen (Hynoca)
Location: Haffner Energy, Vitry-le-François / France
Keywords: Biomass; renewable hydrogen; thermolysis; gasification.
Example user / provider of technology: https://h2energy.ch/en/ ; https://www.h2gopower.com/ ; https://www.haffner-energy.com/

B. Feedstock

Main feedstock
Wood residues
Other potential feedstock
Agricultural residues, recycled biomass
Required feedstock quality
-
Feedstock source, price, trade spot and location
90 €/tonne

C. Technology

Technology Name
Thermolysis
TRL
TRL 8
Description of Technology [1]
The main processing steps include:

- Hynoca exploits thermolysis, followed by thermochemical reactions like the steam reforming of natural gas.
- The first step is to transport and storage the feedstock (wood- based, agro- based and recycled- based biomass) then to decompose the biomass into thermolysis gas (initial flow of gas produced by the thermal decomposition of the biomass) and a biochar (carbonaceous solid product).
- The second step consists of treating the thermolysis gases in an equipment that will perform the cracking and hydrogen enrichment reactions by the "gas to water" reaction. This step is the key link in the destruction / cracking of long molecules, especially tar, to obtain a high energy syngas called "Hypergas" very rich in H_2 with the help of catalyst (ZnO).
- The following steps consist of separating, extracting and removing the residual CO_2 and CO from Hypergas and then purifying the hydrogen to a degree of purity of 99.97 % by means catalyst (CuO) and membranes.
- Finally, Hydrogen can be used for different applications as mobility, power generation or production of methane.
- Other Input Materials: catalyst

Capacity
500 tonne/year feedstock in, 41 tonne/year hydrogen production. [11]
Investment Costs and Operational Costs
Investment Costs 5.4 million €.

D. Product(s)

Product Name(s): Hydrogen. Secondary products are hypergas and biochar.
Price, trade spot and location: Hydrogen: 10 €/kg

E. Environmental Impact

Environmental Benefits

Use of renewable resources. Carbon neutral conversion process.

F. Financial Aspects

Financial Support

Funding Schemes (CAPEX): a) Financing: 2.7 M€ (0.9 M€ grant and 1.8 M€ repayable assistance); b) Eligible 3.3 M€: 1 M€ Centrale Supélec, 0.3 M€ Communauté de Communes, 3.2 M€ Haffner Energy and 0.8 M€ SEM Vitry Energies.
Public Support: Investment funds EUREFI proposed by CAISSE DES DEPOTS and obtaining 1,7 M€ of PRI (Partenariat Régionaux d'Innovation) from BPI France et la région Grand-Est.

G. Institutional and Organizational Aspects

Type of Organization and Governance Structure

Haffner Energy has been in energy engineering and biomass to energy projects for nearly 30 years and is the designer and builder of the HYNOCA process since 2010. A first large industrial and commercial HYNOCA installation, with a capacity of 720 kg of hydrogen per day, started operation in July 2021. [2]

Actors Involved

Feedstock providers; logistics company; customers.

H. Public Perception and Social Impact

This solution needs specific skilled workforce in order to be transferred to the rural environment. In addition, new jobs opportunities in regards to infrastructure, logistics and supply should be created.
Decentralized production: the plant can be built up and operated at almost any location, its size can be adjusted to the local needs (contribution to circular economy). Local and renewable raw materials can be used in the process. The plant size can be adjusted to the local needs.

Competitiveness of the solution - The main advantages are the production of hydrogen with high quality (degree of purity of 99.97 %) achieving renewable hydrogen selling price lower than 4 €/kg with respect to the 2021 price of 10 €/kg. Energy efficiency rate is claimed to be exceeding 70 %.
The utilization of the hypergas, a side stream, can be used as energy source for steam and heat production in farms and in auxiliary facilities. Another side stream, biochar, may be used as soil amendment in the fields.

I. Challenges for implementation

Operation cost and flexibility of the production.

G. References

[1] Catalogue MainstreamBIO, Annex C11.1
[2] https://www.haffner-energy.com
[3] https://hydrogentoday.info/news/4534
[4] https://solarimpulse.com/companies/haffner-energy
[5] https://www.verif.com/bilans-gratuits/HAFFNER-ENERGY-813176823/
[6] https://www.transplo.com/FR/Vitry-le-François/1398295953810683/Haffner-Energy
[7] https://www.actu-environnement.com/ae/news/hydrogenerenouvelable-biomasse-33338.php4
[8] https://fuelcellsworks.com/news/france-green-hydrogen-in-2021-forstrasbourg-buses/
[9] https://infolocs.files.wordpress.com/2019/08/190826_cp_rhynoca_ok.pdf
[10] http://www.hydrogenfuelnews.com/france-to-demonstrate-theproduction-of-hydrogen-from-biomass/8536346/
[11] Power4Bio Catalogue - Hynoca factsheet.

22. (BR-01) The Containerized-Mobile Pyrolysis (ETIA Biogreen - FR)

A. General

Title: Mobile pyrolysis for secondary biomass (residues)
Location: France
Keywords: Residues, energy products, small scale
Example user / provider of technology: ETIA Biogreen [1]

B. Feedstock

Main feedstock

Secondary biomass: Residues from forestry and forest-based industry (pruning wood); Residues from agriculture and verge grass.[2]

Other potential feedstock

Plastic residue, dried sewage sludge, carbon-based materials.[3]

Required feedstock quality

The biomass preferably does not contain too much water (less than 20%) to minimize the water in the product liquid oil. Dried wood, dried manure, straw, olive residues and dried sludge have been tested or specified.[2]

Feedstock source, price, trade spot and location

C. Technology

Technology Name

Pyrolysis

TRL

TRL 8-9

Description of Technology

- The biomass is dried and ground (approx. 2 mm) to give sufficiently small particles to ensure rapid reaction in the pyrolysis reactor.
- The biomass is thermally cracked (400°C -600°C) in an oxygen-free environment.
- Pyrolysis converts biomass into a solid product (char), condensable vapours (bio-oil) and gases (e.g. CO_2, CO, CH_4, H_2 etc.). The interaction between pyrolysis temperature and residence time influences the yield distribution and quality characteristics of these products.
- This ready to use technology is suitable for fast, temporary applications.
- In the fast pyrolysis process at 500°C around 75% of the biomass is converted into bio-oil and the remainder into biochar (12%) and gas (13%).
- often a system is added to combust the produced gas and char to provide heat for the reactor or dryer or export. [4]

The process does not need to operate under pressure. Pyrolysis oil has an energy density which is up to 4 to 20 times higher than the solid biomass.

Capacity

Up to 16 tons/day of feedstock. Pyrolysis oil (8 tons/day), syngas (9 MWh/day to be used as heat for drying or to be converted into energy), biochar (4,8 tons/day to be used as solid fuel, soil amendment, fertilizer, water retention material).[6]

Investment and Operational Costs

Basic unit cost $436,000 (2018). However Capital costs, operational expenses and return on investment are linked to the individual business case and operational model.[5]

D. Product(s)

Product Name(s)

Pyrolysis oil (a mixture of components containing aromatic compounds like phenol, it also contains sugar derivatives, organic acids and other substances. Pyrolysis oil can be used as fuel and as a source for a naphtha-cracking process in which chemicals can be extracted. The oil has a far higher density than the original biomass, which is more convenient for storage and transport purposes. The gas by-product is usually burned in order to generate heat for the pyrolysis reactor, and the biochar is a solid carbonaceous residue and it is suitable as soil improver or as solid fuel.

E. Environmental Impact

Environmental Benefits

Pyrolysis has several advantages over traditional treatment methods. Enhances the of renewable energy replacing petroleum-based products. It allows the conversion of various feedstocks including different plastic types, mixed and contaminated plastics, into valuable resources. The absence of oxygen in the process prevents harmful emissions, making it an environmentally friendly option.

F. Financial Aspects

Biogreen is currently selling biochar for $980 euro per ton, ($1156 dollars US or $0.58 per lb) in France. They are also currently the only supplier in France with EU Biochar Certification.

G. Institutional and Organizational Aspects

Actors Involved

Biomass suppliers, technology suppliers, fund managers and investors, consultants, research institutions, associations, local government.

H. Public Perception and Social Impact

The technology is suitable for a decentralized utilization on a small scale, since it does not require interferences in local infrastructure. The technology can create new income streams and value-added products [2].

I. Challenges for Implementation

- Lack of Awareness: Many potential customers are unaware of the benefits and uses of mobile pyrolysis plants, making them hesitant to invest in this new technology.
- High Initial Costs: The significant initial investment needed can deter small and medium-sized businesses from adopting this technology.
- Operational Challenges: Difficulties in sourcing and transporting feedstock can increase operational complexity and costs.
- Regulatory Hurdles: Strict regulatory approvals and permits in some regions can delay the setup and expansion of mobile pyrolysis plants.

J. References

[1] https://www.biogreen-energy.com/
[2] Colmorgen F., Khawaja C. Small-scale technology options for regional bioeconomies. BE-Rural, Sep 2019.
[3] https://circularenergy.eu/mobile-plastic-waste-pyrolysis-system/
[4] https://www.biogreen-energy.com/containerised-plant-module
[5] https://www.rffi.org/Library/RFFI_Final_Biochar_System_Chart_12_14_18.html
[6] https://www.rffi.org/Library/RFFI_Equipment_Alternatives_Report%2012_14_18.pdf

23. (MB-C12.1) Sewage Sludge hydrothermal carbonization (HTC) producing bio-coal (TerraNova - DE)

A. General

Title: Sewage Sludge based hydrothermal carbonization (HTC) producing bio-coal TerraNova.
Location: Düsseldorf, Germany
Keywords: Sewage sludges, hydrothermal carbonization, Biocoal, Phosphorous
Example user / provider of technology: https://terranova-energy.com, https://ingelia.com , https://www.c-green.se/ , https://htcycle.ag/ , https://www.suncoal.com

B. Feedstock

Main feedstock
Sewage Sludges.
Other potential feedstock
Forestry residues, agricultural residues, food residues, organic fraction (urban solid wastes)
Required feedstock quality
Dry matter content: minimum: 5 w-% and maximum: 30 w-%
Feedstock source, price, trade spot and location
-

C. Technology

Technology Name
Hydrothermal carbonization
TRL 9
Description of Technology

- Dewatered sewage sludge with a dry matter content of 5-30% is conveyed into the input heat exchanger. Then, the preheated sewage sludge is carbonized in an agitated reactor under the addition of catalyst for 3 hours at a temperature level of around 200°C.
- The resulting coal slurry is cooled down and dewatered to a dry matter content of 65-70%.
- The extracted water contains valuable nutrients like Phosphorous and Nitrogen that can be recovered as fertilizer.
- By means of fixation to Calcium Silicate Hydrate (CSH), the Phosphorous is bound and extracted in a filter press.
- The sludge water is not evaporated but mechanically extracted in a very energy efficient way saving up to 80 % energy compared to drying. Another advantage is that biomass with high water content can be used with this technology.
- Other Input Materials: heat, catalyst, power

Capacity
-
Investment and Operational Costs
2.1 million €; 28 €/ton input DM

D. Product(s)

Product Name(s)

- Biocoal: The slurry coal or bio-coal produced can be sold to heat and power plants, cement plants and waste-incineration plants and is used to generate neutral CO2 energy.
- Phosphorus: Phosphorus is recovered as part of the process and can be used as particularly rich organic fertilizer.
- Side Product: Filtrate (rich in P and N).

Price, trade spot and location

- Biocoal: 500 €/tonne in Germany
- Economic value increase: 28 (€ output / ton input DM)

E. Environmental Impact

Environmental Benefits

- Phosphorous recovery
- Destruction and safe disposal of pollutants (e.g. toxins, heavy metals, organic compounds and pathogens)
- Reduction of disposal volume by 75%
- 80% less energy demand than drying

F. Financial Aspects

Financial Support

-

G. Institutional and Organizational Aspects

Type of Organization and Governance Structure

Actors Involved

- Feedstock providers
- Converters
- Operation technicians
- Logistics company

H. Public Perception and Social Impact

This solution is easily implemented in rural areas to small scale, new jobs can be created by the cooperation of the farmers in the activities developed by other industrial partners.

Role of the biorefinery in the rural ecosystem - This solution can use local residues (agricultural residues) contributing to the cooperation with other industrial partners near to the farm. Solution can produce locally products useful to farmers with a high added value as fertilizers for lands or energy carriers for energy supply in the farm.

Contribution to social impact - The implementation of this solution in the rural environment can lead an improvement on living conditions of the rural communities, avoiding problems generated from the traditional disposal of sewage sludges and helping to generate a closed valorisation value chain.

De-centralized bioproducts production - The adoption of this sewage sludges conversion technology in rural communities can help to guarantee the supply of low cost raw materials for primary production (less dependency). The operation cost in the farm (mainly the cost regarding the energy production) would be reduced with the use of the bio-coal and maybe with fertilizers formulated from nutrients recovered.

Advantages for Farmers: Collaboration between wastewater treatment plants, waste management companies, and energy/fertilizer producers can benefit farmers by reducing raw material costs, mainly fertilizers from nutrient recovery (P and N), bio-coal for energy self-consumption, and HTC filtrate for co-digestion with other agricultural residues.

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24. (OTH-06) Grass-based insulation mats (Gramitherm Europe - BE)

A. General

Title: Grass fibres to produce innovative insulation materials.
Location: Wallonia, Belgium.
Keywords: Local biomass (grass), insulation materials, peri-urban areas.
Example user / provider of technology: Gramitherm

B. Feedstock

Main feedstock

Grass clippings from mowed grass. only use grass that doesn't have any other commercial uses, like the grass that is used for animal feed.

Other potential feedstock

Straw, or other fibrous plant materials.

Required feedstock quality

-.

Feedstock source, price, trade spot and location

Local resources in the Benelux area. For example, we cut and use grass from airports in the Netherlands and other countries.

C. Technology

Technology Name

Extraction, drying and anaerobic digestion

TRL

TRL 8-9

Description of Technology

The manufacture insulating boards made with natural grass call The Gramitherm® process extracts from raw grass, cellulose fibres (used to produce the insulation material and juices which are supplied to biogas units as energy booster. The Gramitherm® process secures a full utilisation of all grass components, and generates high efficiency and added value to the raw material. The Gramitherm® is a patented innovation based on 3 key steps :

- The cutting and harvesting of "waste" grass ;
- The grass fibres extraction from the raw material ; valorisation of the juice ; drying and opening fibres. The biogas produced from grass juice recovered and supplies all the energy to dry and treat the fibre.
- Finally, the semi-rigid boards production (AIR-LAY process, thermobonding oven).

Capacity

The production capacity is 200,000m³/year. Approximately 200 m³ of Gramitherm® insulation material is produced from one hectare of grassland. production of biogas.

Investment and Operational Costs

-

D. Product(s)

Product Name(s)

Insulation materials (mats) with a life span of 50 years. These products can be used for new buildings as well as for renovations.

Price, trade spot and location € 21,85 per m²

E. Environmental Impact

Environmental Benefits

Gramitherm® products are 100% eco-friendly and demonstrate high insulation performance. Produced from grass which grows naturally and does not need any ploughing or expensive treatments. The grass absorbs more CO_2 during its growth than is emitted during production. Gramitherm® has made a life cycle analysis, and confirm that 1kg of Gramitherm® will absorb 1.5 kg of CO_2. 1 acre of grass equivalent to 200 m3 of Gramithem, i.e. insulation for 7 family houses, equivalent to 3.6 T CO_2 captured (or go/return flight from Brussel to Cape Town). In the production process of

Gramitherm, digestible materials are dissociated from fibres to be used separately (animal food and fertilizer). There is not in competition with food production.

F. Financial Aspects

Financial Support

Gramitherm® has received the support of the European Regional Development Fund (ERDF)

G. Institutional and Organizational Aspects

Type of Organization and Governance Structure

Gramitherm is a Private company.

Actors Involved

This project has been made possible thanks to the partnership between CLEAN INSULATING TECHNOLOGIES (which holds the intellectual property rights to Gramitherm®, an innovative industrial process for making thermal insulation panels based on grass), INVESTSUD and NAMUR INVEST, two Belgian regional funds. The project has the financial backing of Sowalfin's EasyGreen in association with the banking world as well as the investors referred to above.

H. Public Perception and Social Impact

Gramitherm® is an insulation material considered environmentally friendly and high-performing. The panels are easy to install and non-irritating: they can be touched without a mask or gloves. To produce Gramitherm®, local resources are integrated into a regional value chain for local markets. Agriculture is a key production partner. The "silage" grass sourcing is done through partnerships with local farmers. The solution also contribute to the education and awareness-of the benefits of eco-friendly insulation materials and sustainable building practice.

I. Challenges for Implementation

The insulation market is highly fragmented, numerous competing products and technologies available. Gramitherm must differentiate from other options by effectively communicate their unique value proposition to potential customers.

J. References

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25. (OTH-07) Phytoextraction of nickel with perennial plants to extract nickel from mining site's soil (Botanickel - FR)

A. General

Title: Cultivation of hyperaccumulator plants to extract nickel from abandoned mining sites or contaminated soil (Agromining, Phytomining). Biomass is chopped to produce pellets and nickel is recovered and recycled via a combustion process where energy is produced and nickel is recovered from the ashes and it is used in the production of stainless steel.

Location: Technology has been developed in France. Several soil remediation operations using hyperaccumulator plants have taken place in Europe (France, Albania, Spain, Greece and Austria) [1] and it is reported that a pilot production for nickel recovery has already started in several countries.[2]

Keywords: Recovery of valuable metals, soil contaminated with heavy metal, rural areas or abandoned industrial areas.

Example user / provider of technology: botanikel (https://www.botanickel.com/), econick (https://www.econick.fr/), aperam (www.aperam.com).

B. Feedstock

Main feedstock

Nickel hyperaccumulator plants e.g. perennial herbs like: Odontarrhena chalcidica (formerly Alyssum murale) and other species of the genus Odontarrhena.[1]

Additional feedstock

At least 30 taxa of Odontarrhena are Ni hyperaccumulators. However, the genus Odontarrhena (Alyssum) is by no means the only with suitable metal crops, others include Bornmuellera/Leptoplax, Noccaea, etc. Other species from Mediterranean-type climate may also be used, such as Berkheya coddii from South Africa. [1]

Required feedstock quality

Hyperaccumulator species that can accumulate >1 wt% (10,000 mg/kg) of Ni in dry shoot biomass are suitable. Desirable properties include fast growth rates, easy mass propagation, high biomass production and adaptation to local edaphic and climate conditions.

Feedstock source, price, trade spot and location

Botanickel, exploits local endemic plants on nickel-rich land and opens up new opportunities for agricultural areas. This innovation has been fully integrated into the new value chain that Aperam is now defining.

C. Technology

Technology Name

Cultivation of hyperaccumulator plants, thermochemical conversion of biomass, metal recovery.

TRL

Phytoremediation of soils has been reported to have TRL 5. Botanickel mentioned that the technology for their nickel recovery has been proved at pilot production . Estimated TRL 6-7. [4]

Description of Technology

Phytomining is an eco-friendly alternative to traditional mining methods. It can be particularly useful for recovering metals from low-grade ores or contaminated soils. This biobased solution consist of the following steps:

- Cultivation of native hyperaccumulator crops for the remediation and improvement of land with low agricultural yields due to the presence of nickel. These plants can grow in specific metalliferous soils that are often inhospitable for cultivating traditional crops and have the ability to safely accumulate extraordinarily high amounts of heavy metals, including cobalt, cadmium, manganese, zinc, and nickel.
- Combustion of harvested biomass. The plants are dried and chopped into pellets which are burned (combustion) to produce energy that used by local communities and ashes with high nickel content.
- Recovery and upgrading of extracted nickel for use in the production of stainless steel. Nickel is concentrated and transferred to Recyco, Aperam's European recycling unit initially dedicated to recovering and treating the metallic content from melting shop dusts.
- Production of bio-based fertilisers. The process generates by-products that can be used as high value fertilizers.

Capacity

Agromining cannot yet compete with industrial extraction, the amount of metal that can be extracted from a field is relevant. Botanickel reports a 20 metric tonnes biomass hectare/year yielding up to 300 kg nickel metal and suggests an annual yield of >80 kg Ni/ha/year (optimum >200 kg Ni/ha/year). [1] Botanickel reported that the plant 'shrub *phyllanthus rufuschaneyi'*, cultivated by Econick, can absorb around 250kg Ni/ha/year.[5]

Investment and Operational Costs

Agromining investment and operational cost need to consider the following aspects [1]:

- The hyperaccumulator plan is generally a biannual species that requires re-sowing every other year.
- A sustained yield last over 20–30 years of 150–250 kg of nickel-metal per hectare per year.
- At the base nickel value of $15 kg (5-year average price), this is worth $2250– 4000 per hectare per year (excluding production and processing costs of the biomass).[6]

D. Product(s)

Product Name(s)

Nickel metal, local renewable energy, bio-based fertilisers.

Price, trade spot and location

-

E. Environmental Impact

Environmental Benefits

Botanickel, promotes phytoextraction and aims to become a reference in the production of bio-sourced nickel contributing to nickel circularity and to the sustainable production of stainless steel. It also contributes to the reduction of GHG emissions associated with the production of ferronickel and stainless steel.

Native hyperaccumulator plants are cultivated in accordance with the principles of agroecology to improve soils that are naturally inhospitable to common crops while also preserving the local environment and protecting biodiversity.

F. Financial Aspects

Financial Support

Econick one of the companies leading this solution was created with the funding support from the European Union's Horizon 2020 research and innovation programme via the projects Agronickel and LIFEAGROMINE.

G. Institutional and Organizational Aspects

Type of Organization and Governance Structure

Joint venture (2023) between Aperam a leading stainless steel company and Econick, a young spin-off company from the University of Lorraine (Nancy, France) which develops the technology of producing biosourced metals from hyperaccumulator plant crops. With this joint venture Botanickel gets into an industrial phase to providing the Aperam Group with a real biosourced metal supply.

Actors Involved

The development and deployment of this activity needs to be carried out in close collaboration with local populations and communities (local farmers), local energy generators, companies, regional authorities.

H. Public Perception and Social Impact

Botanickel has already established as a reference for agronomy and industrial feasibility projects, and for land diagnostics. This type of solution contribute to improve local ecoystems, population health, empowering local communities involved in the new value chain. Botanickel's strategy is developing opportunities in research, education, training, fair employment, and renewable energy production aligned with local priorities.

I. Challenges for Implementation

Not all areas and types of soils are suitable for agromining. Some of the key factors to consider for site selection include [1]:

- Occurrence of >100 km2 contiguous soil to establish a local industry
- Soils >2000 mg/ kg total Ni and >200 mg kg-1 DTPA-extractable Ni

- Suitable native hyperaccumulator species are available
- Soils capable of being easily cropped with local agricultural methods
- Local infrastructure and 'social license to operate' are important

Agromining may in principle be undertaken to produce Se, Cd, Co, rare earth metals (REEs), Mn, Ni, Tl, and Zn, as hyperaccumulator plants are known for these elements. However, Cu and Pb hyperaccumulators have poor accumulation characteristics and are therefore not suitable for agromining. Nevertheless, the plants currently used are used in their natural state and breeding efforts focussing on the plant's behaviour, in particular its speed of growth, and metal yield may be a solution for these cases. For 'phytomining' to be profitable, perennials need to be able to regrow quickly after each harvest.

J. References

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26. (OTH-08) Phytoremediation to produce bioenergy products and biofuels (UK, ES, LT, SB, RO)

A. General

Title: Phytoremediation of contaminated land by using plant cultivation (e.g. perennial and annual plants) for bioenergy applications

Location: Several European brownfields and contaminated sites with hydrocarbons and heavy metals (urban and rural). Pilot projects: Tarragona-Spain and Siauliai-Lithuania are contaminated sites with hydrocarbon, Serbian-Romanian border site is contaminated with heavy metals [1] and a site on Stockton-on-Tees in the United Kingdom also brownfields contaminated with heavy metals [2,3].

Keywords: Phytoremediation of contaminated soils, bioconversion thermochemical conversion of biomass to energy products.

Example user / provider of technology: Phyto2Climate [4], Terravesta [5], Fraunhofer UMSICHT Institute Branch Sulzbach-Rosenberg [6]], University of Life Science from Timișoara [7]

B. Feedstock

Main feedstock: Perennial and annual grasses (miscanthus, giant reed, reed canary grass and switchgrass) [1], [2], [7], [8].

Other potential feedstock

Rotational crops: sorghum, rapeseed plants [7].
Other crops: Jerusalem artichoke, amaranth, and herbaceous plants common in the region[7].
Trees (poplars and willow trees, pine and eucalyptus) [12,13].

Required feedstock quality

The biomass has to be dried and pelletized. If the concentration of contaminants in the biomass reaches higher concentrations than permissible level for its application, the biomass should be mixed with clean materials to bring down level of pollutants in the product.

Feedstock source, price, trade spot and location

Miscanthus giganteus and sweet sorghum cultivation has been reported.

C. Technology

Technology Name

Phytoremediation (cultivation of energy crops) and Thermo-Catalytic Reforming (TCR®) which combines an intermediate pyrolysis process and catalytic reforming of the pyrolysis products.

TRL

Phytoremediation TRL 7.
Process for biorefining sugar plants with preservation and extraction of sugars to obtain biofuels and other biochemicals TRL 4.
Combined technologies (Phytoremediation + Thermo-Catalytic Reforming (TCR®) has a TRL 5.

Description of Technology

In this solution multiple technologies are used:

Cultivation of perennial plants such as Miscanthus giganteus and annual plants such as sweet sorghum to sequester inorganic contaminants into the root system; the above-ground biomass can be safely used for biorefinery despite the contamination.

The proposed circular approach proposed here consists in processing crops biomass in cascade. Biorefinery will primarily process sugars to liquid biofuels-biochemicals. Crops harvested from polluted areas, especially heavy metals (HM) contaminated soils (high or low polluted) is considered as feedstock for an industrial scale biorefinery. The harvested biomass (highly polluted and low polluted) from the envisaged area is used as feedstock in biorefinery for liquid biofuels, anaerobic digestion and subsequently thermal decomposition, or Thermo-Catalytic Reforming (TCR®), applied in cascade:

Biorefinery – Anaerobic digestion – Thermo-Catalytic Reforming

Thermal decomposition (combustion-pyrolysis) is performed to concentrate HM from digestate obtained by processing biomass from very polluted areas, primarily envisaged to carry heavy metals in high concentration.

After biorefining, both lightly polluted and heavily polluted biomass (by-products) are sent to anaerobic digestion (AD) to continue this way the biorefinery of the feedstock and to deliver more energy (gaseous biofuel - biogas) and to continue decomposition of the vegetal organic complex structures. After AD process, the obtained digestate is separated in liquid and solid fraction, which will contain HM in varying concentrations. The solid fraction containing HM above legal limits, is sent to TCR®. The ash/char is used to extract metals in concentrated form and re-delivered to metals industry. The solid fraction containing HM within legal limits, is used as soil improver and immobilizer for lightly polluted soil, this way gradually returning polluted soil back to produce edible crops.

The Thermo-Catalytic Reforming (TCR®), is a thermochemical conversion process that combines two stages. 1) An intermediate pyrolysis process and 2) catalytic reforming of the pyrolysis products. [9] In the pyrolysis step, the biomass is gently broken down into biochar (a carbon rich fraction also called bio-coke) and volatile gases in a continuously operating screw reactor in the absence of oxygen at temperatures between 400-500°C. The second stage, take place in a post-reformer at temperatures of 500- 700 °C, where the biochar and the volatile gases become in contact to improve the gas yield and product quality. In the pots-reforming step, the biochar acts as a catalyst to further refine the pyrolysis gases (increasing the hydrogen content within the gas) and to reduce the formation of tar and other pollutants. The gases are then cooled and a condensate containing oil and process water produced. The products of the TCR® are: bio-coke containing heavy metals (that can be used in the steel industry), hydrogen-rich syngas, bio-crude oil and an aqueous phase.

Subsequently, the TCR® products are upgraded to high-quality energy carriers:

- The bio-crude oil is refined by distillation for its direct use as marine fuel (ISO 8217).
- The bio-coke, is evaluated for the substitution of petroleum-based coke in the copper melting industry without further refinement.
- The aqueous phase of purify by electro-oxidation (electro chemical process) to produce hydrogen. The hydrogen and the non-condensable hydrogen-rich syngas from the TCR ®process are the feed for a Gas-to-Liquid process in other to produce liquid hydrocarbons like gasoline and diesel.[7]

The TCR process works with a broad spectrum of biomasses and residues with a dry content of 70 percent or more, e.g. sewage sludge, fermentation residues from biogas plants, wood residues, landscape conservation material, industrial biomass residues such as spent grains or sludge from paper recycling, biowaste fractions, straw and other agricultural residues up to animal excrements.[8]

Capacity

The first technologies applied in this processing in cascade are mature, several biorefineries, including lingo-cellulosic (second generation) biofuels production capacities are in operation, while anaerobic digestion technology for biogas production is applied for decades around the world. Regarding the last technology in the cascade processing chain, Thermo-Catalytic Reforming, currently, there are several TCR® plants available ranching from lab-scale with a feed capacity of 2kg/h until large scale with 500 kg/h to convert pelletized and dried biomass collected from pilot sites. The TCR technology was developed for a containerized, compact plant design. The technology thus represents a decentralised solution for the recycling of biogenic residues of various kinds all over the world.

Investment and Operational Costs

-

D. Product(s)

Product Name(s)

The products of the cascade processing proposed here are: bioethanol (1st and 2nd generation), biomethane, while TCR® deliver: bio-coke containing heavy metals (that can be used in the steel industry), hydrogen-rich syngas, bio-crude oil and an aqueous phase.

Price, trade spot and location

-

E. Environmental Impact

Environmental Benefits

With this solution contribute to restore degraded lands by phytoremediation and application of digestates, to restore soil biodiversity applying microbes-rich digestate as soil improver and fertilizer, to lower the pressure in land-use competition, to increase carbon uptake in the soils, to substitute petroleum-based fuels and to make the development of renewable fuels an economically attractive endeavour.[10]

F. Financial Aspects

Financial Support

In Europe, phytoremediation projects have been highly supported by Horizon 2020 EU's Research and Innovation programme like:

- 'Biomass, Remediation, Regeneration (BioReGen): Phytoremediation with willow trees, miscanthus, reed canary and switch grasses cleaned up the soil by absorbing contaminants such as zinc, copper, cadmium and heavy metals in coal ash [10]
- 'MIScanthus biomass options for COntaminated and MARginal land: quality, quantity and soil interactions. (MiSCOMAR): to develop techniques for Miscanthus production on marginal land in Europe by improving the understanding of sustainable integration of Miscanthus on farm and landscape levels. [11] 2020
- GRowing Advanced industrial Crops on marginal lands for biorEfineries (GRACE): non-food industrial crops miscanthus and hemp as a source of biomass for the bio-economy using marginal, contaminated and unused land at an industry relevant scale.[13]
- Phytoremediation solutions from contaminated lands worldwide (Phy2climate): focus on clean biofuel production and phytoremediation solutions from contaminated lands worldwide. [1]
- Development of an universally applicable methodology to assess the impacts of soil degradation upon soil functions and ecosystem services, in collaboration with stakeholders, innovative measures, and evaluate the efficacy of these regarding soil functions and ecosystem services as well as costs and benefits; assessment of existing soil related policies and to derive recommendations for improvement (RECARE project). [14]

In the UK, miscanthus growers can take advantage of the Sustainable Farming Incentive (SFI) for permanent crops, which rewards farming practices that can protect and improve the environment. For Miscanthus classified as non-horticultural permanent crop three SFI action plans are available for soils, nutrient management and for integrated pest management.[15]

G. Institutional and Organizational Aspects

Type of Organization and Governance Structure

-

Actors Involved

Farmers, companies producing biofuels, energy supply industry, policy makers, research institutions e.g. Industrial biotechnology companies to design crops with increased yields, higher calorific value and lower ash content to end-markets. Biorefining contaminated biomass will require that all actors involved a secure supply of feedstock.

H. Public Perception and Social Impact

The use of contaminated sites facilitates the cultivation of energy crops without the risk of increasing food competition, increases the security on fuels and more stable energy prices. Improved land soil quality, biodiversity and resilience. For farmers, they can increased financial returns compared to other crops (OSR/wheat/barley) rotations on marginal lands which are prone to changes on grain prices caused by international geo-political and climate conditions.

I. Challenges for Implementation

Biomass application has to be limited to biofuel or energy and not extended in applications like bedding and textiles. One important hurdle is the handling of the contaminated biomass. Any combustion step should occurs taking care that the contaminants are capture, treated and reused or dispose properly. The use of processes like fermentation processes for 1st and 2nd generation bioethanol and biogas production present the problem of contaminant spreading in high volume by-product streams such as fermentation residues or vinasse. Similarly, in state of the art 1st generation biodiesel, the contaminants can also end up in the products and by-products such as glycerine and press cake. Therefore, all these by-products should be processed in cascade, by TCR® proposed here and the bio-coke containing heavy metals is delivered to metallurgic industry for extraction of heavy metals in a circular economy. Additionally, a main hurdle to produce biofuels from phytoremediation is the legal framework on soil management remediation, including soil quality standard and remediation targets and legal limitations to the use of GMO for soil remediation.[9]

J. References

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Annex 4. Format catalogue biobased social innovations

#. Solution Code - Name of the social innovation for small scale bio-based solution

A. Description

Short description of the social innovation:

- Main objectives
- Social innovation's target
- Approach
- Location and Example user

B. Activities

Short description of the main activities perform by the social innovation.

C. Actors Involved

What are the main actors involved in the social innovation , e.g., local farmers, regional authorities, local volunteers, companies, civil society, etc.

D. Impact for bioeconomy development

What is the main impact of the social innovation to bioeconomy development, e.g., resource and energy efficiency, waste management, lower water consumption, contribution of reduction of GHG gases, etc.

E. Social Impact

What is the main social impact of the social innovation, e.g., public participation education, training, assistance and advise, job creation, reduction of food residues.

F. Challenges for implementation

Indicate the main hurdles for social innovation. These could be legal, economic, organizational, environmental, social.

G. References

Numbered references ([1], [2], etc.) that can be mentioned in the description above. Each social innovation solution starts numbering at [1] again.

Annex 5. Catalogue of biobased social innovations

27. (MB-D-01) Cooperative network in France of small-scale farmers, employees, and agricultural development organizations, providing a tool box of farmer-driven technologies and practices (L'Atelier Paysan, FR)

A. Description

This cooperative of small-scale farmers, employees, and agricultural development organizations is a social innovation dedicated to empowering farmers by disseminating agricultural knowledge and promoting technical and technological sovereignty. Through an open source resource platform for farm production tools, the collective aims to collectively develop tools adapted to the regional agro-ecological practices. This platform provides access to online resources, videos, trainings on construction and autonomy, and knowledge exchange sessions.

B. Activities

The cooperative supports farmer-led research and development: i) on farm innovations, ii) collective farmer-led designs and iii) engineering expertise to design replicable machinery. Furthermore, the cooperative is disseminating open source materials for organic farming such as: a) promoting technologies that are wanted by farmers, b) supplying information tailored to the needs of small-scale farmers: forum posts, articles, designs, tutorials and a self-build guide. And finally, it leads training sessions to create self-sufficient farming systems by training courses, workshops on farms and bulk orders for parts and materials. The tools developed are adapted to the context in which they are used in concrete terms. The cooperative also encourages farmers to think innovatively and come up with sustainable solutions to the problems they face.

C. Actors Involved

- Civil society : the Association Groupement des Agriculteurs Biologique du Finistère, the Association Agriculteurs Bio de Cornouaille, the Association Vignes Vivantes
- Industry: network of partners working on organic farmers (FNAB, FNCIVAM, FADEAR, RENETA).

D. Impact for bioeconomy development

The impact of this social innovation on bioeconomy development is significant, as it enhances collaboration among key rural actors and their involvement in decision-making, ensuring there is critical feedback on the technologies developed and promoted. The cooperative raises awareness and provides education and training sessions to build acceptance for technologies and nutrient recycling practices.

E. Social Impact

In terms of social impact, the cooperative's efforts in disseminating knowledge and promoting technological sovereignty result in increased awareness and utilization of technologies, as well as access to online resources.

F. Challenges for implementation

- Limited access to resources.
- Securing funding and investment.

G. References

[1] Annevelink, E., M. van den Oever, I. Rodilla Ojeda, A. Casillas González, B. Deltoro Bernardes, A. Galatsopoulos & S. Michopoulou, 2023. Catalogues of technologies, business models and social innovations for small-scale bio-based solutions. MainstreamBIO project, Deliverable D2.1, 186 pp.
[2] https://www.latelierpaysan.org/English

28. (MB-D-02) Cooperative network Organic Food Valley in Poland (EkoLubelszczyzna, PL)

A. Description

This social innovation project aims to develop a cooperative network between different actors involved in the production, processing, and marketing of organic food and eco-products/services.

B. Activities

By creating an eco-region in cooperation with local authorities, the project seeks to establish a platform that can promote and create organic food. The project also aims to enhance cluster cooperation among scientific institutions, innovation entities, and entrepreneurs in the organic industry. This will increase the competitiveness and innovation of cluster participants and contribute to the creation of a lively and active agricultural region.

C. Actors Involved

- Industry: producers of organic food and eco-products/ services, organic farmers
- Civil society: organizations of agricultural consulting and certification, other ecological organizations
- Academic & Research Institutions: Universities and research institutions.

D. Impact for bioeconomy development

In terms of impact for bioeconomy development, the project will increase the export of goods and services, preserve the environment and agricultural landscape, and enable the economic development of rural areas by diversifying and increasing the income of people living in those areas.

E. Social Impact

The social impact of the project includes the generation of jobs and access to the network for all actors involved in the organic industry, including producers, farmers, services, ecological/organic shops, organizations of agricultural consulting and certification, and other ecological organizations.

F. Challenges for implementation

- Securing funding and investment.
- Difficult to build markets for the bio-based products and services and increasing consumer awareness and acceptance.
- Strong competition.
- Need for consumers education.

G. References

[1] Annevelink, E., M. van den Oever, I. Rodilla Ojeda, A. Casillas González, B. Deltoro Bernardes, A. Galatsopoulos & S. Michopoulou, 2023. Catalogues of technologies, business models and social innovations for small-scale bio-based solutions. MainstreamBIO project, Deliverable D2.1, 186 pp.

[2] http://ekolubelszczyzna.pl/

29. (MB-D-03) Centre for Education and Personal Development in Nature, an innovative co-working space and educational complex in Serbia (Rural HUB)

A. Description

Rural HUB is a non-governmental organization that has created an innovative co-working space and educational complex in order to connect socially responsible individuals and organizations with traditional farmers. The organization offers comprehensive educational programs, social business design training, and sustainable farm development, among other activities. Its target groups are individuals of all ages living in rural areas who wish to start socially responsible and innovative individual or family businesses, young people, and women.

B. Activities

Rural HUB is committed to the development of the local community and uses its services and products to preserve nature, tradition, and households. It encourages and supports the development of the local community through the development of a unique touristic offer and specific domestic products and services. In addition, it prepares young people for green jobs and provides service learning opportunities.

C. Actors Involved

- Government agencies and public bodies: Centre for Socially Responsible Entrepreneurship, Municipality Sokobanja, Erste Bank a.d. Novi Sad, GIZ YEP
- Civil Society: villagers, new-comers.

D. Impact for bioeconomy development

Rural HUB's impact on bioeconomy development is significant. It promotes sustainable living through the ecovillage model across the country and region, and opens dialogue on sustainable living development policies and measures among relevant stakeholders. The organization provides sustainable development education workshops and trainings for the local community, develops human resources in ecovillage design and social business, and raises awareness of diverse aspects of sustainable living. Additionally, it supports the local community to apply different examples of eco-housing and appropriate eco-technology solutions, and establishes cooperation with the Vrmdza community. The organization also supports the building of eco-tourism facilities and accommodation capacities.

E. Social Impact

Rural HUB's social impact is also noteworthy, as it provides financial support, generates jobs, and provides education and training opportunities for the local community. Overall, Rural HUB's efforts have resulted in the development of a sustainable and socially responsible ecosystem that promotes the preservation of nature and tradition while supporting the growth of innovative businesses and green jobs.

F. Challenges for implementation

- Securing funding and investment.

G. References

[1] Annevelink, E., M. van den Oever, I. Rodilla Ojeda, A. Casillas González, B. Deltoro Bernardes, A. Galatsopoulos & S. Michopoulou, 2023. Catalogues of technologies, business models and social innovations for small-scale bio-based solutions. MainstreamBIO project, Deliverable D2.1, 186 pp.

[2] https://ruralhub.rs/en/

30. (MB-D-04) Assessing Reforestation and Forest Development Activities in partnership with local communities in Lebanon (ARDAC, LBN)

A. Description

The reforestation and sustainable forest management project in a remote rural area aimed to address deforestation and local development. One of the innovative aspects of the project was the management of non-wood forest products from the biggest laurel forest in Lebanon.

B. Activities

A feasibility study and business plan for the extraction of laurel essential oil were developed, and specific equipment for the extraction of essential oil was designed and industrialized. Locals were trained on how to harvest laurel products sustainably and process them for oil extraction. In addition, socio-economic and environmental needs of residents were identified, and training workshops were designed and delivered in response to these needs. This included promoting job opportunities as part of an eco-tourism plan, and a number of inhabitants were trained on processing and marketing laurel products while also being involved in eco-tourism activities.

C. Actors Involved

- Government agencies & public bodies: Institute of the Environment (IoE)
- Academic & Research Institutes: University of Balamand (UOB)

D. Impact for bioeconomy development

The project had a significant impact on bioeconomy development, as it ensured the sustainable collection of laurel leaves and berries for the extraction of essential and crude oil, respectively. The specific equipment designed for the extraction of essential oil also contributed to the development of the bioeconomy. The project also contributed to sustainable forestry, including efficient and sustainable use of natural resources and the involvement of young people in sustainable rural activities. Additionally, the project provided job opportunities for poor villagers and jobless residents, thereby empowering vulnerable people and contributing to a secure society.

E. Social Impact

The social impact of the project was also notable, as it generated jobs, utilized technology, and involved public participation. The project helped to improve the livelihoods of locals by providing them with new skills and job opportunities. The eco-tourism plan also provided an opportunity for locals to showcase their natural resources and cultural heritage while also generating income. Overall, the project was a success in addressing deforestation and local development while also contributing to the bioeconomy and social development.

F. Challenges for implementation

- Securing funding and investment.
- Lack of supportive policy frameworks to incentivize sustainable practices and investment in the bioeconomy.
- Need for consumers education.

G. References

[1] Annevelink, E., M. van den Oever, I. Rodilla Ojeda, A. Casillas González, B. Deltoro Bernardes, A. Galatsopoulos & S. Michopoulou, 2023. Catalogues of technologies, business models and social innovations for small-scale bio-based solutions. MainstreamBIO project, Deliverable D2.1, 186 pp.

[2] https://www.balamand.edu.lb/IOE/OurProjects/Details/Pages/LNR/ForestryActionsLebanon.aspx

31. (MB-D-05) Biological farm collaboratively run by employees and a group of around 300 consumers in Austria (Gela Ochsenherz, AUT)

A. Description

The Demeter farm in Lower Austria is an example of a partnership format in the social innovation context. This farm is collaboratively run by employees and a group of around 300 consumers, known as "harvest-sharers", who have founded an association to work together with the farm enterprise.

B. Activities

The consumers finance the operation of the farm enterprise and support it in other ways, such as voluntary work. This model allows the farm to detach from the constraints of the profit-driven market and to withstand risks of weather and markets with a diverse and labour-intensive form of agriculture. What's interesting about this model is that there is no price for individual products; instead, the members get their share of the harvest and can meet their requirements for vegetables in free weekly take-outs. This blurs the role of producer and consumer, as consumers may also help in production and distribution. The Demeter farm covers 4 hectares throughout the year with about 80 kinds of vegetables, herbs, and soft fruits. It almost exclusively uses saved seed, which means that the farm can maintain a high level of crop diversity and resilience.

C. Actors Involved

- Industry: farmers, producers
- Civil Society: consumers

D. Impact for bioeconomy development

The partnership format of the farm has several impacts on bioeconomy development, including the viability of the farm holding, job creation, and more resilience because of crop diversity.

E. Social Impact

The social impact of this model includes access to networks, job generation, and public participation.

F. Challenges for implementation

- Securing funding and investment.
- Difficult to build markets for the bio-based products and services and increasing consumer awareness and acceptance.
- Need for consumers education.

G. References

[1] Annevelink, E., M. van den Oever, I. Rodilla Ojeda, A. Casillas González, B. Deltoro Bernardes, A. Galatsopoulos & S. Michopoulou, 2023. Catalogues of technologies, business models and social innovations for small-scale bio-based solutions. MainstreamBIO project, Deliverable D2.1, 186 pp.

[2] https://www.ochsenherz.at/

32. (MB-D-06) Federation Agriculture and Care - Network for Care Farming in The Netherlands (NL)

A. Description

The organization Federation Agriculture and Care (Federatie Landbouw en Zorg) is a foundation that aims to professionalize the agriculture sector and facilitate regional organizations in caring for farmers. As a foundation, it is likely a non-profit organization that receives funding from donations or grants.

B. Activities

One of the key activities of the organization is networking, which involves building relationships and connections with individuals and organizations in the same or related fields. By doing so, the organization can better understand the needs of stakeholders and facilitate cooperation among them. The organization also provides assistance and advice to stakeholders in the agriculture and rural sector, which can help them overcome challenges and make informed decisions. In addition to working with stakeholders in the agriculture and rural sectors, the organization also engages with individuals and groups outside of these sectors through public participation. This can include engaging with consumers, policymakers, and community organizations to raise awareness about the importance of agriculture and care and to promote sustainable practices. Another important activity of the organization is experimentation, which involves testing new ideas and approaches to address challenges and promote innovation. By doing so, the organization can identify new solutions and best practices that can benefit stakeholders in the agriculture and care sectors.

C. Actors Involved

- Industry: farmers
- Civil Society regional farm care organizations, client organizations
- Government agencies and public bodies.

D. Impact for bioeconomy development

The impact of this social innovation for bioeconomy development includes offering access to networks, sharing knowledge, and providing a social network sustaining the future of the farm and offering clients a better quality of life. By doing so, the organization can promote economic and social benefits for stakeholders and contribute to the growth and sustainability of the bioeconomy.

E. Social Impact

The social impact of this innovation includes providing access to networks, assistance and advice, and public participation. By doing so, the organization can empower stakeholders in the agriculture and care sectors and promote greater awareness of their importance to society.

F. Challenges for implementation

- Securing funding and investment.

G. References

[1] Annevelink, E., M. van den Oever, I. Rodilla Ojeda, A. Casillas González, B. Deltoro Bernardes, A. Galatsopoulos & S. Michopoulou, 2023. Catalogues of technologies, business models and social innovations for small-scale bio-based solutions. MainstreamBIO project, Deliverable D2.1, 186 pp.

[2] https://www.zorgboeren.nl/

[3]https://www.greenforcare.eu/wp-content/uploads/2021/01/green4c_case-studies-Federatie-Landbouw-Zorg-.pdf

33. (MB-D-07) Land Sharing for food and social good, a project promoting and preserving traditional farming techniques in Slovenia (SL)

A. Description

Land Sharing for Food and Social Good is a social innovation project that focuses on promoting and preserving traditional farming techniques to create sustainable, multifunctional farms that benefit the environment and the community. The project recognizes the value of these techniques and aims to reintroduce them into modern times through intergenerational cooperation between elderly farmers and unemployed people from towns. This cooperation helps to transfer knowledge about past techniques of multipurpose organic farming from older farmers to younger unemployed individuals, providing them with new skills and opportunities. This transfer of knowledge not only benefits the younger generation but also helps to preserve valuable farming techniques that may be lost without this intervention.

B. Activities

The project engages in various activities such as networking, training, teaching, production of goods, services delivery, social media, public participation, fundraising, project management, marketing, and promotion, as well as action-research.

C. Actors Involved

- Industry: InTerCer, local farmers
- Government agencies and public bodies: regional authorities
- Civil society: disadvantaged people

D. Impact for bioeconomy development

The impact of the project on bioeconomy development includes the transfer of knowledge related to organic agriculture practices, the creation of a new economic segment of social entrepreneurship, and the reintroduction of agriculture with a low carbon footprint. Additionally, the project contributes to nature conservation by promoting sustainable farming practices.

E. Social Impact

The project also has a significant social impact by providing education and training, assisting and advising elderly farmers, and creating intergenerational cooperation between the older generation and the younger generation. Ultimately, the Land Sharing for Food and Social Good project seeks to improve the well-being of farmers, unemployed individuals, and the broader community by promoting sustainable farming practices and preserving traditional farming techniques.

F. Challenges for implementation

- Limited access to resources.
- Limited access to appropriate technology, equipment, and infrastructure.
- Securing funding and investment.

G. References

[1] Annevelink, E., M. van den Oever, I. Rodilla Ojeda, A. Casillas González, B. Deltoro Bernardes, A. Galatsopoulos & S. Michopoulou, 2023. Catalogues of technologies, business models and social innovations for small-scale bio-based solutions. MainstreamBIO project, Deliverable D2.1, 186 pp.
[2] https://instituteintercer.org/land-sharing-for-food-and-social-good-tv/

34. (MB-D-08) Regeneration of degraded farmland in Greece through sustainable agriculture practices (Mazi company, GR)

A. Description

Mazi is a company that is taking the lead in the regeneration of degraded farmland in the Mediterranean through sustainable agriculture practices. This community-supported agroforestry farm is run by a diverse intergenerational team from multiple nationalities who share a passion for restoring the land and promoting a more holistic approach to farming. Mazi recognizes the importance of working with nature, not against it, and adopts the 'syntropic' model of agriculture. This method mimics nature's patterns in everything the farmers do, from farm design to crop choices, to ensure a diverse and resilient ecosystem that benefits both the environment and the community.

B. Activities

Through its community-supported model, Mazi connects directly with consumers and builds a strong network of support for its mission. Members receive fresh, locally-grown produce while providing financial and other forms of support to the farm. This not only helps to ensure financial sustainability but also fosters a sense of community and connection between the farm and its supporters. Mazi's innovative approach to sustainable agriculture combines traditional and modern practices to restore degraded farmland and promote the well-being of both people and the environment. Local farmers and volunteers are also actively involved in Mazi's activities, making it a collaborative effort for a better future.

C. Actors Involved

- Industry: local farmers
- Civil society: volunteers

D. Impact for bioeconomy development

The impact of Mazi on bioeconomy development is immense. By renewing existing resources and regenerating damaged ecosystems, Mazi is providing a local and healthy production system that promotes sustainability. Moreover, by introducing and promoting the 'syntropic- regenerative ' model of agriculture, Mazi is contributing to a larger movement towards ecological farming practices.

E. Social Impact

Overall, Mazi's impact on society is not limited to just agriculture but also extends to the production system, and assistance and advice to local farmers and communities. Mazi truly represents a unique and inspiring approach to sustainable agriculture that is making a difference in the world.

F. Challenges for implementation

- Limited access to resources.
- Limited access to appropriate technology, equipment, and infrastructure.
- Securing funding and investment.
- Need for consumers education.

G. References

[1] Annevelink, E., M. van den Oever, I. Rodilla Ojeda, A. Casillas González, B. Deltoro Bernardes, A. Galatsopoulos & S. Michopoulou, 2023. Catalogues of technologies, business models and social innovations for small-scale bio-based solutions. MainstreamBIO project, Deliverable D2.1, 186 pp.
https://www.mazifarm.com/
[2] https://www.arc2020.eu/letter-from-the-farm-greeces-mazi-farm/

35. (MB-D-10) Fish farming in symbiosis with pulp mills in Sweden (Big Akwa, SE)

A. Description

The social innovation "Big Akwa - Fish farming in a new innovative way - symbiosis with pulp mills" is a company that focuses on sustainable and resource-efficient food production through industrial symbiosis. The company combines resources between fish farming and pulp mills to achieve lower costs and higher efficiency while reducing negative climate and environmental impacts.

B. Activities

This social innovation has several activities, including food production using bio-based industrial side streams. The actors involved in this innovation include pulp and paper mills and technology companies.

C. Actors Involved

- Industry: pulp and paper mills, technology companies

D. Impact for bioeconomy development

This social innovation has significant impacts on bioeconomy development, as resource and energy efficiency are key focuses of this innovation. The technology can be paired with any pulp or paper mill, helping the local economy and providing a fresher sustainable product. Based on existing global pulp production capacity, the technology has the potential to farm 50,000 tons of sustainable fish in Sweden (5 times the actual aquaculture production) and 1.2 million tons globally at a reduced cost. The innovative technology has the potential to create more sustainable pulp and aquaculture business models.

E. Social Impact

In terms of social impact, this innovation provides a more sustainable production system and utilizes innovative technology to achieve sustainable and efficient food production.

F. Challenges for implementation

- Securing funding and investment.
- Improvements needed of resource efficiency.

G. References

[1] Annevelink, E., M. van den Oever, I. Rodilla Ojeda, A. Casillas González, B. Deltoro Bernardes, A. Galatsopoulos & S. Michopoulou, 2023. Catalogues of technologies, business models and social innovations for small-scale bio-based solutions. MainstreamBIO project, Deliverable D2.1, 186 pp.

[2] https://www.bigakwa.com/

36. (MB-D-11) Fish farming in symbiosis with Tomato farming in Sweden (Agtira, SE)

A. Description

In terms of resource and energy efficiency, the closed-cycle system implemented by Agtira is highly beneficial. By using the water from the fish farm to nourish the greenhouse, the company is able to significantly reduce water consumption, which is an important resource in agriculture. Additionally, the fact that the system operates in a closed cycle means that there is no need to dispose of waste water or nutrients, which is both cost-effective and environmentally sustainable. The system also helps to reduce transport needs, as the produce can be grown on-site and sold directly to consumers in restaurants and grocery shops. This can help to reduce the carbon footprint associated with transportation and increase the freshness of the produce, which can lead to longer shelf life and lower food waste.

B. Activities

Circular food production - Agtira engages in circular food production, which means that they use the byproducts products from one process to feed another process, creating a closed loop of production.

C. Actors Involved

- Civil society: restaurant, grocery shops, actors in the food industry, consumers

D. Impact for bioeconomy development

Agtira's innovative closed-cycle system for growing tomatoes and fish has a significant impact on bioeconomy development. Firstly, the system is highly resource and energy-efficient, as waste products are used to nourish other parts of the system. Additionally, by growing food where the consumer is, Agtira reduces the need for fossil-based transport, which is better for the environment. The closed circulating systems used by Agtira also reduce water consumption by up to 95% compared to conventional cultivation, which is a huge benefit to the environment.

E. Social Impact

In terms of social impact, Agtira's production system has a positive impact on the industry by reducing waste and increasing efficiency. The innovative use of technology to create a closed-cycle system for food production has the potential to change the way we think about food production and consumption. Consumers can benefit from having fresh, locally grown produce available year-round, and the potential to reduce food waste by harvesting and placing vegetables on the shelf the same day they are harvested. Overall, Agtira's innovative closed-cycle system has the potential to make a significant contribution to the development of a more sustainable and efficient bioeconomy.

F. Challenges for implementation

- Securing funding and investment.
- Improvements needed of resource efficiency.

G. References

[1] Annevelink, E., M. van den Oever, I. Rodilla Ojeda, A. Casillas González, B. Deltoro Bernardes, A. Galatsopoulos & S. Michopoulou, 2023. Catalogues of technologies, business models and social innovations for small-scale bio-based solutions. MainstreamBIO project, Deliverable D2.1, 186 pp.

[2] https://www.agtira.com

37. (MB-D-12) An innovative waste management system that prioritizes the recycling of food waste in Sweden (Örnsköldsvik municipality, SE)

A. Description

The Örnsköldsvik municipality has implemented an innovative waste management system that prioritizes the recycling of food waste. In this system, each household collects their food residues separately, which is then picked up by the municipality's waste management company. The collected food residues is transported to a biogas plant in Härnösand, where it is recycled through digestion to extract vehicle gas in the form of biogas. This process is highly efficient as food residue contains a significant amount of energy. In fact, just 1 kg of food residues can drive a biogas car for almost 2 kilometres. Apart from producing biogas, the process also generates biofertilizer. By returning the biofertilizer to agricultural land, the cycle is closed, and the benefits of food waste are maximized. This means that the waste generated by households is not only effectively managed, but it also contributes positively to the agricultural sector. The Örnsköldsvik municipality's waste management system is not only environmentally sustainable, but it is also economically efficient. The production of biogas and biofertilizer from food residues is an innovative and practical solution to tackle the issue of waste management. The system has a positive impact on the environment and society by reducing the amount of food waste that ends up in landfills, generating renewable energy, and producing biofertilizer that can be used to enhance agricultural production.

B. Activities

The main activity of Örnsköldsvik municipality is waste handling and energy recovery through the recycling of food waste.

C. Actors Involved

- Government agencies & public bodies: municipalities
- Civil Society: citizens

D. Impact for bioeconomy development

The recycling of food waste has a significant impact on the bioeconomy development. The process is highly resource and energy-efficient, and food residue contains a lot of energy that can be converted into biogas. The production of biogas and biofertilizer from food residues contributes positively to the agricultural sector and enhances agricultural production.

E. Social Impact

The waste management system implemented by Örnsköldsvik municipality has a positive impact on the production system, food waste management, and energy generation. The system effectively manages waste and generates renewable energy and biofertilizer that can be used to enhance agricultural production. The system has the potential to reduce the environmental impact of waste management and contribute positively to the bioeconomy development.

F. Challenges for implementation

- Securing funding and investment.
- Improvements needed of resource efficiency.

G. References

[1] Annevelink, E., M. van den Oever, I. Rodilla Ojeda, A. Casillas González, B. Deltoro Bernardes, A. Galatsopoulos & S. Michopoulou, 2023. Catalogues of technologies, business models and social innovations for small-scale bio-based solutions. MainstreamBIO project, Deliverable D2.1, 186 pp.

[2] https://miva.se/avfall-och-atervinning/sa-funkar-avfall-och-atervinning/matavfall/matavfallets-miljonytta

38. (MB-D-13) An educational community partnership, the Cloughjordan EcoVillage in Ireland (IR)

A. Description

Cloughjordan EcoVillage is a unique development that emphasizes sustainable living practices and community engagement.

B. Activities

As an educational community partnership, the ecovillage offers opportunities for research and educational visits to primary, post-primary, third level, and corporate groups. The ecovillage includes more than 50 low-energy homes and work units, a biomass-fueled district heating system, and a green enterprise center with high-speed broadband. The village also features a member-owned community farm and 50 acres of land for allotments, farming, and woodland.

C. Actors Involved

- Industry: Local farmers
- Civil Society: volunteers, citizens

D. Impact for bioeconomy development

One of the most significant impacts of Cloughjordan EcoVillage is its contribution to bioeconomy development. The ecovillage demonstrates an environmentally sustainable community model that is done in a collaborative and co-creative manner. The project facilitates quality academic research into the development of the ecovillage and contributes to harvesting valuable lessons from the community. The ecovillage's approach to sustainable living emphasizes localization as an alternative to consumer capitalism and prioritizes low carbon impact, zero waste, renewable energy, and organic food. The strong ethical worldview of the ecovillage is also an essential element of its impact on bioeconomy development.

E. Social Impact

Furthermore, the social impact of Cloughjordan EcoVillage is significant. The project's production system emphasizes a collaborative approach that involves local farmers, volunteers, and citizens. The ecovillage's research activities contribute to the documentation of its development and the advancement of sustainable living practices. Overall, Cloughjordan EcoVillage is a pioneering example of how community-driven developments can contribute to bioeconomy development and sustainable living practices while enriching the social fabric of local communities.

F. Challenges for implementation

- Securing funding and investment.
- Ensuring financial sustainability and generating sufficient returns on investment.
- Need for consumers education.

G. References

[1] Annevelink, E., M. van den Oever, I. Rodilla Ojeda, A. Casillas González, B. Deltoro Bernardes, A. Galatsopoulos & S. Michopoulou, 2023. Catalogues of technologies, business models and social innovations for small-scale bio-based solutions. MainstreamBIO project, Deliverable D2.1, 186 pp.

[2] https://www.thevillage.ie/

39. (MB-D-14) - Shared composting approach for urban agriculture in Bulgaria (The Root, BU)

A. Description

Shared composting is an innovative approach to urban agriculture that is gaining popularity around the world. The "Root" Foundation, a Bulgarian organization focused on promoting sustainable development, is at the forefront of this movement. By working with beekeepers, permaculture farms, herbalists, biodynamic farmers, and environmental organizations, the foundation is able to restore and conserve biodiversity, the environment, and natural resources, with a particular focus on the soil.

B. Activities

Through its activities in architecture, agriculture, education, and culture, the foundation integrates environmental principles and values in the development and validation of different strategies, models, and technologies for sustainable development in cities and their peripheries. One of their notable achievements is the establishment of a Sustainable Practices Platform with 32,000 followers and 33 active users in 2020.

C. Actors Involved

- Industry: beekeepers, permaculture farms, craftsmen, herbalists, biodynamic farmers
- Civil Society: Environmental organizations

D. Impact for bioeconomy development

The foundation's impact on bioeconomy development is significant, as evidenced by its successful funding proposal for the "First steps to create a system for shared composting and growing edible plants in urban environments" project under the Europe Programme. This project has the potential to revolutionize urban agriculture and create new opportunities for sustainable development in cities.

E. Social Impact

Aside from environmental impact, the "Root" Foundation has a significant social impact. It promotes public participation in sustainable development, provides education and training, and offers assistance and advice on various sustainable practices. The foundation also provides online resources to help people learn more about sustainable development and food waste management.

F. Challenges for implementation

- Securing funding and investment.
- Inconsistent or overly restrictive regulations specially for residues reuse.
- Need for consumers education.

G. References

[1] Annevelink, E., M. van den Oever, I. Rodilla Ojeda, A. Casillas González, B. Deltoro Bernardes, A. Galatsopoulos & S. Michopoulou, 2023. Catalogues of technologies, business models and social innovations for small-scale bio-based solutions. MainstreamBIO project, Deliverable D2.1, 186 pp.

[2] www.koren.bg

40. (MB-D-15) An organization for the promotion of sustainable forest management in Spain (Planeta Madera, ES)

A. Description

Planeta Mandera is an initiative that focuses on promoting sustainable forest management in Spain. The organization disseminates information about the benefits of utilizing forest resources in a sustainable manner and encourages the implementation of practices that support this goal.

B. Activities

One of the main activities of the initiative is to promote the use of wood throughout its entire life cycle, from the forest to the end consumer, in various industries such as sawmills, board and veneer industries, furniture manufacturing companies, pallets, containers and packaging, wooden doors or carpentry, biomass, and structural timber for construction.

C. Actors Involved

- Civil Society: UNEmadera, the Spanish Wood and Furniture Business Union

D. Impact for bioeconomy development

The impact of Planeta Mandera on bioeconomy development is significant. Sustainable forest management and the use of wood are essential tools to fight against the hollowing out of Spain, as they generate value and wealth in rural areas and prevent depopulation, as well as being an indispensable element to meet the Sustainable Development Goals (SDGs).

E. Social Impact

In terms of social impact, Planeta Mandera promotes public participation by raising awareness about sustainable forest management and the importance of utilizing forest resources in a responsible manner. The organization also provides assistance and advice to those who are interested in implementing sustainable forest management practices.

F. Challenges for implementation

- Limited access to appropriate technology, equipment, and infrastructure.
- Securing funding and investment.
- Need for consumers education.
- Improvements needed of resource efficiency.

G. References

[1] Annevelink, E., M. van den Oever, I. Rodilla Ojeda, A. Casillas González, B. Deltoro Bernardes, A. Galatsopoulos & S. Michopoulou, 2023. Catalogues of technologies, business models and social innovations for small-scale bio-based solutions. MainstreamBIO project, Deliverable D2.1, 186 pp.

[2] https://planetamadera.org/

41. (MB-D-16) Fight against depopulation, sponsorship of abandoned olive trees (Apadrina un olivo, ES))

A. Description

Apadrina un olivo is an initiative that promotes the sponsorship of abandoned olive trees in the small town of Oliete, Teruel. Sponsors can visit their sponsored tree and receive a reward of 2 litres of olive oil each year. The initiative has successfully recovered over 10,000 olive trees in the last eight years with the support of more than 5,000 sponsors. This has created 10 job positions and attracted over 18,000 visits to Oliete.

B. Activities

Crowdfunding initiative encouraging people to 'adopt' an olive tree through a website with the options for a 'gift adoption', 'yearly adoption' and 'monthly adoption'. The stepparent christens the olive tree and receives photos periodically of it (through an app), and also information about the weather conditions of the area, of the work being done on it, etc. And also two litres of extra virgin olive oil from the olive trees part of the project. Besides, field trips are organised to visit the adopted olive trees promoting rural tourism in the area. The true owners of the olive trees receive the 10% of the harvest from the 6th year that the olive tree enters the project. It also runs volunteer days for people to help restore the olive trees as well as working closely with the ATADI organisation to provide days for those with learning disabilities to help restore the trees.

C. Actors Involved

- Industry: farmers
- Civil Society: citizens

D. Impact for bioeconomy development

The initiative has promoted the opening of an oil mill where people outside the project can bring their own olives and get their oil, securing the recovery of their own olive trees. This oil mill provides a local service, which promotes the development of the local economy.

E. Social Impact

The initiative has raised awareness about the importance of preserving traditional farming practices and cultural heritage, as well as the potential for crowdfunding initiatives to support local initiatives and rural development.

F. Challenges for implementation

- Securing funding and investment.
- Need for consumers education.

G. References

[1] Annevelink, E., M. van den Oever, I. Rodilla Ojeda, A. Casillas González, B. Deltoro Bernardes, A. Galatsopoulos & S. Michopoulou, 2023. Catalogues of technologies, business models and social innovations for small-scale bio-based solutions. MainstreamBIO project, Deliverable D2.1, 186 pp.
[2] https://apadrinaunolivo.org/en

42. (MB-D-17) Promoting sustainability, food culture, and health among children and young people in Denmark (Haver til maver, DK)

A. Description

Haver til Maver is a non-profit organization that focuses on promoting sustainability, food culture, and health among children and young people in Denmark. They do this by providing school gardens where children can learn about gardening, outdoor cooking, and nature communication.

B. Activities

The program is an open outdoor school, where children and their teachers spend up to 8 full school days in the garden during the growing season. Each class has their own plot of land, where they plant, tend, and harvest their own crops. In addition to gardening, children engage in various activities within nature, the garden, and outdoor kitchens. These activities cover different subjects such as biology, reading, writing, mathematics, history, art, and more.

C. Actors Involved

- Civil Society: teachers, school managers, nature guides, chefs, volunteers, policy makers
- Industry: farmers

D. Impact for bioeconomy development

The impact of Haver til Maver is multi-factorial. School gardens provide children with life skills and help them understand the basics of nature and resources. They also offer an alternative learning environment for children who may not be motivated by traditional classroom teaching. Moreover, Haver til Maver promotes a different way of learning, playing, and living. When children grow, harvest, and cook together, they learn how to care for themselves, each other, and the planet in a safe and magical way. This has significant social impact on awareness raising, education/training, and public participation, with children developing a deeper appreciation for nature and the environment.

E. Social Impact

Overall, Haver til Maver is an excellent example of how non-profit organizations can contribute to sustainable development by providing innovative programs that educate and empower children and young people.

F. Challenges for implementation

- Securing funding and investment.
- Need for consumers education.

G. References

[1] Annevelink, E., M. van den Oever, I. Rodilla Ojeda, A. Casillas González, B. Deltoro Bernardes, A. Galatsopoulos & S. Michopoulou, 2023. Catalogues of technologies, business models and social innovations for small-scale bio-based solutions. MainstreamBIO project, Deliverable D2.1, 186 pp.
[2] https://havertilmaver.dk/

43. (MB-D-18) Initiative to reduce food waste in Denmark (Too good to go, DK)

A. Description

Too Good To Go is a Danish success case in the fight against food waste. In just 6 years, 5 entrepreneurs have developed their business from an apartment in Copenhagen to include 1,400 business partners in 17 countries. The purpose of Too Good To Go is to reduce food waste worldwide. The concept is based on a service with a mobile application that connects customers to restaurants and stores that have surplus unsold food. Customers can buy whatever food the outlet considers surplus to requirements, without being able to choose ('lucky bags') at a much lower price than normal. The food on the app is priced at one-third its original price. The service covers major European cities and was introduced to North America in 2020. In 2022 Too Good To Go was the fastest-growing sustainable food app startup by number of downloads. Today, 47.5 million people have their app on their phone.

B. Activities

Fighting food waste via an app. To Good To Go is developing their list of activities to go beyond linking restaurants etc. with costumers, as they are developing a knowledge hub, has become a company that both politicians and companies listen to for good ideas to reduce food waste, recording videos about food waste to put on YouTube as well as making educational material and together with the dairy company Arla to create food waste schools.

C. Actors Involved

- Civil Society: restaurants, retail, grocery shops, hotels, manufacturers, consumers, policy makers

D. Impact for bioeconomy development

Reducing food waste is a crucial aspect of bioeconomy development, and it has a significant impact on the environment, society, and the economy. By reducing food waste, we can save resources, reduce greenhouse gas emissions, and create new opportunities for sustainable development. A reduction in food waste can also lead to the creation of new products and services, such as composting, biogas production, and new food products made from food residues. Additionally, by reducing food waste, we can reduce the demand for land, water, and other resources needed to produce food, which can free up these resources for other purposes, such as reforestation or renewable energy production.

E. Social Impact

Reducing food waste has a significant impact on society. By reducing food waste, we can create new jobs, reduce costs for households, and improve access to nutritious food. Additionally, reducing food waste can help reduce hunger and food insecurity by redirecting food to those in need. By managing food residues more effectively, we can also reduce the negative impacts of waste on communities, such as odour and vermin. Finally, by reducing food waste and promoting sustainable development, we can create a more equitable and just society that benefits all.

F. Challenges for implementation

- Need for consumers education.

G. References

[1] Annevelink, E., M. van den Oever, I. Rodilla Ojeda, A. Casillas González, B. Deltoro Bernardes, A. Galatsopoulos & S. Michopoulou, 2023. Catalogues of technologies, business models and social innovations for small-scale bio-based solutions. MainstreamBIO project, Deliverable D2.1, 186 pp.
[2] https://toogoodtogo.com/en-us

44. (MB-D-19) Community-based project in Northern Greece that collects used coffee grounds from cafes and converts them into clean biofuel (Kafsimo, GR)

A. Description

Kafsimo is a community-based project in Northern Greece that collects used coffee grounds from cafes and converts them into clean biofuel. Their aim is to reduce organic waste sent to landfills while also promoting inclusivity, employment, and sustainable consumption habits. With the goal of creating a prototype model for the collection and recycling of coffee residues, Kafsimo hopes to expand their impact to other regions and waste streams, encouraging citizens to change their coffee-drinking habits and promoting a fair and equitable economy. The project's slogan "Close the Circle" captures its focus on environmental, social, and economic sustainability.

B. Activities

The Kafsimo project collects used coffee grounds from coffee shops in Kilkis and Thessaloniki using an electric van and transports them to a specially designed greenhouse for dehydration and processing. The grounds are converted into biofuel pellets or briquettes using a formula and method perfected after months of experimentation and testing. The resulting biofuel can be used for heating in houses, local industries, and public spaces. The project also aims to address social issues by training and employing people from vulnerable groups, providing job opportunities, and developing their employability potential.

C. Actors Involved

- Participating coffee shops in Kilkis and Thessaloniki, which provide the used coffee grounds
- People from vulnerable groups who are trained and employed by the project
- Local industries and public spaces that use the biofuel for heating
- The Greek community, which is encouraged to change their habits and reduce organic waste

D. Impact for bioeconomy development

The main environmental impact is the reduction of coffee waste that ends up in landfills, which pollutes the environment. By collecting coffee grounds from cafes and transforming them into biofuel pellets or briquettes, the project helps to reduce the reliance on fossil fuels and the atmospheric output associated with their use. The low-emissions vehicle used for transportation also contributes to a reduced environmental footprint. The project also raises awareness about environmentally friendly ways to consume coffee and other drinks, such as through Staramaki and reusable coffee cups. Overall, 'Kafsimo' promotes a circular economy model that reduces waste and environmental pollution while contributing to the bioeconomy.

E. Social Impact

The Kafsimo project creates job opportunities and offers training in the green economy for vulnerable social groups, leading to economic independence and empowering them. This approach also promotes social integration. The Kafsimo team educates the public on the reuse and repurposing of organic waste, and conducts specialized training workshops with university students. This public engagement inspires active citizenship and highlights the potential for individuals to contribute to environmental and social transformation through local actions and small habit changes.

F. Challenges for implementation

- Limited access to appropriate technology, equipment, and infrastructure.
- Securing funding and investment.
- Difficult to build markets for the bio-based products and services and increasing consumer awareness and acceptance.
- Need for consumers education.

G. References

[1] Annevelink, E., M. van den Oever, I. Rodilla Ojeda, A. Casillas González, B. Deltoro Bernardes, A. Galatsopoulos & S. Michopoulou, 2023. Catalogues of technologies, business models and social innovations for small-scale bio-based solutions. MainstreamBIO project, Deliverable D2.1, 186 pp.
[2] https://incommon.gr/kafsimo/
[3] https://www.interregeurope.eu/good-practices/use-of-coffee-waste-to-produce-biofuels

45. (CL-01) Production of bokashi from leaves to improve soil quality (Gemeente Apeldoorn, NL)

A. Description

The city of Apeldoorn decided to treat bio-residues from green spaces locally rather than exporting it to produce compost and acquire compost from outside the city to improve the quality of the soil. Instead of composting a bokashi process is used to convert the leaves. The bokashi process is an anaerobic fermentation process where leaves and a bokashi starter are mixed and allowed to react for about 3 months.

B. Activities

Leaves are removed from the streets in build areas in the autumn, as they provide a safety risk for pedestrians and bikers. The streets are cleaned from litter by volunteers and municipal workers to obtain a clean batch of leaves prior to collecting. Afterwards the leaves are processed locally into bokashi during the winter and spread out on green spaces in the same build areas in the spring. The application of bokashi returns the nutrients of the leaves back to the soil and improves the soil quality.

C. Actors Involved

- An active group of volunteers that pick-up litter throughout the year.
- The department of Management and Maintenance of public spaces of the municipality of Apeldoorn.
- A company “Bij de oorsprong” processing the leaves into bokashi.
- The Apenheul primate parc, this zoo is closed during the winter, the parking lot is used as one of the locations for the bokashi production.

D. Impact for bioeconomy development

Changing to local production of bokashi rather than exporting the leaves outside of the city for compost production and buying compost for application resulted in local job opportunities. In the past only a limited amount of compost was procured to improve soil, where now all leaves are used for bokashi production and application.

E. Social Impact

The local production of bokashi increases the visibility of the biobased activities of the city.
The purity of the collected leaves was improved compared to the leaves exported for compost production as the impurities in the collected leaves are visible during the processing and during the application of the bokashi.

F. Challenges for implementation

During the start of the bokashi process and during the application of the bokashi a slight smell can be observed that is sometimes referred to as forest smell. Also, the first days after application the bokashi is visible on top of the soil. Both points may result in complaints for the citizens, so proper information on the entire process is necessary.
Soil improvement in cities take years and is not easily noticeable. Cheaper and easier ways of getting rid of leaves are possible (e.g., using leaf blowers to blow them under the nearby vegetation, and although they may be less beneficial to the soil could be chosen.

G. References

[1] Hellemans, A.H., E. Keijsers, and S. van de Laar, 2023, Circular bio-waste in Apeldoorn Demonstration report, Deliverable 3.4 of EU-project Cityloops, 84 pp.
https://cityloops.eu/fileadmin/user_upload/D3.4_Apeldoorn_Bio_waste_demo_report.pdf

46. (CL-02) Production of paper from grass (Gemeente Apeldoorn, NL)

A. Description

Traditionally in Europe paper is made from chemically pulped wood. Alternative fibres like cotton and hemp are sometimes used for specialty paper. In the Netherlands numerous trials have been performed on industrial scale using grass (and other green plants) as raw material. In contrast with wood grass is abundantly available. Apeldoorn is home to several paper factories and a paper museum with a working paper machine. Verge grass from Apeldoorn was used after some mechanical upgrading as pulp to produce "Grass" paper on the old paper machine in the Museum. The project was used to show the citizens of Apeldoorn that bio-residues from the city can be reused to produce products.

B. Activities

An active group of volunteers cleans the green spaces of Apeldoorn throughout the year from litter. The municipality harvested the fresh grass from verges. The grass was treated using a disk refiner at WFBR to create a usable pulp. The pulp was used (in combination with wood pulp) to produce paper at the paper museum "De Middelste Molen" in Apeldoorn.

C. Actors Involved

- An active group of volunteers that pick-up litter throughout the year
- The department of Management and Maintenance of public spaces of the municipality of Apeldoorn
- Wageningen Food & Biobased research to provide pulping knowledge
- Volunteers at museum "De Middelste Molen" (mostly retired workers from the local paper industry)

D. Impact for bioeconomy development

Grass has been used as pulp for the paper industry in Apeldoorn in the past. The use was stopped because of lack of interest from the industrial paper buyers. Other initiatives in the Netherlands are ongoing, although the demand for paper with grass is still lacking. However, it is highly likely that with the upcoming interest in the biobased economy, paper with grass other alternative raw materials will appear on larger scale on the market. Packaging materials from alternative raw materials are already used (sugar cane, straw) but the pulp is imported from outside the Netherlands.

E. Social Impact

The local production of grass paper increases the visibility of the biobased activities of the city. Changing towards a biobased economy will take time and a change of mind. By showing the retired workers of the paper industry (the volunteers at the museum) that grass can be a valuable raw material, the ideas of the paper industry are gradually changing towards local, alternative raw materials instead of wood.

F. Challenges for implementation

- There is no economical business case for the production of paper from grass. Mainly because of lack of demand for this paper.
- On small scale grass can be obtained from one supplier, on larger scale grass should be sourced from a large number of suppliers, which may also lead to inconsistencies in cleanliness of the grass.
- The paper industry in the Netherlands is mainly owned by large consortia operating in multiple countries. They focus on producing paper from wood, with little interest in producing paper from other raw materials in selected areas.

G. References

[1] Hellemans, A.H., E. Keijsers, and S. van de Laar, 2023, Circular bio-waste in Apeldoorn Demonstration report, Deliverable 3.4 of EU-project Cityloops, 84 pp.
https://cityloops.eu/fileadmin/user_upload/D3.4_Apeldoorn_Bio_waste_demo_report.pdf

47. (CL-03) Production of 3D filament from Japanese Knotweed and PLA (NL)

A. Description

Filament 3D printing is a technique that is used to produce all kind of objects. In Apeldoorn, the Netherlands, filament was produced from Polylactic acid (PLA) a thermoplastic bioplastic made from sugars and fibres from Japanese Knotweed. Japanese Knotweed is an unwanted plant, which is removed on a yearly basis. The filament was used in a local museum and makerspace “Coda” and in a local repair Café. The filament production was part of a project focussing on reusing bio-residues in a circular city.

B. Activities

An active group of volunteers cleans the green spaces of Apeldoorn throughout the year from litter. A specialised company harvests/mows Japanese Knotweed apart from other bio-residues to prevent spreading of the plant. Regular practice is to burn the plant, but for the project the stalks and leaves were mechanically refined and compounded with PLA. Afterwards filament was produced from the compounded material. The filament was distributed between several interested parties in Apeldoorn and used to produce different object.

C. Actors Involved

- An active group of volunteers that pick-up litter throughout the year
- The department of Management and Maintenance of public spaces of the municipality of Apeldoorn
- Wageningen Food & Biobased research to extract fibres from the Japanese Knotweed, compound and produce fillament
- Volunteers at museum “CODA” and other 3D printing enthusiasts in Apeldoorn.

D. Impact for bioeconomy development

The market for 3D printing filament is small. However, 3D printing can be an important process to provide new parts to repair e.g. household equipment. Using local bio-residues as resource for filament production could be part of a circular economy.

E. Social Impact

The local production of 3D printing filament from Japanese Knotweed increases the visibility of the biobased activities of the city. Changing towards a biobased economy will take time and a change of mind. Combining bio-residues with an upcoming technology like 3D printing can increase the enthusiasm for the circular economy.

F. Challenges for implementation

The production of filament for 3D printing can be performed on small scale. All kind of fibre materials derived from plants have been used in filament production, and fibre containing filaments are readily available on the market. As demand for filament is (still) low, only batchwise production of filament is currently feasible. Costs of the filament will therefore be high.

G. References

[1] Hellemans, A.H., E. Keijsers, and S. van de Laar, 2023, Circular bio-waste in Apeldoorn Demonstration report, Deliverable 3.4 of EU-project Cityloops, 84 pp.
https://cityloops.eu/fileadmin/user_upload/D3.4_Apeldoorn_Bio_waste_demo_report.pdf

48. (CL-04) Organizing contest to encourage new bio-based initiatives (FoodLoop, PT)

A. Description

A contest for Circular Ideas - FoodLoop - was launched in Porto, Portugal to mobilise citizens and organisations to the circular transition in bio-waste and more broadly in the food system.

The contest awarded ideas that:

- encourage the creation of synergies between several sectors and actors, mainly the social and tourism sectors.
- promote and support innovative food waste management ideas.
- prevent food waste with donation and/or recovery schemes.
- satisfy the nutritional needs of vulnerable communities and at the same time reduce food waste.
- promote local/regional agri-food value-chains.
- strengthen multi-sector and multi-actor collaboration to raise awareness and reduce food waste.

The contest was designed with a focus on providing training and mentoring to the winners rather than offering prize money. This approach aimed to add value to the participants by helping them to develop their ideas into projects with potential for successful implementation and resilience.

B. Activities

The activities were:

1. Foodloop call - submission of ideas
2. Bootcamp – evolution from idea to a project
3. Mentorship (six months) – writing an implementation plan.

The bootcamp was aimed at 20 ideas/teams. The bootcamp provides the possibility for networking and start collaborations, the ideas were explored further, and business plans were developed. The mentorship program aimed at 5 winners. It involved creating an implementation plan, finding possible funding, and preparing applications.

C. Actors Involved

- Porto Municipality.
- The teams entering the contest.
- Experienced people in entrepreneurship, social economy and circular economy.
- Numerous organisations from Portugal interested in the circular economy.

D. Impact for bioeconomy development

Twenty circular biobased initiatives were granted a bootcamp to develop their ideas. Five initiatives obtained a six-month mentorship to further guide them towards becoming viable businesses. Specific procurement guidelines for food and catering services, a decision-making support tool and a food demand management tool were piloted in the project.

E. Social Impact

The contest created visibility of the circular economy in Porto.

F. Challenges for implementation

Close partnerships between the involved parties and visibility of the municipality's commitment to the purpose of the contest was key. To contribute to a real transformation toward a circular and regenerative food system.

G. References

[1] https://cityloops.eu/cities/porto

[2] H. Claro et al., 2023, CIRCULAR Bio-waste in PORTO, Demonstration Report, Deliverable 3.7 of EU-project Cityloops, 77 pp.
https://cityloops.eu/fileadmin/user_upload/D3.7_Porto_Bio_waste_demo_report.pdf

49. (CL-05) Redistributing of food residues to vulnerable groups (Zero Desperdicio, PT)

A. Description

In Porto, Portugal a food donation network was expanded, which connects food distribution and social economy sectors to support citizens with low income and social needs in the city of Porto. This also resulted in a reduction of food waste. The network involves restaurants, hotels, companies in the wholesale and retail sector with municipal services related to social and school canteens, and events promoted by the municipality. The donation network is supported by an online dashboard.

B. Activities

A collaboration protocol was set up to connect the municipality with the initiative Zero Desperdicio (No waste commitment). New food donors and receivers were identified. Food safety and food security trainings for new partners were organised. Families were supported with meals.

C. Actors Involved

- Porto Municipality
- Lipor, Intermunicipal Waste Management Service of Greater Porto
- Food donors and receivers

D. Impact for bioeconomy development

Both the reduction of food waste and the donation of meals to families have a significant impact on the city.

E. Social Impact

A food donation network was created connecting food distribution and social economy sector actors to support citizens with low income and social needs in the city of Porto. This action will allow food waste reduction in the city. From May 2021 to December 2022, there were 14 donors and 6 receivers, 207 957 equivalent meals were distributed by 12 083 families, and 104 metric tons of food waste were avoided, resulting in the prevention of 437 metric tons CO2 eq emissions

F. Challenges for implementation

The population participation and engagement are the key to the success of the project.

G. References

[1] H. Claro et al., 2023, CIRCULAR Bio-waste in PORTO, Demonstration Report, Deliverable 3.7 of EU-project Cityloops, 77 pp. https://cityloops.eu/fileadmin/user_upload/D3.7_Porto_Bio_waste_demo_report.pdf

50. (CL-06) Combine Kitchen garden concept with food waste to produce meals by vulnerable groups (PT)

A. Description

A private social institution organises the production of meals by young adults with disabilities. Part of the ingredients is harvested in their own kitchen garden; part is contributed by nearby supermarkets to prevent food waste. The municipality is involved to optimise the circularity of this activity.

B. Activities

Production of meal by young adults with disabilities combined with a kitchen garden and prevention of food waste.

C. Actors Involved

- Somos Nós Association is a Private Institution of Social Solidarity, created by parents and friends of young adults with disabilities, who have reached the end of their school life and need alternatives for their personal and professional fulfilment. Their personal fulfilment goes through the interaction with the community, not only enjoying the training, culture, and leisure spaces that it provides, but also through the execution of useful tasks for that same community, which stimulate their abilities and self-esteem.
- Porto Municipality.
- Lipor, Intermunicipal Waste Management Service of Greater Porto.

D. Impact for bioeconomy development

The activity connects a group of young adults with the bioeconomy, actively preventing food waste and supporting others with nutritious meals.

E. Social Impact

The activity provides personal and professional fulfilment to a vulnerable group of people. It establishes a link with the community and supplies meals to other vulnerable groups.

F. Challenges for implementation

It is fundamental to find the person inside the institution who is sensitive to sustainability and has enough power and motivation to change the practices.

G. References

[1] H. Claro et al., 2023, CIRCULAR Bio-waste in PORTO, Demonstration Report, Deliverable 3.7 of EU-project Cityloops, 77 pp. https://cityloops.eu/fileadmin/user_upload/D3.7_Porto_Bio_waste_demo_report.pdf

[2]https://cityloops.eu/fileadmin/user_upload/Materials/Implementation_plans/CityLoops_OIP_Porto_BW.pdf

[3] Somos Nós (somosnos.pt)

51. (CL-07) Improve separate bio-waste collection for biogas production by digestion (ES)

A. Description

In Seville, Spain the municipality and the waste management companies have started to introduce separate collection of bio-waste from households. This includes education the citizens on separating waste, creating enthusiasm for separating, setting up new (and intelligent) collecting routes and the production of biogas from the collected bio-waste. The biogas is produced in an existing wastewater treatment plant that used to run solely on sludge.

B. Activities

- Awareness campaigns
- Door to door information visits to educate people on separating waste.
- Workshops and school lessons to educate people on separating waste.
- Design of a versatile tool to monitor the amount of collected bio-waste per bin and optimise the collection routes based on this information.
- Introducing the collected waste into an existing fermentation installation to produce biogas and establishing the expected biogas production based on the variable composition of the collected bio-waste.

C. Actors Involved

- City Council of Seville
- Limpieza Pública y Protección Ambiental S.A.M (LIPASAM)
- Mancomunidad de Los Alcores
- The citizens of Seville
- Idener (Development of routing tool)

D. Impact for bioeconomy development

Separation of bio-waste from households is enforced by EU-legislation. By removing this fraction from the mixed solid waste fraction, landfill or burning of the bio-waste is avoided. Composting and/or biogas production are the logical alternatives to dispose of the separated bio-waste.

E. Social Impact

Separate collection of bio-waste from household requires active participation of citizens. Awareness campaigns are necessary to obtain the cooperation of the citizens. Throughout the whole of Europe, it is noted that getting and keeping the enthusiasm of citizens towards separating waste is a challenging endeavour.

F. Challenges for implementation

Bio-waste management needs to be a key factor in urban planning and political decision making now and in the coming years, defining and testing different instruments (technological, organisational, legal, relationship with citizens, etc.) to meet the European objectives of quantity and purity of this flow of material.
Political commitment is fundamental to reinform the importance of Bio-waste management as well as to promote opportunities for circular economy in the city.

Awareness campaigns are fundamental for the change, both the initial campaigns, as well as regular reminders. Additionally, the inspection and sanction of those establishments and citizens that do not comply with municipal ordinances, and particularly the separation of bio-waste, are crucial.

G. References

[1] Pedro Cruces González et al., 2023, CIRCULAR Bio-waste in Seville, Demonstration Report, Deliverable 3.8 of EU-project Cityloops, 94 pp.
[WP3_BW_Seville_Demonstration_report.pdf (cityloops.eu)]

52. (CL-08) Create certified green spaces to improve general wellbeing (PT)

A. Description

In Porto, Green Space Certification System was started. This system aims to increase the sustainable management of any kind of urban green spaces, promoting biodiversity and recognising the spaces already working on these issues, so that citizens can identify and enjoy safe and environmentally well-managed green areas. The Green Space Certification System, together with other sustainable practices, will specifically encourage dedicated gardening practices to promote and reuse the locally compost produced at LIPOR's composting plant – to highlight the importance of returning bio-waste to urban soil in the form of compost and the sustainable management of green spaces.

The adoption of good practices for green space management and maintenance aims to:

- Reduce the production of bio-waste (from park and garden management and maintenance).
- Reduce water consumption and the use of environmentally harmful products.
- Reduce maintenance needs and resources used.
- Promote biodiversity.
- Improve urban living conditions by restoring natural spaces.
- Raise awareness of the need for sustainable green spaces.

B. Activities

The activities towards a certification system involved the design of the certification system, the identification of green spaces for implementation, demonstration of the certification system in the selected spaces and evaluation of the demonstration.

C. Actors Involved

- The citizens and users living near the specific green spaces.
- Porto Municipality
- Lipor, Intermunicipal Waste Management Service of Greater Porto

D. Impact for bioeconomy development

Green spaces in Porto are created and maintained according to sustainable gardening principles. The space combines more efficient maintenance and irrigating, while considering the intended used of these spaces.

E. Social Impact

The Green Space Certification System, together with other sustainable practices specifically encourage dedicated gardening practices to promote and reuse the locally produced compost to highlight the importance of returning bio-waste to urban soil in the form of compost and the sustainable management of green spaces.

F. Challenges for implementation

The involvement of the gardening team of Porto was fundamental to deliver this type of certification.

G. References

[1] H. Claro et al., 2023, CIRCULAR Bio-waste in PORTO, Demonstration Report, Deliverable 3.7 of EU-project Cityloops, 77 pp. https://cityloops.eu/fileadmin/user_upload/D3.7_Porto_Bio_waste_demo_report.pdf

53. (CL-09) Improve separate bio-waste collection for biogas production to fuel local busses (Mikkeli, FI)

A. Description

In Mikkeli, Finland the municipality is introducing bio-waste collection from households focussing on high rise buildings. This includes educating the citizens on separate collection and setting up new collection bins. The collected bio-waste is fermented in a biogas installation. The biogas is upgraded to be used in the local busses as biofuel.

B. Activities

- Awareness campaigns towards citizens and specifically at the people living in high rise buildings.
- Educating citizens to use paper bags to collect bio-waste as the (bio-)plastic bags are undesired in the biogas production.
- Setting up new collection bins outside the high rise buildings.
- Determination of the reduction of the bio-waste fraction in the mixed solid waste fraction from households.
- Establishing the amount of biogas that can be generated from the collected bio-waste.

C. Actors Involved

- Xamk (University of applied sciences)
- Citizens of Mikkeli
- MikseiMikkeli (Mikkeli Development Company Miksei Ltd.)
- Metsäsairila Ltd. (City owned municipal waste company)
- BioSairila Ltd. (Industrial biogas producer)

D. Impact for bioeconomy development

Bio-waste produced by citizens is received by the city municipal waste company Metsäsairila Ltd. For years, Mikkeli has recycled its bio-waste into soil products by composting, however the intention is to now upcycle the bio-waste material into biogas. Landfilling is not an issue in Finland or Mikkeli, since t beginning of 2016 organic waste has not been allowed to be disposed in landfills. The Government Decree on Landfills (331/2013).

Because of the gradual decline of Nokia as large industrial player, Mikkeli has chosen to develop bio-based industries as alternative. Producing biogas to fuel the local busses was one of the new developments. Originally sludge and agricultural residues were the main feedstock. Adding bio-waste from households will increase the biogas production while at the same time reducing the amount of bio-waste burned (as part of the mixed solid waste fraction)

E. Social Impact

Separate collection of bio-waste from household requires active participation of citizens. Awareness campaigns are necessary to obtain the cooperation of the citizens. Throughout the whole of Europe, it is noted that getting and keeping the enthusiasm of citizens towards separating waste is a challenging endeavour.

F. Challenges for implementation

The cooperation of citizens is crucial to optimise the separate collection of bio-waste from households.

G. References

[1] Vuokko Malk et al, 2023, CIRCULAR Bio-waste in Mikkeli, Demonstration Report, Deliverable 3.6 of EU-project Cityloops, 76 pp.
https://cityloops.eu/fileadmin/user_upload/D3.6_Mikkeli_Bio-waste_demo_report.pdf

54. (OTH-09) Urban Vertical Farms (DE, NL,SG)

A. Description

Vertical farming is a method of cultivating crops in vertically stacked layers or structures, often indoors or in controlled environments. Instead of spreading out horizontally over large areas of land, plants are grown upwards in stacked trays, shelves, or towers. It is an innovative agricultural technique mostly widespread in regions where there is a high population density, limited arable land, and a strong focus on sustainability and innovation in agriculture.

B. Activities

Vertical farming uses and implement ideas, concepts, or practices to address social or environmental challenges and improve the well-being of communities. This practices include the use of:

- Stacked Systems: Plants are grown in trays or shelves stacked on top of each other, maximizing the use of vertical space. This can be done indoors or in specially designed vertical farming facilities.
- Hydroponics or Aeroponics: Vertical farms often utilize soilless growing techniques like hydroponics (where plants grow in a nutrient-rich water solution) or aeroponics (where plant roots are suspended in air and periodically misted with nutrient solution).
- Efficient Lighting: Vertical farms may not receive natural sunlight, they rely on artificial lighting, often using energy-efficient LED lights that can be adjusted to provide specific light spectrums to different plant growth stages.
- Controlled Environment: Vertical farming allows for precise control over environmental factors such as temperature, humidity, and CO2 levels. This controlled environment helps optimize plant growth and minimize the risk of pests and diseases.
- Integration with Technology: Many vertical farming systems incorporate advanced technologies like automated nutrient delivery systems, sensors for monitoring plant health, and data analytics for optimizing growing conditions.

C. Actors Involved

The successful implementation of vertical farms requires collaboration and coordination among multiple stakeholders, for example: Investors and financers, farm owners, technology providers, research institutions and universities, government agencies and regulatory bodies, Non-profit organization and NGO's.

Examples of vertical farming:

- Infarm (DE): This start up based in Berlin that designs and operates modular vertical farming systems. They install these systems directly in grocery stores, restaurants, and distribution centers, allowing for ultra-fresh produce to be grown and harvested onsite. [1]
- Urban Farmers (Switzerland): This company specializes in rooftop aquaponic farming. Their flagship project, located in Basel, involves converting disused industrial buildings into urban farms where fish and vegetables are cultivated symbiotically. [2]
- Sky Greens (NL): Sky Greens developed commercial-scale vertical farm using a patented A-Go-Gro system. Their farm in The Hague produces fresh vegetables such as lettuce and herbs using minimal land and water resources. [3]
- Urban Health Farms (NL): produced and distributed large-scale indoor vertical farms at the cutting-edge intersection between agriculture and technology. They produce natural food free from pesticides, minimising the distribution chain and offering competitive prices for the consumer. [4]

D. Impact for bioeconomy development

Vertical farming can offer many advantages. For example, by growing crops in layers above one another in empty office blocks it is possible to achieve a more sustainable, efficient and fully-controlled cultivation than traditional farming methods. It typically uses less water and fewer pesticides, and reduces the need for long-distance transportation of produce, thereby lowering carbon emissions. With controlled environments, vertical farms can produce crops year-round regardless of external weather conditions, providing a consistent supply of fresh produce.

E. Social Impact

Urban vertical farming could provide several social benefits that extend beyond food production. This solution also contributes to: more inclusive, resilient, and sustainable communities by fostering social connections, promoting education and skill-building, enhancing food security in the case of contaminated soils, building healthier, more equitable cities.

F. Challenges for implementation

Energy consumption is still high, but researchers are working hard to grow products using less energy than needed in a greenhouse. [5]

G. References

[1] https://www.infarm.com/vision
[2] https://www.urbanfarmers.com/
[3] https://www.skygreens.com/about-skygreens/
[4] https://urbanhealthfarms.com/about-us/
[5] https://www.wur.nl/en/dossiers/file/vertical-farming.htm

55. (OTH-10) Wooden bicycle and fitness frames (ES, DE)

A. Description

Use eco-friendly materials to create fitness frames and bikes. The main value proposition is to promote use of hardwood and other natural fibres sourced exclusively from sustainably managed forests at local level and renewable tree stocks from Basque forest and Germany and using innovative techniques. The hardwoods offer not only durability but also an aesthetic appeal which is important on final design of the products.

B. Activities

- Sourcing of sustainable material (hardwood): this activity involves identifying reliable wood sources, ensuring the wood meets quality standards, and managing relationships with suppliers.
- Design and development: aesthetically, durable, repairable and functional products including prototypes.
- Manufacturing: this includes in-house or outsource production to third-party manufacturers. This activity involves assembling components, crafting wooden frames, and ensuring product quality through rigorous testing and inspection processes and using energy-efficient practices.
- Marketing and sales: markets its products through various channels, including online platforms, social media, fitness expos, and specialty retailers. They may also engage in advertising and promotional activities to reach their target audience.
- Customer services: providing assistance with assembly and maintenance, and addressing any inquiries or concerns from customers.
- Sustainability Initiatives: sustainability is a core value for this solution, including engagement in activities such as using eco-friendly materials, implementing recycling programs, or supporting reforestation efforts.

C. Actors Involved

- Wood Suppliers: Companies or individuals who provide the raw materials, such as sustainably-sourced wood, for the bicycle frames.
- Designers and Engineers: responsible for conceptualizing and designing the wooden bicycle, ensuring that it's both aesthetically pleasing and structurally sound.
- Craftspeople or Artisans: Skilled woodworkers who craft the wooden bicycle frames. This can involve various techniques such as carving, shaping, and laminating wood to create the desired frame design.
- Bicycle Manufacturers: Companies or workshops that assemble the wooden bicycle frames with other components such as wheels, gears, brakes, and handlebars to create a fully functional bicycle.
- Retailers: Bicycle shops or online stores that sell wooden bicycles to consumers.
- Customers: Individuals who purchase and use wooden bicycles for commuting, recreational activities or sport.

There may be other stakeholders involved depending on factors such as the scale of production, location, and specific business models adopted. In the case of the Spanish producer AXALKO there was support from European Regional Development Fund (ERDF) to support small and medium sized businesses.

D. Impact for bioeconomy development

This solution contributes to the bioeconomy by promoting responsible and sustainable forestry practices, creating market demand for renewable resources, reducing environmental impact, and supporting the transition toward a more sustainable economy. By using hardwoods, this solution encourages the sustainable management of forests and promotes responsible forestry practices, including reforestation, biodiversity conservation, and the maintenance of healthy ecosystems. It also creates a market demand for this type of biomass and reduce the environmental impact in this applications as hardwoods are renewable and biodegradable materials, unlike many synthetic materials commonly used. By support sustainable materials this application aligns with the transition toward a more sustainable and circular economy.

E. Social Impact

This incentivizes the cultivation and responsible harvesting of hardwoods, which can contribute to the economic viability of forestry operations and rural communities.

F. Challenges for implementation

- High Production Costs: Using high-quality materials such as hardwoods can result in higher production costs compared to using synthetic materials.
- Limited Market Reach: The focus on premium, design-driven equipment may limit its market reach compared to competitors offering more affordable options.
- Educating Consumers: Many consumers may not be aware of the benefits of hardwood in this application or the sustainable practices employed. Educating consumers about the value proposition and the importance of sustainability in purchasing decisions is essential.
- Competition: The bikes and fitness equipment market is highly competitive, This application must differentiate itself effectively to stand out in a crowded market and attract discerning consumers willing to invest in premium products.
- Supply Chain Management: Ensuring a consistent supply of high-quality hardwoods while maintaining sustainability standards can be challenging but it is important to mitigate supply shortages, quality inconsistencies, and environmental concerns. Therefore a local or regional setting can be beneficial.

G. References

[1] https://axalko.com/local-partners/
[2] https://renovo.bike/blog/wood-selection-considerations/
[3] https://www.nohrd.com/
[4] https://www.hausvoneden.com/urban-living/wooden-bicycles-close-tips-top-brands/

56. (OTH-11) Farm Cooperatives for the Use of Agricultural Equipment (CUMAS,FR)

A. Description

A Farm machine cooperatives also known as 'CUMA' (from the French Coopératives d'Utilisation de Matériel Agricole) is a service cooperative set up by and for farmers. The group of farmers buy farm machinery in common and share the costs and access to new technology and therefore improve and make more efficient their working conditions, something that on their own will be almost impossible. The CUMAS were developed in France just after World War II to respond to the urgent necessity of massively mechanizing French agriculture to feed France.

B. Activities

Main activities of a CUMA are related managing or programming activities that imply deciding in advance how activities may be executed. The CUMA must have capacity to organize themselves via formal governance mechanism or via relational governance.* This implies the ability of producers to plan for all eventualities in their production activities, which could be complex due to the uncertainties associated with agricultural activities. The type of activities are: Regular meetings to organize clear schedules, establish clear working criteria defined by the group (e.g. by geographical areas, priority to the farmer who was the last the previous year, plots with an earlier maturity etc.), establish and share responsibilities in relation to suppliers, banks, local government, local community, maintenance activities, share of temporary workers.

*Relational governance focuses on social interactions and joint efforts to develop and maintain long-term bilateral relationships, which primarily bases on mutual trust and commitment.

C. Actors Involved

CUMAs are collective organisations working under a voluntary membership equity, democratic management, social capital and community commitment. A CUMA includes at least four members people work and decide together in a community (a CUMA will only operate in a precise geographic area), with people who are committed in the long term so that the whole group benefits from the investment.

D. Impact for bioeconomy development

The first goal of the CUMA is to reinforce farmers revenue by reducing mechanization and overhead costs. With this type of initiatives a farmer can save between 5-15% of mechanization costs, have access to up-to-date machinery and share the risk (an asset for new projects). They can also work together to access to economic incentives: credit access, grants, and appropriate legal support through an advisory network. Nowadays, farmers have created the CUMAs , because they found that is becoming increasingly difficult to build partnerships with large companies.

E. Social Impact

The CUMA bring quality of life to farmers through a better work organisation, social interaction, and it provides an easier setup of young farmers which receive advices from the group and cost cutting. CUMAs are also taking part is creating more solidarity, reinforcing communities and generating social interactions within the economy. Thus making the economy more social.

In rural areas, an increasing number of jobs are carried out by local CUMA partners. Many schools, for example, are using wood pellets supplied by a CUMA to power boiler heaters. In some rural communities CUMAs function even more efficiently by renting out their machinery to local authorities to complete a range of works, including snow clearing in winter.

F. Challenges for implementation

The CUMA requires programming activities which implies the ability of producers to plan for all eventualities in their production activities, which could be complex due to the uncertainties associated with agricultural activities. In a CUMA, members expose themselves to tensions between self-interest and group-interest. This tension occurs when, for instance, a specific type of machinery is used only during a very short period due to weather conditions or due to the presence of opportunistic behaviour within CUMAs that can undermine the success of the group.

G. References

[1]https://www.farmersjournal.ie/machinery/farm-machinery/50-of-all-french-farmers-are-in-cuma-machinery-sharing-741846
[2]https://ec.europa.eu/eip/agriculture/sites/default/files/20191028_eipagri_ws_small_is_smart_stephane_diard.pdf
[3]https://www.farmersjournal.ie/machinery/farm-machinery/50-of-all-french-farmers-are-in-cuma-machinery-sharing-741846
[4] D. Diakit´e et al. Journal of Co-operative Organization and Management 10 (2022) 100181
[5] https://www.cuma.fr/resource/decouvrir-les-cuma/

57. (OTH-12) Recycling wood from local construction sites (Usefulwood, UK)

A. Description

Usefulwood is a non-profit organization based in the UK dedicated to sustainable woodworking practices. Established with the mission of promoting environmental conservation and community empowerment, Usefulwood focuses on utilizing wood resources responsibly while supporting local economies and artisans. Through education, advocacy, and practical initiatives, they strive to raise awareness about the importance of preserving forests, promoting biodiversity, and fostering a sustainable future for woodworking industries. Usefulwood aims to inspire individuals and businesses to adopt eco-friendly practices in woodworking.

B. Activities

- Collection of wood from small local construction sites (charging a small fee to do so),.
- Cleaning and preparing collected wood for reselling for small building and do it yourself (DIY)projects
- Helping our customers in the wood store
- Make wood products in the workshop.
- Marketing wood collection services
- Supervising our volunteers in all activities

C. Actors Involved

- Founders and Leadership: The individuals who initiated the organization and provide strategic direction.,
- Staff-Supervisors and Volunteers: volunteers with good “people-skills” and life experience come alongside others as they work together and supervise activities. Woodworking skills are useful for teaching in the workshop, but no woodworking experience at all is needed to volunteer with us.
- Partner Organizations: Collaborators such as environmental NGOs, forestry associations, educational institutions, governmental agencies, and sustainable businesses, who work with Usefulwood to advance shared goals and initiatives.
- Community Members: who benefit from Usefulwood's activities, including forest-dependent communities, woodworking enthusiasts, consumers of wood products, and individuals interested in environmental conservation.

D. Impact for bioeconomy development

Usefulwood contributes significantly to the bioeconomy by: promoting responsible wood sourcing locally, supporting local woodworkers, artisans, and communities, stimulates economic growth and job creation in in the area, reduces unemployment, and fosters entrepreneurship within the woodworking sector. They also create value-added wood products.

E. Social Impact

Usefulwood is a social enterprise the project focuses on transforming lives. Many skills are required to work on activities involved in operating this community business; both male and female volunteers are welcome with no obligation. The organization especially welcome applications from people who are seeking to get back into mainstream employment and need to gain confidence and useful experience and skills for your next job while working in a supportive team. All equipment and training is provided.

F. Challenges for implementation

The Usefulwood stills requires supports from sponsors and donations as we build our social enterprise operations.

G. References

[1] https://www.usefulwood.org/

Annex 6. SRL Concept

The catalogue offers inspirational examples of innovative bioeconomy solutions. These can be a starting point for regional actors from business sectors, public administration or civil society to bring such innovations to their region or to improve and further develop them. At the regional level the developments typically evolve along the lines of co-creation processes within the structure of a quadruple helix arena. This means that actors from multiple organizations (public, private, civil and knowledge sectors) and at multiple levels are involved in steering regional developments in a desired direction. Next to TRL, there is a need to monitor these developments from a societal readiness perspective, especially in relation to the Just Transition Mechanism of the EU [1)]. For this purpose, we have developed the societal readiness level (SRL) assessment tool.

The societal readiness level depicts the maturity of various societal aspects within a technological environment. We draw upon transition literature to build a new assessment tool for the societal readiness of innovative bioeconomy solutions as they are applied within regions. The regional dimension is important, not only because technologies (and technological innovations) and the uptake thereof are shaped by the regional context, but also because the regions are important hubs in transition government. Innovative bioeconomy solutions often consist of or make use of technologies which reached a certain maturity level, assessed with the technological readiness level (TRL). The design of the SRL tool seeks to go beyond the single dimension of readiness of the product or technique to bring it to the market safely and successfully. The tool also addresses the contribution of the applied solution to the sustainability goals and includes information on its use, uptake and various organizational aspects, especially regarding issues not mediated through markets. An extensive article on the SRL concept has been prepared and is forthcoming (Schrijver et al., in prep.).

In transition literature technological developments are driven by two core principles. One being the coordination of decisions for investments in and uptake of new technologies and the other being path dependencies. The TRL framework was originally developed independently by NASA for the purpose of reaching a safe flight readiness level. In this case a rather linear pathway of technological development was paired with a focus on the technological dimension for the coordination of crucial decisions in the development process. The technology needed to be safe in the first place. The EU adopted the TRL framework for its research and innovation programmes and made some modifications to it (EARTO, 2014). Gradually a need to include more societal aspects emerged. Building on transition literature we distilled five societal aspects (or societal modes /mechanisms for coordination) that play a crucial role in shaping technological development and five stages of maturity (refined from Geels et al., 2017) listed in table A6.2.

The core of the SRL-tool is the 5*5 matrix presented in tables A6.1 and A6.2. This matrix outlines five stages on a transition pathway accompanied by five social dimensions, i.e. the modes of regional coordination of investments in innovative solutions. Coordination of regional development through networks is guided by collaboration based on mutual interest and controlled by the mechanism of reciprocity (Gerritsen et al., 2013; Van Buuren and Eshuis, 2010). The outcome - a quantity of an innovative solution that's being applied - is a negotiated amount that has not been guided by market signals. In contrast coordination through markets is fully driven by the supply and demand dynamics guided by price signals. This approach tends to work well for private goods, but not so well for public goods. Coordination of technological development by public support can be regarded as a special type of network where governments exercise their hierarchical powers to implement positive or negative incentives. Coordination of skills and capacity in terms of human capital needed to produce, provide and use new technologies is usually institutionalized by educational programs of universities and schools (through their curricula and training) serving as overarching facilities and present a special challenge to align with regional development planning. The final mode of coordination, i.e. the regional cultural and ethical dimensions are linked to the local identity and shape technologies for instance through the expression of local preferences in taste.

The various aspects of regional coordination can be at different levels of maturity or in various stages of the transition. To provide guidance for assessing the stage of each regional coordination mode, we developed several canvas templates (tables A6.3 to A6.6). These are based on the well-known Business Model Canvas from Strategyzer [2)] (Table A6.3 represents an adapted variant) and the cluster model canvas (Kranendonk and Schrijver, 2021). The tables provide examples that can be used in practical workshops.

Table A6.1 Societal readiness levels from a regional perspective

	Transition stages	Societal Readiness Level Description
SRL 1	Pre-development	Inception (+/- invention) of biobased innovation(s), competing directions and actors. Many small-scale initiatives start experimenting (start-ups, spin-offs).
SRL 2	Selection and advancement	Direction of innovation is converging, coordination between actors is limited and incomplete. Resources are hard to find but are out there (vested interest in defence). Considerable drop out of initiatives.
SRL 3	Take-off	Shared mission in a fully functioning quadruple helix ecosystem, with supporting instruments available. Participants engage in shared strategy development and implementation. Some initiatives survive, often by technology transfer to larger or other type of organizations. There is a (growing) need for social innovations.
SRL 4	Acceleration	Institutional uptake, deconstructing old or competing routines. Ecosystem transforms into an acceleration-oriented structure. New participants, such as capital-, social enterprise-, training organizations, etc. Regional specialization occurs through localized action and adaptation (innovations). Technology dispersal outside patented organization. Missions are established.
SRL 5	Stabilisation	The biobased innovation(s) have become mainstream. Less need to actively coordinate transitions/ optimize coordination routines; the ecosystem transforms into supporting networks. Technology freely available in society (closure).

Table A6.2 Societal readiness level matrix from a regional perspective

	Social dimensions (modes of societal coordination)				
	(Regional) Network Readiness	**Market Readiness**	**Public Support Readiness**	**Skills Readiness**	**Ethical & Cultural Readiness**
	Characteristics of the .	Level of engagement with commercial structures for market deployment of the innovation.	Type of public support.	Level of capacity building to discover, replicate or implement the innovation.	How the innovation deals with ethical/cultural norms*.
SRL 1	Small group of allied stakeholders, within an organization or crossing organizational boundaries. Start of quadruple helix & mission formation.	Scan opportunities, small enterprises or small groups within corporates.	Limited support, focused on subsidies for research and some network support.	Information or skills about the innovation are only available to directly involved individuals.	Ethical and cultural implications of the innovation and its correspondence to current cultural norms are not yet assessed.
SRL 2	Building coalitions, negotiations, lobbying, confrontation. Further develop and align portfolio and mission development activities.	Probing and validating of propositions, investment in standards, some alignment with corporates. Active lobby, advertisement and promotion.	Stimulate development with subsidies. Clearance of regulatory barriers towards its development. Pilots with exemptions and scouting efforts for funding instruments enabled. Interest in already existing policies and regulatory framework expressed.	Existing information and skills adapted to emerging needs of the innovation	Ethical and cultural implications of the innovation and its correspondence to current cultural norms are identified and open to public debate
SRL 3	Mission is formally agreed upon and communicated, establish innovation cluster organization, alignment in goals, strategies and roles & actions. Avoid internal competition & overlapping roles.	Venture investment, strategic cooperation's, large scale demos. Visible returns on promotion campaigns.	Balance in regulations /incentives for cooperation and competition with other innovations found. Subsidies are available for upscaling and spreading out of the innovation.	Information and skills needs are identified & necessary capacity is built up in agreement with stakeholders along the value chain	Solutions are found for ethical and cultural implications of the innovation and new norms are developed.

SRL 4	Formalized cooperation with nested enterprises, NGO's, knowledge and education & government structures, e.g. in the form of an economic board.	Horizontal & vertical integration & consolidation, push back of existing /incompatible interests	adjustments to institutional arrangements (e.g. rules and regulations) that hinder acceleration and upscaling.	Information and skills are codified and gradually made available (mainly through experimental programs or corporate initiatives).	Possible ethical issues are cleared (either by adaptation of the innovation, or of the rules). The innovation fits cultural norms and expectations of large strata of population.
SRL 5	Quadruple Helix collaboration is limited to anchoring and exploiting innovation within the network.	Full alignment with the dominant market forces in mainstream production system.	optimize market- and network i nterventions.	Information and skills are available through mainstream education centers. Universities and technical schools have dedicated curricula	Fully accepted by the cultural mainstream. No pressing ethical concern.

* The definition of cultural norms refers to shared beliefs, or values, and the human behaviors that support these values within a given society, such as the standards of conduct that are met with social approval or disapproval. (a def. from google)

Table A6.3 Canvas Bioeconomy 3)

<table>
<tr>
<td rowspan="2">Actors

How many and which companies are involved?

Are these SMEs/large companies/mixed? What is the share between large companies/SMEs?

What different sectors are involved?

Who are the Value Chain partners?

How are the companies organised? Do the companies have other industry platforms / associations / federations representing and influencing their joint goals?</td>
<td>Technology and activities

What kind of technologies are applied in your hub?

What is the TRL level of the activities in your hub?</td>
<td rowspan="2" colspan="2">Value proposition and products

What kind of (consumer) products are produced in your hub?

Where would you position your hub in the bioeconomy graph?

Do you have circular activities in your hub?</td>
<td>Customers and citizens

What kind of customers does your hub produce for? (businesses or consumers?)

Are these customers locally/nationally/ internationally located?

What kind of citizens are involved in your hub activities?</td>
<td rowspan="2">External influences

What kind of external influences will impact your near and more distant future? (EU policy, EPR, market forces, etc)</td>
</tr>
<tr>
<td>Resources and feedstock

What are the main (material) resources for the production in your hub?

Are they sourced locally/nationally/internationally?

Are they new or recycled or otherwise?

What kind of side streams do you have and how do you handle them?

How do circular activities provide value and to whom, in your hub?</td>
<td>Channels

Are your hub activities in general visible to citizens?

Does your hub advertise locally? How do companies sell the products?</td>
</tr>
<tr>
<td colspan="3">Threats

What are the main threats you see in the (further) transition towards a circular bioeconomy?

What are the main threats that could impact the viability of your hub?</td>
<td colspan="3">Opportunities

How do you see your hub in 15 years' time (what are your ambitions in terms of circularity, bioeconomy, growth or expansion, size)?

What opportunities do you identify in terms of increasing sustainability or circularity and bioeconomy activities in your hub?

How are opportunities identified in your hub and how are development activities organized?

Do you have connections with R&D parties, education parties, or others, to develop the opportunities you see?</td>
</tr>
</table>

Table A6.4 Canvas regional development 4)

<table>
<tr>
<td rowspan="2">Playing field

Who are the key actors in advancing the bioeconomy in your hub?

What actor domains are present? Public, private, knowledge, education, society

Who are missing?

What are the formal competences of involved partners?

How is action between different actors coordinated? Is there a network or cluster organisation?</td>
<td>Capacities

What capacities are available for developing the regional bioeconomy, in terms of human capital, knowledge and skills..

Is there an established ongoing dialogue and cooperation between sectors, between public and private sectors, involving NGOs and representatives of the civil society?</td>
<td rowspan="2">Mission

What is the current state of the bioeconomy in your hub?

What are its impacts on the region?

What objectives for the bioeconomy do regional actors share and what are the differences?

Is there a regional bioeconomy strategy and what does it aim for?

Is there a clear mission? [tactical strategy]</td>
<td>Specialisation

What are the regional strengths, opportunities and comparative advantages for your bioeconomy hub and region?

What strategic choices have been made regarding a specialization within the bioeconomy?</td>
<td rowspan="2">Innovation pipeline

What activities are initiated to foster the bioeconomy in your hub?

How mature is the regional bioeconomy in its development?

What facilities and/or other supporting infrastructure are present?

How well is the bioeconomy hub anchored in civil society and within the strategies and activities of other quadruple helix actors? Please, mention 3 or more examples.</td>
</tr>
<tr>
<td>Finance

How are these activities financed?

Is funding available for initiatives and investments in the bioeconomy?</td>
<td>Learning

Is there a network of regional actors for joint learning -how is this organised?
Does this learning process lead to adjusted and new activities? What are strong and weak points?</td>
</tr>
<tr>
<td colspan="3">Existing conditions – challenges and obstacles

What needs to change and what can be changed?

What are the current challenges and obstacles for bioeconomy activities described above?

Please list at least 3 challenges/obstacles providing some contextualization. Please provide relevant example at different level, such as policy, strategic planning, funding, participation, community support, etc.</td>
<td colspan="2">Requirements – opportunities and enablers

What is needed?

What are the main enabling factors of the current bioeconomy hub, its mission and supporting activities?

What opportunities there are to develop further the bioeconomy hub, its mission and supporting activities?
What outputs and outcomes are needed for the short term?</td>
</tr>
</table>

Table A6.5 Canvas regional development Gap analysis [3)]

The second step of this analysis focuses on identifying current or emerging needs for regional development that are not yet available or for significant needs for improvements in the existing ones, including for example expanding the actors involved, the topics and the type of activities.

<table>
<tr>
<td rowspan="2">Playing field

Who do you need to advance the bioeconomy in your hub?

How can the interplay of the quadruple helix be improved?

Is there a need for a different or adjusted type of coordination?</td>
<td>Capacity

How can the dialogue and cooperation be strengthened between sectors, between public and private sectors, involving NGOs and representatives of the civil society?

What capacities are needed for taking the next step of the regional bioeconomy?

What (type of) initiatives and activities should be started?</td>
<td rowspan="2">Mission

What is the desired future state of the bioeconomy in your hub?

What objectives for the bioeconomy do regional actors need to develop and agree with?

What does this imply for the regional bioeconomy strategy and what it aims for?

What would be the (options for) an adjusted mission?</td>
<td>Specialisation

What can or should the regional strengths, opportunities and comparative advantages become for your bioeconomy hub and region?

What strategic choices should be made regarding a specialization within the bioeconomy? What choices and dilemmas are present?</td>
<td rowspan="2">Innovation pipeline

What activities should be initiated to further advance the bioeconomy in your hub?

What facilities and/or other supporting infrastructure are needed to implement the future mission?

How can the bioeconomy hub be anchored better in civil society and the other quadruple helix actors?</td>
</tr>
<tr>
<td>Finance

How should these new activities be financed?

How can funding be made available for the needed investments in the bioeconomy</td>
<td>Learning

How can the learning by regional actors as a network be organised to support the needed changes?

How can this regional actors learning process lead to adjusted and new activities?</td>
</tr>
<tr>
<td colspan="3">Future conditions – challenges and obstacles

What are the future challenges and obstacles for bioeconomy activities described above?

Please list at least 3 challenges/obstacles providing some contextualization.

Please provide relevant example at different level, such as policy, strategic planning, funding, participation, community support, etc.</td>
<td colspan="2">Requirements – opportunities and enablers

What are the main enabling factors of the future bioeconomy hub, its mission and supporting activities?

What are the opportunities to develop further the bioeconomy hub, its mission and supporting activities?

What are needed future outputs and outcomes?</td>
</tr>
</table>

Table A6.6 Canvas Lifelong learning for Bioeconomy [3)]

<table>
<tr>
<td rowspan="2">Actors

Who are the key actors currently providing educational and training programmes of relevance for the purpose of bioeconomy practice uptake in the area/region?

What different sectors are involved?

What different kind of education providers are involved?</td>
<td>Technology and activities

What kind of learning activities and programmes are offered?

Please, provide an overview in terms of type (formal, non formal, awareness raising etc.), level (secondary school, higher education etc.) and formats (online, face to face, duration etc.), for various topics (skills) that are relevant for bioeconomy.

Please mention also the learning methods, if known, and what kind of innovation level they have.</td>
<td rowspan="2">Value proposition and activities

What is the impact of the current educational offer for the various learners groups?

What is the impact for the bioeconomy practices uptake?</td>
<td>Audience/learners

Who are the main audiences/learners of the learning activities?

Please, provide an overviews and link to the type of learning activities mapped.</td>
<td rowspan="2">External influences

Which kind of enablers or challenges not directly related to the regional context or sector have an impact on the current educational provisions?

Please, list a few enablers and a few challenges/obstacles.</td>
</tr>
<tr>
<td>Resources

How these mapped learning activities are funded and supported?

Please, provide an overview of the sources of funding, other forms of support and the impact on the activities relevance for the current bioeconomics practices.</td>
<td>Channels

How are the relevant learning activities you have described promoted to relevant potential learners?

Which channels are used and how efficient and impactful are they?</td>
</tr>
<tr>
<td colspan="2">Challenges and obstacles

What are the current challenges and obstacles for the provision of the education and learning activities described above?

Please list at least 3 challenges/obstacles providing some contextualization.

Please provide relevant example at different level, such as policy, strategic planning, funding, participation, community support, etc, including also reference to the core dimensions of regional development for bioeconomic.</td>
<td colspan="3">Opportunities and enablers

What are the main enabling factors of the current educational provision of educational activities linked/relevant to bioeconomics?

What are the opportunities to develop further the current for the provision of the education and learning activities described above?

Please list at least 3 enablers and 3 opportunities and provide some context.

Please provide relevant example at different level, such as policy, strategic planning, funding, participation, community support, etc, including also reference to the core dimensions of regional development for bioeconomic.</td>
</tr>
</table>

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1) https://www.europarl.europa.eu/erpl-app-public/factsheets/pdf/en/FTU_3.1.10.pdf
2) https://www.strategyzer.com/library/the-business-model-canvas
3) Source: Bos et al., 2022 Engage4Bio D1.1 section 2 Manual and Canvases
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