Project of the Interreg Baltic Sea Region Programme 2014–2020
"Unlocking the Potential of Bio-based Value Chains in the Baltic Sea Region."

Project Acronym: BalticBiomass4Value

Project Number: #R095

Report on good practice implementation guidelines for circular bioeconomy development and a training programme targeted at regional/local public authorities in the BSR

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November 2021

Project co-funded by the European Regional Development Fund

Preface

This report is an output of the implementation of Work Package 3, Group of Activities 3.1 "Good practice implementation guidelines for circular bioeconomy development and a training programme targeted at regional/local public authorities" as specified in the latest approved version of the Application Form of the BalticBiomass4Value project.

For the implementation of the BalticBiomass4Value project, a subsidy was awarded from the European Regional Development Fund under the Interreg Baltic Sea Region Programme 2014–2020.

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Citation:
Lenerts A., Muška A., Pilvere I. (2021). Report on good practice implementation guidelines for circular bioeconomy development and a training programme targeted at regional/local public authorities in the BSR. Jelgava: Latvia University of Life Sciences and Technologies

TABLE OF CONTENTS

I. About the BalticBiomass4Value project

The BalticBiomass4Value project brought an opportunity to build a transnational partnership representing eight countries of the Baltic Sea Region (BSR) to support the replacement of fossil-based resources with renewable bio-based resources and to promote innovative circular bioeconomy production approaches.

The Baltic Sea Region (BSR) holds great potential for circular bioeconomy development. Therefore, the project aims to enhance the capacity of public and private actors within the BSR to produce products in a more environmentally sustainable and economically viable way by utilizing biomass sources (chiefly, biological waste) for energy and production of all kinds of products, as well as possibilities to use side streams for higher value bio-products. Biomass from different sources (agriculture, the food and feed industry, forestry, the wood industry, municipal waste and sewage sludge, fisheries, algae), its logistics, various biomass conversion technologies and value chains were mapped to identify good practices of bio-based product production and the potential of more efficient and sustainable deployment of biomass in the BSR. Seventeen partners from Lithuania, Latvia, Estonia, Germany, Poland, Sweden, Norway and the Russian Federation represent the producers of biomass and bio-based products, as well as relevant public authorities and policy stakeholders to stimulate green growth.

The general aim of this study was to map policy support measures for circular bioeconomy development and prepare good bioresource-based practice implementation guidelines for regional/local public authorities in Baltic Sea Region countries. More specific objectives were:

- to analyse the EU and BSR countries' national-level circular bioeconomy policies and strategies,
- to identify good practice policy support measures and enable organisational setups to promote circular bioeconomy development at regional/local level in the BSR countries,
- to create a training programme for regional/local public authorities on circular bioeconomy development and its support systems in the BSR countries,
- to develop an online library of good practices and a collaboration/experience exchange platform for regional/local public authorities on the project website.

Project coordinator:

- Vytautas Magnus University (Lithuania)

Project partners:

- Ministry of Energy of the Republic of Lithuania (Lithuania)
- Forest and Land Owners Association of Lithuania (Lithuania)
- Lithuanian Biotechnology Association (Lithuania)
- Vidzeme Planning Region (Latvia)
- Latvia University of Life Sciences and Technologies (Latvia)
- Ministry of Rural Affairs of the Republic of Estonia (Estonia)
- Estonian Chamber of Agriculture and Commerce (Estonia)
- Estonian University of Life Sciences (Estonia)
- Agency for Renewable Resources (FNR) (Germany)
- 3N Lower Saxony Network for Renewable Resources and Bioeconomy (Germany)
- State Agency for Agriculture, Environment and Rural Areas of Schleswig-Holstein (Germany)
- University of Warmia and Mazury in Olsztyn (Poland)
- Halmstad University (Sweden)
- Norwegian Institute of Bioeconomy Research (Norway)
- Norwegian University of Life Sciences (Norway)
- Municipal enterprise of the city of Pskov "Gorvodokanal" (Russian Federation)

For more information, please visit the project website at: www.balticbiomass4value.eu

In the following sections, a theoretical background on a circular bioeconomy (CB) and criteria for related policy support measures (SM) is shortly introduced. The methodology section describes the selection of macro- and micro-level support measures and impact factors of activities. The third section provides a description of value chain support measures for sustainable CB business models (BM). The training programme for regional/local public authorities on CB development and its support systems is presented in the fourth section, followed by conclusions in the fifth section. The extended descriptions of business cases are presented in the appendix.

II. List of concepts and abbreviations

Baltic Sea Region (BSR)	Area of the Interreg Baltic Sea Region Programme, which includes eight EU Member States (i.e. Denmark, Estonia, Finland, Germany (the States (Länder) of Berlin, Brandenburg, Bremen, Hamburg, Mecklenburg-Vorpommern, Schleswig-Holstein and Niedersachsen (only NUTS II area Lüneburg region)), Latvia, Lithuania, Poland, Sweden) and two partner countries (i.e. Norway, Russia (St. Petersburg, Arkhangelsk Oblast, Vologda Oblast, Kaliningrad Oblast, Republic of Karelia, Komi Republic, Leningrad Oblast, Murmansk Oblast, Nenetsky Autonomous Okrug, Novgorod Oblast and Pskov Oblast)).
Bioeconomy	All sectors and systems that rely on biological resources (animals, plants, micro-organisms and derived biomass, including organic waste), their functions and principles. It includes and interlinks: land and marine ecosystems and the services they provide; all primary production sectors that use and produce biological resources (agriculture, forestry, fisheries and aquaculture); and all economic and industrial sectors that use biological resources and processes to produce food, feed, bio-based products, energy and services (European Commission 2018).
Bioenergy	Energy created from renewable biomass.
Biomass	Biodegradable fraction of products, waste and residues from biological origin from agriculture (including vegetal and animal substances), forestry and related industries including fisheries and aquaculture, as well as the biodegradable fraction of industrial and municipal waste (European Parliament … 2009).
Business case (BC)	Description of a real-life business and its context for the study of the particular phenomenon.
Business model (BM)	Simplified description of how an enterprise conducts its business.
Circular economy (CE)	Economy, where the value of products, materials and resources is maintained for as long as possible, while generation of waste minimized (European Commission 2015).
Value capture	Enterprise's ability to monetize its transactions with its customers and earn profit.
Circular bioeconomy (CBE)	The circular bioeconomy covers all sectors and systems that rely on biological resources (animals, plants, micro-organisms and derived biomass, including organic waste), their functions and principles. It includes and interlinks land and marine ecosystems and the services they provide; all primary production sectors that use and produce biological resources (agriculture, forestry, fisheries, and aquaculture); and all economic and industrial sectors that use biological resources and processes to produce food, feed, bio-based products, energy and services
Value chain	An interconnected set of primary and support activities that are carried out in order to transform ideas into products and services for customers end-use and beyond, starting from the conception and going through stages such as design, production, marketing, delivery, consumption, disposal/recycling.
Support measures (SM)	A range of tools or mechanism used by publics authorities or political parties, profit or non-profit organisations to achieve a desired effect through legal/regulatory, economic/financial or soft means

III. List of figures

IV. List of tables

Introduction

This report is prepared within the project "Unlocking the Potential of Bio-based Value Chains in the Baltic Sea Region (BalticBiomass4Value)", group of activities 3.1 "Analysis of regional / local support systems for circular bioeconomy development and the preparation of good practice implementation guidelines for public authorities".

There are five major **tasks** within activity 3.1:

1. To analyse how to translate EU and national level circular bioeconomy policies and strategies into local actions and how to integrate agricultural, energy and waste policy measures and enable organisational setups to enhance their combined effect.
2. Identify good practice policy measures and enable organisational setups to promote circular bioeconomy development at local level.
3. Prepare good practice implementation guidelines for public authorities.
4. Create a training programme for regional / local public authorities on circular bioeconomy development and its support systems.
5. Develop an online library of good practices and a collaboration / experience exchange platform for regional / local public authorities on the project website.

The structure of this report corresponds to the tasks – one first-level chapter of the report is devoted to each task.

According to the project description, all the actions of group of activities 3.1 are planned for the following **aims**:

- The purpose of the guidelines is to provide a comprehensive set of tools for regional / local authorities to promote bioenergy and the circular bioeconomy in regions / municipalities.
- The purpose of the training programme is to engage stakeholders, foster exchange of information and sharing of experience, as well as disseminate the project results, specifically the best practices guidelines produced.
- The purpose of the online library is to collect good practice examples from different regions and make them accessible for a wider community than we could reach by trainings only. The online library will be promoted among the stakeholders through partnership networks, trainings and transnational events. The content of the online library will be an element integrated into the best practice guidelines and trainings.

The **output** of group of activities 3.1 is good practice implementation guidelines for circular bioeconomy development and a training programme targeted at regional / local public authorities, which consists of:

- The good practice implementation guidelines for circular bioeconomy development targeted at regional/local public authorities.
- The training programme for regional/local public authorities on circular bioeconomy development and its support systems.

- The online library of good practices and a collaboration/experience exchange platform for regional/local public authorities on the project website.

This document is prepared with the objective of improving the capacity of regional / local authorities in the BSR to foster good circular bioeconomy development, provide sustainable bioenergy production support and promote related practices.

1. EU and BSR countries' national circular bioeconomy strategies and policy support measures for the agriculture, forestry, waste and bio-energy industrial sectors in the use of bioresources

The transition to a sustainable society is threatened by concrete four key factors:

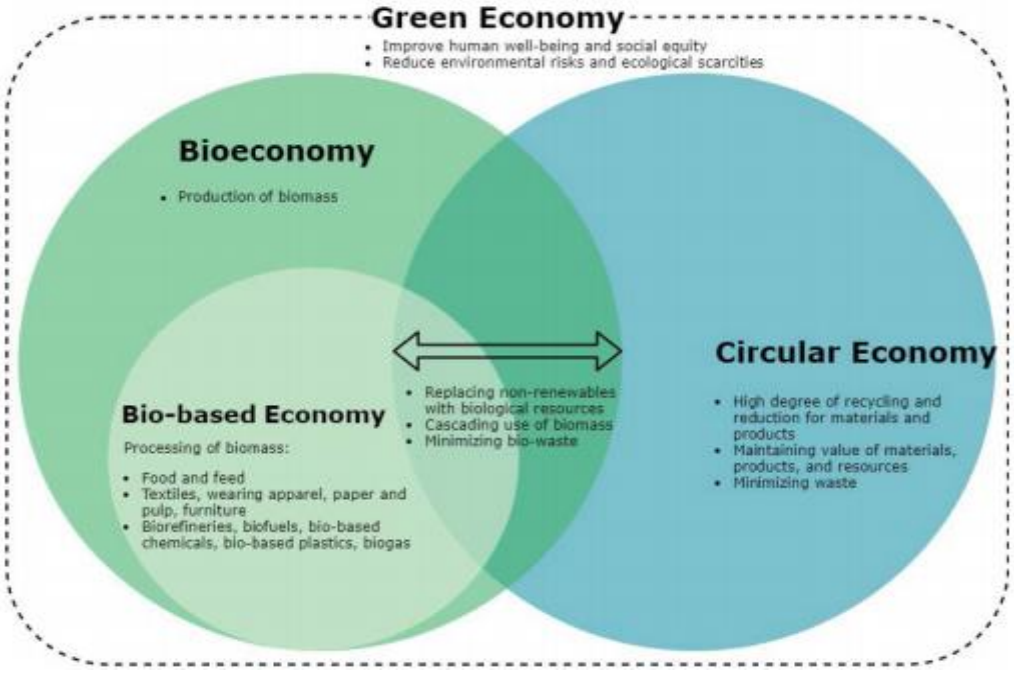
- Climate change,
- Growing global population,
- Rapid increase in urbanisation,
- Growing income inequalities.

In 2018, the United Nations renewed sustainable development objectives that can strike a balance between the country's economic growth, social inclusion and environmental protection. Over the last years, EU policymakers have seen the bioeconomy and circular economy as playing an important role in achieving sustainable development. The new European Green Deal Green initiative and the economic transition towards a climate-neutral economy as outlined in the 2050 Long-term Strategy are a good example of this. To transit to a sustainable society, we need to create a new policy, develop strategies, make legislation and identify the most effective support measures.

The bioeconomy has a cross-sectoral and interdisciplinary nature, and the sustainability of the circular bioeconomy is an especially important aspect of the monitoring framework. It has three main dimensions: the economy, society and the environment.
For this reason, the implementation of good policy support measures depends heavily on stakeholders (scientists, policy makers, society, or the private sector) involved in the implementation of the bioeconomy strategy.

1.1. Definition of a Circular Bioeconomy

The notion of a bioeconomy received attention early this century in the EU (European Commission, 2002), and more global interest was created with the OECD policy paper on the bioeconomy "The Bioeconomy to 2030 – Designing a Policy Agenda" (OECD 2009). To identify the concept of a circular bioeconomy, we use a VENN diagram of a bioeconomy, bio-based economy, green economy and circular economy proposed by Kardung M. et al. (2020) as shown in Figure 1.



Source: Kardung M. et al. (2020)
Figure 1. Concept of a Circular Bioeconomy.

The bioeconomy encompasses the production of renewable biological resources and the conversion of these resources and waste streams into value added products, such as food, feed, bio-based products, and bioenergy (European Commission 2012, European Commission 2018).

In the circular economy (CE) [as the economic space], the value of products, materials and resources is maintained in the economy for as long as possible, and the generation of waste minimised (European Commission 2015, OECD 2018).

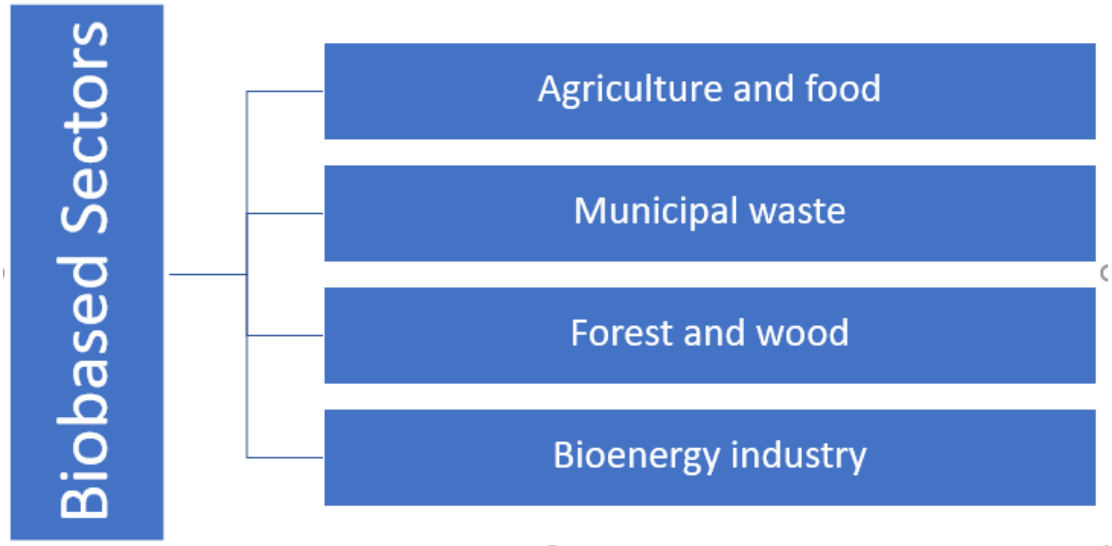
The circular bioeconomy (CBE) is a dynamic concept providing goods and services, emission of pollutions, negative and positive externalities, and helps keep in order biosphere capacities and functionalities viable and sustainable (European Environment Agency 2018, Avdiushchenko A. 2018).

Five key principles for a sustainable CBE are as follows: feed first; sustainable yields; the cascading approach; circularity; diversity (Carus M. and Dammer L., 2018, Hetemäki et al., 2017).

The definition of CBE in the BB4V project is as follows: "*The **circular bioeconomy** covers all sectors and systems that rely on biological resources (animals, plants, micro-organisms and derived biomass, including organic waste), their functions and principles. It includes and interlinks land and marine ecosystems and the services they provide; all primary production sectors that use and produce biological resources (agriculture, forestry, fisheries, and aquaculture); and all economic and industrial sectors that use biological resources and processes to produce food, feed, bio-based products, energy and services*".

However, in order to exploit the potential of CBE in the EU and to create a competitive bioeconomy sector, a coherent policy and strategy is needed for the agriculture, forestry, waste management and bioenergy sectors.

All CBE-related bio-based industrial sectors analysed in the BB4V project are shown in Figure 2.



Source: authors' construction
Figure 2. Bio-based CBE Industrial Sectors Analysed in the BB4V Project.

In next steps, we identify the most commonly used policy support measures in the BB4V project countries, which are needed for sustainable resource use and technological innovation in the agriculture, forestry, waste management and bioenergy sectors. A CBE business case (BC) study helped to identify the most effective support measures enabling companies create and gain value from the bioeconomy.

1.2. EU and BSR countries' national-level bioeconomy policies and strategies

1.2.1. Circular economy goals in the European Union

A new Circular Economy Action Plan for a cleaner and more competitive Europe

The 'New Circular Economy Action Plan for a Cleaner and More Competitive Europe' (European Commission 2020), adopted by the European Commission in March 2020, is one of the cornerstones of the European Green Deal. Its goal is to reduce the EU consumption footprint and to double the use of circular materials in the EU in the coming decade, while at the same time promoting economic growth. This will be done in full cooperation with stakeholders and businesses. The implementation of major circular economy activities in Europe by 2030 can increase the EU's GDP by another 0.5% and create some 700,000 new jobs.

Priority will be given to addressing product groups identified in the context of the value chains featuring in this Action Plan, such as electronics, ICT and textiles but also furniture and high impact intermediary products such as steel, cement and chemicals. Further product groups will be identified based on their environmental impact and circularity potential.

The Plan states that circularity is a key element in the overall transition of industries towards climate neutrality and long-term competitiveness. This can help to create significant material savings along the entire value chain and, as part of all production processes, generate more added value, which results in economic opportunities.

According to the Plan, *the Commission will enable greater circularity in industry by:*

- *assessing options for further promoting circularity in industrial processes in the context of the review of the Industrial Emissions Directive, including the integration of circular economy practices in upcoming Best Available Techniques reference documents;*
- *facilitating industrial symbiosis by developing an industry-led reporting and certification system, and enabling the implementation of industrial symbiosis;*
- *supporting the sustainable and circular bio-based sector through the implementation of the Bioeconomy Action Plan;*
- *promoting the use of digital technologies for the tracking, tracing and mapping of resources;*
- *promoting the uptake of green technologies through a system of solid verification by registering the EU Environmental Technology Verification scheme as an EU certification mark.*

The Circular Economy Action Plan, which is a part of the EU industrial strategy, proposes the following activities (European Commission, 2020):

- Make sustainable products the standard in the EU. The Commission will propose laws governing sustainable product policy to ensure that products sold in the EU market are developed in a way that extends their service life, simplifies their reuse, repair and recycling, and makes sure that their manufacture involves as many recycled materials, and not primary raw materials, as possible. Single-use products will be restricted, the issue of premature obsolescence will be resolved, and the destruction of unsold durable goods will be banned.
- New opportunities will be created for consumers. Consumers will have access to reliable information about the durability of products and possibility of repairing them, in order to help them make eco-friendly choices. Consumers will become capable of using their 'right to repair' in practice.
- Focus on the industries that consume the most resources and have high circularity potential. The Commission will initiate specific activities in the following fields:
  - Electronics and ICT: a 'circular electronics initiative' to extend the service life of products and improve the collection and processing of waste;
  - Batteries and vehicles: new legal regulations pertaining to batteries to improve their sustainability and increase the circular potential of batteries;
  - Packaging: new binding requirements for what is allowed in the EU market, including the reduction of the use of (excessive) packaging;

  - Plastics: new binding requirements for the content of recycled materials, with particular attention paid to microplastics, as well as bio-based and bio-degradable plastics;
  - Textiles: a new EU strategy for textile products, with the aim of boosting competitiveness and innovations in this industry and developing an EU market for the reuse of textile products;
  - Construction and buildings: a comprehensive strategy for sustainably developed environments that uphold the principles of circularity in construction;
  - Food: a new legislative initiative for the replacement of single-use disposable packaging and tableware with reusable products in the food services industry.
- Generate less waste. The main focus will be on eliminating waste altogether, or on converting it into high-quality secondary resources, the use of which is supported by a well-functioning market of secondary raw materials. The Commission will look into the possibility of creating a harmonised model for the separate collection and labelling of waste for the entire EU. The Action Plan also proposes a number of activities to reduce the amount of waste exported by the EU, and to prevent illegal shipments.

Towards a Sustainable Europe by 2030

The European Commission Reflection Paper 'Towards a Sustainable Europe by 2030' states that the economic growth of the European Union must rely less on non-renewable resources and maximise the use of sustainably managed renewable resources and ecosystem services.

The Reflection Paper notes that the *transition to a circular economy, including a circular bioeconomy, is an enormous opportunity to create competitive advantages in a sustainable manner. The application of the principles of circular economy in all sectors and industries will create environmental and social benefits for Europe, while the net economic benefit could be as high as EUR 1.8 trillion by 2030; using this principle could create more than 1 million new jobs across the EU by 2030, and significantly contribute to the cutting of greenhouse gas emissions. Given the high reliance of EU-made products on resources extracted elsewhere in the world, the transition to a circular economy will also help relieve the global environmental, social and economic pressure on the EU and increase its strategic autonomy*.

The European Commission Reflection Paper 'Towards a Sustainable Europe by 2030' emphasises that the European Commission will continue focusing on successfully working on what relates to the *circular economy of plastics and will support and incentivise the circular transition of resource and pollution-heavy industries, such as food, textile and electronics. We must expand and strengthen the bio-based sectors, while at the same time protecting our ecosystems and preventing the overuse of natural resources. Through our activities, we should turn circular economy into the backbone of the EU industrial strategy, promoting circularity in new sectors and industries, making it possible for consumers to make informed decisions, and helping the public sector in its efforts through the use of sustainable public procurement*.

1.2.2. European Union bioeconomy policy

The European Commission communication 'A sustainable bioeconomy for Europe: strengthening the connection between economy, society and the environment'

The European Commission communication 'A sustainable bioeconomy for Europe: strengthening the connection between economy, society and the environment' emphasises that: *We live in a world of limited resources. Global challenges such as climate change, land and ecosystem degradation, coupled with a growing population force us to seek new ways of producing and consuming that respect the ecological boundaries of our planet. At the same time, the need to achieve sustainability constitutes a strong incentive to modernise our industries and to reinforce Europe's position in a highly competitive global economy, thus ensuring the prosperity of its citizens. To tackle these challenges, we must improve and innovate the way we produce and consume food, products and materials within healthy ecosystems through a sustainable bioeconomy*.

The European Commission also noted that '*To be successful, the European bioeconomy needs to have sustainability and circularity at its heart.' This will drive the renewal of our industries, the modernisation of our primary production systems, the protection of the environment and will enhance biodiversity.*

In explaining the need for bioeconomic development in Europe and the way the bioeconomy fits in with EU policy priorities, the European Commission stated that:

(1) *With a turnover value of € 2.3 trillion and accounting for 8.2% of the EU's workforce, the bioeconomy is a central element to the functioning and success of the EU economy. The deployment of a sustainable European bioeconomy would lead to the creation of jobs, particularly in coastal and rural areas through the growing participation of primary producers in their local bioeconomies. In the bio-based industries one million new jobs could be created by 2030, according to industry estimates. The strong and fast-growing startup ecosystem in the biotechnology sector will play a leading role in realising this potential. (...);*

(2) *A sustainable European bioeconomy is necessary to build a carbon neutral future in line with the climate objectives of the Paris Agreement. (...);*

(3) *A sustainable bioeconomy is also essential to the reduction of [CO2] emissions in the European Energy sector. (...);*

(4) *A sustainable European bioeconomy supports the modernisation and strengthening of the EU industrial base through the creation of new value chains and greener, more cost-effective industrial processes. By capitalising on unprecedented advances in life sciences and biotechnologies, as well as innovations merging the physical, digital and biological worlds, the European industrial base can maintain and enhance its global leadership. Research and innovation and the deployment of innovative solutions for the production of new and sustainable bio-based products (such as bio-chemicals, bio-fuels, etc.) will also enhance our capacity to substitute fossil raw materials in very significant parts of European industry (e.g. construction, packaging, textiles, chemicals, cosmetics, pharma ingredients, consumer goods) in line with the renewed Industrial Policy objectives. According to the projections of the industry, the demand for industrial biotechnologies is expected to almost double within the next decade.*

The European Commission has pointed out that sustainable development of the bioeconomy *requires investments, innovation, developing strategies and implementing systemic changes that cut across different sectors (agriculture, forestry, fisheries, aquaculture, food, bio-based industry). It means enhancing our capacity to translate opportunities from all types of innovation into new products and services on the market, creating new jobs locally. And it means doing it the European way: being economically viable with sustainability and circularity in the driver's seat.*

Maximising the impact of EU research and innovation is key in this respect. Regulation and financing must be innovation friendly for Europe to become a front-runner in market creating innovation. However, it is necessary to move beyond research and innovation and have a strategic and systemic approach to the deployment of innovations to fully reap the economic, social and environmental benefits of the bioeconomy.

The European Commission defined three action areas leading to a sustainable circular bioeconomy:

Action area 1: Strengthen and scale-up the bio-based sectors, unlock investments and markets.

For the implementation of this action area, the European Commission defined six actions, of which Action 1.1 should be emphasised: Mobilise public and private stakeholders in the research, demonstration and deployment of sustainable, inclusive and circular bio-based solutions in order to promote the development and implementation of sustainable and circular bio-based solutions that the modernisation, strengthening and competitiveness of the industrial base of the European Union depend on.

Action area 2: Deploy local bioeconomies rapidly across Europe.

For the implementation of this action area, the European Commission defined four actions, and one should emphasise Action 2.1: *A Strategic Deployment Agenda for sustainable food and farming systems, forestry and bio-based production in a circular bioeconomy*.

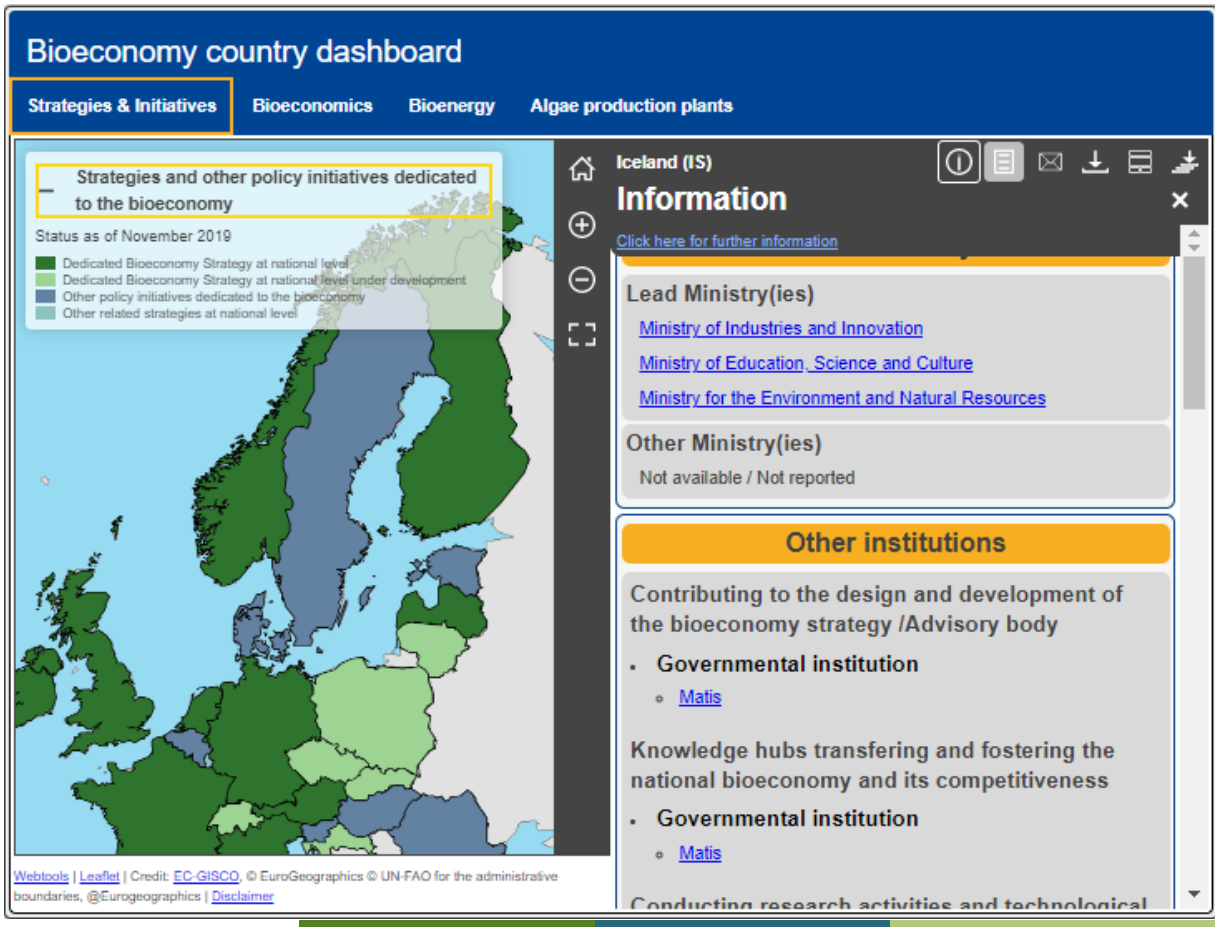
The European Commission undertook to use a systemic cross-sectoral approach, connecting stakeholders, territories and value chains, to actively support and promote all types of innovation and practices that affect sustainable food and agricultural systems, forestry and bio-based manufacturing. The bioeconomy strategy notes that a systemic approach will solve a number of problems, including (...) *replacing non-sustainable raw materials in construction, packaging with bio-based materials and for providing more sustainable innovations in sectors such as forestry-based textiles, furniture and chemicals, and new business models based on the valuation of forestry ecosystem services. (...)*

Action area 3: Understand the ecological boundaries of the bioeconomy, so that it can function sustainably.

1.3. EU and BSR countries' national-level bioeconomy policies and strategies

The EU countries and regions follow a strategic approach to support the bioeconomy. Many countries have produced their own strategies and many more countries have tackled bioeconomy problems in other policy papers. The study "Bioeconomy development in EU regions. Mapping of EU Member States'/regions' Research and Innovation plans & Strategies for Smart Specialisation (RIS3) on the Bioeconomy for 2014-2020" (Spatial Foresight et al., 2017) shows that 19 Member States already have a bioeconomy strategy (or a similar strategic document) in place or are in the process of developing a strategy. Of the regions analysed in the study, 49 have developed a regional bioeconomy strategy or a similar comprehensive document. In the regions and countries without an explicit bioeconomy strategy, support for the bioeconomy is often embedded in one or several other strategic documents or funding programmes which include support measures. These are mainly specific national or regional research and investment strategies and plans, sectoral innovation strategies and plans (e.g. innovation in agriculture, fisheries, waste management) or strategic frameworks partially covering the bioeconomy, circular economy and blue economy (Spatial Foresight et al., 2017).

The EU Baltic Sea Region (BSR) BalticBiomass4Value (BB4V) project countries (LT – Lithuania, LV – Latvia, EE – Estonia, DE – Germany, PL – Poland, SE – Sweden, NO – Norway, RU – Russian Federation) – a specific overview of bioeconomy policy developments as of January 2021 is made available on the website (available: https://knowledge4policy.ec.europa.eu/bioeconomy/bioeconomy-policy_en) through an interactive overview map in the "Bioeconomy Policy" page, and separate reports from the partner organizations available through the "Bioeconomy country dashboard" (figure 3).



Source: Bioeconomy Policy, 2021

Figure 3. Website Homepage for Bioeconomy Policy with the Bioeconomy Country Dashboard Highlighted.

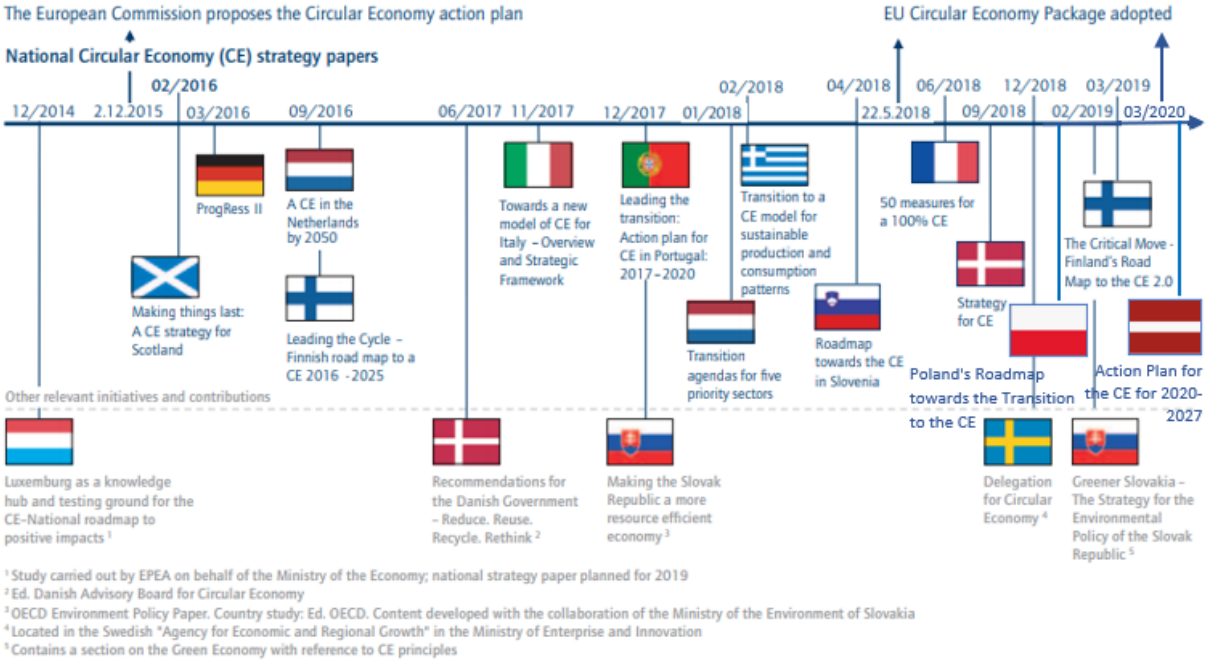
The information on bioeconomy policy developments concern:

- Institutions involved in the development of the bioeconomy at national level,
- Status of national bioeconomy strategies and definitions of a bioeconomy,
- Information on dedicated national strategies, such as goals, sectors included (agriculture; aquaculture; biobased chemicals and materials; biobased electricity; biobased textiles; biofuels; biotechnology; fisheries; food; forestry; organic waste; pulp and paper; wood, wood products and furniture; and other), stakeholders involved, the existence of a monitoring framework, etc.,
- Other bioeconomy-related strategies,
- Bioeconomy strategies at regional level,
- Other relevant bioeconomy-related information (e.g., funding, educational programmes, certification schemes and incentives for biobased products, etc.).

Many scientific articles present a comparative overview of strategies and policies for developing a bioeconomy in the EU. Some studies clarify similarities and differences between national bioeconomy strategies and policies (Staffas et al., 2013) or analyse how available bioeconomy strategies account for the role of entrepreneurship in driving the bioeconomy transformation (Kuckertz A. 2020). The project BioStep, funded by Horizon 2020, made a broad study of bioeconomy policy strategies (bio-step.eu/background/bioeconomy-strategies/ 2018).

1.4. EU and BSR countries' national-level circular economy policies and strategies

A new Circular Economy Action Plan for a cleaner and more competitive Europe was adopted in 2020 (European Commission 2020). The EU countries' progress towards the CE and their strategy document developments are shown in figure 4.



Source: authors' construction based on Weber T. and Stuchtey M. (2019)
Figure 4. Timeline of Circular Economy Developments in the European Union Countries (status as of December 2020). Available: https://www.circular-economy-initiative.de/english.

To achieve resource-efficient biomass use, the European bioeconomy strategies increasingly consider the concept of a CBE. In the study "The circular bioeconomy: Its elements and role in European bioeconomy clusters", their authors stress that the clusters move towards a CBE by increasingly considering residues and wastes as a resource, developing integrated biorefineries and focusing more on material and high value applications of biomass (Stegmann et al., 2020).

The circular biobased economic paradigm can be this – it builds on the synergies of the circular economy and bioeconomy concepts. These two concepts have so far been developed in parallel, but now need to be connected to reinforce each other (Hetemäki et al., 2017).

1.5. Summary of the research on the circular bioeconomy policies and strategies in the BSR countries

In the following section (Table 1), the outcomes of the research on circular bioeconomy policy document developments are schematically summarized for 8 European BB4V project countries: Lithuania, Latvia, Estonia, Germany, Poland, Sweden, Norway, and the Russian Federation. For details of the entire country profile of the BB4V project, see Annex 1.

Table 1

Overview of Available Information on Circular Bioeconomy Policy Developments as of December 2020 for Each BB4V Project Country

Status Indicator		LT	LV	EE	DE	PL	SE	NO	RU
National bioeconomy definition									N.D.
Status of national policies on bioeconomy									
Status of national policies on circular economy									
National institutions involved in bioeconomy	Lead Ministry								
	Another Ministry								
Regional bioeconomy strategy									
National bioeconomy strategy information	Goal								N.D.
	Actions								N.D.
	Sectors included								
	Monitoring framework								N.D.
	Stakeholders involved								N.D.

Legend: Yes | No | Under development | Other initiatives

Source: authors' construction.

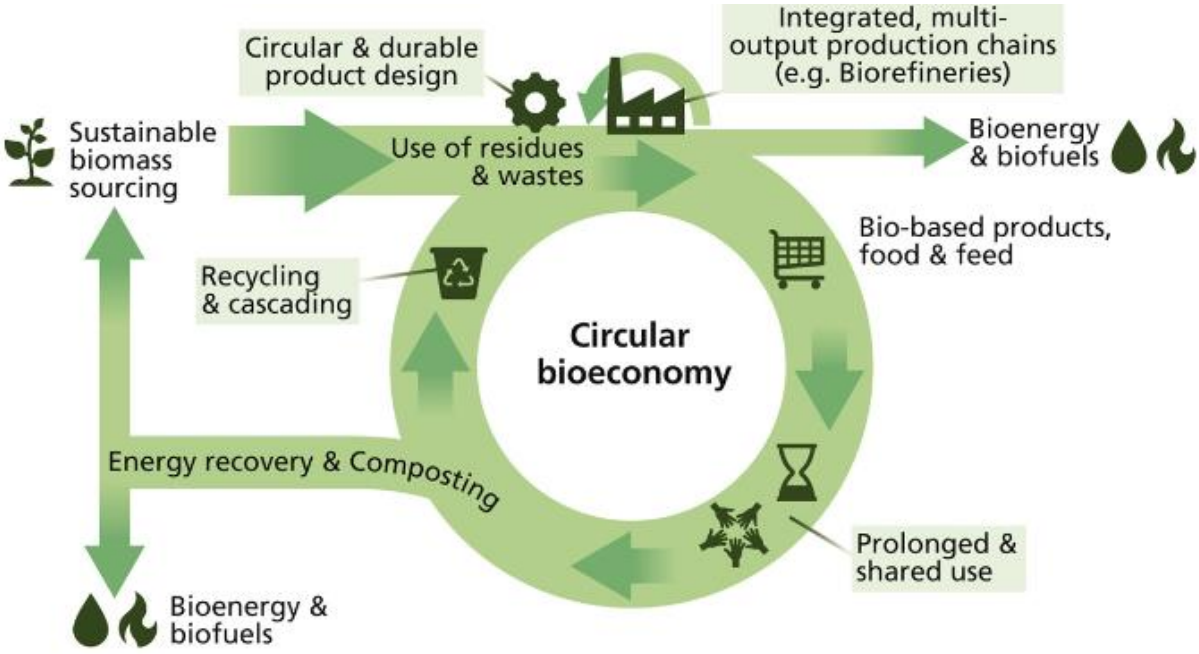
The results of the study show that most of the countries have strategies, policies or initiatives related to CBE. Even if the circularity or bioeconomy-related strategy is not explicitly referred to as a bioeconomy strategy/programme or initiative, it contains issues related to the CBE. This assumption is supported by the results of this study on CBE objectives that are currently included in circularity or bioeconomy related strategies (e.g. in rural development programmes, regional programmes, action plans for the circular economy, climate and energy programmes, smart specialisation programmes etc.)

The CBE is linked to a wide variety of policy areas and interests. Knowledge-based dialogue plays a particular role in the implementation of CBE policy support measures. By providing targeted information and developing a comprehensive dialogue with CBE researchers, national public authorities and business representatives may lay down requirements for the development of the CBE and how to strengthen it by appropriate policy support measures.

1.6. Theoretical approach to developing strategies and support measures for the sustainable CBE Business Model

The concept of strategy over time has been addressed by several authors. According to Chandler, a strategy is developed to define the long-term goals and objectives of the organisation, adopt actions and allocate the resources needed to achieve the objectives (Chandler A.D. 1962).

CBE strategies' long-term objectives and actions implemented via support measures focus on economic, environmental or social aspects and ideally considers all three pillars of sustainability to achieve the Sustainable Development Goals (SDG). Analysing the elements of the CBE, it is possible to identify the necessary actions and support measures for strategy adoption. Figure 5 illustrates the CBE and its elements.



Source**:** The circular bioeconomy: Its elements and role in European bioeconomy clusters (Stegmann et al., (2020)

Figure 5. Circular Bioeconomy and its Elements of Support Measures for the Adoption of the strategy.

Bearing in mind a comprehensive understanding of CBE, we theoretically distinguish four ways to transform the bio-based sectors: 1) replacing fossil fuels with biological raw materials (TP1); 2) increasing productivity in primary industries without fossil resources (TP2); 3) increasing the efficiency of biomass use (TP3); 4) creating value and using additional biological principles and processes separated from large-scale biomass production (TP4).

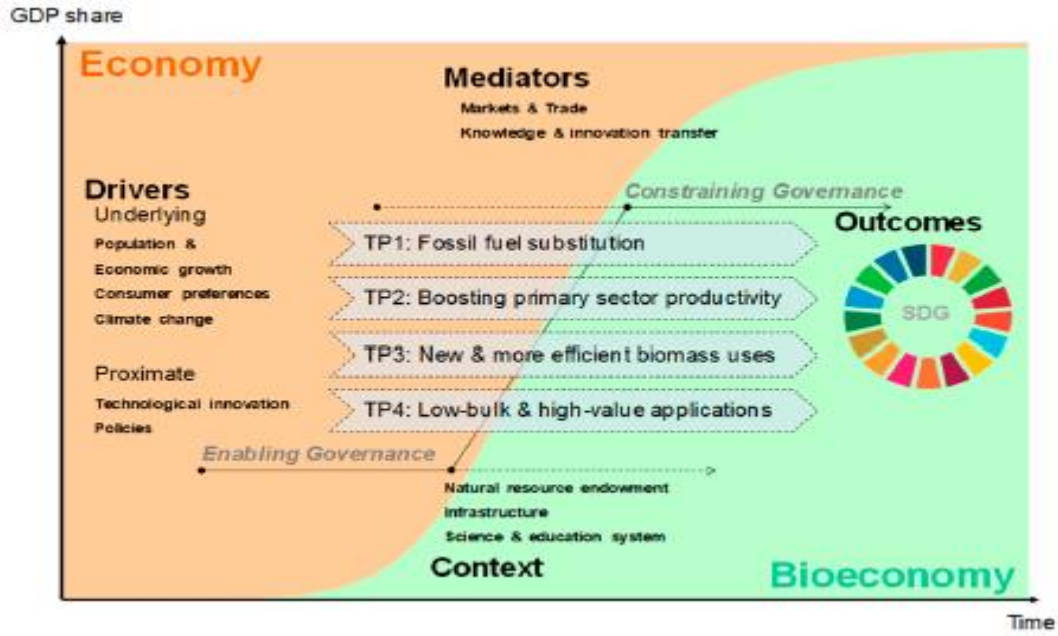
All these four CBE transforming pathways (TP) focus on the sustainable, resource-efficient management of biomass in integrated, multi-output production chains, while also making use of residues and wastes and optimizing the value of biomass over time to cascading use. Policy can support the growth of the CBE through appropriate political support measures and by ensuring their management. Ensuring management of political support measures can be understood as the process by which societies adapt their rules to new challenges. In theory, the development of the CBE is achieved by introducing restrictive or incentive rules, measures or initiatives.

Implementing a CBE development strategy involves:

- The substantia dimension, where we define the rules, measures or initiatives,
- The procedural dimension, where we explain how the rules, measures or initiatives are developed,
- The legislation dimension – what are the procedural rules, measures or initiatives and institutions that determine rule-making, how the rules are implemented and enforced, and how conflicts over the rules are resolved.

Figure 5 shows that the CBE covers different activities. The concept of CBE is trans-disciplinarian. Therefore, the way regional authorities support measures helps to build a CBE can vary significantly between support measures, because it can cover different regions, it may have different objectives, or it may be designed for different bio-based sectors or topics, different raw materials, different end products. As a result, different rules, measures or initiatives are adopted in EU regions for supporting the sustainable CBE Business Model (BM).

While changes related to the development of the CBE promise long-term sustainability benefits for both individual companies and society, companies are currently avoiding changing their organizational structures and BM to cover the costs of biological processes, as such changes continue to threaten their competitiveness in certain circumstances. The economic paradigm transformation management process is shown in Figure 6.



Source: Governance of the Bioeconomy: A Global Comparative Study of National Bioeconomy Strategies (Dietz et al., 2018)
Figure 6. Economic Paradigm Transformation Management Process.

Transformation processes can be caused by the interaction of drivers, such as population growth and technological innovation, or by political or social action. Depending on the national context and its interaction with other economies, such as trade and knowledge transfer, the bioeconomic transformation can take place on one or more of the four paths (TP) illustrated in Figure 6, with different potential impacts to CBE BM development.

Public authorities can use a range of specific management mechanisms to develop the regional CBE BM. In order to better understand the policy management process, the terms used in policy support documents were discussed during the project: rules, measures and instruments.

- **Rules** are a standard, statement or procedure, other than a policy or regulation, adopted by public authorities. A rule may supplement but not conflict with policies and regulations.
- **Support measures** – any initiatives such as grants, tax rebates, exemptions and other forms of facilitation meant to make it easier for biobased sector businesses to start up and operate.
- **Policy instruments** are the tools which can be used to overcome problems and achieve objectives.

A literature review learned that the terms: rules, support measures or policy instruments are often used as interchangeable terms, depending on the context and source. Differences in terms are mostly interpretational nuances. For example, in the project Berst (Guissong R. 2014) these terms are defined as follows:

- **Instruments** - the policy instruments that use markets, price, and other economic variables to provide incentives for actors to exploit bioenergy resources.
- **Measures** - a range of tools to address bioenergy issues such as regulations, subsidies, taxes, emission/consumption quotas, etc.

Based on the literature review and the internal expert discussion within the BB4V project, these terms are defined as follows:

Support measures - a range of tools or mechanisms used by public's authorities or political parties, profit or non-profit organisations to achieve a desired effect through legal/regulatory, economic/financial or soft means.

Firstly, support measures (SM) could address the implementation of a comprehensive research and development strategy to promote investments in technological innovations whose costs and risks private actors are not willing to incur under the given conditions. Secondly, political SM can aim at increasing the competitiveness of bio-based products through subsidies, thereby creating markets for the bioeconomy that do not independently develop in the economy. Thirdly, SM could address the creation of favourable legal frameworks, the state-supported training of the labour force or the promotion of industry clusters to make them more attractive for companies to invest in the CBE BM. Finally, public authorities can promote economy paradigm change at a societal level through deliberate political campaigns to increase the understanding and acceptance of the CBE.

In reference to the study "Bioeconomy Governance: a global comparative study of national bioeconomy strategies", the breakdown of support measures is shown in Table 2.

Table 2

Circular Bioeconomy Policy Support Instruments and Mechanisms for Public Authorities

Support Measures	Implementation management focus area
Promoting research and development for a bio-based transformation	Funding of research projects
	Establishment of specific research facilities
	Promotion of research networks and strategic partnerships
	Promotion of knowledge and technology transfer (science-praxis-nexus)
Improving the competitiveness of the bioeconomy through subsidies	Quotas for the bioeconomy
	Promotion of bio-based public procurement
	Promotion of sustainable consumption behaviour
	Tax benefits
	Specific credit programmes
Industrial location policies for bio-based industries	Promotion of industry clusters in the field of bioeconomy
	Promotion of knowledge and technology transfer between research and industry
	Promotion of labour education in the field
	Creation of appropriate intellectual property rights
	Promotion of foreign direct investment (FDI) in the field
Political support for bio-based social change	Promotion of public dialogues to increase understanding of the functioning of the bioeconomy
	Promotion of public dialogues on technological risks in the field of the bioeconomy

Source: Governance of the Bioeconomy: A Global Comparative Study of National Bioeconomy Strategies (Dietz et al., 2018).

According to Chandler A.D, a SM document for CBE policy must answer four questions. These are explained in Table 3.

Table 3

Actions Adapted and Resources to be Allocated to Circular Bioeconomy Policy Objectives

Target	CBE document content
What	A method or mechanism
Who	Used by government/political parties, profit (business) or non-profit (NGO, individuals)
Why	To achieve a desired effect (i.e. boosting biobased economies)
How	Through legal/regulatory (binding), economic/financial or soft (non-binding) means

Source: Berst (Guissong R. 2014).

The aim of this project's WP 3.1 is to identify good practice policy SM and enable organisational setups to promote CBE development at local level (desk study, experience of project partners, surveys/interviews of public authorities). In order to achieve the objective pursued by the study of this project's WP 3.1 group, firstly, it is necessary to perform the task by responding to the question – *which implementation management support mechanisms are used to develop the CBE?* Secondly, we need to identify legal/regulatory (binding), economic/financial or non-binding (non-binding) policy instruments for good practices in the CBE. On the basis of the discussion with BB4V project experts and the information gathered from the scientific literature, the CBE support measures and implementation management were identified. The CBE impact policy instruments and SM implementation management proposed by the BB4V project are summarized in Table 4.

Table 4

CBE Impact Policy Instruments and SM Implementation Management Proposed by the BB4V Project

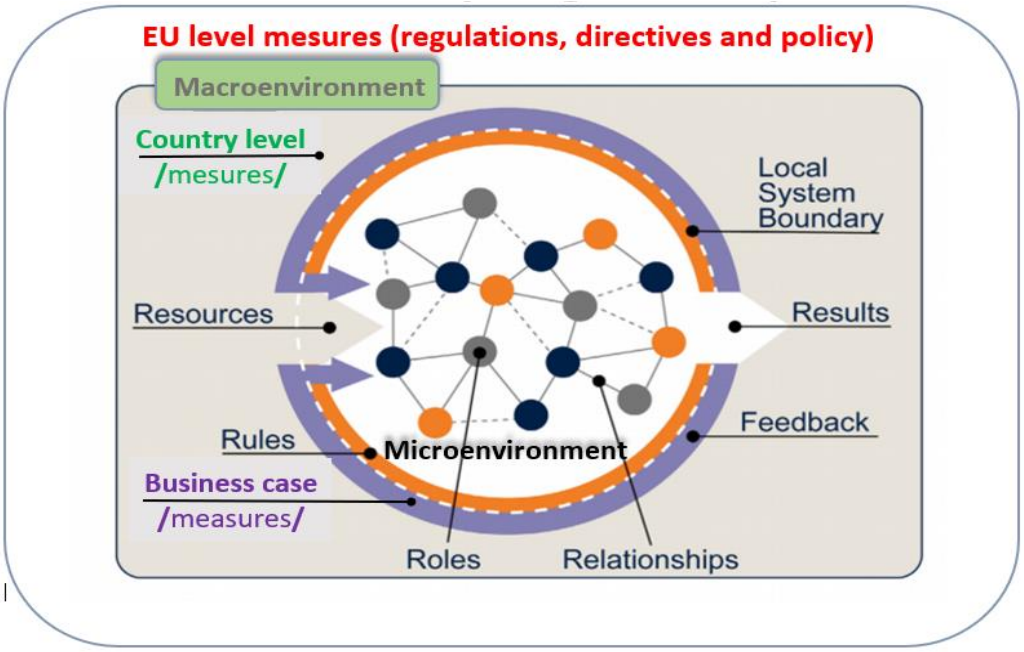
Policy impact	Support measure implementation management
Fiscal	CO^2 tax
	Tax incentives / credits
	Market introduction programmes
	Removing subsidies on fossil fuel industries
	Fossil carbon tax
Regulatory	Implementation management focus area
	Quotas
	Mandates
	Bans
	Green public procurement
Societal	Harmonized sustainability assessments
	Labels
	Certificates
Sustainability	Obligatory GHG emissions goals for chemicals & materials
	Tighter environmental standards for chemicals & materials
	Self-committed targets on bio-based
	Becoming part of a renewable carbon strategy

Source: authors' construction.

2. Selection of good practice policy measures to promote circular bioeconomy development in the agriculture, forestry, waste and bio-energy industrial sectors

Good practices refer to successful experiences that have been tested and proven, could be replicated, and deserve to be recommended as models to adopted and improved by others (FAO, 2013). There are also opportunities for evolvement and improvement of the practices, and thus can be differentiated from the term "best practices" that can be associated with the proven best approach that does not need further improvement. The focus on activities 2.3 of WP2 was to collect data on successful business models of biomass enterprises from the BSR and share this knowledge so that those models could be replicated and improved around the BSR.

The BB4V section activities 3.2 of WP 3.1 are aimed at identifying the policy SM that best guarantee the formation of the CBE BM in the regions and that, in relation to the SM, are better used to support the bioeconomy. The top-down research environment for CBE policy documents is shown in Figure 7.



Source**:** authors' construction
Figure 7. Research environment for CBE policy documents.

For analysis, we used the top-down approach, which means first analysing EU CBE policy documents, followed by national documents, and then using CBE business cases (BC) to identify the best possible support measures.

A common methodology was used to analyse all operational environmental policy documents. A summary of the CBE policy documents on impact policy instruments and the management of implementation of SM in the agriculture, forestry, waste management and bioenergy sectors was developed by using the model shown in Table 5.

Table 5

CBE Impact Policy Instruments and the SM Implementation Management Model Proposed by the BB4V Project

Fiscal SM implementation management		
Implementation management focus area	**Name/Title of Policy support measure**	**Short description (coverage)**
CO_2 tax		
Tax incentives / credits		
Market introduction programmes		
Removing subsidies on fossil fuel industries		
Fossil carbon tax		
Regulatory SM implementation management		
Implementation management focus area	**Name/Title of Policy support measure**	**Short description (coverage)**
Quotas		
Mandates		
Bans		

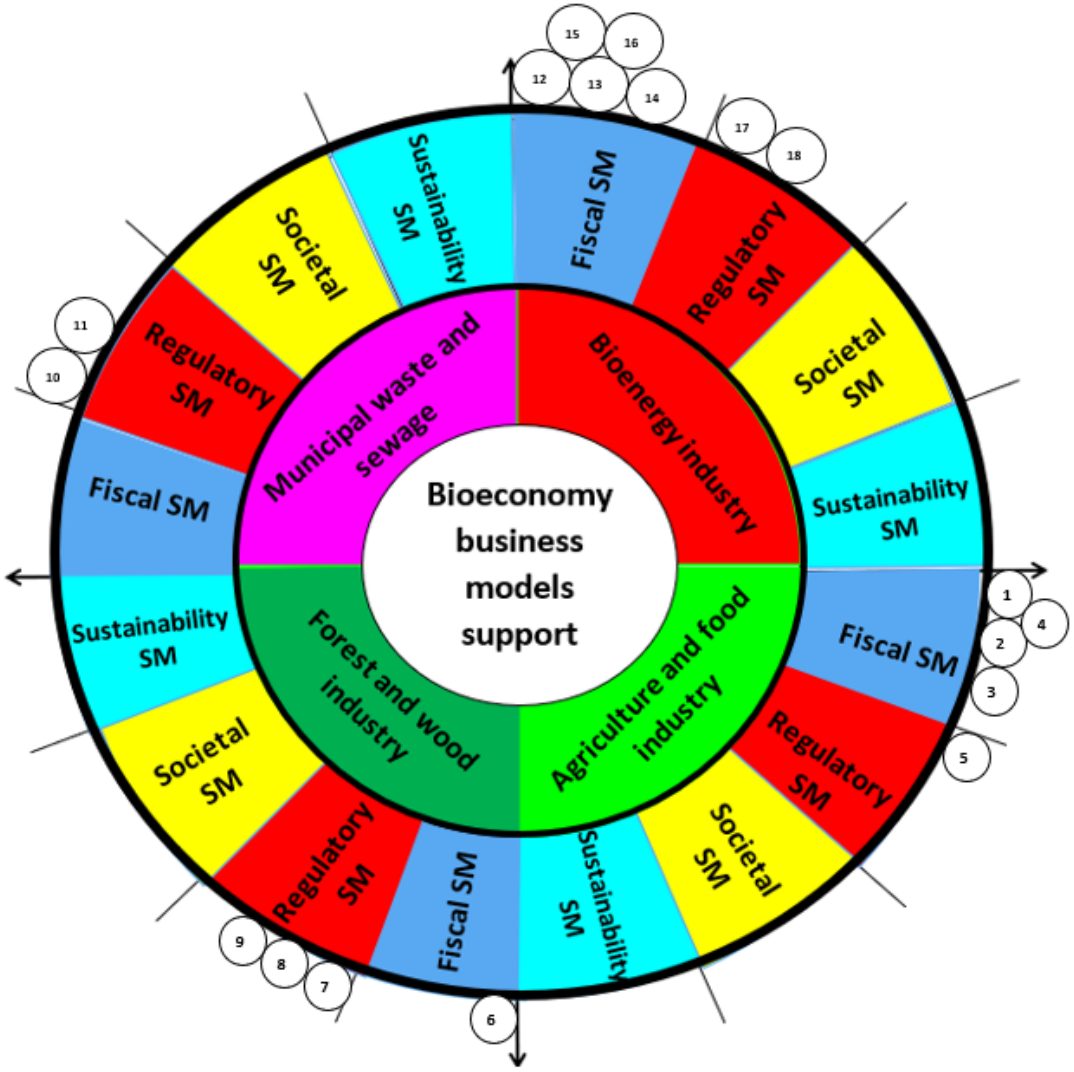
Green public procurement		
Societal SM implementation management		
Implementation management focus area	**Name/Title of Policy support measure**	**Short description (coverage)**
Harmonized sustainability assessments		
Labels		
Certificates		
Sustainability SM implementation management		
Implementation management focus area	**Name/Title of Policy support measure**	**Short description (coverage)**
Obligatory GHG emissions goals for chemicals & materials		
Tighter environmental standards for chemicals & materials		
Self-committed targets on bio-based		
Becoming part of a renewable carbon strategy		
Land use led restrictions		

Source: authors' construction

2.1. EU and national-level support measures for a sustainable circular bioeconomy for the agriculture, forestry, waste management and bioenergy sectors

The policy documents at EU level relating to a sustainable circular bioeconomy and its support measures in the agricultural, forestry, waste management and bio-energy sectors are summarised in Annex 2.

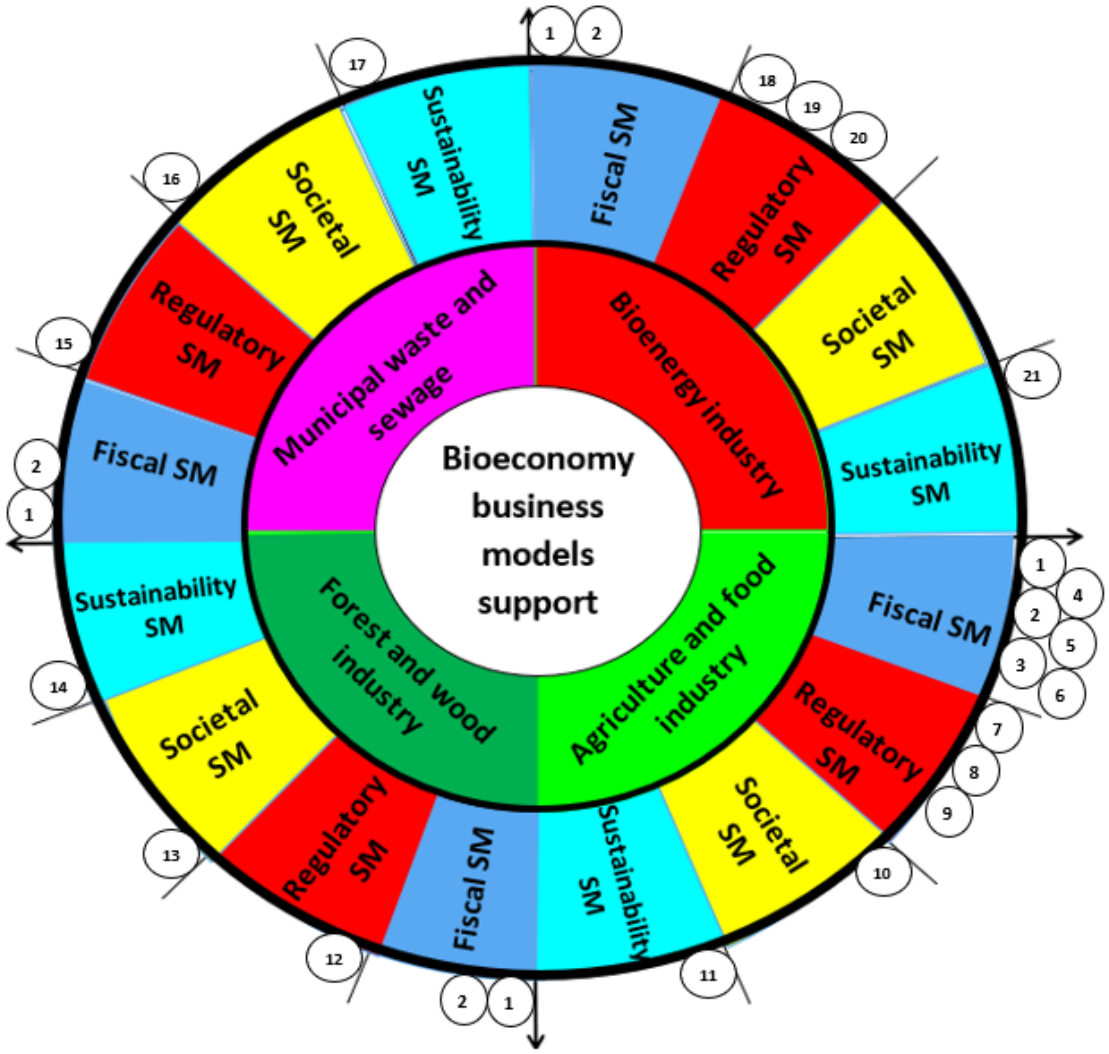
Experts from the partner countries of the project carried out a macro environment analysis of policy documents using the evaluation methodology developed.
Using a circular policy document analysis chart in Table 5, the CBE SM selected were grouped according to the bioeconomy sector (agriculture, forestry, waste and bioenergy) and impact policy measures. A circular chart was created for each BSR country, except for Russia, because no information was available on it. The policy documents supporting the CBE of all the BB4V project Member States are summarised in the following figures.



List of the SM (Lithuania)

1. Support for investments in agricultural holdings to produce biogas in a livestock farm from waste generated on the farm (LRDP 2014-2020).
2. Support for investments in agricultural holdings to planting of short rotation plantations (LRDP 2014-2020).
3. State aid to compensate for part of the rapeseed oil intended to produce rapeseed methyl (ethyl) ester (RME) (Law on the Renewable Energy).
4. Compensate the prices of rape and cereal (raw material) purchased to produce dehydrated ethanol.
5. Protections of water and soil from pollution caused by nitrates from agricultural activities.
6. Facilitating the supply and use of renewable energy sources, by-products, waste, residues and other non-food raw materials for bioeconomic (LRDP 2014-2020).
7. Forest cutting approved.
8. Preparation of internal forest management projects to promote the use of logging waste.
9. Increase logging waste and fine non-liquid wood biofuel (NFSDP 2012-2020).
10. Determination of mixed municipal waste composition, assessment of municipal biodegradable waste.
11. Protection to Separation of the biodegradable fraction.
12. Excise tax exemption for biofuels.
13. Installing renewable energy generation capacities (Law on the Renewable Energy).
14. The share of renewable energy in the final energy balance
15. Installation of new high efficiency biofuel cogeneration units.
16. Replacement of worn biofuel heat production plants in new district heating systems.
17. Compulsory blending of biofuels into mineral fuels (Law on the Renewable Energy).
18. Legal bases for the organization, administration, regulation, supervision and control of the market of energy resources.

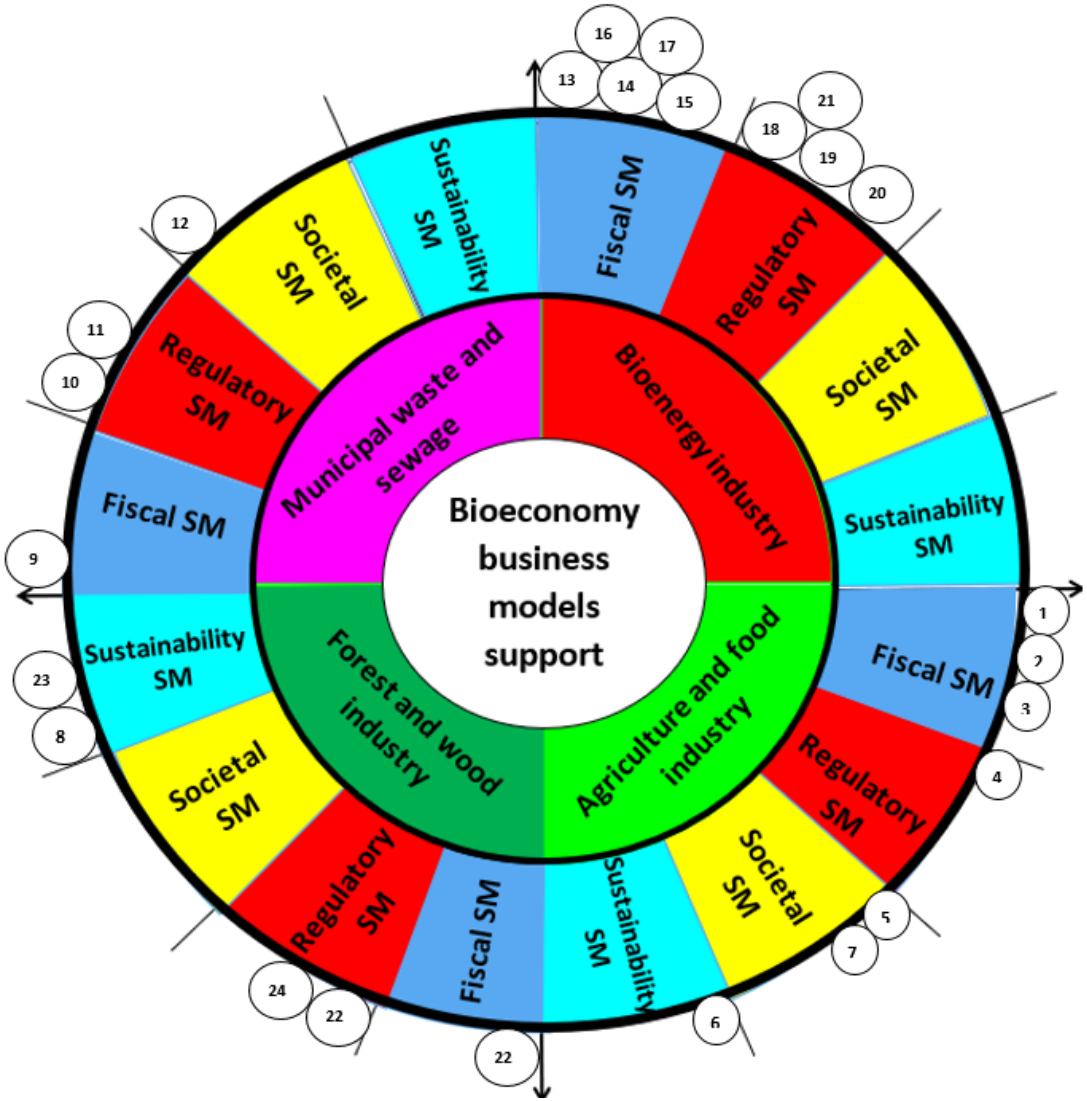
Source**:** authors' construction based on Lithuanian expert information
Figure 8. CBE Policy Analysis Diagram for Lithuania.



List of the SM (Latvia)

1. Reinvesting in a company, including the bioeconomy, the tax rate for profit sharing is 0%.
2. Taxation on noxious air polluting emissions creates synergy effect with CO_2 taxation.
3. Loans and guarantees for rural entrepreneurs (4%).
4. Reduced VAT for fruits and vegetables characteristic for Latvia.
5. Promoting the use of advice and services (LRDP for 2014–2020).
6. Support for investment in agricultural holdings: investment in recycling and infrastructure (LRDP for 2014–2020).
7. Management of nitrate use at vulnerable territories.
8. Improvement of manure management systems.
9. State categories of goods and services for which mandatory application of green procurement is stated.
10. Organic farming support (LRDP for 2014–2020).
11. Support promotes the use of biomethane.
12. Environment protection and resource usage efficiency.
13. Support small and medium establishment of merchants and development, especially bioeconomy (RIS3 priority industries).
14. Afforestation and improvement of stand quality in naturally afforested areas.
15. Incineration of collected green waste - leaves, grass and plant residues.
16. Development of the separate collection system for waste.
17. All biogas plants are equipped with biogas treatment (biomethane) plants.
18. Feed-in Tariffs for renewable electricity and fo combined heat-power (CHP) production.
19. Promotion of self-generation and self-consumption of energy.
20. Guarantees for biomethane trade and further use as fuel in transport.
21. Increase of the RES share in electricity consumption.

Source**:** authors' construction based on Latvian expert information
Figure 9. CBE Policy Analysis Diagram for Latvia.



List of the SM (Estonia)

1. Support for investments in agricultural holdings to Production of bioenergy from biomass of agricultural origin (ERDP for 2014–2020).
2. Rebuilding of agricultural machinery to biogas or biofuel consumption (ERDP for 2014–2020).
3. Support is paid for SMEs investing in the production of higher value-added products.
4. Permitted to spread up to 170 kg of nitrogen (Water Act).
5. Big data knowledge transfer program (ERDP for 2014–2020).
6. Reduce ammonia emission 1% by 2030.
7. The purpose of the support is to develop national and international cooperation (ERDP for 2014–2020).
8. Greenhouse gas emissions from land use are compensated by an equivalent absorption of CO_2.
9. Supporting preparation for reuse and recycling in the amount of 18 mln €. (ERDF for 2014–2020).
10. 50% recycling target for municipal waste.
11. Requirements for manufacturing of products from sewage sludge.
12. According to end-of-waste criteria for biodegradable waste and sewage sludge the product has to be certified.
13. Zero tax for biomethane that is used in transport sector.
14. Support scheme for biomethane fuelling stations
15. Renewable Energy Subsidy.
16. Renewable energy charge.
17. Efficient production of heat.
18. 10% renewable energy in transport sector so called "Blending mandate".
19. Environmental requirements for fuels.
20. Guarantees of Origin for renewable electricity.
21. Promoting the usage of biomethane in transport sector.
22. Forest act.
23. PEFC Programme for the Endorsement of Forest Certification.
24. FSC Forest Stewardship Council as Regulatory.

Source**:** authors' construction based on Estonian expert information
Figure 10. CBE Policy Analysis Diagram for Estonia.

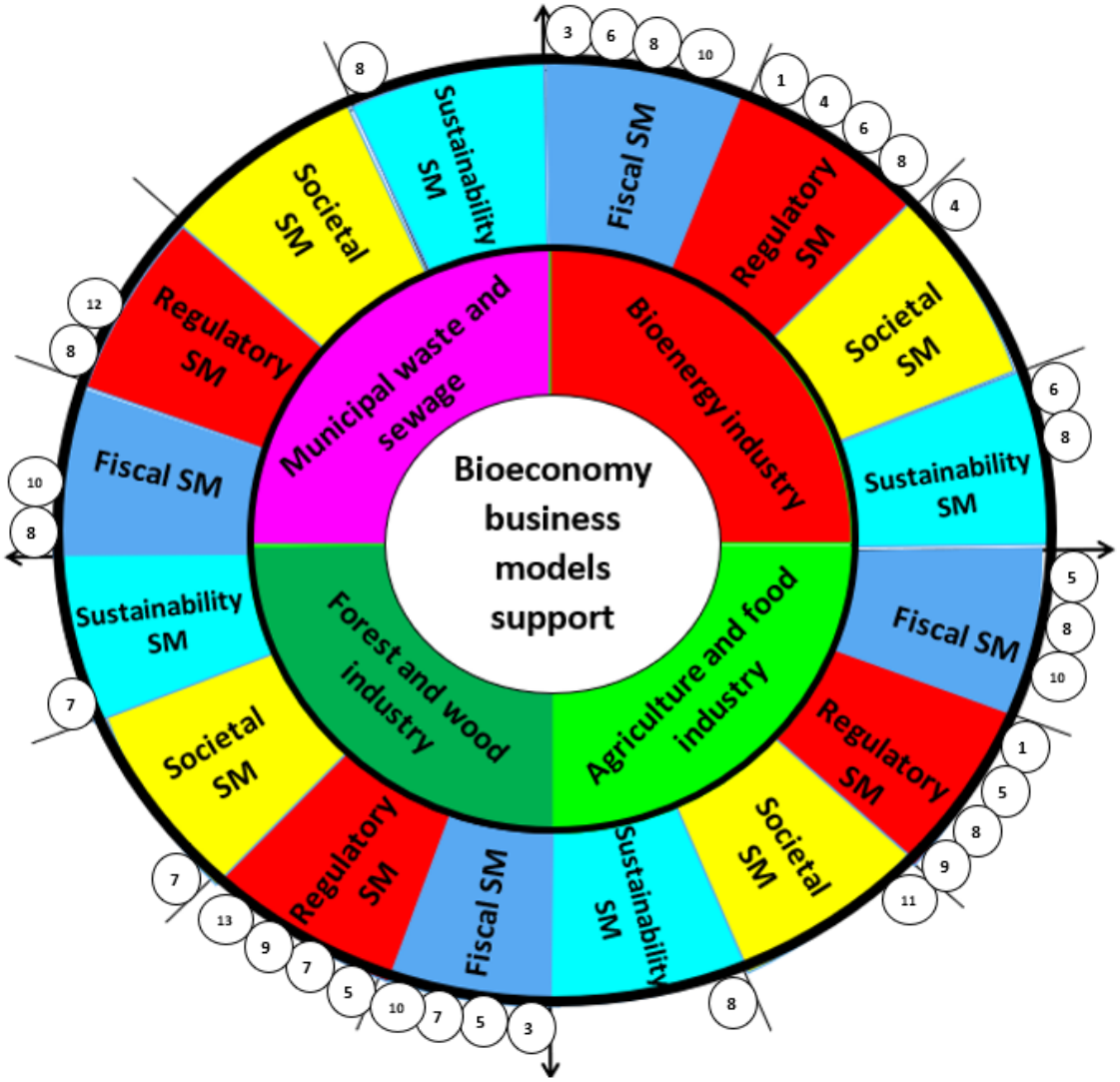
List of the SM (Germany)

1. Ecological Production Act.
2. Agricultural Payments Obligation Act.
3. Direct Payments Implementation Act.
4. Agricultural Organisation and Supply Chains Act.
5. Sewage Sludge Ordinance.
6. Climate Change Act 2021.
7. Germany's Renewable Energy Act (EEG) 2021.
8. Circular Economy and Safeguard the Environmentally Compatible Management of Waste 2021.
9. Renewable Energies Heat Act.
10. Biofuels Quota Act.
11. Federal Forest Act.

Source: FAOLEX Database. Available: http://www.fao.org/faolex/country-profiles

Source**:** authors' construction based on the FAOLEX Database

Figure 11. CBE Policy Analysis Diagram for Germany.



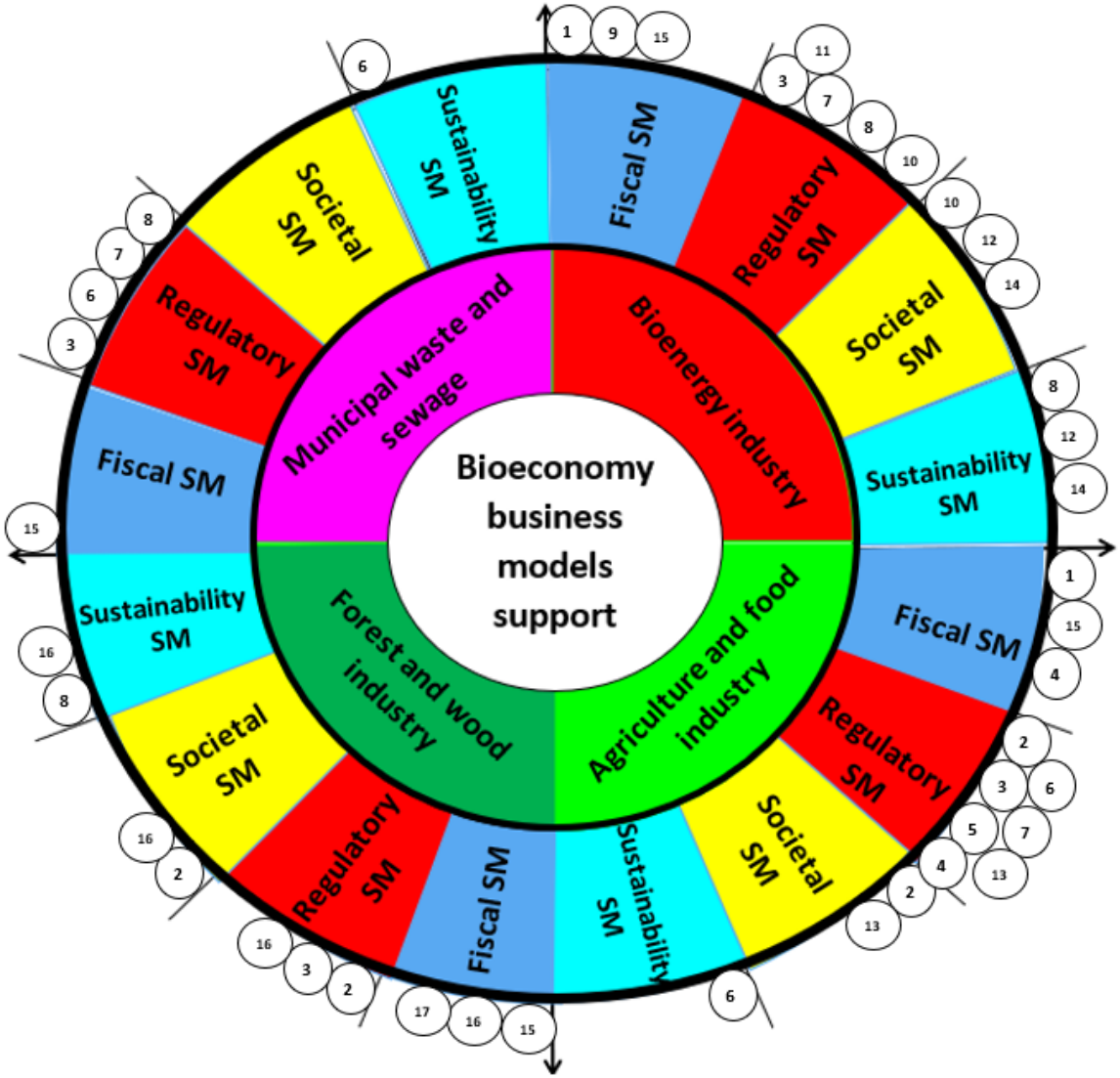
List of the SM (Poland)

1. Act on Biocomponents and Liquid Biofuels.
2. Energy Efficiency Bill.
3. Act on Thermo-Modernisation.
4. Energy efficiency certificates scheme (white certificates).
5. Polish Rural Development Programmes.
6. Energy law act.
7. Forest act.
8. Act on renewable energy sources.
9. Protection of agricultural and forest land.
10. Tax act.
11. Act on organic farming.
12. Waste Act.
13. Act on classification of unprocessed raw timber.

Source: FAOLEX Database. Available: http://www.fao.org/faolex/country-profiles

Source**:** authors' construction based on the FAOLEX Database

Figure 12. CBE Policy Analysis Diagram for Poland.



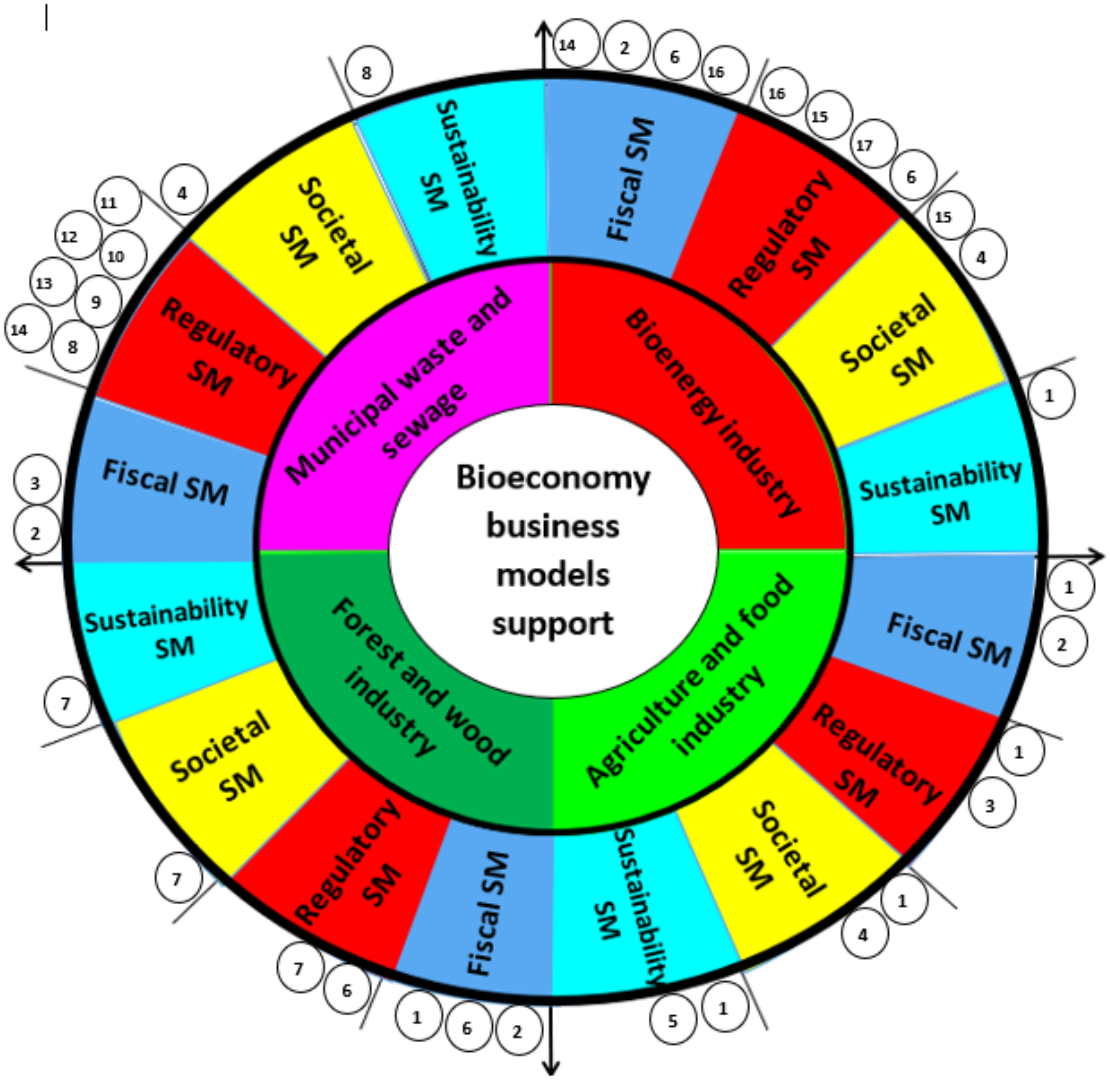
List of the SM (Sweden)

1. Sweden Aid for manure gas 2014-2023.
2. Act (2013:849) on EU Ecolabel.
3. Swedish Environmental Code (1998:808).
4. Swedish Rural Development Programme.
5. Decree on environmental considerations in agriculture (SFS 1998:915).
6. Law carrying into effect the Swedish Environmental Code (1998:811).
7. Climate Law (2017: 720).
8. Regulation (2013:253) on waste combustion.
9. Energy Taxation Act (1994:1776).
10. Fuel Act (2011:319).
11. Act (2013:984) on a quota obligation for biofuels.
12. Act (2010:598) on sustainability criteria for biofuels and bioliquids.
13. Act on organic production control (SFS 2013:363).
14. The Electricity Certificate System.
15. Sweden carbon tax.
16. The Forestry Act.
17. Regulation No. 31 on financial support for activities in the forest sector.

Source: FAOLEX Database. Available: http://www.fao.org/faolex/country-profiles

Source: authors' construction based on the FAOLEX Database

Figure 13. CBE Policy Analysis Diagram for Sweden.



List of the SM (Norway)

1. Familiar resources – undreamt of possibilities. (Regjeringens bioøkonomistrategi: Kjente ressurser – uante muligheter).
2. CO2 tax (Avgift på utslipp av klimagasser).
3. National Law on fertilizer use and content - the Law is under revision. (Forskrift om gjødselvarer mv. av organisk opphav – Lovdata).
4. Certification of "Miljøfyrtårn" ("Eco-lighthouse").
5. Forskrift om plantevernmidler (National Law: Regulations on pesticides).
6. A national strategy for the forest and tree industry. (Skog22: En nasjonal strategi for skog-og trenæringen).
7. PEFC Programme for the Endorsement of Forest Certification.
8. Waste as a resource - waste policy and circular economy (White Paper to the Parliament on waste).
9. Planning and Building Act (plan- og bygningsloven).
10. Pollution Control Act (forurensningsloven).
11. Pollution Regulations (forurensningsforskriftens del).
12. Water Regulations (vannforskriften).
13. Fertilizer Product Regulations (gjødselvareforskriften).
14. Water Frameword Directive (vanndirektivet).
15. National cross-sectoral biogas strategy (Nasjonal tverrsektoriell biogasstrategi).
16. Energi21.
17. Government Proposition: Prop. 1 LS (2017–2018) Skatter, avgifter og toll 2018

Source: authors' construction based on Norwegian expert information

Figure 14. CBE Policy Analysis Diagram for Norway.

The results are summarised in Table 6.

Table 6

Overview of Available Information on Circular Bioeconomy Policy Measures as of September 2019 for each BB4V Project Country

Circular Bioeconomy policy measures status indicator			LT	LV	EE	DE	PL	SE	NO
Bioeconomy funding programme	Biobased industrial sector								
	Bioeconomy R&I								
	Infrastructure investments								
	Other								
Educational programmes on the bioeconomy?									
Biobased industrial sector	Agriculture and food industry	Fiscal support measures	4	6	3	3	3	3	2
		Regulatory support measures	1	3	1	2	4	7	2
		Societal support measures		1	2		1	2	2
		Sustainability support measures		1	2	2	1	1	2
	Forest and wood industry	Fiscal support measures		2	1	1	4	3	3
		Regulatory support measures	3	1	2	2	4	3	2
		Societal support measures		1			1	2	1
		Sustainability support measures		1	2		1	2	1
	Municipal waste and sewage	Fiscal support measures		2	1	1	2	4	2
		Regulatory support measures	2	1	2	2	2		7
		Societal support measures		1	1	1		1	1
		Sustainability support measures		1			1	3	1
	Bioenergy industry	Fiscal support measures	5	2	5	2	4	3	4
		Regulatory support measures	2	3	4	4	4	5	4
		Societal support measures					1	3	2
		Sustainability support measures		1		1	2	3	1

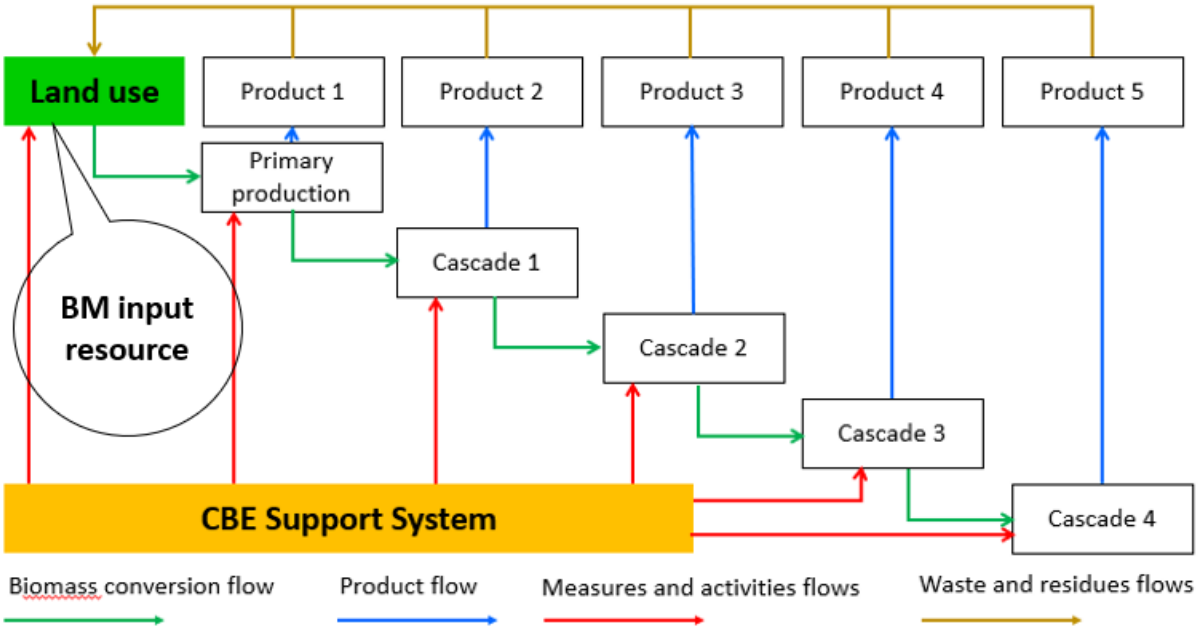
Legend: Yes | No | Under development | Other initiatives

Source: authors' construction based on expert information and the FAOLEX Database.

2.2. Policy support measures of the Sustainable Circular Bioeconomy Business Model (BM) for the agriculture, forestry, waste management and bioenergy sectors

The BM describes the logic of a business in a strategic view – what is offered to whom and how. The BMC of Osterwalder and Pigneur (2010) was used as a framework to compare the archetypes formed in the CA. At first, data from each BC for particular BM archetype was used to fill the BMC. In the following steps, the data was examined, grouped and main features of particular BMC block were identified and interpreted in the abstraction process.

Firstly, the BM identified by the project was analysed using the algorithm shown in Figure 15, which identified the SM used.



Source**:** authors' construction

Figure 15. Value Chain Support Measures for Business Models.

Secondly, the identified BM archetypes SM were analysed by bioeconomy sector, as illustrated in Table 7.

Table 7

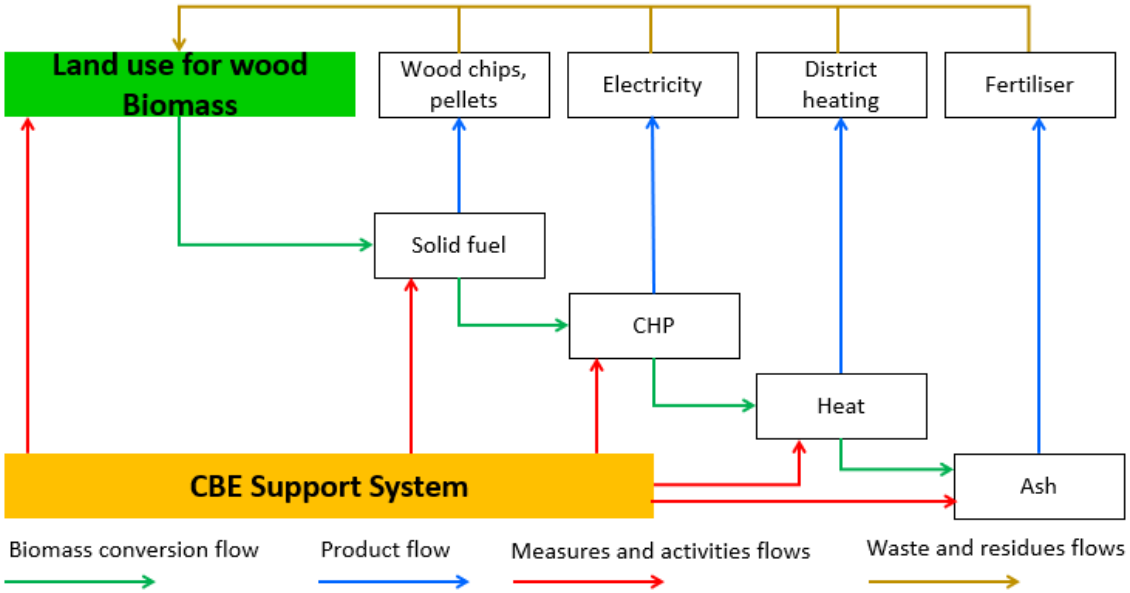
CBE BM by Source of Biomass and by Type of Production

Type of Circular Business Models	BM archetype	Source of biomass				Type of production		
		Agriculture and food industry	Municipal waste and sewage	Fishery and algae	Wood	Energy production	Circular bioeconomy development	Production of non-energy high value-added products
Heat and Fuel from Woody Biomass	BM1				x	x		
Fuel and Electricity from Biogas	BM2	x				x	x	
District Heating and Electricity from Various Biomass Sources	BM3	x				x	x	
Specialized Heat and Electricity Production and Services	BM4		x		x	x		
Innovation in Novel Fuels and Bio-chemicals	BM5	x			x	x		x
Circular Bioeconomy in Agricultural Production	BM6	x				x	x	
Bio-based Fertilizer for Increased Soil Quality	BM7	x	x		x		x	x
Sustainable Bio-based Products from Plant-based Biomass	BM8	x			x	x	x	x
Sustainable and Novel Bio-based Products from Food waste and Biomass	BM9	x		x			x	x
High-value Products from Knowledge-based Processing	BM10	x		x				x
High-value Products from Circular Bioeconomy	BM11	x		x	x		x	x
Utilization of Municipal Waste and Sewage	BM12		x			x	x	

Source: authors' construction.

2.2.1. Heat and Fuel from Woody Biomass (BM1)

The bioresource flow and the products – Heat and Fuel from Woody Biomass – manufactured according to the business model are shown in Figure 16.



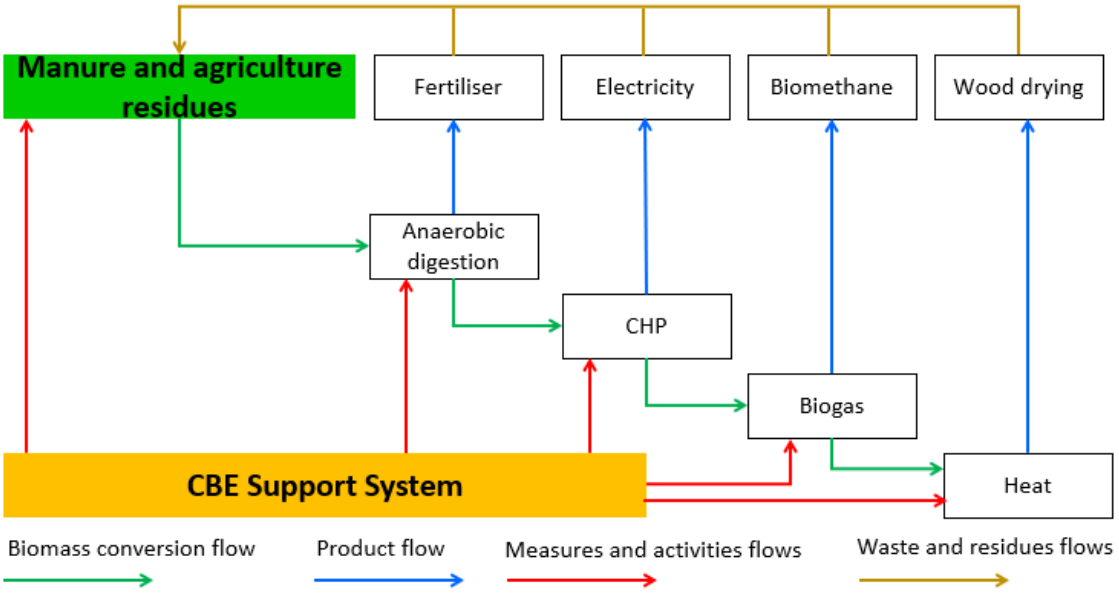
Source: authors' construction

Figure 16. Overview of the BM Heat and Fuel from Woody Biomass.

The policy dependency lies in access to investment support that has been used for establishing the plants. The EU renewable energy targets have considerably facilitated the expansion of pellet and heat production in the BSR in the last two decades.

2.2.2. Fuel and Electricity from Biogas (BM2)

The bioresource flow and the products – Fuel and Electricity from Biogas – manufactured according to the business model are shown in Figure 17.



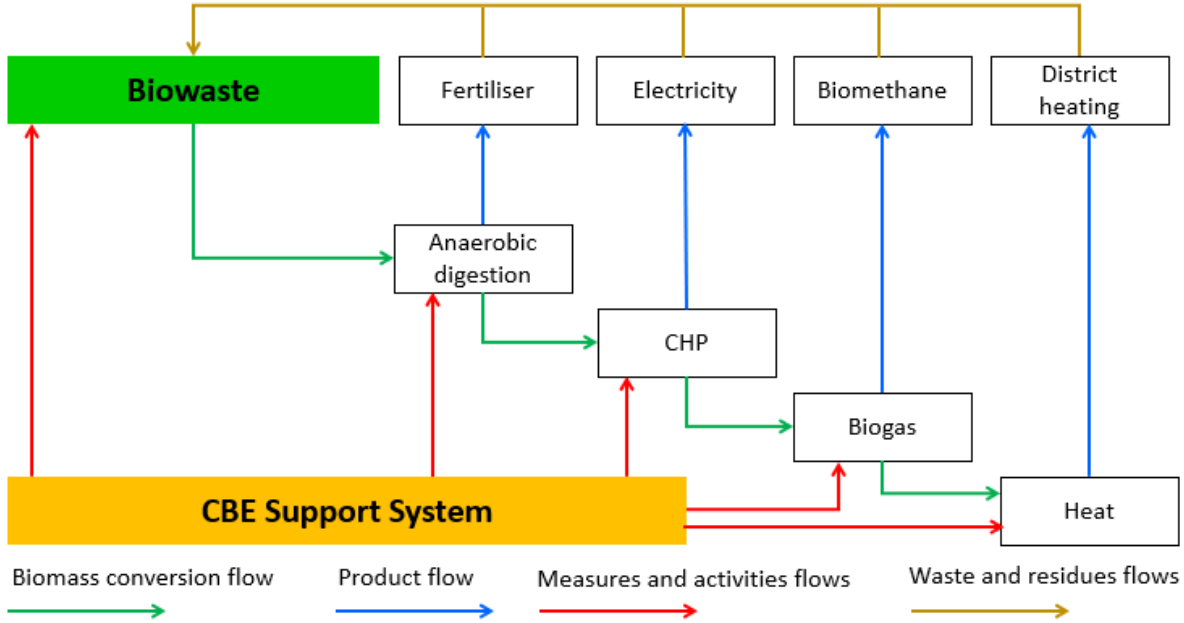
Source**:** authors' construction

Figure 17. Overview of the BM Fuel and Electricity from Biogas.

Relationships with operators of gas stations, owners of electricity infrastructure and district heating providers are required. Other partners include substrate and technology suppliers, financial capital providers. Municipal authorities setting requirements for construction of facilities, biogas use have considerable impact on the planning, infrastructure development and access. Those BM are very policy dependent, as energy policies and their bioenergy targets and related SM on investment subsidies for biogas plants have affected the investments into biogas plants and related gas distribution infrastructure.

2.2.3. District Heating and Electricity from Various Biomass Sources (BM3)

The bioresource flow and the products – District Heating and Electricity from Various Biomass Sources – manufactured according to the business model are shown in Figure 18.



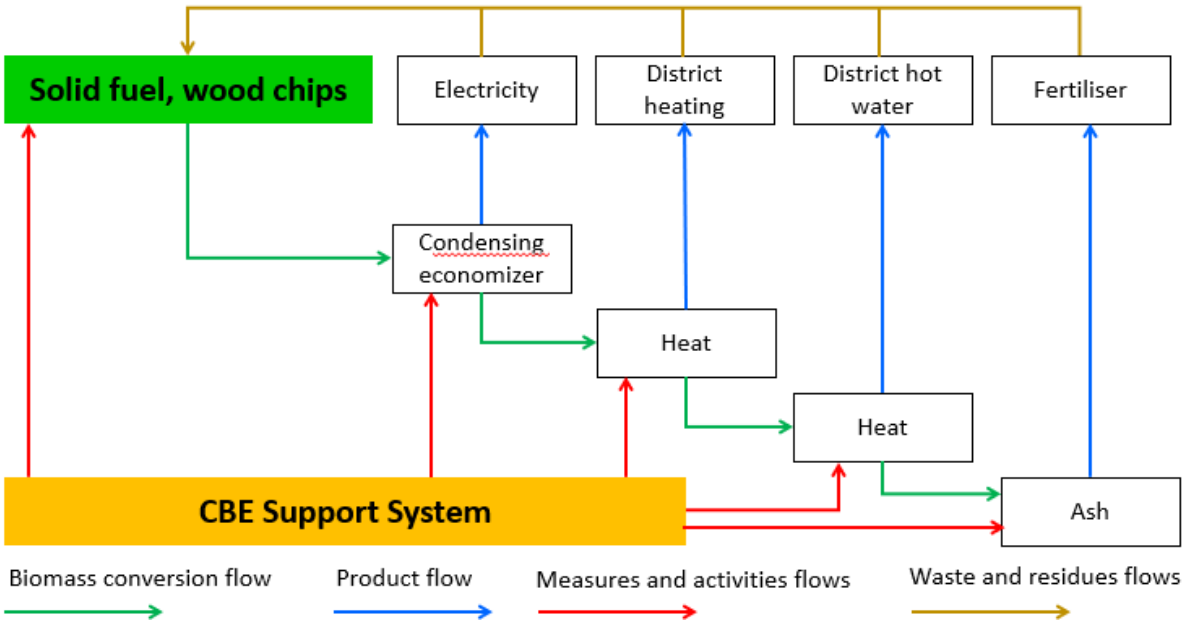
Source: authors' construction

Figure 18. Overview of the BM District Heating and Electricity from Various Biomass Sources.

The BM is easily transformable to use a variety of bioresources. The BM's support measures depend on local and national regulatory policies regarding access to heat and electricity, prices and bioenergy targets.

2.2.4. Specialized Heat and Electricity Production and Services (BM4)

The bioresource flow and the products – Specialized Heat and Electricity Production and Services – manufactured according to the business model are shown in Figure 19.



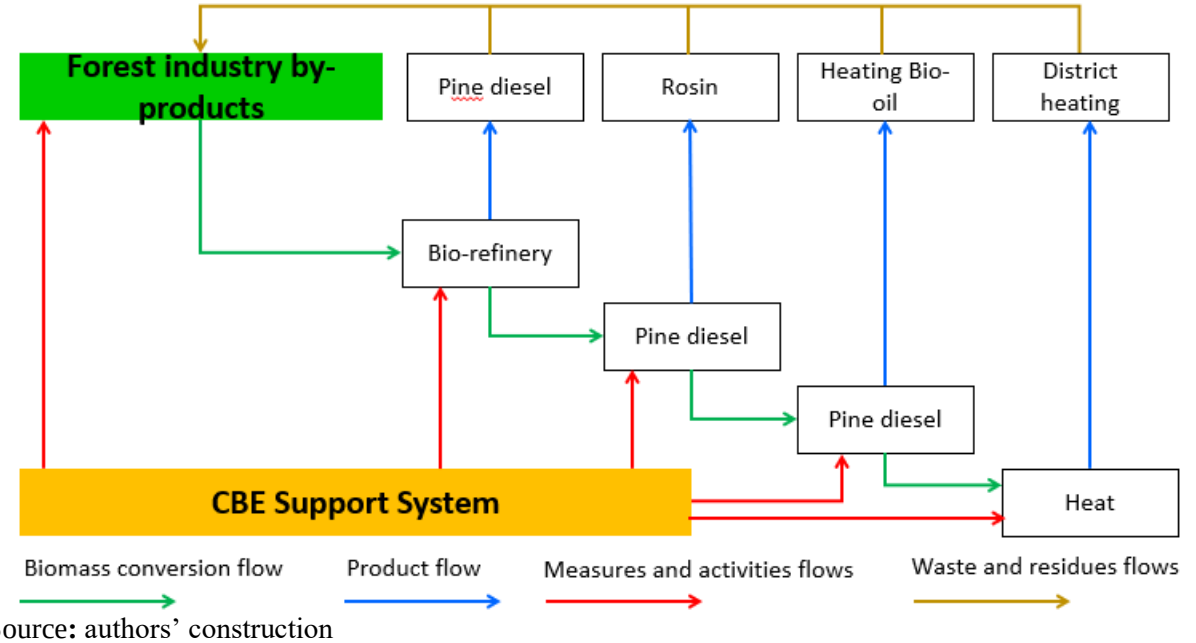
Source**:** authors' construction

Figure 19. Overview of the BM Specialized Heat and Electricity Production and Services.

The BM is transferable, but it also depends on the characteristics of the particular location and its grid infrastructure. The BM is heavily policy and regulation dependent. This type includes large and specialised district heating providers, and those companies are the main subjects of the EU and national bioenergy policy targets requiring adjusting their BMs. This is demonstrated with the BC of Przedsiębiorstwo Energetyki Cieplnej, a Polish company shifting its production from coal use towards biomass use.

2.2.5. Innovation in Novel Fuels and Bio-chemicals (BM5)

The bioresource flow and the products – Innovation in Novel Fuels and Bio-chemicals – manufactured according to the business model are shown in Figure 20.



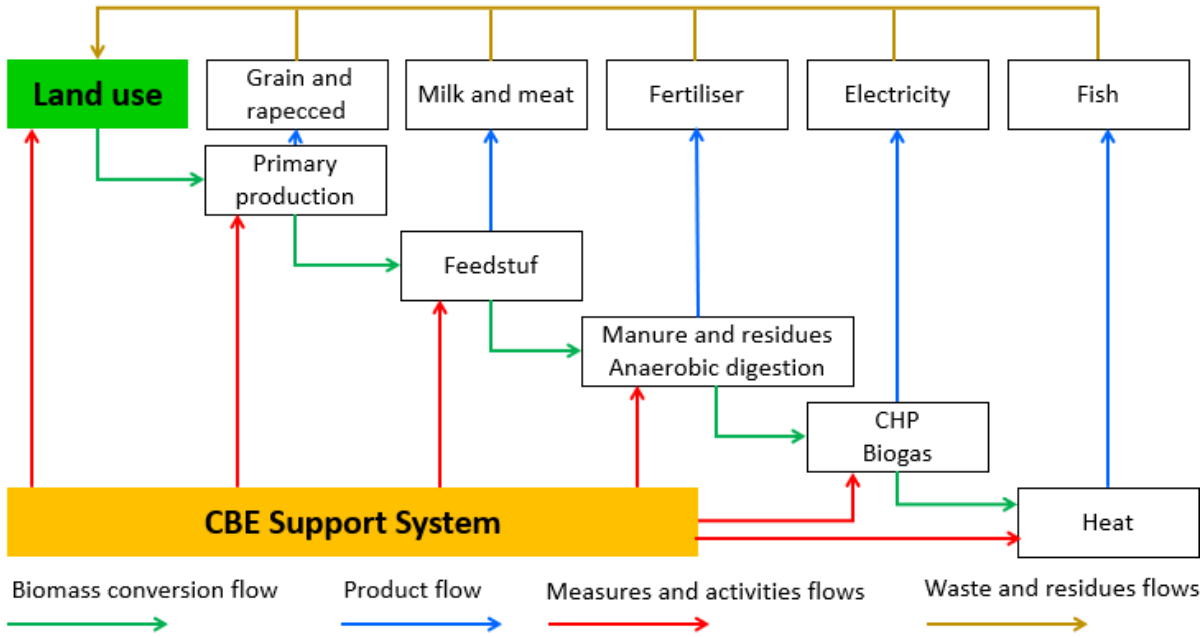
Source**:** authors' construction

Figure 20. Overview of the BM Innovation in Novel Fuels and Bio-chemicals.

An important factor is the policies implemented in Sweden and the EU. The industry is dependent on long-term regulation and cost-neutral energy policies. Companies are able and willing to invest if the rules are stable for many years, however, the political climate has been unstable with rules changing annually. Backing national ambitious policies and arguing for the importance of use of biomass for different purposes and taxation to increase the competitiveness of renewable fuels are required.

2.2.6. Circular Bioeconomy in Agricultural Production (BM6)

The bioresource flow and the products – Circular Bioeconomy in Agricultural Production – manufactured according to the business model are shown in Figure 21.



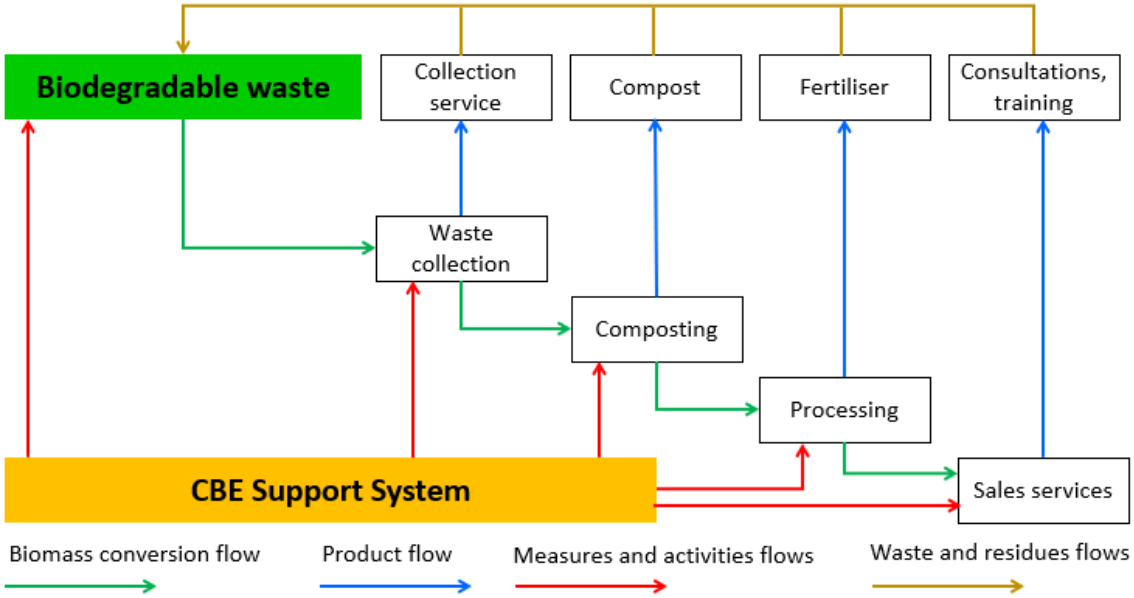
Source**:** authors' construction

Figure 21. Overview of the BM Circular Bioeconomy in Agricultural Production.

The BM uses agriculture-based bioresources. SM for crop farming are CAP direct payments, immovable property tax, crop fertilization plans, traditional family business and knowledge and compulsory GHG emission targets. SM for anaerobic digestion, cogeneration and central heating system development represent the Rural Development Programme's support for investment in tangible assets. For fisheries, it is support for investment in tangible assets for the growing EU aquaculture fish market.

2.2.7. Bio-based Fertilizer for Increased Soil Quality (BM7)

The bioresource flow and the products – Bio-based Fertilizer for Increased Soil Quality – manufactured according to the business model are shown in Figure 22.



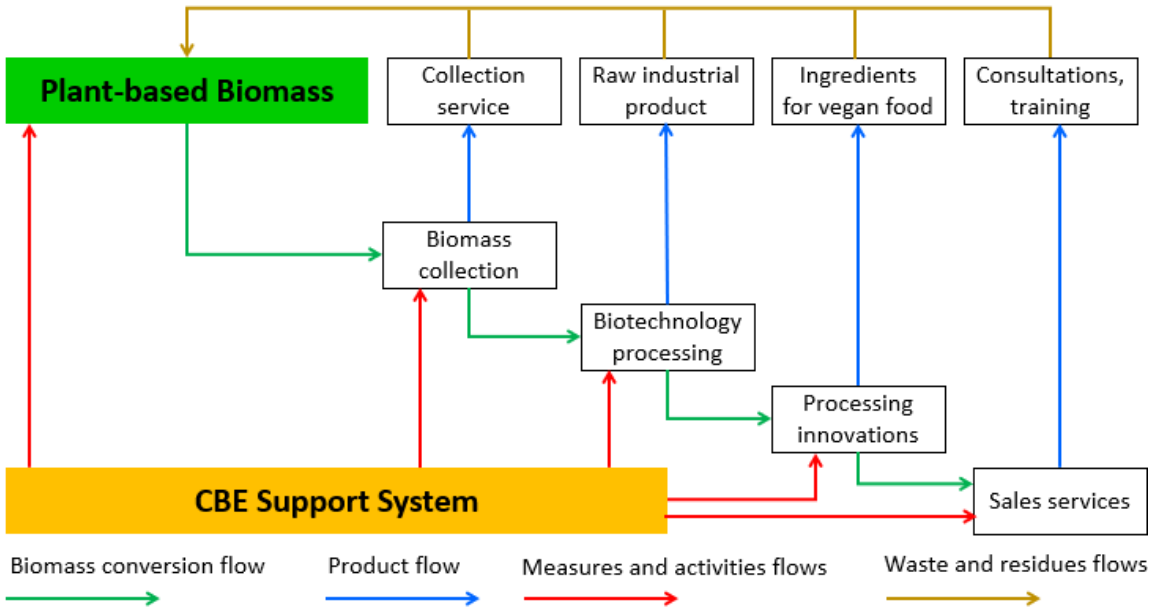
Source: authors' construction

Figure 22. Overview of the BM Bio-based Fertilizer for Increased Soil Quality.

The BM for utilization of biodegradable waste from landscaping and plant growing as a valuable local resource provides sustainable jobs for local community, additional income streams and cost savings from waste handling for local producers. Waste is collected from customers who do not have the opportunity to recycle it themselves. BM support measures for replacing mineral fertilizers with organic fertilizers has a positive effect on the environment and health. Besides waste reduction, the environmental benefits include soil quality improvement, reduction of air and water pollution, higher biodiversity.

2.2.8. Sustainable Bio-based Products from Plant-based Biomass (BM8)

The bioresource flow and the products – Sustainable Bio-based Products from Plant-based Biomass – manufactured according to the business model are shown in Figure 23.



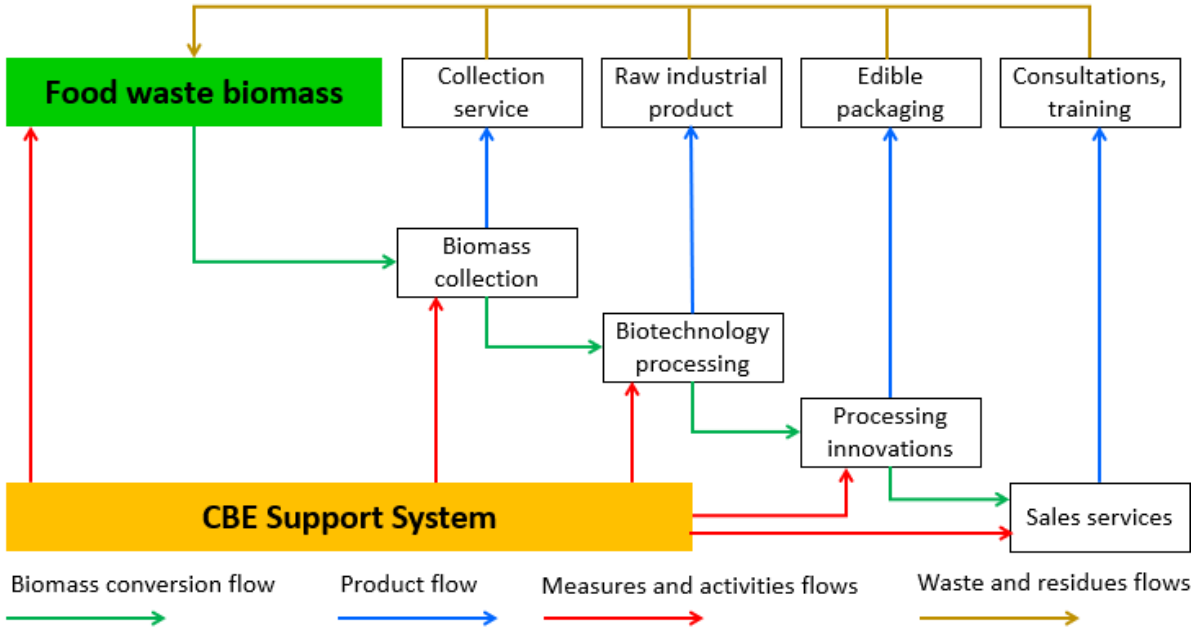
Source: authors' construction

Figure 23. Overview of the BM Sustainable Bio-based Products from Plant-based Biomass.

Policy SM for R&D to Universities and other research institutions provide opportunities for concept development for materials, processes, products, verification and prototyping and design. The role of business and industrial associations was especially emphasized for network, export and product development. Cooperation with regulatory authorities, which is required for meeting the environmental and other requirements for ingredients for the food and feed industry, were important for some companies.

2.2.9. Sustainable and Novel Bio-based Products from Waste and Biomass (BM9)

The bioresource flow and the products – Sustainable and Novel Bio-based Products from Waste and Biomass – manufactured according to the business model are shown in Figure 24.



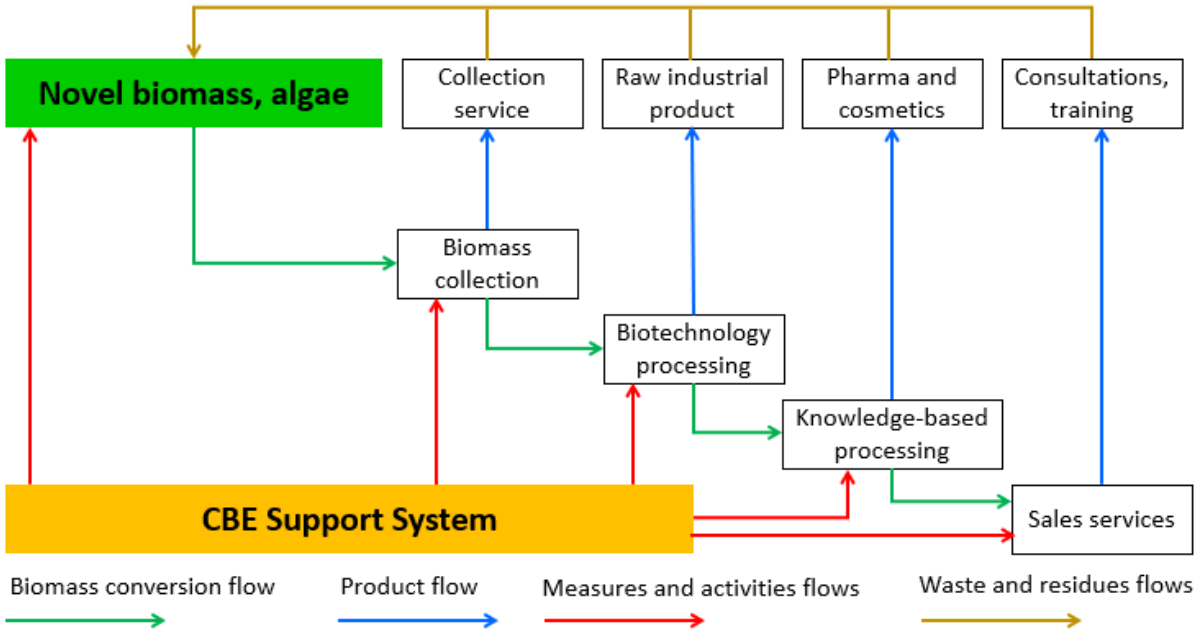
Source: authors' construction

Figure 24. Overview of the BM Sustainable and Novel Bio-based Products from Waste and Biomass.

Support measures for this type of companies are to develop new products, so emphasis was placed on cooperation with universities in the field of research and development and mentors for business development. As the use of food waste and biomass and the use of plastic products are subject to different rules, it is necessary to work with different public administrations.

2.2.10. High-value Products from Knowledge-based Processing (BM10)

The bioresource flow and the products – High-value Products from Knowledge-based Processing – manufactured according to the business model are shown in Figure 25.



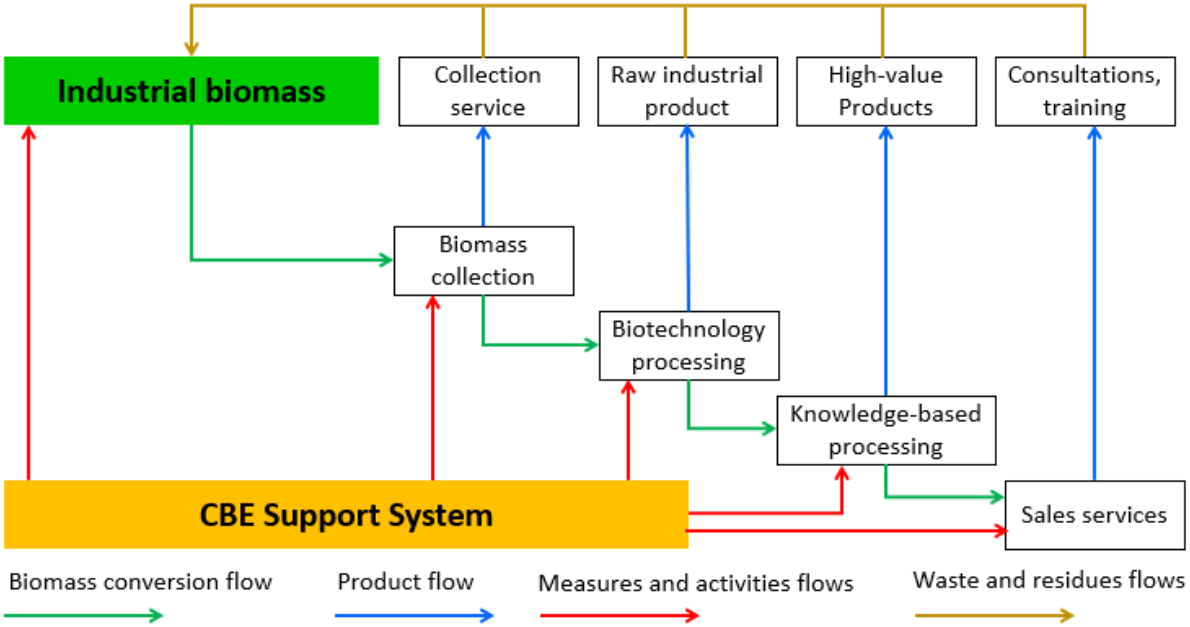
Source: authors' construction

Figure 25. Overview of the BM High-value Products from Knowledge-based Processing.

Support measures for this type of companies are to develop new products, so emphasis was placed on cooperation with universities in the field of research and development and mentors for business development. As the use of novel biomass, for example algae and the use of pharmaceutical, nutraceutical, cosmetics products are subject to different rules, it is necessary to work with different public administrations.

2.2.11. High-value Products from Circular Bioeconomy (BM11)

The bioresource flow and the products – High-value Products from Circular Bioeconomy – manufactured according to the business model are shown in Figure 26.



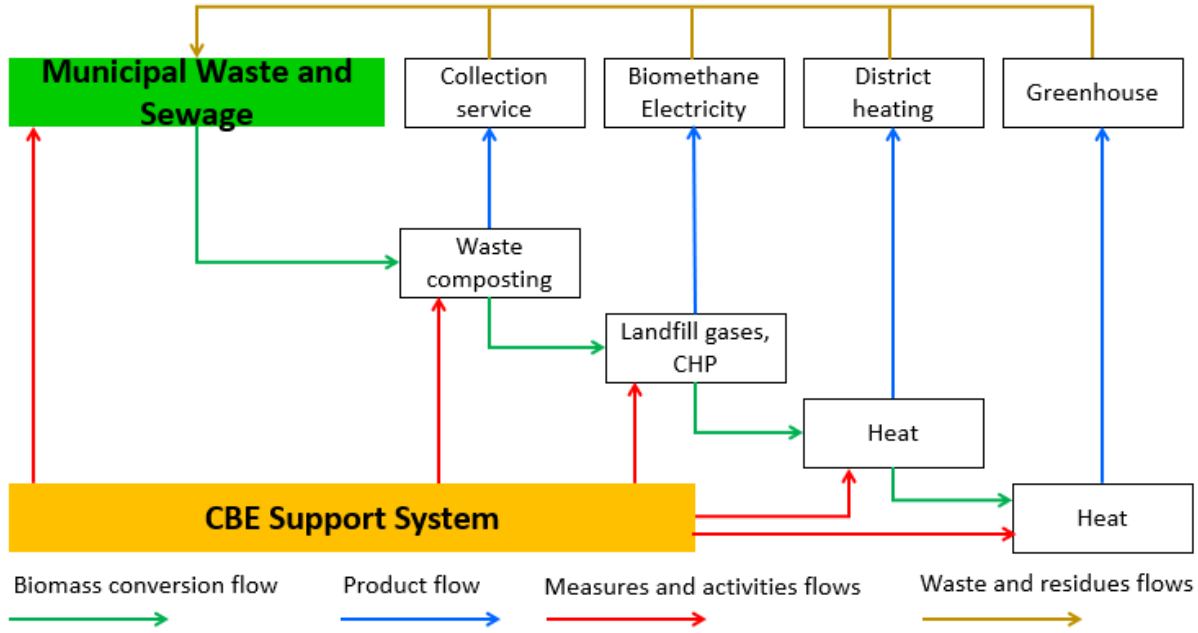
Source**:** authors' construction

Figure 26. Overview of the BM High-value Products from Circular Bioeconomy.

The companies in this BM are relatively specialized R&D companies, as well as large-scale biochemical and food processors, which create a significant number of jobs and economic activities for biomass producers in their region. In many cases, companies are not dependent on a network for the purchase of raw materials alone, but external actors play a key role in the R&D process by jointly designing and testing systems, providing funding and accessing markets. Policy support measures for research are being used to develop and deliver more environmentally friendly solutions to reduce water pollution and the use of waste and fossil fuels.

2.2.12. Utilization of Municipal Waste and Sewage (BM12)

The bioresource flow and the products – Utilization of Municipal Waste and Sewage – manufactured according to the business model are shown in Figure 27.



Source: authors' construction

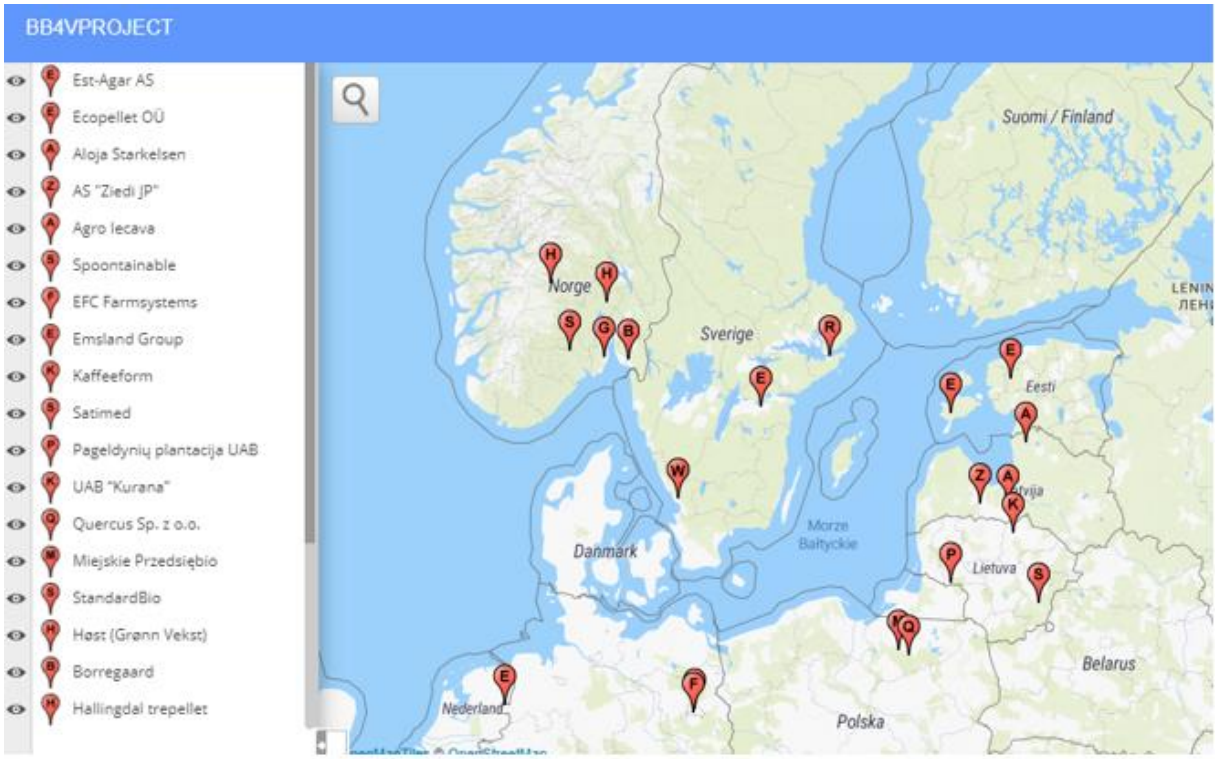
Figure 27. Overview of the BM Utilization of Municipal Waste and Sewage.

The companies representing this BM type were very regulation and policy dependent, as waste management policies, support measures, environmental goals and municipal interests not only facilitated setting up the companies but also provided public subsidies for investment and continuing operation. The BM is dependent on cooperation with the network of different actors – from providing biowaste to access to energy grids.

2.3. BB4V project policy support measures (SM) identified based on sustainable circular bioeconomy business cases (BC) for the agriculture, forestry, waste management and bioenergy sectors

Sustainable CBE BC policy SM for the agriculture, forestry, waste management and bioenergy sectors in the BSR were identified by using the expert method.

Following the BB4V project's research activities WP2.3 in the country of each partner, we identified the most representative practical business examples of the circular bioeconomy. The team at EMU has defined twelve (12) business models and identified twenty (20) nice practical examples representing these CBE BM. The analysed BC geographical locations are shown on a map, see Figure 28.



Source**:** authors' construction,
available: https://www.scribblemaps.com/maps/view/BB4Vproject/nArq1imFPR
Figure 28. BC Analysed and their Geographical Locations.

At this stage of project development, it is necessary to identify which support measures (i.e. policies, support instruments, communication and awareness raising measures) have contributed to an increase in the value of the use of bioresources in each project partner country.

The research results on business SM are fundamentally significant for a project online library to prepare guidelines for CBE development support at local level and promote them among public authorities in the countries of the BSR.

LLU (PP6) will be responsible for the analysis of regional/local support systems for CBE development and the preparation of good practice implementation guidelines for public authorities.

PP6 will involve leading experts from other project partners (PP1, PP5, PP9, PP10, PP11, PP12, PP13, PP14, PP15, PP16, AO1 and AO6) to carry out surveys/interviews with business authorities involved in the implementation of this activity. The surveys/interviews must be conducted with the expert/representative of the company.

We have examples of fifty-eight (58) companies (farms or holdings) in all countries of the BSR project that wanted to share their practices and help with contacts for survey/interviews (Germany, Poland, Lithuania, Latvia, Estonia, Norway, Sweden).

Theoretical research background

Behaviours, intentions and attitudes of farmers, entrepreneurs and company managers are influenced by endogenous factors related to personality, the structure and operation of the company and external effects including the political, economic drivers and societal influences (Rose, Keating, and Morris 2018; Feola and Binder 2010). Understanding these processes can help to design interventions and support measures (policies, support instruments, communication and awareness raising activities) that promote certain, desired behaviours (West et al., 2019), for example, sustainable farming practices for bioresource recycling and cascading, including those reducing greenhouse gas emissions from farms, and produce high value bio-based goods.

Researchers in behavioural sciences, environmental economics and interdisciplinary agricultural sciences have generated substantial evidence in the past decades on behavioural change, also in particular in the farming sector. Still, (policy) interventions are not always successful in achieving their goals, both due to the interventions not fully considering the scientific available knowledge (Michie and Prestwich, 2010) and the cognitive and psychological processes being context specific. This latter aspect makes it difficult to derive a theory that is uniformly applicable and can give clear directions in the pragmatic task of designing support measures interventions.

Bioresource recycling practices in agriculture, the food industry, municipal waste and sewage, fisheries, algae, and wood in the EU countries have been given a general common approach attention regarding the level and drivers of their uptake. But now, a comprehensive view on the various ways the overall uptake of the policy measure could be increased in the BSR countries (considering the differences in the processes between the bioresource recycling development intervention measures and between entrepreneurs or farmers to make a decision) is missing.

The aim of this study is to explore endogenous and exogenous factors related to the decision of farmers or entrepreneurs to change their actions in the context of available support policy measures.

The purpose of this study includes two tasks:

1. How different are the choice and the intention to use EU policy support measures for bioresource recycling in each of the individual 58 companies (exogenous, macroenvironmental factors),
2. How different are the choice and the intention in relation to any available measure and activities used by each company that helps to speed up bioresource use development and helps to create a bio production environment (endogenous, microenvironment factors).

This questionnaire is an overall environmental assessment to determine what available support measures are used by public and private actors to promote the reuse of biomass in agriculture, the food industry, fishing, the wood industry and the use of municipal waste and sewage.

The questionnaire is meant to evaluate what external (macro-level) and internal (micro-level) measures your company uses for development and implementation of the new biomass-related product/service (Figure 7).

For an assessment of the macro-environment, we identify any municipality-, regional- or national-level measures and activities used by the company that help to speed up bioresource use development and help to create a production environment for the long-term viability. For business long-term viability, we focus on policy support measures for four factor groups which are weighted on the Likert scale.

These groups are as follows:

- Fiscal/economic focus measures,
- Regulatory focus measures,
- Societal focus measures,
- Sustainability of natural environment focus measures.

The experts selected by the project partners had to assess the impact of macroenvironmental factors on the development of BC by assessing their significance by answering the question: *To what extent do such impact indicators and factors characterize your* ***business****?* (Rate on a descending scale from very high to very low and mark 8).

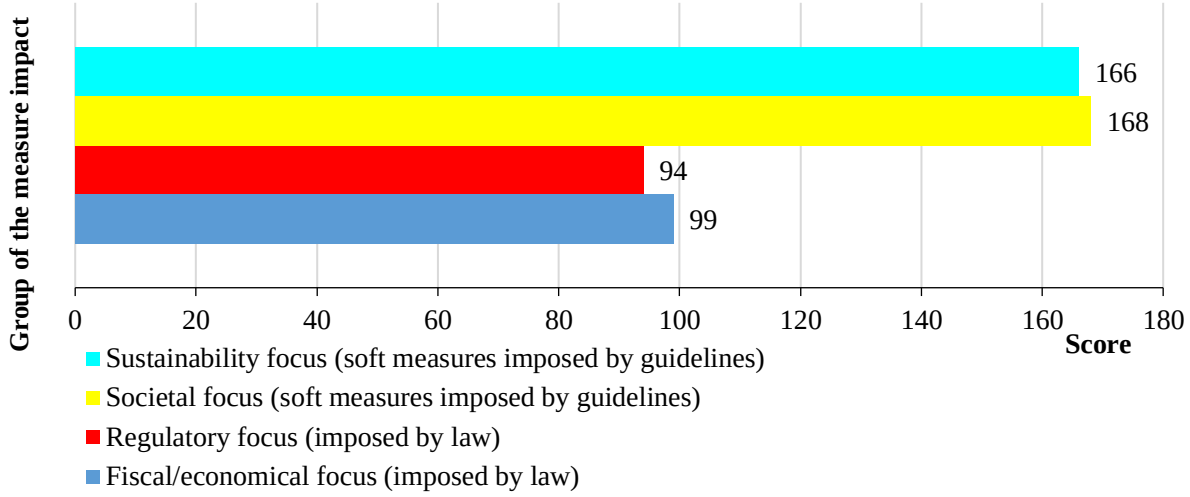
Table 8

Assessment of the Impacts of Macroenvironmental Measures and Activities

Group of the measure impact	Impact measures	Very high Impact (5)	High Impact (4)	Moderate Impact (3)	Low Impact (2)	Very low Impact (1)	No Impact	Score	Factor group score ∑
Fiscal/economical focus (imposed by law)	Rural Development Programme 2014-2020 (add investments, financing farm and business development)								
	Rural Development Programme 2014-2020 (company has used the subsidies, example: area- and animal-based payments)								
	Local funding instrument (specify - underline: municipality, regional or national funding instrument)								
	Reduced tax rate (specify - underline: municipality, regional or national level)								
	Market introduction programme (specific field or technology to enter to the market)								
	Other measures (specify)								
Regulatory focus (imposed by law)	Common Agricultural Policy legislative restriction (limit the use of resources: example - greening, nitrate sensitive areas, manure management, storage)								
	Green procurement (fossil-based resources substitution)								
	Quotas (example: quota on fishing in the Baltic Sea)								
	Supported product production (example: feed-in tariffs for renewable electricity)								
	Soft law (non-legal binding) as instrument of regulation								
	Other measures (specify)								
Societal focus (soft measures imposed by guidelines)	Production and supply of bio-resources certified according to sustainability principles (market demand)								
	Society boosts demand for bio-resource based products								
	Society accepting fossil-based production replacement								
	Training and advice support from public authorities for use of bioresources								
	Sharing of knowledge and skills for available bio-based product market opportunities and technologies based on collaboration and use of industrial symbiosis								
	Other measures (specify)								
Sustainability focus (soft measures imposed by guidelines)	Public participation to ensure stricter biodiversity conservation measures								
	Preventing or stopping decreases in or degradation of soil, forests and marine environments								
	Public pressure to pursue climate change mitigation and adaptation								
	Food loss and waste is minimized and, when unavoidable, its biomass is reused or recycled								
	Consumption patterns of bioeconomy goods match the sustainable and available supply of biomass								
	Other measures (specify)								

Source: authors' construction.

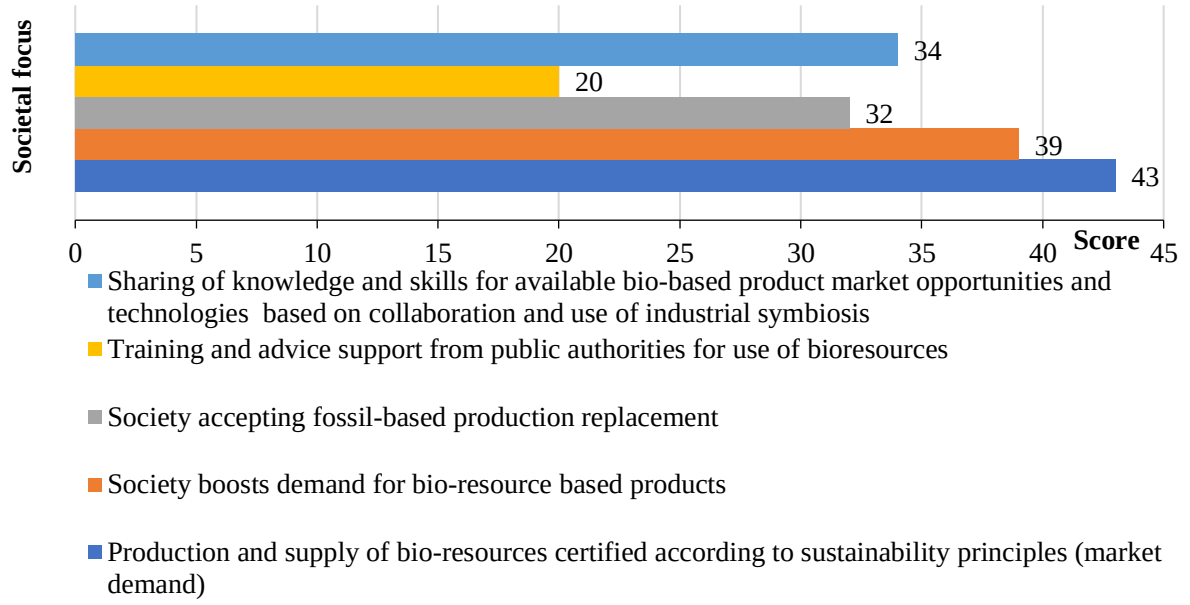
The results of the BC macroenvironmental assessment survey are summarized and presented in the following figures.



Source: authors' construction

Figure 29. CBE BC SM Macroenvironment Assessment Results, n=12.

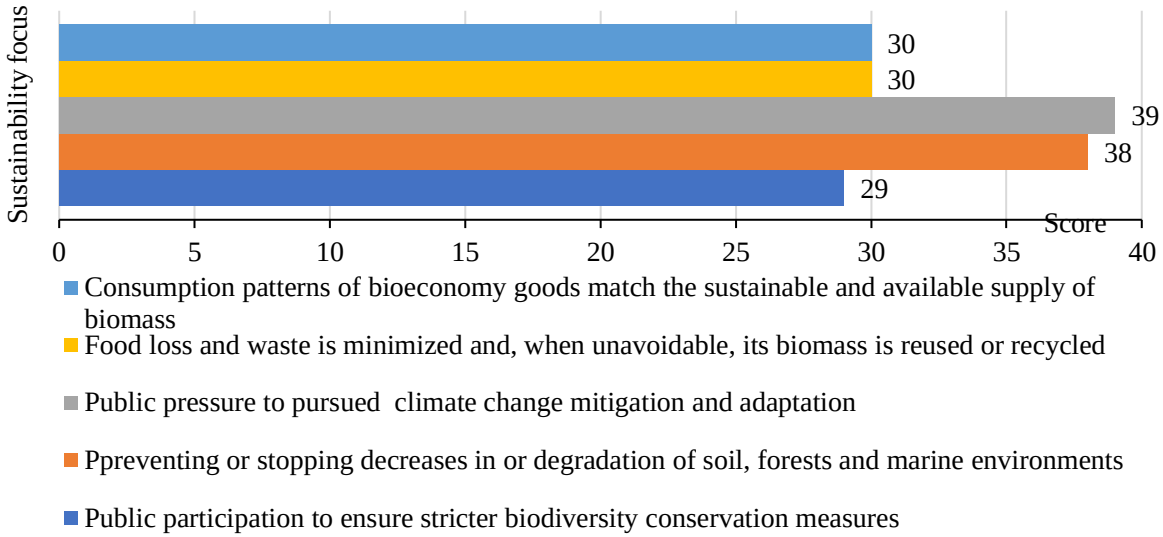
The results of the evaluation by experts associated with the BB4V project for areas of impact of macroenvironmental support measures show that measures focusing on social interest (sharing of knowledge and skills, training and advice support, society accepting fossil-based production replacement boosts demand for bioresource-based products and bio-resources certified) factors are the most important. In the expert assessment, regulatory focus support measures are of minor importance for the development of CBE BC.



Source: authors' construction

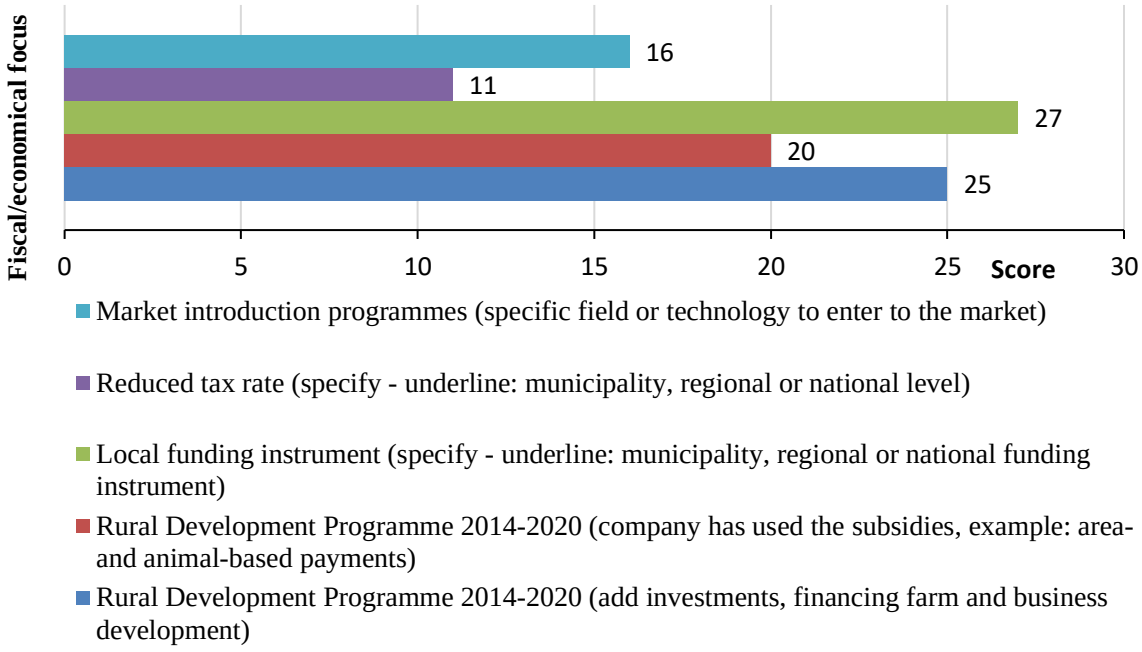
Figure 30. Societal focus CBE BC SM Assessment Results, n=12.

The assessment of the impact of public support measures is not a great surprise, since in the business environment the decision to create a new product or service is based on market demand. Therefore, in the expert assessment, the main support measures relate to production and supply of bioresources certified according to sustainability principles.



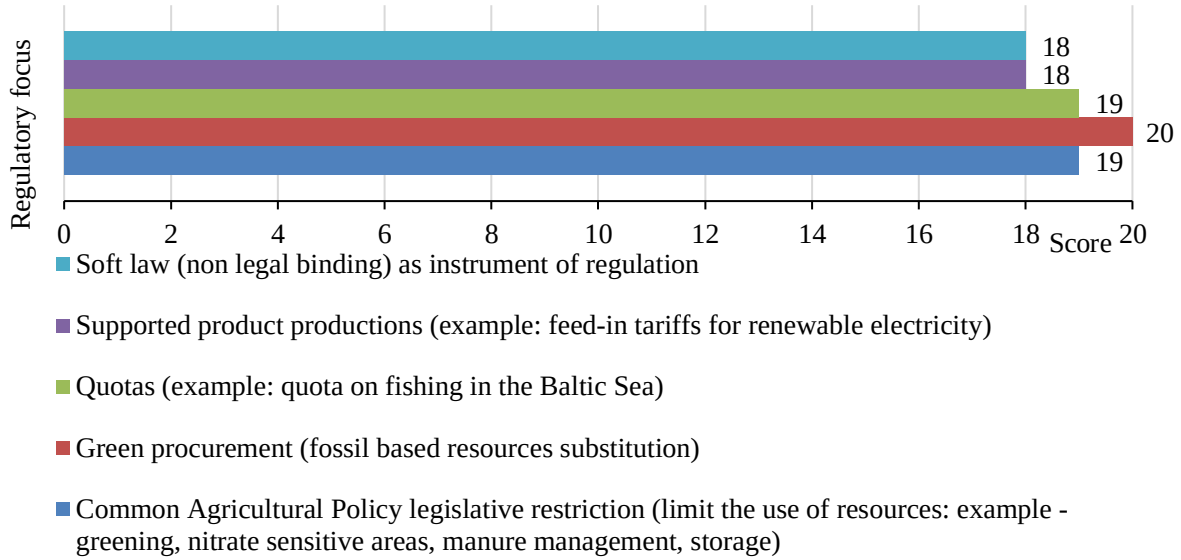
Source: authors' construction
Figure 31. Sustainability Focus CBE BC SM Assessment Results, n=12.

The assessment of the sustainability focus group shows that support measures regarding public pressure on climate change mitigation and adaptation are the most important.



Source: authors' construction
Figure 32. Fiscal/Economical Focus CBE BC SM Assessment Results, n=12.

The assessment of the fiscal/economical focus group shows that support measures for funding (regional or national) are very important for bio-based business development.



Source: authors' construction

Figure 33. Regulatory Focus CBE BC SM Assessment Results, n=12.

The assessment results for regulatory focus support measures show that for entrepreneurs, clear rules for green procurement of bio-based products and services are very important.

For an assessment of the micro-environment, we identify any available measure and activities used by your company that helps to speed up bioresource use development and helps to create a production environment for long-term viability. We focus on measures and activities for five group exogenous factors and weight impacts for each of them on the Likert scale.

These groups are as follows:

Results:

- What results are currently being produced by the local system?
- What is the current state of the problem or issue you have defined?

Roles:

- Which roles currently exist in the system?
- Are actors playing diverse roles?
- Are multiple actors competing to perform the same role, or collaborating in complementary roles?

Relationships:

- How do the actors in the system interact with each other?
- How are the actors in the system connected through their interactions?
- Are there clusters of actors who tend to work together?

Rules:

- What rules or practices constrain the actions of actors within the system?
- Are these represented in formal laws and policies?
- What social norms, practices, or standards of acceptability shape the action of actors within the system?

Resources:

- Financial resources,
- Environmental resources,
- Human resources,
- Infrastructure.

The experts selected by the project partners had to assess the impact of microenvironmental factors (Table 9) on the development of BC by assessing their significance by answering the question: *To what extent do such impact indicators and factors characterize your **business***? (Rate on a descending scale from very high to very low and mark).

Table 9

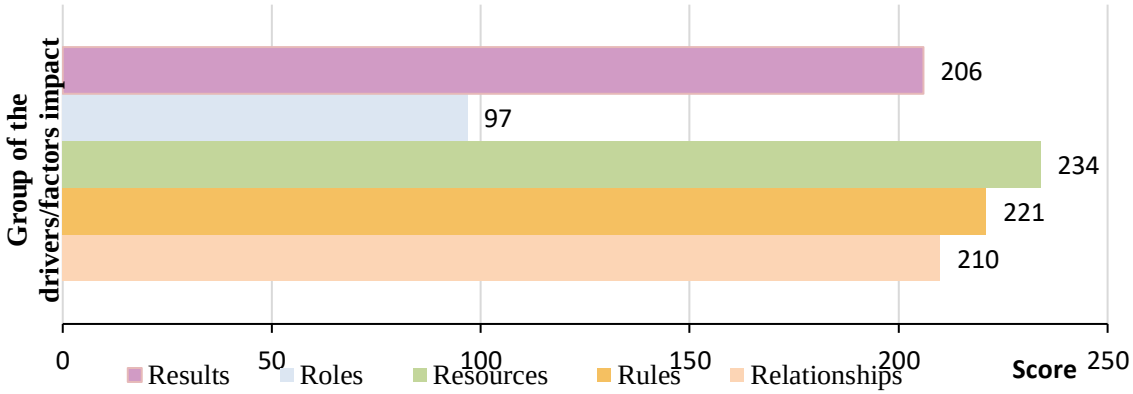
Assessment of the impacts of Microenvironmental Measures and Activities

Group of the drivers/factors impact	Impact drivers/factors	Very high Impact (5)	High Impact (4)	Moderate Impact (3)	Low Impact (2)	Very low Impact (1)	No Impact	Score	Factor group score ∑
Resources	The company has sufficient supply and available use of side stream bio-resources								
	The company has specific technological knowledge								
	The company has specific market intelligence/knowledge								
	The company has specific knowledge about the available support/regulatory measures								
	The company has available funding for recycling existing resources								
	Other impact drivers (specify this factor)								
Rules	The company operates an efficient/circular bio-resources management system								
	The company has an internal motivation system to promote residues/side stream resource use for bio-product production						`		
	There is a vision for a company development strategy in place for process innovations								
	There is a vision for a company development strategy in place for side streams popularization and internationalization								
	There is a vision for a company development strategy in place for product innovations								
	Other impact drivers (specify this factor)								
Relationships	Active business collaboration with product consumers								
	Long-term contract with suppliers of bio-resources								
	Cooperation with science institutions								
	Cooperation with education institutions								
	Cooperation with technology producers								
	Other impact drivers (specify this factor)								
Roles	The company is part of an international corporation								
	The owner of the company is a cooperative								
	The companies collaborate with others, the relevant cluster's members share, exchange and obtain knowledge and apply it in their own company								

	Whether the owners of the company are national/local government									
	Whether the owners of the company are individuals									
	Other impact drivers (specify this factor)									
Results	Natural environmentally friendly ecological/biological product production system									
	Seasonal adjustment of employment in the company									
	Increasing profits									
	Increasing market share									
	Produce a unique product									
	Other impact drivers (specify this factor)									

Source: authors' construction.

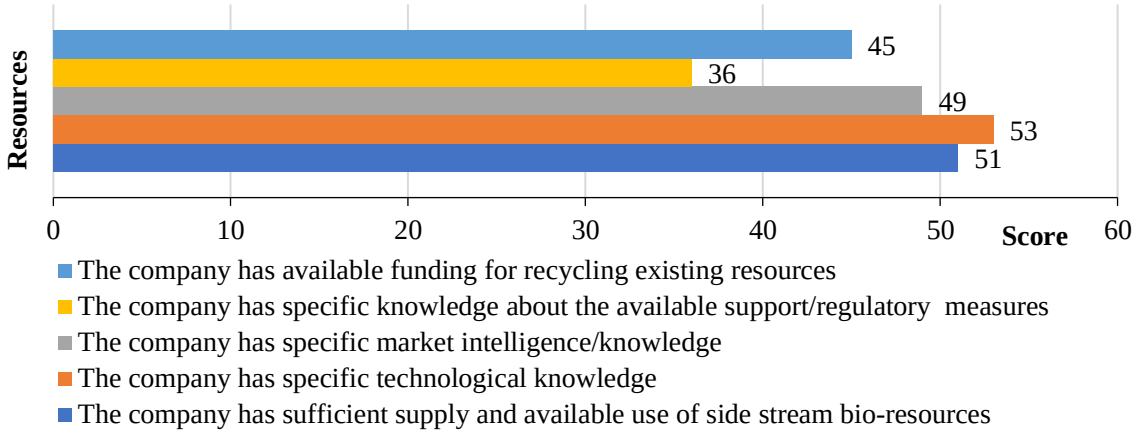
The results of the BC microenvironmental assessment survey are summarized and presented in the following figures.



Source**:** authors' construction

Figure 34. CBE BC SM Microenvironmental Assessment Results, n=12.

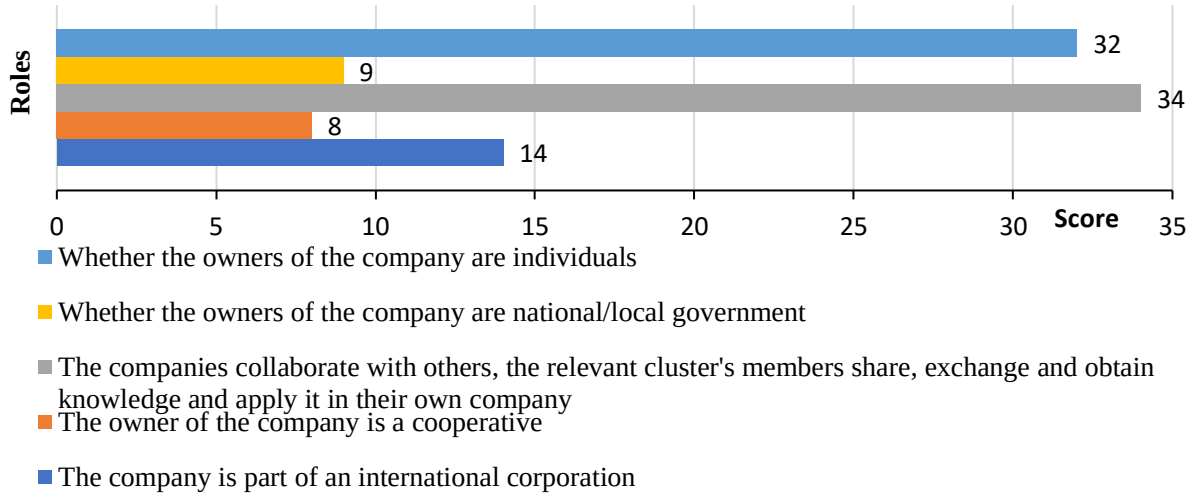
An assessment of the most important microenvironmental impact group for the development of CBE BC reveals that the most important thing for business start-ups was the availability of bioresources.



Source: authors' construction

Figure 35. Resource Group Factor Impact Assessment, n=12.

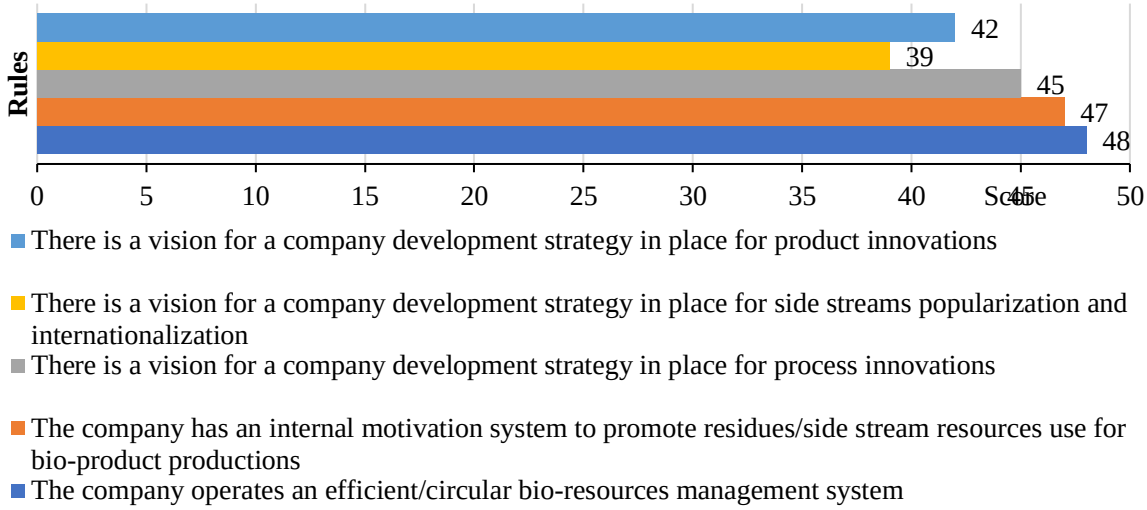
A detailed analysis of the support measures of the resource group shows that the most important support measure for entrepreneurs is linked to the uptake and deployment of new production technologies.



Source: authors' construction

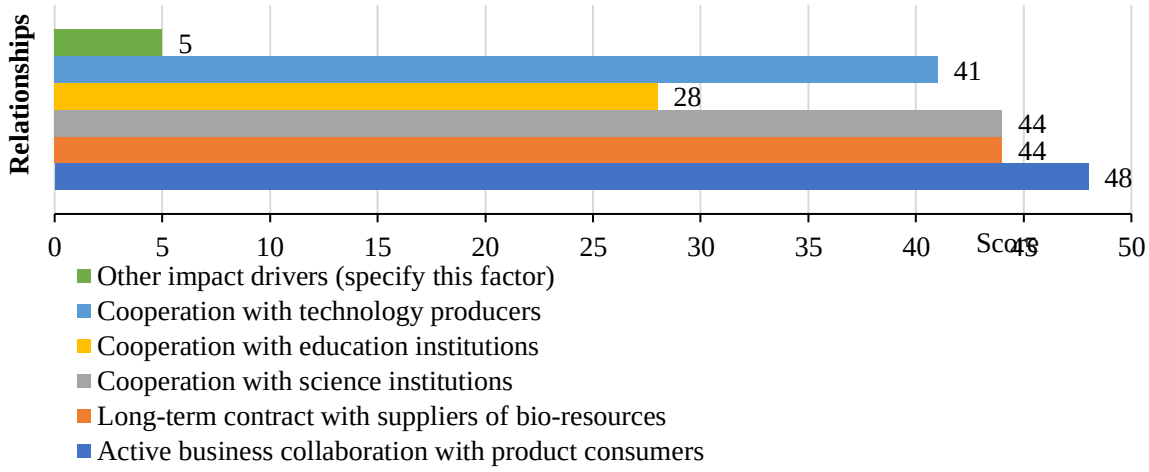
Figure 36. Roles Group Factor Impact Assessment, n=12.

An assessment of the roles group factors shows that for the companies, collaboration with others and the fact that the relevant cluster's members share, exchange and obtain knowledge and apply it in their own company is important. Regional and local authorities can play an important role in the development of any kind of collaboration forms, including bio-cluster or business incubators.



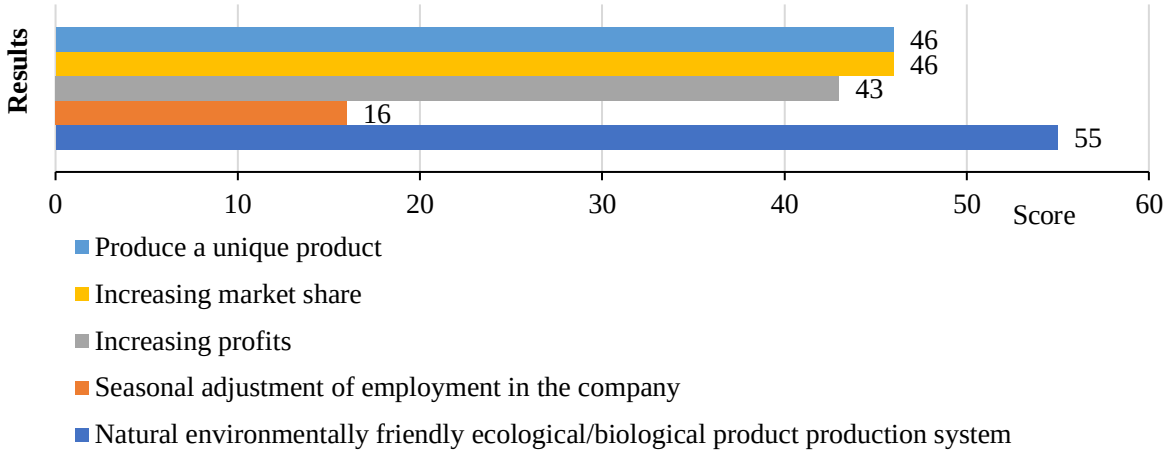
Source: authors' construction
Figure 37. Rules Group Factor Impact Assessment, n=12.

According to the expert assessment, the microenvironmental factor group - the rules - are the second most important contributor to the development of CBE BC. Local and regional authorities can help companies to promote an efficient/circular bio-resource management system, as is the case in our business examples analysed.



Source: authors' construction
Figure 38. Relationships Group Factor Impact Assessment, n=12.

Active business collaboration with product consumers is an important support measure for bio-based products and services. In this case, eco-labelling and bio-certification systems play an important role in increasing consumer confidence.



Source: authors' construction

Figure 39. Results Group Factor Impact Assessment, n=12.

Evaluating the microenvironmental factors group, the experts has found that the measure "natural environmentally friendly ecological/biological product production system" is the most important. Like in the group of factors – relationships -, in this case eco-labelling and bio-certification systems also play an important role in increasing consumer awareness raising.

3. Good practice implementation guidelines for sustainable circular bioeconomy business models

Using the information gathered during the project development, the following project report section has developed CBE BM good practice implementation guidelines for regional and local public authorities. The main aspects that would be relevant to the CBE BM **Good Practice Implementation Guidelines** are:

- Organisational development for interdisciplinary and inter-institutional cooperation (CBE BC examples: **oceanBASIS, Greve Biogass AS);**
- Funding schemes that regional / local public authorities could launch for effective support of circular bioeconomy development **(**CBE BC examples: **AS Ziedi JP, Est-Agar);**
- Knowledge and technology transfer uses R&D services and consultation schemes, business incubators and other innovation support structures, study and training programmes (CBE BC examples**: Aloja Starkelsen, Ltd);**
- Cross-border cooperation uses knowledge and technology transfer, attraction of FDI (CBE BC examples**: Pageldynių plantacija UAB);**
- Awareness raising uses labelling, certification and campaigns to promote green products and recycling schemes, image improvement of agriculture and other bioeconomy businesses (CBE BC examples **Wapnö Farm, oceanBASIS).**

The development of the content of the project report for the guidelines for the implementation of good practices consisted of two stages: first, the information published in scientific articles (Reim W., Parida V. and Sjödin D.R. 2019) and other similar project deliverables (BioStep, BERST and POWER4BIO) was analysed; secondly, using the descriptions of business examples in BB4V report 2.3, the business cases with good practice CBE BM implementation were identified.

The main aspects of the examples of implementing good practices relevant to the CBE BM are described in a common box template (Table 10).

Table 10

Good Practice Implementation Template

Business Model		
Country/Business Case		
Implementation aspects		
Business case support measures for impact policy instruments	**Fiscal**	
	Regulatory	
	Societal	
	Sustainability	

Source: authors' construction.

The definition of **guidelines** in the BB4V project: "*The guidelines are directions or principles presenting current or future rules of policy action plan which care of development support mechanism"*. Guidelines can be developed by government agencies at any level, institutions, professional societies, governing boards, or by the convening of expert panels. The text may be cursive or in outline form but is generally a comprehensive guide to problems and approaches in any field of activity.

Taking into account the definition of a circular bioeconomy given in the BB4V project, all good practice implementation guidelines must address the development of new BM for each source of biomass (agriculture and the food industry, municipal waste and sewage, wood) and type of production (energy production, circular bioeconomy development, production of non-energy high value-added products).

Resource efficiency and implementation of the principles of circularity, sustainable economic growth, environmental friendliness, social justice and integration are integral to the development of further sustainable circular bioeconomy BM. In that perspective, the "**new CBE BM**" require thinking in systems and in cascades, as underlined by Geissdoerfera et al.:

- thinking in systems, where not only bioresource flows and stocks are of crucial importance but also relationships between the various stakeholders,
- thinking in cascades, where additional value from products and materials can be created by cascading them through other applications.

The BM of the CBE is shaped and determined by a set of endogenous factors, but it is essential to consider the constantly changing external environmental factors which, in most cases, serve as a basis for the continuous development of the BM in line with the requirements. Consequently, each company is responsible for changing its BM in a changing environment (**new business models**). Changes in the environment are driven by new policy documents adopted, the objectives pursued, and the measures taken to achieve the objectives pursued (Donner M. and de Vries H. 2021).

The project's previous study has showed that all the BSR countries already have national policies on the circular economy and bioeconomy strategies (or a similar strategic document) in place or are in the process of developing a strategy. In the regions and countries without an explicit circular economy and

bioeconomy strategy, the CBE support is often embedded in one or several other strategic documents or funding programmes. The national policies on the circular economy and the bioeconomy strategies have strong objectives. At the same time, the implementation of the CBE policy strategy makes an impact on economic, social and environmental sustainability. The list of economic, social and environmental sustainability factors to be measured in the process of implementing the CBE policy strategy is summarized in Table 11.

Table 11

List of Economic, Social and Environmental Sustainability Factors to be Measured in the Process of Implementing the CBE Policy

Economic, social and environmental sustainability factors		
Environmental	**Social**	**Economic**
Greenhouse gases emissions	Employment	New business model
Reduced fossil resource consumption	Relocating of activities at local level	New innovative bioresource product market
Biodiversity decrease	Household income	Reindustrialization
Land use change	New jobs, new skills	New value chain
Soil quality decrease	Food safety	Change in farmer incomes
Water pollution	Quality of life	Change in public sector costs
Atmospheric pollution	Health	Changes in GDP
Carbon storage materials		Municipal tax revenue
Ecosystem services decline		

Source: authors' construction.

The CBE is transdisciplinary and has cross-sectoral, cross-policy and cross-border implications. Public (including regional and local) authorities are responsible for CBE policy strategy implementation governance in a sustainable way.

3.1. Organisational development for interdisciplinary and inter-institutional cooperation

As the CBE has an interdisciplinary role and cross-sectoral, cross-policy implications, all primary industries and stakeholders should be involved in the design and implementation of a Circulation Bioeconomy Strategy and an Action Support Plan.

This is why an integrative and transversal approach is needed with an essential role for public authorities in order to steer and facilitate the development of the bioeconomy by:

- Contributing to sustainability and circularity,
- Reducing the carbon impact of our consumption and production patterns,
- Respecting the priority given to food purposes,
- Reducing the need for materials,
- Supporting healthy ecosystems and reducing anthropogenic pollution.

The various stakeholders involved in CBE activities generally prioritise their own interests over those of others. The diversity of views and interests needs to be acknowledged and effectively channelled into a constructive dialogue, where public authorities act as a focal point bringing together the various stakeholders in the perspective of public interest and local or regional sustainable development. Regional public authorities must take leadership to steer and facilitate the development of the CBE in their territories and identify which CBE BM are the best one for achieving regional purposes.

The regional CBE policy strategy should be based on a higher-ranking EU or national policy document that includes the region's specific needs and objectives. Since the top-down regulatory and policy framework at EU and national level will strongly influence local and regional strategies.

According to Hannequart J.P. and Naudet P.M., the preparation of a regional CBE strategy should include the following elements:

- Mobilising the **planning process** and support to the strategy (including at political level),
- Identifying the **main actors** in the territory (stakeholders' analysis),
- Structuring the work framework with **specific working group**s (covering transversal cross-sectoral, cross-policy issues related to local characteristics),
- **Territorial analysis** and the identification of locally **available feedstocks** (from agriculture, the agri-food sector, forestry, maritime activities and fisheries, residual streams, municipal bio-waste),
- Global and/or **sectorial diagnosis**, including an analysis of current and **planned actions**,
- **Mapping** of opportunities and **key working areas** in particular to support the establishment of innovative value chains (sectors, streams, products/services),
- Establishing a strategic framework for planning: defining a **strategic vision** and objectives as well as the **area of intervention,**
- **Developing** the **CBE ecosystem**, in particular bridging elements and platforms between traditional (agro-food, fisheries) sectors, industry, science and research, technology as well as public administration,
- **Identifying** and evaluating the **options**, particularly taking into account initiatives from front-runners and/or regions with the **same bioeconomy profile**/approach,
- Preparing the **action plan**: by **sector**, stream or **product/service**, including short-/mid-/long-term actions related in particular to **supporting** bio-based **value chain**/cycle development, **research** on technologies and **innovation**, capacity building, **awareness raising** and **bio-based solution acceptance**,
- **Assessing risks** and opportunities, in particular those related to the **integration of bio-based solutions** in existing **local** bioresources **management systems,**
- Setting deadlines and accompanying the actors,
- Controlling the implementation of the action plan and the performance,
- Improving the plan according to the results achieved.

Achieving the goal requires the implementation of all the elements of CBE strategy preparation, including improving internal governance and interdepartmental cooperation by bringing relevant public administrations and departments closer together at local or regional level. Special attention shall be paid to those responsible for economic development, agriculture and rural affairs, the environment and waste, and research and innovation in the region.

Local governments have to: 1) identify existing cooperation with CBE policy makers in order to find a way to participate more widely in the development of CBE policies and strategies; 2) identify stakeholders and their networks at the level of the particular municipality; 3) develop solutions for activation of stakeholders and other interested parties in the territory of the local government in order to activate their activities for the development of the CBE in the territory of the local government.

Two examples of good practices for interdisciplinary and interinstitutional cooperation are presented below. The first example (Table 12) describes joint interdisciplinary cooperation between agricultural producers and local authorities to develop CBE BM.

Table 12

Examples of Business Case Support Measures and Good Practice Implementation Based on Interinstitutional Cooperation

Business Model		**Utilization of Municipal Waste and Sewage (BM12)**
Country/Business Case		**Norway / Greve Biogass AS**
Implementation aspects	**Interdisciplinary and interinstitutional cooperation**	Greve Biogas is a partnership established by 11 different municipalities in the Western region of Oslo-fjord. The story of company started in 2008 and when, on the one hand, the local politicians wanted to do something regarding the green sector, and on the other by farmers in the region who had problems with too much manure. The establishment of Greve Biogass was one way to keep up the agricultural production and use the manure and agricultural residues for biogas production. It was decided that all public transport (buses in the region) should be fuelled by biogas and thus a market was established.
Business case support measure for impact policy instruments	**Fiscal**	CO_2 tax (Avgift på utslipp av klimagasser). National Law on fertilizer use and content - the Law is under revision. (Forskrift om gjødselvarer mv. av organisk opphav – Lovdata). Water Frameword Directive (vanndirektivet). Energi21.
	Regulatory	Waste as a resource - waste policy and circular economy (White Paper to the Parliament on waste). Pollution Control Act (forurensningsloven). Pollution Regulations (forurensningsforskriftens del). Water Regulations (vannforskriften). Fertilizer Product Regulations (gjødselvareforskriften).
	Societal	Certification of "Miljøfyrtårn" ("Eco-lighthouse"). National cross-sectoral biogas strategy (Nasjonal tverrsektoriell biogasstrategi).
	Sustainability	National cross-sectoral biogas strategy (Nasjonal tverrsektoriell biogasstrategi).

Source: authors' construction based on Norway expert information

The second example (Table 13) describes the joint interdisciplinary cooperation of researchers and experts in marine ecology and economics with private and public clients.

Table 13

Examples of Business Case Support Measures and Good Practice Implementation Based on Interdisciplinary Cooperation by Involving Researchers and Experts

Business Model		**High-value Products from Knowledge-based Processing (BM10)**
Country/Business Case		**Germany / oceanBASIS**
Implementation aspects	**Interdisciplinary and interinstitutional cooperation**	CRM conducted environmental studies and projects for private and public clients. Different studies about the impact of aquaculture on the aquatic environment has led to the development and establishment of the first seaweed farm in the Baltic Sea followed by the first certified organic mussel farm in the Baltic Sea demonstrating the principles of Integrated Multitrophic Aquaculture (IMTA). In 2000 the first biomass produced was *Saccharina latissima*, the sugar kelp, which served as the basic material for the development of two bioactive extracts for the cosmetics industry and an own natural cosmetics line.
Business case support measure for impact policy	**Fiscal**	Ecological Production Act.
	Regulatory	Act to Promote the Circular Economy and Safeguard the Environmentally Compatible Management of Waste 2021.

	Societal	Climate Change Act 2021. NATRUE-certification.
	Sustainability	Climate Change Act 2021. Preventing or stopping the degradation of marine environments.

Source: authors' construction based on the FAOLEX Database.

3.2. Funding schemes for effective support for circular bioeconomy development

As with other businesses, investment in the CBE is needed. There are several sources of funding as well as different approaches to promoting the growth of the bioeconomy sector and financing BM projects and companies. The most used sources of financing in bioeconomy business are equity, loan capital and grants.

EU grant funding for the CBE

The European Union has set up a wide range of financing instruments and mechanisms that can support the development and implementation of circular bioeconomy activities in Europe. Some of these instruments and mechanisms are general, while others are specific to the topic embraced by the concept of circular bioeconomy as defined supra. The most recent approach considers sustainability as a key element to be taken into account for the allocation of financial support.

- **Reinforced Multiannual Financial Framework** (MFF) 2021-2027: with a total of EUR 1,074.3 billion, the proposed EU budget aims to finance a fair socio-economic recovery, repair and revitalise the Single Market, guarantee a level playing field, and support the urgent investments, in particular in the green and digital transitions. Over half of EU funding is channelled through the 5 European structural and investment funds (ESIF) which are jointly managed by the European Commission and the EU countries: the **European Regional Development Fund** (ERDF), the **Cohesion Fund** (CF), the **European Social Fund** (ESF), the **European Agricultural Fund for Rural Development** (EAFRD) and the **European Maritime and Fisheries Fund** (EMFF).
- **Next Generation EU**: a new temporary instrument which will boost the EU budget with new financing of EUR 750 billion borrowed on the financial markets for 2021-2024. This additional funding will be channelled through EU programmes and repaid over a long period of time throughout future EU budgets – not before 2028 and not after 2058.

Other grant funding for the CBE

- **Bio-based Industries Joint Undertaking:** a EUR 3.7 billion partnership between the EU and the Bio-based Industries Consortium. Available: www.bbi.europa.eu
- **European Circular Bioeconomy Fund** (ECBF): ECBF is the first venture fund exclusively focused on the bioeconomy and the circular bioeconomy in Europe. With a target size of EUR 250 million, to which the European Investment Bank (EIB) has committed EUR 100 million, the ECBF will be an important financial instrument in achieving the European Green Deal goals of making Europe climate neutral by 2050. We believe in the potential of innovation and sustainable impact to generate favourable returns. The EBCF is a new thematic investment platform for the circular bioeconomy resulting from cooperation between the EIB, the European Commission and ECBF Management GmbH. Available: www.ecbf.vc
- **Horizon 2020**: Horizon 2020 is the biggest EU Research and Innovation Programme with nearly EUR 80 billion of funding available over 7 years (2014 to 2020). It provides research and innovation funding for multi-national collaboration projects as well as for individual researchers and supports SMEs with a special funding instrument. Bioeconomy related calls for

proposals have been published under Societal Challenge 2 – "Food security, sustainable agriculture and forestry, marine, maritime and inland water research, and the bioeconomy". Available: www.ec.europa.eu/programmes/horizon2020/en

- **Horizon Europe:** Horizon Europe has a budget of EUR 95.5 billion for the period from 2021-2027. This includes EUR 5.4 billion from the Next Generation EU instrument, particularly to support the green and digital recovery from the COVID crisis. The budget is divided amongst four pillars and 15 components to create a programme that will support all the areas of research and innovation: excellent science, global challenges and industrial competitiveness (including a cluster on Food, Bioeconomy, Natural Resources, Agriculture and Environment), an innovative Europe as well as widening participation and strengthening the European Research Area. Available: ec.europa.eu/info/research-and-innovation/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe_en
- **LIFE**: The LIFE programme is the EU's funding instrument for the environment and climate action. Created in 1992, it has co-financed thousands of projects. LIFE is the European Programme for co-financing projects that demonstrate or pilot solutions that tackle environmental (including circular economy, nature and biodiversity) or climate issues. Available: https://cinea.ec.europa.eu/life_lv

Loan capital financing for the CBE

Debt or loan capital is the capital that an enterprise obtains by taking out a loan. It is usually repaid on time. As debt capital providers do not become business owners but are only creditors, debt capital is different from equity. Debt lenders usually receive a contractual percentage of their loan. This part of the investment must be repaid over a fixed period at a fixed interest rate, regardless of the company's financial situation. The types of loans may vary depending on various variables, such as the way interest rates are calculated or otherwise deadlines. In the simplest version, interest is the cost of borrowing money, which is usually a percentage of the total loan. Thus, the borrower has to repay the initial amount of money borrowed plus the cost of borrowing money (interest). The percentage of the loan to be repaid depends on the lending institution and the terms of the loan.

Local governments need: 1) to identify possible support instruments for the development of the CBE in your country; 2) to promote the relevant support instruments for entrepreneurs; 3) to consider the possibility of implementing joint projects with entrepreneurs in order to develop the CBE in the relevant municipal territory. Two examples of good practices for funding schemes that launch effective BM support for circular bioeconomy development were identified during the project. The first example (Table 14) describes the uses of EU grants for financing CBE BM development.

Table 14

Examples of Business Case Support Measures and Good Practice Implementation Based on Funding Schemes by Using EU Funds

Business Model		**Circular Bioeconomy in Agricultural Production (BM6)**
Country/Business Case		**Latvia/ AS Ziedi JP**
Implementation aspects	**Funding schemes that regional / local public authorities could launch for effective support of circular bioeconomy development**	The company has obtained bank loans for development and used the EU funds (EAFRD and EMFF) for a variety of projects. In addition, annual agricultural direct payments and national livestock subsidies are used. The initial investment for establishing circular production and biogas facilities has been more than EUR 10 million.

Business case support measure for impact policy instruments	**Fiscal**	Taxation on noxious air-polluting emissions creates a synergy effect with CO_2 taxation. Loans and guarantees for rural entrepreneurs (4%). Promotion of the use of advice and services (LRDP for 2014–2020). Support for investment in agricultural holdings: investment in recycling and infrastructure (LRDP for 2014–2020).
	Regulatory	Management of nitrate use in vulnerable territories. Improvement of manure management systems. National categories of goods and services for which mandatory application of green procurement is stated. Feed-in tariffs for renewable electricity and for combined heat-power (CHP) production. Promotion of self-generation and self-consumption of energy.
	Societal	Sharing of knowledge and skills for bio-based product market opportunities and technologies available.
	Sustainability	Increase of the RES share in electricity consumption.

Source: authors' construction based on Latvian expert information.

The second example (Table 15) describes the uses of creditors, investment loans and owners' own capital for financing CBE BM development.

Table 15

Examples of Business Case Support Measures and Good Practice Implementation Based on Funding Schemes by Using Creditors, Investment Loans and Owners' Own Capital

Business Model		**High-value Products from Knowledge-based Processing (BM10)**
Country/Business Case		**Estonia / Est-Agar**
Implementation aspects	**Funding schemes that regional / local public authorities could launch for effective support of circular bioeconomy development**	Est-Agar has been funded by using creditors, investment loans and owners' own capital. In addition, public sector opportunities (investment grants from ERDF) have been used. It is planned to continue such a funding scheme soon.
Business case support measure for impact policy instruments	**Fiscal**	Support for investments (ERDP for 2014–2020). Support is paid for SMEs investing in the production of higher value-added products.
	Regulatory	Algae quota.
	Societal	New product or service is based on market demand.
	Sustainability	Bio-based products and services (fossil-based resources substitution).

Source: authors' construction based on Estonian expert information.

3.3. Knowledge and technology transfer

In terms of economic development and innovation, smart specialization was seen as a catalyst for the development of a bio-economy in the EU's regions, bringing together several regional stakeholders from different regions on the same topic. Smart specialisation has made a real difference in the way European regions are designing their innovation strategies, creating, or reinforcing cooperation at all levels, especially with local business spheres.

The final decision to be a member of the S3 Platform is left to the relevant policy-making bodies at the appropriate territorial level, taking into consideration the institutional structure of the country concerned and the actual responsibilities for the policy processes in terms of both research/innovation strategies

and public funding tools. We suggest registering at the most relevant territorial level (**NUTS I, II or III**) with respect to the mentioned policy processes. The leading department should thus be the one having the responsibilities for the preparation/implementation of innovation strategies and/or the management of funding tools (like the EU Structural Funds). We also recommend that all the main departments involved, as well as major stakeholders, are included in the registration. With regard to the mentioned policy processes, there might be the case, for specific countries, that registration is recommended at both national and regional levels (www.s3platform.jrc.ec.europa.eu/join-the-s3-platform).

Under the reformed EU Cohesion Policy, smart specialization is a place-based approach aimed at strengthening innovation in Europe's regions, characterized by the identification of strategic areas based on stakeholder involvement in the analysis of economic benefits and potential.

Through this partnership and bottom-up approach, the S3 Platform (Bioeconomy - innovative use of non-food biomass) brings together local authorities, academia, business and civil society to work on long-term growth strategies supported by EU funds. Study results from the previous projects (Overbeek et al., 2016) have shown that the EU smart specialisation strategies have been considered as a primary driver of bioeconomy strategy development.

Other organisations that S3 and useable initiatives **for knowledge** and technology exchange to develop regional CBE and **cross-border cooperation**:

- The Agricultural European Innovation Partnership (**EIP-AGRI**) works to foster competitive and sustainable farming and forestry that 'achieves more and better from less'. It contributes to ensuring a steady supply of food, feed and biomaterials, developing its work in harmony with the essential natural resources on which farming depends (https://ec.europa.eu/eip/agriculture/en/european-innovation-partnership-agricultural).
- **BIOEAST Initiative**. Five BIOEAST Thematic Working Groups were established at macro-regional level to support the work of the BIOEAST Governing Board in specific strategic areas. The BIOEAST Initiative is a policy initiative, and 11 Central and Eastern European countries without bioeconomy strategies and/or action plans are working on policy level developments with the aim of contributing to knowledge- and cooperation-based circular bioeconomies until 2030. Bioeconomy is rather a new topic in the BIOEAST macro region, and there is a need to mobilise research organisations, industry, NGOs and the general public. Therefore, the BIOEAST Governance defines the role of national BIOEAST HUBs as a network to gather the national stakeholders and support their engagement (https://bioeast.eu/).
- European Network for Rural Development **(Rural Bioeconomy Portal).** Innovative and resource-efficient bioeconomy can offer economic opportunities to producers and enterprises in rural areas while preserving biodiversity and reducing greenhouse gas (GHG) emissions. This portal was launched by the ENRD Thematic Group on „Bioeconomy and Climate Action in Rural Areas". It also links to the work of the Thematic Group on „European Green Deal and Rural Areas". It shares information and examples of sustainable bioeconomy and nature-based solutions in rural areas (https://enrd.ec.europa.eu/).
- **International Bioeconomy Forum** (IBF). The IBF is a platform for regular, strategic international cooperation building policy coherence and exploiting synergies between countries and regions to support the development of a sustainable, global bioeconomy (https://www.bioeconomy-forum.org/).

Example of good practices for knowledge, technology exchange that launch effective BM support for circular bioeconomy development were identified during the project. The first example (Table 16) describes the uses of knowledge and technology exchange for CBE BM development.

Table 16

Examples of Business Case Support Measures and Good Practice Implementation Based on Knowledge and Technology Transfer by Using R&D Services and Consultation Schemes

Business Model		**Sustainable Bio-based Products from Plant-based Biomass (BM8)**
Country/Business Case		**Latvia / Aloja Starkelsen, Ltd**
Implementation aspects	**Knowledge and technology transfer by using R&D services and consultation schemes**	Since 2013, the company is the second world's largest organic potato starch producer. The new business strategy was developed, and it included measures to build a production chain, where the starch processor and producers of raw material – potato – are linked by cross-cutting interests. The company has created a network by joining organic potato growers, breeders and researchers in one chain and has established an organic potato starch competence centre, whose main objective is to promote knowledge-based organic potato breeding and production in the Baltic States.
Business case support measure for impact policy instruments	**Fiscal**	Support for investment in agricultural holdings: investment in recycling and infrastructure (LRDP for 2014–2020). Promotion of the use of advice and services (LRDP for 2014–2020). Reinvesting in a company, including the bioeconomy, the tax rate for profit sharing is 0%. Taxation on noxious air-polluting emissions creates a synergy effect with CO_2 taxation. Loans and guarantees for rural entrepreneurs (4%). Reduced VAT on fruits and vegetables typical of Latvia.
	Regulatory	Management of nitrate use in vulnerable territories. Improvement of manure management systems. National categories of goods and services for which mandatory application of green procurement is stated.
	Societal	Organic farming support (LRDP for 2014–2020). Baltic Organic Potato for the World Markets*
	Sustainability	Latvian high value added and healthy food cluster. The consumption patterns of bioeconomy goods match the sustainable available supply of biomass.

Source: authors' construction based on Latvian expert information.

***Baltic Organic Potato for the World Markets.** The BALTORGPOTATO project focuses on fruitful cooperation among organic potato growers, breeders, processors and scientific institutions in Latvia and Estonia involved in the organic potato food production chain, aiming to promote and ensure recognition of Baltic region organic potato products and sales volume growth in global markets.

The second example (Table 17) describes the uses of cross-border cooperation for CBE BM development.

3.4. Cross-border cooperation and FDI attraction

Latvian national high value added and healthy food cluster (LFC). The cluster strives to promote more sustainable use of resources and environmentally friendly food production, progress towards EU-level climate neutrality goals and UN sustainable development goals and also increase the awareness and knowledge in society about the potential of sustainable innovation in the food production and consumption value chain, which is grounded on the principles of circular bioeconomy, sustainable use of biological resources and conservation of biodiversity (https://clustercollaboration.eu/cluster-organisations/latvian-food-bioeconomy-cluster).

Local governments have: 1) to analyse the existing documents (strategies, policies etc.) in the field of CBE in the country; 2) to find their connection with the documents of the particular local government; 3) if necessary, to decide on the review and specification of the local government documents. The example of cross-border technology transfer between the BSR countries: Lithuania, Latvia, Estonia and Sweden is described in table 17.

Table 17

Examples of Business Case Support Measures and Good Practice Implementation Based on Knowledge and Technology Transfer by Using Cross-border Cooperation

Business Model		**Utilization of Municipal Waste and Sewage (BM12)**
Country/Business Case		**Lithuania / Pageldynių plantacija UAB**
Implementation aspects	**Knowledge and technology transfer by using cross-border cooperation**	Cross-border cooperation in research and experimental development for fast-growing tree clones adapted to local climatic conditions and fertilization trials using nutrient rich waste. The initial research was conducted during the EU Eurostars-funded project Snowtiger, during which first poplar plantations were established in Lithuania and fertilized with municipal water treatment sludge. During the project, frost resistant poplar varieties were tested in Lithuania, Latvia, Estonia and Sweden, and fertilization trials with municipal water treatment sludge digestate were performed in Lithuania.
Business case support measure for impact policy instruments	**Fiscal**	Facilitating the supply and use of renewable energy sources, by-products, waste, residues and other non-food raw materials for bioeconomic (LRDP 2014-2020).
	Regulatory	Amount of forest cutting approved. Preparation of internal forest management projects to promote the use of logging waste. Increasing the production of fine non-liquid wood biofuel from logging waste (NFSDP 2012-2020). Determination of mixed municipal waste composition, an assessment of municipal biodegradable waste.
	Societal	Production and supply of bio-resources certified according to sustainability principles (market demand). Society boosts demand for bio-resource based products. Society accepting fossil-based production replacement.
	Sustainability	Public participation to ensure stricter biodiversity conservation measures. Public pressure to pursue climate change mitigation and adaptation.

Source: authors' construction based on Lithuanian expert information.

3.5. Awareness raising through labelling, certification and campaigns

According to the European Commission study "Bioeconomy development in EU regions" (European Commission, 2017), regional bioeconomy ecosystems in Europe are usually built around a triple helix:

- Governments and public administration,
- Businesses,
- Representatives of sectoral associations,
- Business intermediaries,
- Financial organisations,
- Academic and scientific institutions,
- Technological institutions.

The advantage of sustainable business is that it is not just a concept based on economic benefits, availability of resources and cooperation. It also considers social interactions and integrates companies' internal and external resources. This is a prerequisite for creating a cluster of stakeholders involved in the business model. Clusters are an important tool to gather stakeholders around specific bioeconomy

sectors/products and promote regional CBE ecosystems development. As a result, stakeholders become very important in obtaining the resources and opportunities needed to start and develop a new business. Clusters' cooperation is facilitated at EU level via the European Cluster Cooperation Platform (ECCP).

Financial organisations have specific criteria and programmes that have to be considered early in the process in order to ensure that circular bioeconomy solutions can get the appropriate support. Individuals and communities also have influential power with regards to sustainability that can be activated using culture and art as a bearer of changes in the mindset on sustainability.

Involving CSOs and NGOs will enable them to share and give direct feedback on circular bio-based solutions and related activities, and at the same time will be likely to increase acceptance of those solutions by consumers.

Under Directive 2014/24/EU of the European Parliament on public procurement, contracting authorities have the possibility of using labels as a source of information for defining technical specifications to check compliance with the technical specifications and requirements or assessing award criteria. In checking compliance with the requirements set in a tendering process, accepting a label as one means of proof of compliance with the technical specifications can help a procurer save time while ensuring that high environmental standards have been applied in the procurement process.

In Europe, three multi-issue ecolabels are available according to ISO 14024, Type I, as shown in Figure 40.

Source: www.biobasedconsultancy.com/en/about-biobased/certification-and-ecolabels
Figure 40. EU Ecolabel, the Nordic Ecolabel, and the Blue Angel Ecolabel.

ISO differentiates between Type I, II and III ecolabels, of which Type I are the strongest ones. They are voluntary, multiple-criteria based, third party programmes that award a license that authorises the use of environmental labels on products indicating overall environmental preferability of a product within a particular product category based on life cycle considerations. Type II labels are self-declarations and Type III labels do not set any thresholds and do not claim overall environmental preferability.

- Sustainable wood certification. **FSC** (shown in Figure 41) runs a global forest certification system with two key components: forest management and the chain of custody

Source: www.fsc-uk.org/en-uk/about-fsc/what-is-fsc
Figure 41. EU Forest Management and Chain of Custody Label.

FSC also licenses retailers and other end users to promote FSC labelled products without holding FSC certification.

- Sustainable wood certification. **PEFC** (shown in Figure 42).

With over 330 million hectares of PEFC-certified forest, this is the largest forest certification system in the world. To this, there must be added more than 20,000 companies that have obtained PEFC chain of custody certification, demonstrating their commitment to responsible sourcing of certified products.

Source: www.pefc.org/discover-pefc/what-is-pefc
Figure 42. PEFC-certified Forest Certification System Label.

The PEFC, the Programme for the Endorsement of Forest Certification, is a leading global alliance of national forest certification systems. As an international non-profit, non-governmental organization, it is dedicated to promoting sustainable forest management through independent third-party certification.

- Roundtable on Sustainable Palm Oil (**RSPO**) shown in Figure 43.

Source: www.rspo.org
Figure 43. Roundtable on Sustainable Palm Oil Certification Label.

The RSPO is a multi-stakeholder initiative that was founded in 2004. The Secretariat is based in Kuala Lumpur with a RSPO Liaison office in Jakarta. The standard focuses on palm oil certification. It is globally applicable and can be adapted at a national level. The RSPO EU RED standard is a part of the overall scheme and has to be implemented together with the principles and criteria of the basic standard – the principles and criteria from 2007 were used for the analysis.

- The standard is designed specifically for sugarcane production (Bonsucro), as shown in Figure 44.

Source: www.bonsucro.com
Figure 44. Sugarcane Production Certification Label.

Bonsucro is a global multi-stakeholder non-profit organisation that exists to promote sustainable sugarcane production, processing and trade around the world. Bonsucro supports a community of over 250 members in over 50 countries, from all elements of the sugarcane supply chain, including, farmers, millers, traders, buyers and support organisations. More information about labelling and certification biobased products and systems in the Forum for Bio-Based Innovation in Public Procurement **(InnProBio)** is available at: (www.biobasedconsultancy.com/en/about-biobased/certification-and-ecolabels).

- A natural and organic cosmetic certification organizations is presented in Figure 45.

Source**: www https://www.natrue.org. and https://www.cosmos-standard.org/**

Figure 45. Natural and Organic Cosmetics Certification Labels.

NATRUE is a Brussels-based international non-profit association committed to promoting and protecting natural and organic cosmetics worldwide. Founded in 2007, it provides a home to all true friends of natural and organic cosmetics and welcome all who commit to its high standards of quality and integrity.

The COSMOS-standard is managed by a not-for-profit, international and independent association – the Brussels based COSMOS-standard AISBL. The COSMOS-standard signature is a consumer guarantee for organic and natural cosmetics that you can trust. To date over 26,000 products in 70 countries carry our COSMOS ORGANIC or COSMOS NATURAL signature.

Local governments need to identify product labelling possibilities in their territories and promote them. During the project, we identified two good practical business cases that raised awareness through certification schemes and campaigns to promote environmentally friendly CBE products.
The first example (Table 18) describes the use of certification schemes for the development of CBE BM.

Table 18

Examples of business case support measures and good practice implementation based on awareness raising by using certification schemes

Business Model		**High-value Products from Knowledge-based Processing (BM10)**
Country/Business Case		**Germany / oceanBASIS**
Implementation aspects	**Awareness raising uses certification schemes and campaigns to promote green products**	The first skin care product ("Baltic Care") containing a new fermented seaweed extract was launched in 2002. In 2009, the brand name was changed to "Oceanwell" and the marketing has been professionalised with the help of a marketing agency. Furthermore, "Oceanwell" received the NATRUE-certificate as "natural cosmetics". In 2010, a native collagen could be isolated from a jellyfish and patented. The technical development of two medical products on the basis of the jellyfish collagen – a wound gel and a bio scaffold – was successful, and oceanBASIS gained valuable knowledge on quality management (ISO 13485).
Business case support measure for impact policy instruments	**Fiscal**	Ecological Production Act.
	Regulatory	Act to Promote the Circular Economy and Safeguard the Environmentally Compatible Management of Waste 2021.
	Societal	Climate Change Act 2021. NATRUE-certification.
	Sustainability	Climate Change Act 2021. The society's participation to ensure a stricter biodiversity conservation measure.

Source: authors' construction based on the FAOLEX Database.

The second example (Table 19) describes the use of campaigns to promote green products for the development of CBE BM.

Table 19

Examples of Business Case Support Measures and Good Practice Implementation Based on Awareness Raising Using Campaigns

Business Model		**Circular Bioeconomy in Agricultural Production (BM6)**
Country/Business Case		**Sweden / Wapnö Farm**
Implementation aspects	**Awareness raising uses certification schemes and campaigns to promote green products**	The farm Wapnö opened its production to public through a series of events and festivals such as the cow release day in May, the Christmas market etc. Wapnö is an open farm and has around 60,000 visitors every year. The visitors are welcome year-round to get a closer look at the animals, barns and dairy. Wapnö claim that it wants to be a place that restores the relationship between agriculture and the consumer's plate.
Business case support measure for impact policy instruments	**Fiscal**	Sweden Aid for manure gas 2014-2023. Energy Taxation Act (1994:1776). Sweden carbon tax. Swedish Rural Development Programme. Regulation No. 31 on financial support for activities in the forest sector.
	Regulatory	Swedish Environmental Code (1998:808). Decree on environmental considerations in agriculture (SFS 1998:915). Law carrying into effect the Swedish Environmental Code (1998:811). Climate Law (2017: 720). Regulation (2013:253) on waste combustion.
	Societal	Act (2013:849) on EU Ecolabel Society boosts demand for bio-resource based products.
	Sustainability	Law carrying into effect the Swedish Environmental Code (1998:811). The society participation to ensure a stricter biodiversity conservation measure.

Source: authors' construction based on the FAOLEX Database.

4. Training programme for regional/local public authorities on development of circular bioeconomy business models and their support systems

The goals of the training programme developed under task WP3.1 of the BB4V project were two. Firstly, to contribute to an increase in the CBE support system capacity of the regions involved in the project. Secondly, to promote new CBE BM support system initiatives in any other region across the BSR, as we hope the participants in the training courses will be open, no-restricted to BB4V partners.

The information gathered and developed during the project was used to generate the materials of the training. The expertise and knowledge acquired has been condensed and structured to define the content of the training material.

Training programme ***annotation:***

The course provides representatives of public authorities with the knowledge and understanding of the fact that the bioeconomy and its development is of great importance both in our country and around the world and human existence to ensure the products are used to produce renewable resources. The main condition for a continuous development cycle to ensure continuous development, which is impossible without attracting investments and their realization by the project management-oriented approach.

Training programme ***objective:***

To link the knowledge, skills and competencies acquired in theory with the development of bioeconomy sectors (agriculture and the food industry, municipal waste and sewage, wood) and the type of production (energy production, circular bioeconomy development, production of non-energy high value-added products) to differentiate and manage CBE BM projects related to attracting investment in innovative biotechnologies used in the agricultural, forest and waste sectors.

4.1. Training programme content

The content of the training programme was addressed to national local public authorities. For the elaboration of baselines of the content, similar activities developed in the projects at regional, national, and international level and topics included under a broader umbrella of contents extracted from reports on research and development projects on the bioeconomy and circular economy, drafts of bioeconomy strategies in the BSR countries and industrial cases were reviewed.

The design of a methodology includes different fields of activities, the definition of a field or sphere, an area of interest, innovations involved, facilitators and key aspects. In this specific case, the objective of the training programme was defined under the following fields of activity: the rural field; the biomass and bioproducts area; innovations related to processes; products and services; facilitators as financing and regulation benefits or incentives and right conditions for re-investment; re-manufacturing or recycling and others more related to governance and knowledge.

The criterion for the selection and development of the content for the training courses was the application of a methodology covering as many key aspects as possible. These key aspects as well as the pilot and industrial success cases exposed as examples tried to cover not only the entire value chain for the projects of valorisation of biomass but also other residues for bioproducts.

The design of the trainings programme was based on the priorities mentioned in the WP3.1 report according to the needs of the local BSR regions. From the preliminary analysis, WP 2.3 has already undertaken the BB4V MB and BC narrative. The following modules were shown and described in Table 20.

Table 20

Information Contained in Each Training Programme Module

Module	Module content	Knowledge and information	Benefits and skills
1	Bioeconomy and circular economy (CBE) definitions in different sources. CBE strategies in the EU and other BSR countries. Bioeconomy sector characteristics in the BSR countries.	Participants will be able to demonstrate an in-depth knowledge and the theoretical understanding of circular bioeconomy issues, strategic documents and bioeconomy sectors in different countries.	Participants can reasonably explain and discuss bioeconomy and CBE issues, independently employ theory about bioeconomy and circular economy definitions and strategies, using their analytical skills.
2	CBE support measures – the national authority's management mechanisms. CBE business case (BC) studies in the Baltic Sea region (good practice examples).	Participants demonstrate a conceptual knowledge and understanding of the analysis of support measures in production and supply chain processes in CBE business.	Independently apply the theoretical aspects of support measures and management mechanisms to make decisions on the innovative development of bioeconomy sector companies.
3	Business model (BM) value chain support measures. The BalticBiomass4Value project's BM macro-level support measures and activities. The BalticBiomass4Value project's business models micro-level support measures.	Demonstrate the knowledge and complex understanding of different business model value chain support measures.	Find, critically assess, and creatively use information for assignments and solving problems in different business models and support measures.
4	Practical exercise (research on bioeconomy sector support measures).	Demonstrate an in-depth knowledge about the bioeconomy sector and its support measures in a municipality.	Cooperate and communicate with others participants, integrate knowledge and skills from various fields into an assessment of the bioeconomy sector solutions in a municipality.

Source: authors' construction.

The proposed content of the four modules is shown in Table 21.

Table 21

Content and Structure of the CBE BM Development Training Programme for Regional/Local Public Authorities

Module	Topics	Duration (academic hours)
1	Bioeconomy and circular economy definitions in different sources	1 acad. hour
	Bioeconomy and circular (CBE) economy strategies in the EU and other BSR countries	
	Bioeconomy sector characteristics in the BSR countries	
2	CBE Support measures – the national authority's management mechanisms	1 acad. hour
	CBE business case (BC) studies in the Baltic See region (best examples)	
	Business Model (BM) value chain support measures	1 acad. hour

3	BB4V project BM macro-level support measures and activities	
	BB4V project business model micro-level support measures	
4	Practical exercise (research on bioeconomy sector support measures)	1 acad. hour

Source: authors' construction.

The information relative to the characterization of the regions included in WP3.1. of the project has served as a model to make visible the needs and priorities of regions with a different level of development. Additionally, teleconferences were organised with the regions to present the structure and content of the training and webinars and get their feedback.

Circular business models (CBM) are in general driven by the objective to reconcile commercial value creation with resource efficiency strategies. In the first step, we must identify the kind, quantity and availability of bio-resources in your region. Regional ambitions: bioeconomy feedstocks. CBM development depends on the larger business ecosystem and a broad range of actors and stakeholders involved. CBM are by nature networked: they require collaboration, communication, and coordination within complex networks of interdependent but independent actors/stakeholders.

Table 22

Municipality Characteristics and Bioeconomy Sector Development

Biobased sectors	Sector land use as % of total region area	Main types of primary production products	Primary production quantity, tonnes	Number of entrepreneurs
Agriculture and food industry				
Forest and wood industry				
Municipal waste and sewage				
Bioenergy industry				

Source: authors' construction.

4.2. Methodology followed for the design and organization of the training

The methodology followed for the design and organization of the training for the local/regional authorities involved could be consistent in following steps:

- Definition of the aim and the tasks;
- Review of the task with the aim of adapting the content of every training and the adaptation of the topics to the interests, priorities and needs of the local regions;
- Development of a first draft concerning the structure of the content;
- Collection and analysis of the information to be included;
- Production of a first draft of the content to be discussed;
- Selection of speakers and design of the tentative agenda;
- Advanced draft of the presentations;
- Final design and organization of the technical session-final agenda;
- Dissemination of the sessions;
- Implementation of the training.

4.3. Training programme materials available at web site: www.balticbiomass4value.eu/

Source: authors' construction

Figure 46. Training Programme Presentation.

5. Online library of good practices and circular bioeconomy business models and a collaboration / experience exchange platform for regional/local public authorities on the project's website

The online library of good practices and circular bioeconomy business models and a collaboration platform is available at: https://balticbiomass4value.eu/.

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ANNEXES

Annex 1. BB4V project country circular bioeconomy policy and strategy profile

Case of Lithuania

Table 47. BB4V Project Lithuanian CB Profile

	Lithuania	**BSR country circular economy and bioeconomy profile**
National institutions involved in the bioeconomy	- Lead Ministry: Ministry of Agriculture of Republic of Lithuania; Ministry of Economy of Republic of Lithuania, Industry of Education and Science - Other Ministries: Not known - Other Institutions: Not known	
National bioeconomy definition	No	
Status of national policies and bioeconomy	In Lithuania, a dedicated Bioeconomy Strategy at national level is under development. Lithuania also participates in the "Bioeconomy in the Baltic Sea Region", a macro-regional bioeconomy initiative being developed by the Baltic sea countries.	
National bioeconomy strategy information	- Goals: Not known - Actions: Not known - Sectors included: Not known - Monitoring framework: Not known - Stakeholders involved: Not known	
Other national bioeconomy-related strategies	Not known	
Regional bioeconomy strategy	Not known	
Other information	Bioeconomy funding programmes: Not known. - Educational programmes on the bioeconomy: No - National register of bio-refineries or bio-based industries: No - National certification schemes for biomass and biobased products: No - Incentives for biobased products: No	
National policies on the circular economy	Not know.	
Other national activities related to the circular economy	*Žiedine Ekonomika* (Circular Economy) is a Lithuanian association promoting a circular economy. This non-profit organisation networks local, national and European public authorities with companies to help develop circular business models in Lithuania.	

Case of Latvia

Table 48. BB4V Project Latvian CB Profile

	Latvia	**BSR country circular economy and bioeconomy profile**
National institutions involved in the bioeconomy	-Lead Ministry: Ministry of Agriculture of the Republic of Latvia - Other Ministries: Ministry of Economics of the Republic of Latvia; Ministry of Education and Science of the Republic of Latvia - Other Institutions: Forest and Wood Products Research and Development Institute (MeKA); Institute of Agriculture Resources and Economics; Institute of Food Safety, Animal Health and Environment "BIOR"; Institute of Horticulture; Latvia University of Life Sciences and Technologies; Latvia Plant Protection Research Centre; Latvia State Forest Research Institute "Silava"; Latvia State Institute of Wood Chemistry.	
National bioeconomy definition	The bioeconomy covers those parts of the economy where renewable bio-resources (plants, animals, microorganisms etc.) are used in the production of food, feed, industrial products and energy in a sustainable and well-considered way (Source: Bioeconomy is defined in the Latvian Bioeconomy Strategy 2030). The definition is based on the EU definition provided by the Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions "Innovating for Sustainable Growth: A Bioeconomy for Europe".	
Status of national policies and bioeconomy	Dedicated Bioeconomy Strategy at national level (Latvian Bioeconomy Strategy 2030)	
National bioeconomy strategy information	- Goals: 1) Advancement and retention of employment in the bioeconomy sectors for 128 thousand people; 2) Increasing the value added of bioeconomy products to at least EUR 3.8 billion in 2030; 3) Increasing the value of bioeconomy production exports to at least EUR 9 billion in 2030 - Actions: Funding for Research and Innovation/Public - Private Partnership; Public procurement (Wood for construction of public buildings, organically certified products, environmentally-friendly packaging or locally produced products); and other (achieving the goals of the Bioeconomy Strategy involves five key integrated and complementary lines of action: 1 - Attractive business environment for the entrepreneurship in bioeconomy; 2 - Result-oriented, efficient and sustainable resource management; 3 - Knowledge and innovation development in the bioeconomy; 4 - Promotion of production in the bioeconomy; 5 - Socially responsible and sustainable development. Nevertheless, it is important to note that the Strategy does not include an action plan) - Sectors included: agriculture; aquaculture; biobased chemicals and materials; biobased electricity; biobased textiles; biofuels; biotechnology; fisheries; food; forestry; organic waste; and wood, wood products and furniture. - Monitoring framework: No - Stakeholders involved: academia; industry; NGOs; and PUBLIC institutions, organizations.	

Other national bioeconomy-related strategies	Bioeconomy Research Strategy (not published); Action Plan for the Circular Economy for 2020-2027; Sustainable Development Strategy of Latvia until 2030.
Regional bioeconomy strategy	Vidzeme Planning Region (Latvian Food **Bioeconomy** Cluster)
Other information	- Bioeconomy funding programmes: Infrastructure investments - Educational programmes on the bioeconomy: a joint master's degree programme – Agri-Food Business Management - National register of bio-refineries or bio-based industries: No - National certification schemes for biomass and biobased products: No - Incentives for biobased products: Differentiation of VAT for food (reduced VAT for fruits and vegetables typical of Latvia). - Smart Specialization Strategy (RIS3). Knowledge-intensive bioeconomy: Smart Specialisation is a strategic approach to economic development through targeted support for research and innovation. It involves a process of developing a vision, identifying the place-based areas of greatest strategic potential, developing multi-stakeholder governance mechanisms, setting strategic priorities and using smart policies to maximise the knowledge-based development potential of a region, regardless of whether it is strong or weak, high-tech or low-tech.
National policies on the circular economy	Action Plan for the Circular Economy for 2020-2027.
Other national activities related to the circular economy	The objectives of the European Green Deal in Latvia will be supported by documents already approved by the government – the Action Plan for the Circular Economy for 2020-2027. Currently, Latvia is developing a circular economy strategy and has implemented isolated initiatives mostly in the sector of waste management. Circular economy initiatives: the Green Technology Incubator, the most relevant organisations: Green Liberty (Zaļā brīvība).

Case of Estonia

Table 49. BB4V Project Estonian CB Profile

	Estonia	**BSR country circular economy and bioeconomy profile**
National institutions involved in the bioeconomy	-Lead Ministry: Ministry of Rural Affairs: Ministry of Economy Affairs and Communications; Ministry of Environment - Other Ministries: Ministry of Education and Research - Other Institutions: Estonia Research Council	
National bioeconomy definition	The bioeconomy covers almost all industrial and economic sectors. Mostly, however, it is based on agriculture, fisheries and forestry, as well as related industries, which produce, manage, or otherwise exploit biological resources (for example, food, feed, fibre, paper, power, chemical, biotechnology). The Ministry of Economic Affairs and Communications considers also bioenergy as part of the bioeconomy. The most commonly used definitions are: the bioeconomy means the production of sustainable biomass and conversion of biomass into food, feed, energy and other bioproducts; the bioeconomy means adding value to the sustainable utilization of biomass in interrelated economic activities.	
Status of national policies and bioeconomy	In Estonia, a dedicated Bioeconomy policy paper at national level is under development. Other national bioeconomy-related strategies also exist. Estonia also participates in the macro-regional bioeconomy initiatives: BIOEAST and the “Bioeconomy in the Baltic Sea Region”.	
National bioeconomy strategy information	- Goals: Not known - Actions: Not known - Sectors included: Not known - Monitoring framework: Not known - Stakeholders involved: Not known	
Other national bioeconomy-related strategies	Climate Change Adaption Development Plan until 2030; Estonian Forestry Development Plan 2011-2020; National Development Plan of the Energy Sector Until 2030; Research and Development Strategy until 2025 Knowledge-based bioeconomy; National Waste Management Plan 2014-2020.	
Regional bioeconomy strategy	Not known	
Other information	- Bioeconomy funding programmes: Not known - Educational programmes on the bioeconomy: Biogas plant operator; Biosystems Engineering; other lectures related to bioeconomy, but not as an educational programme - National register of bio-refineries or bio-based industries: No - National certification schemes for biomass and biobased products: No - Incentives for biobased products: Estonian Biogas Association; Polli Horticultural Research Centre; Bio-Competence Centre of Healthy Dairy Products LLC (BioCC).	
National policies on the circular economy	Not know.	

Other national activities related to the circular economy	Estonia has committed to developing a circular economy strategic document and an action plan by the end of 2021. The documents will be prepared by the Ministry of the Environment. The Estonian Ministry of Environment is preparing a roadmap. The roadmap builds on current circular economy principles in the national strategy on sustainable development 'Sustainable Estonia 21', the Estonian Environment Strategy 2030 and the national reform programme "Estonia 2030". Circular economy initiatives: Institute of Circular Economy, Tallinn Technology University, courses, Stockholm Environment Institute Tallinn Centre project "Towards a Nordic-Baltic circular textile system", CircPro.

Case of Germany

Table 50. BB4V Project German CB Profile

	Germany	**BSR country circular economy and bioeconomy profile**
National institutions involved in the bioeconomy	- Lead Ministry: Federal Ministry of Education and Research; Federal Ministry of Food and Agriculture. - Other Ministries: Federal Ministry for Economic Affairs and Energy; Federal Ministry for Economic Cooperation and Development; Federal Ministry for Environment, Nature Conservation, Building and Nuclear Safety. - Other Institutions: Federal Office of Agriculture and Food; German Bioeconomy Council; National Contact Point Bioeconomy, Project Management Juelich, Fachagentur Nachwachsende Rohstoffe (FNR).	
National bioeconomy definition	The bioeconomy is the knowledge-based production and utilization of renewable resources in order to provide products, processes and services in all economic sectors, within the framework of an economic system that is viable for the future (National Research Strategy Bioeconomy 2030; National Policy Strategy an Bioeconomy; German Bioeconomy Council).	
Status of national policies and bioeconomy	National Research Strategy Bioeconomy 2030.	
National bioeconomy strategy information	The Federal Government's strategy on the bioeconomy addresses a broad spectrum of objectives at different levels of society and across all economic sectors. It can be summarised in six common strategic goals: • Develop bioeconomy solutions for the sustainability agenda, • Recognise and harness the potential of the bioeconomy within ecological boundaries, • Enhance and apply biological knowledge, • Provide a sustainable raw material base for industry, • Promote Germany as the leading location for innovation in the bioeconomy, • Involve society in the bioeconomy and intensify national and international collaboration. - Actions: Funding for Research and Innovation/Public - Private Partnership; Public procurement; and Labelling - Sectors included: agriculture; aquaculture; biobased chemicals and materials; biobased textiles; biofuels; biotechnology; fisheries; food; forestry; organic waste; pulp paper; and wood, wood products and furniture - Monitoring framework. Indicators for the monitoring: actions named in the strategies, success of RED projects - Stakeholders involved: academia; consultants; industry; NGO; and public institutions, organization Monitoring programme. The Thünen Institut is still in charge to develop the basics for a Germany-wide monitoring system of current and future biomass flows and their evaluation. A comprehensive monitoring approach to measure the contribution of bioeconomy to the overall economy is currently under development through the project Systemic Monitoring and Modelling of the Bioeconomy (SYMOBIO 10) where one of the goals is the	

	identification of economic key performance indicators to monitor the bioeconomy. The Systemic Monitoring and Modelling of the Bioeconomy (SYMOBIO) project is coordinated by the Centre for Environmental Systems Research (CESR) of Kassel University and runs from March 2017 to February 2020. The main goal of the project is to develop the scientific fundamental for a systemic monitoring and modelling of bioeconomy in Germany.
Other national bioeconomy-related strategies	Climate Action Plan 2050 – the principles and goals of the German government's climate policy; German Resource Efficiency Programme II – a programme for the sustainable use and conservation of natural resources; German Strategy for Sustainable Development; High-Tech Strategy; and National Strategy an Biological Diversity.
Regional bioeconomy strategy	Bavarian Bioeconomy Strategy (https://www.bestellen.bayern.de)
Other information	- Bioeconomy funding programmes: biobased industrial sector; bioeconomy research and innovation; and infrastructure investments - Educational programmes on the bioeconomy: not known - National register of bio-refineries or bio-based industries: No - National certification schemes for biomass and biobased products: Din-Geprüft (Biobased product); REDcert DE (Biofuel); ISCC DE (Biomass and Bioenergy) - Incentives for biobased products: No
National policies on the circular economy	German Resource Efficient Programme II: a programme for the sustainable use and conservation of natural resources. The German Federal government is developing a roadmap on change to a circular economy.
Other national activities related to the circular economy	Many, including TextilBündnis, Recyclable Materials Act reforms. Most relevant organisations: Umweltbundesamt, UnternehmensGrün (Ecopreneur member), Kompetenzzentrum Nachhaltiger Konsum, BUND, DUH, NABU, EPEA, Cradle-to-Cradle e.V., CSCP, Wuppertal Institute, Bundesverband der deutschen Entsorgungs-, Wasser- und Rohstofwirtschaft e.V. - besides many others.

Case of Poland

Table 51. BB4V Project Polish CB Profile

	Poland	**BSR country circular economy and bioeconomy profile**
National institutions involved in the bioeconomy	-Lead Ministry: Ministry of Agriculture and Rural Development; Ministry of Entrepreneurship and Technology; Ministry of Investment and Economic Development; Ministry of Science and Higher Education - Other Ministries: Ministry of Energy, Ministry of Environment; Ministry of Maritime and Inland Waterway Transport - Other Institutions: AgroBioCluster; Green Chemistry Cluster "West-Pomeranian Bioeconomy Cluster"; Institute of Soil Science and Plant Cultivation – State Research Institute; Klaster Life Science Krakóv; Polish Bioeconomy Technological Platform	
National bioeconomy definition	No	
Status of national policies and bioeconomy	Poland participates in BIOEAST, a macro-regional bioeconomy initiative being developed by Central and Eastern European countries.	
National bioeconomy strategy information	- Goals: Not known - Actions: Not known - Sectors included: Not known - Monitoring framework: Not known - Stakeholders involved: Not known	
Other national bioeconomy-related strategies	BIOSTRATEG Strategic and Research programme "Environment, Agriculture and Forestry"; Map towards a Circular Economy (not approved yet); National Smart Specializations.	
Regional bioeconomy strategy	Regional Innovation Strategy of Lubelskie Voivodeship 2020 (Bioeconomy as one of the RIS); Regional smart specializations of Łodzkie (Elements of the Bioeconomy in RIS); Regional smart specializations of Warmińsko-Mazurskie (Elements of the Bioeconomy in RIS); Regional smart specializations of Wielkopolskie (Elements of the Bioeconomy in RIS); Regional smart specializations of Zachodnio-pomorskie (Bioeconomy as one of the RIS).	
Other information	- Bioeconomy funding programmes: Bioeconomy Research and Innovation - Educational programmes on the bioeconomy: Bioeconomy at the Biotechnology and Food Sciences Faculty at Lodz University of Technology; Bioeconomy – specialization implemented in cooperation of three high schools: Warsaw University of Technology, Lodz University of Technology, and Military Technical Academy in Warsaw; Modern bioeconomy – specialization at the University of Life Science in Lublin. - National register of bio-refineries or bio-based industries: Not known - National certification schemes for biomass and biobased products: Not known - Incentives for biobased products: No	
National policies on the circular economy	Poland's Roadmap towards the Transition to the Circular Economy. Adopted in 2019. Two objectives: • to identify cross-cutting measures capable of having the broadest possible impact in Poland, both socially and economically,	

	• to prioritise areas that will enable Poland to take advantage of its current opportunities, and to deal with existing or future challenges. The Roadmap focusses on 5 areas in particular: • Sustainable industrial production, • Sustainable consumption, • Bioeconomy, • New business models • Implementation and monitoring of and financing for the circular economy. The Roadmap includes a set of tools, which are not purely legislative, to create the conditions for a new economic model in Poland.
Other national activities related to the circular economy	E-KUMULATOR, Interdepartmental Circular Economy Group's most relevant organisations: IGOZ Institute, Waste Management and Recycling Cluster, Mineral and Energy Economy Research Institute of the Polish Academy of Sciences.

Case of Sweden

Table 52. BB4V Project Swedish CB Profile

	Sweden	**BSR country circular economy and bioeconomy profile**
National institutions involved in the bioeconomy	- Lead Ministry: Ministry of Enterprise; Ministry of Environment and Energy; Ministry of Finance - Other Ministries: No - Other Institutions: Environmental Protection Agency; Swedish Energy Agency	
National bioeconomy definition	Sustainable production of biomass to enable increased use in a number of social sectors. The aim is to reduce climate impact and the use of fossil raw materials. Increased value added of biomass while minimizing energy consumption and nutrition and energy is taken from the end products. Optimizing the value and contribution of ecosystem services to the economy.	
Status of national policies and bioeconomy	Not now. Sweden participates in the 'Nordic Bioeconomy', a macro-regional bioeconomy initiative being developed by Nordic countries. A national Forest Programme also exists.	
National bioeconomy strategy information	- Goals: Not known - Actions: Not known - Sectors included: Not known - Monitoring framework: Not known - Stakeholders involved: Not known	
Other national bioeconomy-related strategies	Swedish Research and Innovation Strategy for a Bio-based Economy	
Regional bioeconomy strategy	Sweden's regional communication platform for bioeconomic development	
Other information	- Bioeconomy funding programmes: Biobased industrial sector - Educational programmes on the bioeconomy: Not known - National register of bio-refineries or biobased industries: Not known - National certification schemes for biomass and biobased products: Not known - Incentives for biobased products: Reduction quota obligation for petrol and diesel.	
National policies on the circular economy	Circular economy – a Strategy for the transition in Sweden. Focus areas: • A circular economy through sustainable production and product design. • A circular economy through sustainable ways of consuming and using materials, products and services. • A circular economy through toxin-free and circular ecocycles. • A circular economy as a driving force for the business sector and other actors through measures to promote innovation and circular business models.	
Other national activities related to the circular economy	Circular economy initiatives: Resource Effectiveness and the Circular Economy Project; most relevant organisations: IVA, Swedish Sustainable Economy Foundation, Swedish Energy Agency, Vinnova, Formas,	

	Cradlenet, CirEko. The Government has adopted a national strategy for a circular economy that sets out the direction and ambition for a long-term and sustainable transition of Swedish society. This is an important step towards Sweden becoming the world's first fossil-free welfare nation.

Case of Norway

Table 53. BB4V Project Norwegian CB Profile

	Norway	**BSR country circular economy and bioeconomy profile**
National institutions involved in the bioeconomy	-Lead Ministry: Ministry of Agriculture and Food; Ministry of Education and Research; Ministry of Trade, Industry and Fisheries - Other Ministry: Ministry of Climate and Environment; Ministry of Foreign Affairs; Ministry of Petroleum and Energy; Ministry of Transport and Communications - Other Institutions: Not known	
National bioeconomy definition	The Government's bioeconomy policy targets sustainable, effective and profitable production, extraction and use of renewable, biological resources into food, feed, ingredients, health products, energy, materials, chemicals, paper, textiles and numerous other products. The use of enabling technologies like biotechnology, nanotechnology and ICT are in addition to conventional disciplines like chemistry essential for the development of a modern bioeconomy.	
Status of national policies and bioeconomy	The Government's Bioeconomy Strategy 2016	
National bioeconomy strategy information	Goals: • the national effort should underlie all sectors in accordance with four priority areas (cooperation across sectors, industries and thematic areas), • markets for renewable biobased products, • efficient use and profitable processing of renewable, biological resources, • sustainable production and extraction of renewable biological resources. - Actions: funding for research and innovation/public - private partnership; public procurement - Sectors included: agriculture; aquaculture; biobased chemicals and materials; biobased electricity; biobased textiles; biofuels; biotechnology; fisheries; food; forestry; organic waste; pulp, paper; and wood, wood products and furniture - Monitoring framework: No - Stakeholders involved: Academia; consultants; industry; NGO; public institutions, organizations.	
Other national bioeconomy-related strategies	National Strategy for Biotechnology. National Strategy for Forestry and Wood Industries.	
Regional bioeconomy strategy	Not known	
Other information	Not known	
National policies on the circular economy	Not known. New strategies for a circular economy in Norway under development.	

Other national activities related to the circular economy	Strategy for sustainable and circular consumption in Oslo.

Russia relies primarily on its natural resources for its bioeconomy activities: forests, arable land and access to water. Biotechnology will serve as a tool for further development. In 2011, for example, former Russian President Dimitri Medvedev adopted a national bioeconomy strategy developed by the National Technology Platform Biotech 2030. The Ministry of Agriculture, the Ministry of Economic Affairs, the Ministry of Trade and the Ministry of Research are involved in this platform. A number of research facilities are also available. Within the platform, there are six subdivisions: industrial biotechnology, forestry, ecology, agriculture, fisheries and "food for life". As part of the technology platform, cooperation between the state, the free economy, and science and research institutions is regulated and 160 public and private organisations are involved. More than half of its members come from the economic sector. In 2012, the BIO 2020 Programme (Comprehensive Programme for the Development of Biotechnology in Russia by 2020) was signed and the government adopted a roadmap for biotechnology for the period up to the year 2020. These also include a number of projects relevant to the bioeconomy.

Source: http://biotech2030.ru/recent-biotechnology-developments-and-trends-in-the-russian-federation/

Annex 2. Sustainable circular bioeconomy EU and country level Support Measures for agriculture, forestry, waste management and bioenergy sectors

Support measure implementation management group	Name/Title of a policy support measure	Description (coverage)	Responsible institution	Budget source
Agriculture and food industry				
Fiscal:	The Future CAP (2021-2027) CAP Pillar I: Direct Payments and CAP Pillar II –Rural Development	Mandatory support for research and innovation in food, agriculture, rural development and the bioeconomy. LIFE programme for Env and Climate to promote energy-efficiency and clean energy.	European Commission	Measures funded by the EAFRD and the EAGF: financial support to fund bioeconomy activities. EUR 10 billion (Horizon Europe)
	Paris Agreement	Financial supports		
	Nitrates Directive			
Regulatory:	The Future CAP (2021-2027) CAP Pillar I: Direct Payments and CAP Pillar II –Rural Development	Cross Compliance, Standards of good agricultural and environmental condition (GAECs).	European Commission	Measures funded by the EAFRD and the EAGF: financial support to fund bioeconomy activities. EUR 10 billion (Horizon Europe)
	European Standards CEN/TC 383 Sustainably produced biomass for energy applications	Standards based on sustainability principles, criteria and indicators for biomass energy applications		

	Paris Agreement	Requirements for regular reporting on emissions and implementation efforts		
	Nitrates Directive	National monitoring and reporting. Compulsory establishment of action programmes to be implemented by MSs in designated Nitrate Vulnerable Zones (NVZs)		
Societal:	Nitrates Directive	Voluntary codes of good agricultural practice		
	The Future CAP (2021-2027) CAP Pillar I: Direct Payments and CAP Pillar II –Rural Development	Voluntary mechanisms for rural development activities	European Commission	Measures funded by the EAFRD and the EAGF: financial support to fund bioeconomy activities. EUR 10 billion (Horizon Europe)
Sustainability:	Paris Agreement	Framework for a 1.5 degrees Celsius limit on temperature rise for countries to develop Nationally Determined Contributions (NDCs); Capacity building and technological building framework.		
	The Future CAP (2021-2027) CAP Pillar I: Direct Payments and CAP Pillar II –Rural Development	To support and encourage producers to ensure viable food production, sustainable management of natural resources, climate action and territorial development. Specific objective: to promote employment, growth, social inclusion and local development in rural areas, including bio-economy and sustainable forestry.	European Commission	Measures funded by the EAFRD and the EAGF: financial support to fund bioeconomy activities. EUR 10 billion (Horizon Europe)

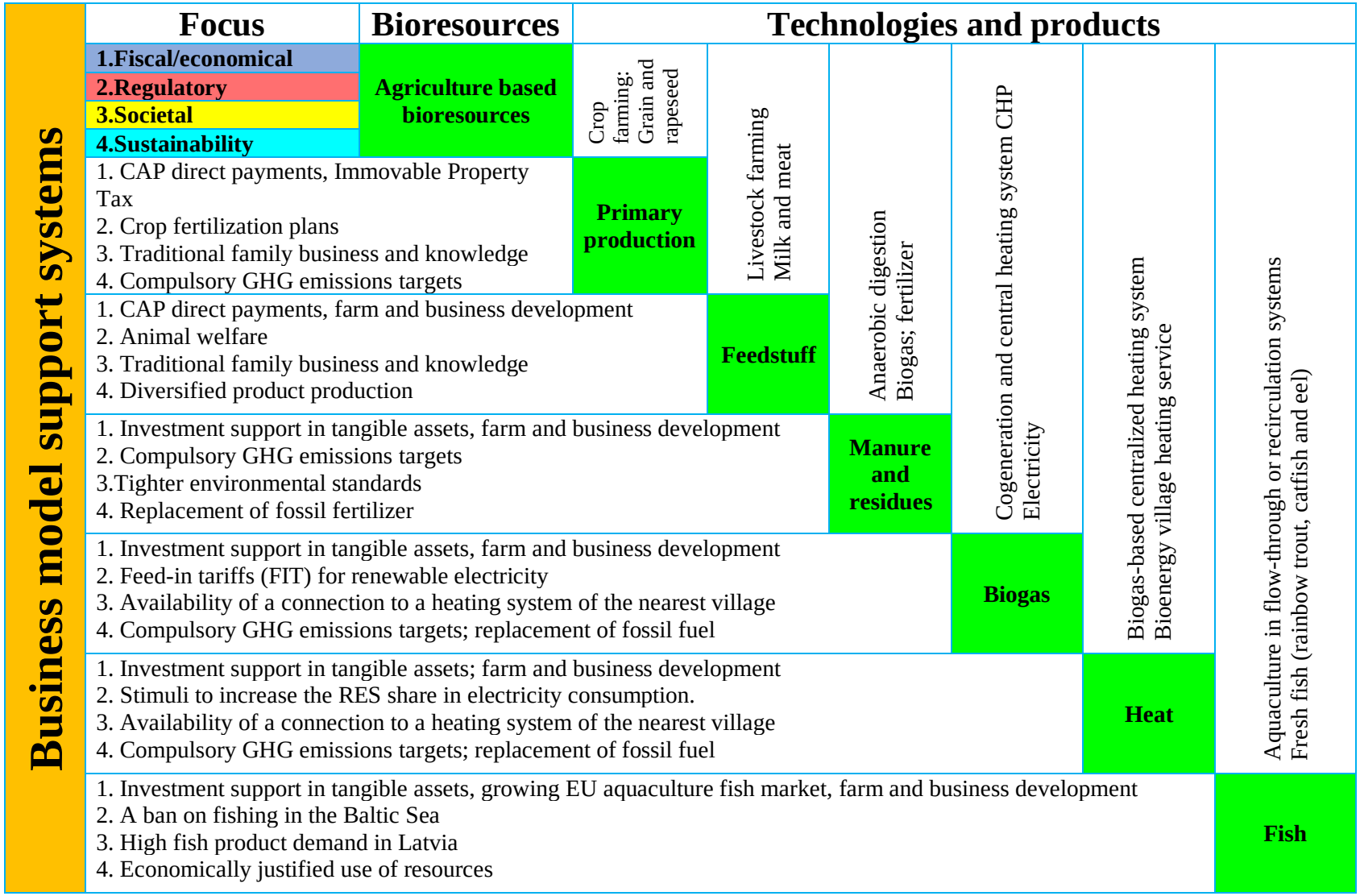
Forest and wood industry				
Fiscal:	LULUCF Regulation (EU) 2018/841 (Land use and forestry regulation) 2021-2030	Accounting rules and governance for forest management, as it is the main source of biomass.		
	EU Forest Strategy 2014-2020	LIFE+ supports nature conservation, climate change adaptation, information and protection need. REDD+		
	Paris Agreement	Financial supports		
Regulatory:	LULUCF Regulation (EU) 2018/841 (Land use and forestry regulation) 2021-2030	Binding targets for inclusion of GHG emissions and removals of CO2 in all sectors by MSs.		
	EU Forest Strategy 2014-2020	Forest Management Plans (FMPs) are instruments to deliver multiple good and services under the principle of SFM.		
	Paris Agreement	Requirements for regular reporting on emissions and implementation efforts		
	Nitrates Directive	National monitoring and reporting. Compulsory establishment of action programmes to be implemented by MSs in designated Nitrate Vulnerable Zones (NVZs)		
Sustainability:	EU Forest Strategy 2014-2020	Strategy (Communication). European Forests 2020 - a common strategy of 47 signatories. It is non-legally binding forest targets; supports MRV of the forest ecosystem services as information for policy making		
	Paris Agreement	Framework for a 1.5 degrees Celsius limit on temperature rise for countries to develop Nationally Determined Contributions (NDCs); Capacity building and technological building framework.		

Municipal waste and sewage				
Fiscal:	Waste Framework Directive (2008/98/EC) updated COM 2015/0595	MSs should introduce financial incentives to apply waste hierarchy. Raw Materials Initiatives to recycle valuable materials and channel back into the economy by brokers, dealers, collectors, transporters for noncompliance.		
	Landfill Directive (1999/31/EC) updated COM/2015/0594	Economic instrument to discourage landfilling		
	Paris Agreement	Financial supports		
Regulatory:	Waste Framework Directive (2008/98/EC) updated COM 2015/0595	Compliance - obligation to set up separate collection. Reinforces targets for diversion of biodegradable waste from landfills as set in the Landfill Directive. Penalties for people responsible for waste management if they did not meet the targets -waste producers, holders, enforcement of standards.		
	Landfill Directive (1999/31/EC) updated COM/2015/0594	Legislative -sets targets for reduction of waste. Ban on separately collected waste to be landfilled.		
	Paris Agreement	Requirements for regular reporting on emissions and implementation efforts		
Sustainability:	Circular Economy Package -COM Closing the loop -An EU Action plan for the Circular Economy	Communication.		
	Waste Framework Directive (2008/98/EC) updated COM 2015/0595	Waste prevention programmes. Reporting by MSs should be uniform and reporting of targets should be based on the input to the final recycling process. Recycling rates can		

		be reported based on output of recycling centres.		
	Landfill Directive (1999/31/EC) updated COM/2015/0594	Harmonised calculation methods for improved calculation of recycling rates		
	Paris Agreement	Framework for a 1.5 degrees Celsius limit on temperature rise for countries to develop Nationally Determined Contributions (NDCs); Capacity building and technological building framework.		
Bioenergy industry				
Fiscal:	Kyoto Protocol	Market mechanism - tradable emission permits, clean development mechanisms (CDM) and Joint Implementation (Emission reduction units ERUs)		
	Paris Agreement	Financial supports		
	Energy Efficiency Directive EU 2018/2002 amending EU (Dir. 2012/27/EU)	Incentives for producers and manufacturers to use low carbon and innovative technologies. Investment support.		
Regulatory:	Kyoto Protocol	Targets and commitments for GHG reduction		
	Paris Agreement	Requirements for regular reporting on emissions and implementation efforts		
	Energy Efficiency Directive EU 2018/2002 amending EU (Dir. 2012/27/EU)	Target for energy efficiency. Energy Labelling. Rules on metering, transparent allocation of cost of heating. Monitoring energy efficiency.		
Societal:	Energy Efficiency Directive EU 2018/2002 amending EU (Dir. 2012/27/EU)	Guidance notes for member states to transpose the Directive into national law.		
Sustainability:	Kyoto Protocol	Land management practices for carbon sequestration in agricultural soils.		

	Paris Agreement	Framework for a 1.5 degrees Celsius limit on temperature rise for countries to develop Nationally Determined Contributions (NDCs); Capacity building and technological building framework.		

Annex 3. Value chain support measures for sustainable circular bioeconomy business models



Annex 4. Narratives of the business cases

The narratives below are presented using the same format as in project RUBIZMO (2020)[1] database. The case description covers the background, main activities, market, and main challenges of the enterprise, funding, innovativeness. The information collected and used in the analysis have been shorted here for clarity. As in case of some archetypes, the enterprises were not willing to have their information publicised, thus some not all archetypes are illustrated with a business case.

Heat and Fuel from Woody Biomass

Case: Ecopellet - environmentally friendly biofuels and pet products from sustainable raw materials

Name of the company: Ecopellet
Country: Estonia
Size of the business: 3 employees
Website: http://www.ecopellet.ee/en/, www.greenfull.eu

Background

The idea for the production of wood pellets came up 10 years ago, when local business partners investigated whether and where wood pellets are produced and sold, and whether there is interest in wood pellets in the local market. As it turned out that there was interest, financial and reliability study was performed together with cost-benefit analysis for production. The calculations gave a positive result, and half a year later, from the birth of the production idea, at the end of 2010, a small wood pellet production company Ecopellet was established in Western Estonia. However, not everything went as originally planned and the first profit was made in the fifth year of operation. Two business partners were involved in setting up the company. Later, a third business partner was added.

Main activities

The company's main and only activity is wood pellet production. Different types of wood pellets are produced: heating pellets, pet pellets and pellets for barbecue. Both coniferous and hardwood sawdust, planer chips, wood processing residues and chips made from debarked fine logs are used for the production of heating pellets. The main raw material for barbecue pellets is gray alder. Separately, bio granules are produced for cat litter, which consists of softwood sawdust and hay biomass. Compared to the early years of the company, the range of products has changed. In some years, straw pellets and hay pellets were also produced. As the market for straw and hay pellets gradually disappeared, the production of these pellets became uncompetitive and production ceased. The production of pet pellets and barbecue pellets replaced them. Heating pellets have remained the main product for many years. In the sector, the other pellet producers usually specialise on heating pellets, and 99% of their production is heating pellets. At Ecopellet, the share of heating pellets in production has decreased over the years. As of 2020, the share of heating pellets in production in different seasons is 35-45%. Despite its small size, Ecopellet has become the largest exporter of pet pellets in Estonia and the only producer of barbecue pellets in the Baltic region.

The size of the company has also changed over time. With the introduction of modern technology, i.e. the automation of production, the number of employees in production has decreased compared to the earlier years. Ecopellet is the only small pellet producer in Estonia that has a full production cycle (raw material preparation and crushing, drying line, production line, packaging line). The company has received the necessary permits for its operations.

[1] https://rubizmo.eu/

Market

The main customers of heating and pet pellets are wholesalers and retailers in Estonia and Finland. The largest customers in Estonia are a local retail chain and specialized pet stores. The sales partners of barbecue pellets in Estonia are a large specialised retailer for barbecue supplies and other sellers of barbecue pellets. The company's products can also be found in the retail chains of neighbouring countries distributed through wholesalers.

Over the years, various marketing channels have been used to reach new customers: teleshopping, web marketing, participation in exhibitions, fairs, etc. There are two internet channels. The company has an internationally registered trademark Greenfull, which has a separate website, and the other is the website of Ecopellet, which is more aimed at the Estonian local market.

Using sales representatives in specific countries have proven to be the most effective marketing channel. In retail chains, the nomenclature of products is decided by the heads of particular product group, and once they have chosen their favourites, it can be quite difficult, if not impossible, to make changes in the selection of products. Thus, the relationships determine a lot in retail market access and further expansion plans.

Challenges and solutions

One of the biggest challenges in the near future is to increase the market share of grilling pellets in Europe. The use of grilling pellets is very common in the USA, but the barbecue pellets are a relatively new phenomenon in Europe, and 90% of barbecue pellets sold in Europe today come from North America. It is estimated that the annual need for barbecue pellets in Europe is about 8-9 thousand tons. Ecopellet, as a niche manufacturer, would be able to cover about 10% of this need. To meet this challenge, Ecopellet has begun looking for a strategic partner to increase the market share of its products in Europe. Gaining trust in the market without a suitable partner is a very long and complicated process. The company is well positioned to increase the market share of barbeque pellets in Europe. The company improves the quality of products, develops the competence and experience of its employees in the production of barbecue pellets. In Estonia, there is sufficient amount of biomass for production of barbeque pellets and expansion of the market.

Funding

When establishing the company, public sector support was used, more precisely, the start-up capital was received from Enterprise Estonia that is a national foundation for enterprise support. That start-up capital was vital for establishing the production until income was earned for starting to cover the running costs. The required start-up capital was calculated during the preparation of the business plan and included all costs, including investments. The start-up capital was supplemented by owners own capital investments and external loans and leases from different lenders. The minimum investment for starting a small-scale production of wood pellets is about 0.5 million euros. The objects of investment are primarily production technology, equipment and buildings.

What makes this case innovative?

Ecopellet is one of the few companies in Estonia that makes pellets from different types of wood and biomass. The wood species preferred by large producers are mainly spruce and pine, but Ecopellet also produces hardwood and hay pellets. The production of hardwood pellets requires more skills and technology adaptation than the production of softwood pellets.

In addition, bio granules are produced for litter cats and other small animals. Bio granules are a good substitute for cat litter made of clay, because the used bio granules can be composted in the garden. All Ecopellet granules are made without additives and are a pure natural product.

Case: Quercus Sp - production of solid biofuels for energy

Name of the company: Quercus Sp. z o.o.
Country: Poland

Size of the business: 86 employees
Website: https://quercus.org.pl/

Background

The Quercus company was founded in 1992 in Jedwabno, within the area of the Regional Directorate of State Forests in Olsztyn. At the beginning of its activity, it dealt with the production of wood chips for chipboard and fibreboard production. In 2005, on the initiative of the President of the Management Board the enterprise was transformed into a limited liability company, eventually adopting the name Quercus Sp. z o.o. (ltd.). The driving force to start and develop the company's activity was the growing need to direct the domestic energy sector (heat and co-generation CHP plants) towards an increase in the share of renewable energy sources in the fuel structure. In addition, logging residues, which were burned at the place of harvest at that time, have gained the possibility of more effective use.

Main activities

The main source of revenue for Quercus Sp. z o.o. (ltd.) is the sale of solid woody biomass for energy purposes. In addition, the company provides chippers maintenance and repair services, varnishing services in own paint shop and transport services (including logistics of rail deliveries with the use of its own reloading terminal). This makes the company the largest producer of biomass in Poland with a well-functioning logistics network.

Compared to the early years, the company's main product (wood chips) the same but is currently produced using the most modern machinery and equipment, making the production process itself more efficient. The main changes include the construction of transhipment terminals with their own railway sidings (two locations: Pasym and Spychowo), the creation of a paint shop and a technical department enabling the service of machine park and the introduction of bulk load transport service. All the above mentioned products and services have been introduced successively, along with the company's growth, to meet its own needs (e.g. machinery service) and to diversify operations to reduce risk.

Market

The clients of Quercus Sp. z o.o. are mainly large heating and co-generation plants, small local heating plants as well as pulp and chipboard industry companies. Due to the B2B relationship model, the acquisition of new customers is primarily based on participating in tenders for the supply of chips or other services. This in turn means that with the current model, the number of potential customers is limited and there not so many feasible measures to increase customer availability. The present B2B relationship limits the need to use marketing channels, but the main forms of marketing are enterprise website, leaflets, participation in industry conferences and fairs and a good market opinion (word of mouth marketing).

Challenges and solutions

The company plans to develop further the main area of its business activity, while developing ancillary activities that diversify the portfolio of revenue sources. However, currently, due to the lack of market stability, it is difficult to identify specific actions and investments.

The main limitation is the large share of biomass imported from outside Poland and the emergence of local competitors using an aggressive pricing policy. The main problems for business development have also been the instability of the renewable energy support system and policy in this area as it has caused fluctuations in demand for biomass for energy purposes.

Funding

The main sources of financing the company's operations are bank loans, leases, EU funds and retained (reinvested) profit. Profit was achieved within 2–3 years of commencing business operations. At present, the initial investment to start such a project would be over PLN 4 million, due to very large entry barriers.

What makes this case innovative?

Quercus Sp. Z o.o. has the goal of the constant development of the core business, which is the production of solid biomass of wood origin for energy purposes and to increase the diversification of operations in order to minimize the risk of negative impact of the potential reduction of the share of renewable energy sources in the national energy sector.

District Heating and Electricity from Various Biomass Sources

Case: UAB Kurana - production of bioethanol, electricity and heat from renewable resources into one closed technological loop

Name of the company: UAB Kurana
Country: Lithuania
Size of the business: 85 employees
Website: http://www.kurana.lt/en/

Background

The company started developing its bioethanol and biogas project in 2008. There were two main reasons for the investment. Firstly, in 2008 the energy was very expensive. Secondly, the construction of biogas power plants was encouraged by a feed-in tariff premium (formerly feed-in tariffs). Thus, the state support policy and market changes facilitated the investments into the biomass use in BSR.

Main activities

The enterprise produces bioethanol and biogas from grain. Biogas is converted to electricity and heat. Approximately 90% revenues come from bioethanol production and selling. Approximately 10% revenues come from energy and heating production and sales. The following changes have taken place in the production over the decade:

- Most bioethanol is produced from first-generation (grain) raw materials. However, the amount of second-generation bioethanol from starchy waste is increasing.
- The biomass after the biogas production process is concentrated and the treated water is fed back into production.
- The product mix was supplemented by disinfectant and industrial ethanol production.
- Production capacity is actually 40% higher than the designed capacity.

The main unique selling point is logistics as the enterprise's physical location is close to the main customer, thus the logistic costs for transmission are lower.

Market

The main customers are a major national refinery (bioethanol), electric and gas utility company (electricity) and major boiler and heating network managing company (heating). When the biogas and bioethanol investment project started, at first no marketing, no publicity was carried out. Only around 2–3 years ago the enterprise started to disseminate information on their technological loop, bioenergy production and environmental impacts.

Challenges and solutions

The enterprise plans to grow in the future, incl. investing into the plant with double production capacity of the current one; to focus on the biomass for the second-generation production and on supplying biomethane through a pipe. The main limit for expansion is the EU and national policy on bioenergy production.

Funding

The funding for the bioethanol and biogas investment had following financial model: 35% equity, 5% subsidies and 60% external capital. The initial investment to start such a project (the amount of total investment) was 30 million EUR. It took about 6–8 years before the company started making a profit.

What makes this case innovative?

UAB "Kurana is the first company inside EU which connected manufacturing of bioethanol (base of biofuels), electricity and thermal energy from renewable energy sources (biogas produced by mesocphilic process) into one closed technological loop. This technological loop produces zero waste plus valuable organic fertilizers that are becoming more and more popular in contemporary farming. When building this factory, they used the newest technologies and facilities bought from EU (Germany, Denmark, Sweden and GB) and US.

Case: 3B Bioenergie- energy production and special processing of digestate

Name of the company: 3B Bioenergie
Country: Germany
Size of the business: 9 employees

Background

The enterprise was originally engaged in dairy farming. In 1998, a small biogas plant was developed to complement agricultural activities. The aim was to process the farm's own slurry in a biogas plant and to produce digestate from manure to improve the nutrient supply of grasslands. They started with a small biogas plant as a dairy farmer, today they are primarily a biogas owner with a few cows.

Main activities

The main activities are energy production (energy and heat) and fertilizer production. The side activity is agriculture. The output from the main activity are heat, electricity, ASL (Amonia-sulphate-solution) and digestate (dried, solid, raw and liquid).

Market

The company is a big energy supplier for regional stakeholders (spa clinic, indoor tennis centre, public building, and indoor swimming pool). Farmers are the customers for the digestate. The main channels for reaching the clients are through direct communication or via the internet.

Challenges and solutions

The enterprise is interested in new fields like insects, algae and mushroom production. The challenge is in utilizing the insects or hydrogen for biological methanisation with feed. There is a potential in the expansion of organic fertilizer processing from fermentation residues and expansion of utilization of farm manure with the help of algae or fish. The limits are set by required nutrients that have to be transported and the availability of substrates in the region and their costs. The biggest challenges are connected with the laws and the legal frameworks, the requirements for the safe handling with nutrients are increasing and thus its costs are increasing, while the income from the activities has stayed the same. The ending of Germany's energy transformation policy *Energiewende* after 20 years is a big problem for the company. Partners are still being sought for the planned expansion.

Funding

The biogas plant, established in 1998, was developed and expanded with *Energiewende* funding and by banks. By selling electricity and heat for a fix price, the company was able to invest in new processes. Without these subsidies no further invest would be possible.

What makes this case innovative?

The 3B Bioenergie plant produces 1.7 mWh electric energy plus heat for local distance heating public houses (library, public bathhouse, etc.). The processing of the produced digestate is also of particular interest due to technological solution. The digestate gets separated by screw presses and dried. The liquid phase after the screw presses runs through a stripping and scrubbing process producing ammonium sulfate solution. The remaining phosphorus after this process is tried to get recovered by producing CAP and MAP (Struvite) precipitation.

Innovation in Novel Fuels and Bio-chemicals

Case: SunPine- an entrepreneurial bio-refinery

Name of the company: SunPine
Country: Sweden
Size of the business: 70 employees
Website: https://www.sunpine.se/en/

Background

The company was founded by innovator and serial entrepreneur Lars Stigsson, who had MSc degree in Chemical Engineering. The entrepreneur had an idea to use plant sterols in pine oil (tall oil) to produce cholesterol lowering food products and started a cooperation with Valeri Naydenov, a PhD student from Bulgaria specialising in analytical chemistry. The entrepreneurs started to cooperate in working on fatty acids and the separation process of plant sterols. The ongoing discussion in media and science regarding biodiesel at the time motivated the entrepreneurs to try to develop biodiesel and work on ideas on other products after biodiesel. Equity in the company SunPine was sold to three major industrial investors in order to build a full-scale plant in Piteå, Sweden, where the development climate was good and there were possibilities to rent tanks in the area. Piteå has also a harbour with sufficient capacity. Additional part of company was sold in 2014. The owner consortium of SunPine represent the entire processing chain from forest raw material to processing, marketing and distribution of renewable diesel fuel and resin.

History in summary:

- 2005 Concept development.
- 2006 Identification of location and tanks for storage.
- 2007 The first employees including appointed CEO.
- 2008 The environmental permit was approved.
- 2009 Construction of a new plant.
- 2010 Production of pine diesel began in May 2010.
- 2010 The first deliveries to Preem were made in October 2010.
- 2011 Improvement of the vacuum system. Problems in production, clogging and cleaning.
- 2012 Complementary improvement investments.
- 2013 During the years up until March 2013, efforts largely concerned the removal of bottlenecks and achieving a stable production. The plant reached its planned capacity in 2013, which was also the first year the company made a profit. In all, the initial investment amounted to around SEK 350 million.
- 2014 Stable production, increased feed and improved process. Handling sludge. The company Lawter, owned by Harima Chemicals in Japan, became a new shareholder and partner.
- 2014 The upgrade the plant for the manufacture of a new product – rosin that is an existing product on the global market, but is not dependent on political decisions.

- 2015 The new production plant became operational. The investment for upgrading the plant and to enable the manufacture of rosin totalled around SEK 210 million.
- 2016 First delivery of rosin, a start-up year for working on recurring production stoppages and a number of supplementary actions and succeeding in creating stable production with good reliability bu the end of year.
- 2017 Achieving smooth and stable production, achievement of set goals and records in delivery and results.
- 2018 Continued stability and good production. EU decides to open up for SunPine pine diesel. Decision to invest 250 million SEK in new factory. Production capacity will be raised by 50 %.
- 2019 In the fall of 2019, a new laboratory and a new office were inaugurated to make room for a new larger SunPine.
- 2020 Production start during the fall of 2020.
- 2021 Production in 2021 is estimated to more than 150 000 m3.

Main activities

SunPine seeks to extract renewable products through sustainable forestry by processing and seeking to make best use of a tree's essential components for the manufacture of renewable products. SunPine's bio-refinery supplies innovative and sustainable products that are based on pine oil, a residual product from Kraft pulp mills. The products reach the world market in everything from Nordic Swan eco-labelled diesel to fragrant perfumes. The main products are:

- Pine diesel - SunPine produces over 100 million litres of pine diesel with plans to expand. In terms of positive climate impact, today's production reduces fossil CO2 emissions by 250,000 tonnes per year, or in simpler terms, equivalent to the emissions from 157,672 vehicles every year.
- Rosin is produced from pine oil and SunPine customers process it into adhesives, ink, tape, paint and road markings and other things. SunPine has an annual rosin production capacity of 24,000 tonnes.
- Heating Bio-oil - SunPine's bio-oil is certified sustainable by the Swedish Energy Agency – a green fuel oil.It is a good renewable alternative to fossil fuel oils for industry. Bio-oil has more potential development possibilities such as for petrol or lubricating oils, development of cholesterol reducing foodstuffs or medications. SunPine produces around 50,000 tonnes of fuel oil per year.
- Turpentine for customers in the perfume industry. SunPine produces around 2,000 tonnes of sulphate turpentine per year.
- Surplus heat used for district heating in the city of Piteå. SunPine supplies around 1,500,000 kWh of district heating annually.

Market

Pine oil is transported from pulp mills in Scandinavia to the factory in Piteå but also by boat from the USA. After processing mixed with diesel from ordinary crude oil, it is sold as Swan-labeled Preem Evolution Diesel to consumers at tank stations all over Sweden. Rosin, heating bio-oil and turpentine are sold to mix of international and Swedish industrial clients. District heating market is the local area of citry of Piteå.

Challenges and solutions

Pine diesel only represents 2 % of the total diesel consumption in Sweden. However, an important barrier to expansion is the supply of pine diesel. But as several pulp mills in Scandinavia are expanding, it means that the volumes of pine oil are increasing and the potential estimates that pine diesel can constitute 5% of the diesel consumption in Sweden in the future. Research in going on on different processes for producing gasoline or diesel from other residues in the forest industry, e.g. converting lignin into fuel. SunPine collaborates with Luleå Technical University (LTU) regarding technical research and development.

One important factor is the policy in Sweden and the EU. The industry is dependent on long-term regulation and cost-neutral energy politics. Companies are able and willing to invest if the rules are stable for many years, however, the political climate has been unstable with rules changing annually. Backing from national ambitious policies arguing for the importance of use of biomass for different purposes and taxation to increase the competitiveness of renewable fuels is required. The BM of SunPine ought to replicable on a general level in other regions of Europe. A combination of new applied technology and access to suitable forms of biomass could lead to new types of sustainable bio-fuels. Challenges are also related to finance and access to the specific value chain, both regarding supply and demand. SunPine has overcome these two challenges, by taking in new owners in the company. These owners have brought economic capital and access to the value chain from both supply and demand perspectives.

Funding

SunPine has not received any financial support or grants from public authorities. The initial development was financed by entrepreneur Lars Stigsson. Further financing was received from three investors each buying initially 20% share in company and each of them investing SEK 100 million (10 million EUR) and later buying additional 5% share each. In 2014, the remaining 25% was sold told to the Dutch company Lawter, owned by Harima Chemicals in Japan.

The investors were particularly important as they represented actors along the value chain:

- Södra is Sweden's largest forest-owner association and a leading global producer of paper pulp.
- Sveaskog is Sweden's largest forest owner and a leading supplier of saw logs, pulpwood and biofuel.
- Preem is Sweden's largest fuel company, with over 600 fuel stations for private and commercial traffic. Preem has two refineries in Sweden: Preemraff Lysekil and Preemraff Göteborg.
- Lawter is a Dutch company owned by Harima Chemicals (Japan). A strong position in terms of chemical products extracted from pine oil.

In 2018 SunPine decided to invest SEK 250 million in a new production plant close to the old plant as the market for sustainable pine diesel fuel is growing and company wants to assume responsibility for the Swedish shift to renewable fuels. The production capacity will be raised by 50% and in the right conditions, SunPine could meet 14 per cent of all renewable diesel requirements in Sweden by 2030.

What makes this case innovative?

Today it is a world-leading bio-refinery with billion-kronor (SEK) sales that continues to develop and invest in new technology and R&D.

Circular Bioeconomy in Agricultural Production

Case: Energifabriken – fossil fuel free circular economy

Name of the company: Energifabriken
Country: Sweden
Size of the business: 12 employees
Website: https://energifabriken.se/

Background

The enterprise was established by three farm families, who were interested in replacing their fossil-based energy they used for heating the premises, drying the grain and for all the farm vehicles and machines with more sustainable options with the vision of becoming fossil-free and sustainable at their farms. The six partners have diversified previous work experience and educational backgrounds, incl.

four partners with degrees in agricultural science. The three farms switched to rapeseed methyl ester (RME) use instead of ordinary diesel and fuel-oil and replaced the conventional electricity contracts with green, sustainably produced electricity contracts and started using transports based on fossil free fuel. The challenges related with reaching the goal of having fossil free fuel on the farms, inspired the partners to use this experience, knowledge and networks for a potential business opportunity and answer the demand from other companies for fossil-free fuel. Private company was established with the plan to build a factory to produce biodiesel out of rapeseed oil. The enterprise received 300,000 EUR financial investment support from the Swedish Environmental Protection Agency through KLIMP, The Climate Investment Program, in order to build a biodiesel refinery. The market analysis showed that trading biofuel instead of building the plant would be more competitive as at the time a local manufacturer was already operating in the region and additional plant was not needed. Thus, the enterprise started to buy biodiesel from other producers and sell it to transportation companies utilizing their own experience in using it in their own farms. In 2018 the company bought a biorefinery developing the circular production starting from farming, producing and distributing biofuel. The company is still growing and at present has offices in three location in Sweden and distribution network in Sweden and Norway. In 2018, it bought another biofuel company and became owner of the largest net of filling stations for renewable fuel in Sweden.

Main activities

The main activity is buying, selling and distributing biofuels, RME, HVO and ED95. The three farming families' interest in becoming fossil free operations helped them to gain the experience and knowledge and use it to create a business opportunity for biofuel.

The owner families are still running their own farms as well with the ongoing goal to achieve sustainable production, including using best available technology (BAT), for example, commercial fertilizers together with modern spreading technology in order to generate a large climate impact.

Market

Energifabriken distributes and sells biofuels, RME, HVO and ED95, to customers in Sweden and Norway. The company has approximately 60 filling stations. The company owns a factory for RME production in Karlshamn, Sweden. Energifabriken is mostly selling to other businesses. The company is selling fuel for vehicles in heavy transports (lorries and busses) with the customer segments growing over time. Bio-fuel is also sold for company cars and to taxi companies and for housing and to crematories. The fuel is distributed by bulk lorries. The company also leases tanks to over 200 customers.

In addition to the fuel station network for completely renewable fuels, Energifabriken has for a long time developed the infrastructure for biofuels with different types of tank solutions. Often including permits, legal aid, level monitoring and rental solutions with various pumping systems for refuelling vehicles. Customers are typically pioneers in renewable transport and renewable energy. The Energy Factory is Sweden's largest specialized distributor of biofuels and bio-fuel oil and delivers to customers throughout Sweden. Company offers consultations regarding energy conversion and offers everything from advice and support to the implementation of the conversion and the follow up on the effects of the fuel change.

Challenges and solutions

The manager at the company see large opportunities for innovation regarding bio-fuels as the norm in society has changed and there is a growing demand for bio-fuels of different kinds. There is room and need for different sustainable solutions. One advantage for Energifabriken was that the company was fast and first mover, but it sees that there is room for many more companies and solutions.

The largest challenges are in the policy system. The industry is dependent on long-term regulation and cost-neutral energy politics and constant rule and policy changes are problematic for investment decisions. Also, the public procurement ought to be a driving force towards more sustainability.

Another potential challenge is that the requirements for more sustainable fuel production may lead into price conflicts regarding food production and fuel prices.

Funding

The Energy Factory has not received much financial support over the years. One important exception is support from The Climate Investment Program, which made it is possible to develop the tank station network. The company also got some smaller support from Vinnova (The Innovation Agency of Sweden) for a pre-study. Otherwise, the company has financed itself over the years, with the using bank loans for the acquisition of the factory as an exception.

What makes this case innovative?

Energifabriken represents a good case of developing circular production motivated by interest in becoming more sustainable in production. The company handles the entire chain of biofuel from cultivation of raw material to production of fuel and use. The primary production in the owners' farms do not use fossil fuels. The use of this experience has boosted the development of biodiesel production and distribution system benefitting other producers and consumers.

Case: Ziedi JP - circular economy in a Latvian farm

Name of the company: AS "Ziedi JP"
Country: Latvia
Size of the business: 100 employees
Website: https://skatskat.lv/virtuala-ture/lauku-seta/lv/kopskats/lauku-seta.html (virtual tour)

Background

The farm Ziedi is a family business. The farm was established in 1991 with family growing vegetables and flowers on 0.25 ha. In 1993, the management was taken over by another family member and in the following years, the area of agricultural land was expanded and the company's operations were supplemented with new activities such as cereals, oilseeds, dairy farming and later biogas and fish production. Expansion was financed by commercial bank loans that were attracted for the development of the farm. The farm has been reorganized several times, adding other interconnected enterprises and changing its legal status. From 2018 it is family-owned joint stock company Ziedi JP and the business is run by owners' son and daughter. The family has been very energetic and active in gaining experience from around the world (especially in the EU, the US and New Zealand), supporting the entry of a new generation into the farm and developing more circular production. Funding opportunities after EU accession have also played an important role.

Main activities

The main activities are agricultural activities (growing cereals and oilseeds, dairy farming), biogas production from slurry that is used for heat and electricity and for fish production. Fish farming mainly grows sturgeon, eel and caviar. Digestate, a by-product of biogas production, is used for own consumption. In addition, agricultural services are provided.

Market

As the farm is engaged in many activities, the target groups of the products are also different. Cereals and rapeseeds are sold to the cooperatives or processing companies, milk to the processing companies, electricity to the state -owned energy enterprises and the fish products to the catering companies. Customers are reached in the traditional way, i.e. through direct contacts, negotiations and contracts.

Challenges and solutions

The biggest problems for the business development have been the short- and long-term financing. By using existing facilities, it is possible to increase milk production, as well as the production of fish products, but future plans depend on the ability to attract funding for investments. Future innovation lies in enhancing no waste process and maximizing existing business results. The goals are to increase digestate drying and granulation for export and reach the intended capacity 20 tons daily and to intensify milk production and processing. There is potential in using the excessive heat for new production opportunities to be set up nearby, i.e. greenhouses, to achieve more circular production.

Funding

The company has obtained bank loans for development and used EU funds (EAFRD and EMFF) for variety of projects. In addition, annual agricultural direct payments and national livestock subsidies are used. The initial investment for establishing the circular production and biogas facilities has been more than 10 MEUR.

What makes this case innovative?

Unique aspect in this case is that the principles of circular economy are well presented in one farm as all the activities and branches on the farm are strongly interconnected and complement each other. Agricultural land is the beginning of production and also the end because the digestate returns to the soil as a fertilizer. One of the products of each industry is the beginning of the production of another branch, thus all raw materials are used in the production process without waste.

Case: Wapnö Farm- sustainability and the circular economy example in a Swedish farm

Name of the company: Wapnö Farm
Country: Sweden
Size of the business: 85 employees
Website: https://www.wapno.se/gaarden/english/

Background

Wapnö Gård is an estate with an old history dating back to 14th century. The current owner's family has owned Wapnö since 1741. Today, Wapnö is organized as a limited company with one owner. Lennart Bengtsson, the CEO, started to work at Wapnö in 1991 having previously worked the Swedish Agricultural University, and with the owners diversified its BM and started to expand from regular the milk production and from the being the primary producers at the onset of the agri-food value chain into processing and advancing in the agri-food value chain and getting closer to the end consumer.

The milk production was integrated with the wide variety of activities in the farm. The farm opened its dairy in 1998 and further developed processing and activities onsite with farm shop, brewery, restaurant, greenhouses etc. The farm has added biogas production for more circular production and in 2020, Wapnö is building a slaughterhouse at the farm. Wapnö has also applied for a permit to produce RME based on animal fat.

Farm opened its production to public through series on events and festivals such cow release day in May, Christmas market etc. Wapnö is an open farm and has around 60,000 visitors every year. The visitors are welcome year-round to get a closer look at the animals, barns and dairy. Wapnö claim that it wants to be a place that restores the relationship between agriculture and the consumer's plate. The Wapnö focuses animal welfare, taste experience and sustainable development with prioritization of reasonable use of natural resources and environmental responsibility. Over the years, Wapnö has received several awards, including Taste Developer of the Year in the food industry and Environmental Award of the Year. An important challenge for Wapnö is to continue to develop the farm's own cycle in order to provide a more sustainable food production and at the same time make the food taste more and

better. Wapnö claims that this strive makes Wapnö not only an interesting place, but also one of the most important ones.

Main activities

Wapnö is developing a circular economy with a diversified sustainable BM that included dairy and crop production, forestry, processing and sales and marketing. The farm has its own dairy, charcuterie, brewery, greenhouse and restaurant that refines everything that the farm provides.

Wapnö has about 2,500 hectares of farming land that provides food for both the farm's animals and people. Wapnö's assortment of cereals contains e.g., wheat and malt. For the last 25 years, Wapnö has not added sludge to the fields in order to avoid risk of heavy metals, remains from medicines etc. Instead, the biogas plant also provides fertilization, which improves the fertility and value of the farmland. Wapnö also has 450 ha of forest.

Wapnö Farm has grown from 90 to 1400 milk cows over the years and are kept free range and grazing outside during summer. The animals feed is produced in the farm. To achieve a sustainable production of meat and milk, Wapnö has four different breeds. Wapnö applies rotation on the fields and maintain the fertility of the fields, minimize diseases and keep the landscape open. The animals contribute to biological diversity.

Since Wapnö farm is a large farm in comparison with ordinary farms in Sweden, Wapnö has been able to create a sustainable small-scale and artisanal food production for consumers. The dairy is an important activity at Wapnö Farm. Wapnö is producing milk, cream, cheese and other milk-based products. The milk flows only 30 meters in a tube from the cowshed to the dairy farm. In order to show the organic cycle, Wapnö signs the milk packages with the actual milking time, not just the date. Wapnö organic meat comes from the farm's cattle, which are free range and never given antibiotics. In the charcuterie, sausages are soured with buttermilk from the dairy.

Wapnö has a 12,000 m^2 greenhouse, plantations and an apple garden. Wapnö grows tomatoes, peppers, chili, kale, cabbage, onions, apples etc. in soil with added nutrients from the farm's organic manure. The products are delivered to the restaurant and the farm shop and sold to consumers. The greenhouse is heated with renewable energy generated on the farm.

Thanks to the relatively large primary production at the farm, it has been possible for Wapnö to create an environmentally efficient biogas plant. Wapnö farm's biogas, produced from cattle manure, contributes to renewable energy in the form of electricity, heat and cooling, which is needed year-round in the food premises. As Wapnö only uses manure from animals on the farm for biogas production and has cut the energy consumption with more than 90%. The biogas also provides high quality digestate which improves the fertility and value of the farmland.

In the brewery, Wapnö brews beer from the farm's water and grains, which are malted on the farm. The farm's brewery is growing fast and today Wapnö has a large range of different beers. In some special beers, leftover tomatoes or kale from the farm are used. Mash from its own brewery and from another large local brewery is used for the production of RME.

Wapnö has a restaurant in the castle and they have registered a trademark: Farm Dining®. The ingredients are coming from the farm. In the restaurant's bakery, bread is baked from malt leftovers.

The farm shop is situated at the farm, and a web shop on the internet, where all the farm's products can be bought; dairy products, beer, lemonade, vegetables, flour and meat & charcuterie products from the farm's beef. Wapnö also sells cakes, jams, sauces and other goodies from the farm kitchen in the shops. Wapnö also has a farm hotel and a conference center that can accommodate 300 people.

Wapnö arranges three large fairs on a yearly basis. The Beer & Whiskey Fair, The Home & Garden Fair and the Christmas Fair. All the fairs are well-known and have visitors from large parts of the country.

Market

Wapnö sells different products. With the open farm strategy, strong focus is on sales and engagement with local customers, but products are also sold through national chains. Through the development of a sustainable diversified business model, Wapnö has climbed the value chain, got closer to the end consumer and developed a very strong brand. Therefore, Wapnö is able to sell its products at a higher price, which reflects the value end-customer put on the products. Wapnö Farm has built and communicated its brand for almost 30 years. Wapnö is focusing all customer segments. Wapnö is a small company in comparison with the big companies in the food value chain as the market in Sweden are dominated by a few very large food retail companies. Today the Wapnö Farm brand is very strong. However, nowadays it is much more expensive to use media to build a brand than it was during the early years of the Wapnö Farm development. And thus it is important to market the company and the place, not the specific product.

Challenges and solutions

A crucial challenge for Wapnö, as other food companies, is the food value chain. There are a few strong actors in the value chain who are close to the end customer. These big actors catch a large share of the total value generated in the food value chain. Wapnö has managed this challenge by ascending in the value chain. Nowadays, Wapnö is closer to the end customer and has built a well-known brand.

A prerequisite for other companies to handle the challenges and develop a BM in line with Wapnö's, is that they regard a sustainability-focus as a possibility to build value for customers, and not as a cost-raising barrier.

Wapnö is a large farm, even though Wapnö is a very small actor on the market. Other large farms can be inspired by the case of Wapnö and develop a circular sustainable BM which brings them closer to the end customers themselves. However, it is a larger challenge for smaller farms. One solution can be that smaller farms cooperate in a network structure and create the same solution as Wapnö has created itself.

Another challenge is the supply of human competence. Wapnö often must train and develop the staff after they have started to work at Wapnö. This is especially important if a company, as Wapnö, has many different business activities and good managerial competeices are needed for the different activities of the farm.

Funding

Today Wapnö is run as a limited company with one main owner. Over the years, a part of the Wapnö area is been sold from the farm when the current main owner bought the other owners' parts of Wapnö. Wapnö has also bought neighbouring farming land over the years.

The company has used bank loans for finacing. Wapnö Farm is a capital-intensive company. Further, when a company like Wapnö wants to raise production volumes the company reaches investment steps, where the company must invest large amounts of money. Hence, it is very important to have good relations with banks. The potential strength is that the value of the farm and the land is high making it an attractive customer for the banks. However, the potential risks related with external capital, costs have to be considered. Wapnö has received some financial support from EU Rural Development Programme over the years.

What makes this case innovative?

For more than twenty years, Wapnö has developed its own ecological cycle directly on the farm. The case represents a good example of circular production and integration of variety of activities to achieve higher sustainability. The focus of the farm is on animal welfare, openness to consumers, sustainable farming and reducing the energy consumption.

Sustainable and Novel Bio-based Products from Waste and Biomass for Replacing Plastic

Case: Kaffeeform- coffee cups made from coffee grounds

Name of the company: Kaffeeform
Country: Germany
Size of the business: 5 employees
Website: https://www.kaffeeform.com/de/

Background

Kaffeeform was founded 5 years ago, but the development goes back at least 8–9 years. Julian, the CEO and founder of Kaffeeform had studied product design and had interest in in material innovation and material composition. The observation that the coffee grounds from sieve carrier machines already have a solid form triggered the founder's interest in whether the whole thing could be made more durable and coffee grounds or waste could be used as a resource.

Eight years ago, scarcity of resources, waste of resources and the worldwide increase in coffee consumption were not yet the big issues as they are today. At that time, the founder had the vision that there should be a way to bind this coffee grounds permanently, to "fix it" and make a product out of. Founder Julian worked on this during his studies and in his thesis. The research included a lot of trial-and-error testing of various additives. The aim of the development was not a once-only product, but a durable, long-lasting product to take the waste out of the cycle and to bind it in the long term. At some point, after various exchanges with material and technology experts, founder Julian had found a suitable "formula" and came up with very robust, durable, light material which, apart from small changes, is still used today. In 2014 and 2015 the first prototypes were available and received a lot of positive press and interest even though the product did not even exist yet. The founder decided to take the risk and establish the company and build it according to their own guidelines, visions and ideas and without outside capital.

In 2015, the first product, the espresso cup came on the market as an obvious product with a great symbolic character and beautifully describing the cycle: drinking the coffee, is how the coffee grounds are created, and in the end, coffee is drunk from the coffee grounds and this closes the coffee cycle. The espresso cup financed the development of the next size, the cappuccino cup. The somewhat bigger breakthrough came in 2018 with the Take Away Cup. The development of this cup was a mixture of own ideas/own product development, but also the consideration of the current zeitgeist and the feedback of the customers. This cup then drove the business up again and it has a certain lifestyle character according to the motto "This is now my coffee cup".

Employees in Kaffeeform organizes the whole production process themselves starting with collecting the coffee grounds in Berlin from larger co-working spaces by a bicycle courier. At first, the idea was to collect coffee grounds from cafes, that was not feasible and a little bit bigger approach was needed. Using co-working spaces has many advantages such as the co-working spaces also know which coffee beans they use, support fair trade with money going directly to the farmer and information available on which farmer it came from. The transparency on the raw material is very important to the Kaffeeform.

This coffee grounds are processed in a workshop employing people with disabilities in Berlin, thus company's activity has another social component. Production process has a lot of manual work. Grounds are dried, processed, vacuumed and collected. In next step, the coffee grounds go to their partner in southern Germany, who has the expertise in the processing, how to generate an intermediate product in form of pellets and the different material components/biopolymers. These pellets have been developed in such a way that theoretically any shape can be made from them by injection moulding. The partner shapes the cups, which are then sent back to them or to the Förderwerkstatt in Berlin. This company takes over the entire storage and logistics for products and has link to their online shop and ships the products to end or business customers.

Thus, coffee cups are made from a fairly large amount of recycled coffee grounds and that product consists only of plant substances. The marbled surface is created by beechwood chips and then there are the biopolymers that do all the binding. These include cellulose fibres, natural resins and oils. There is no added dye. This product is designed to be recyclable. The cups can be thrown to the household rubbish or sent back to Kaffeform, where they will be received and used to create new products.

Main activities

Production and sale of coffee cups and coffee cups. Coffee cups made from coffee grounds.

Market

Kaffeform have a retailer programme and they sell through their own webshop, plus the partner network with over 400 active retailers in Europe. They have not defined very specific target customers. Their clients include everyone from "coffee-earth", families who like Kaffeform large milk coffee cups very much, to large corporate customers. The later includes retailers, cafes, concept stores or museum stores in which Kaffeform are represented for certain exhibitions.

The branding and utilizing the take-away cup, a high quality product with the option to include a logo for corporate and event related gifts, is an important marketing tool. Publicity in Germany and international press has been important. Kaffeeform has appeared in various TV productions, has social media channels with their own community. The company has been also present at events like the Berlin Coffee Festival, or Zero Waste events. In addition, there are also small cooperation through which they become better known to the public.

Challenges and solutions

The enterprise is strengthening their core business in Berlin where they started. The company wants to grow organically in the European market and initially position itself securely. Especially because the company does not have a financial backup that would allow them to expand worldwide quickly. However, the enterprise would like to open itself up to the international market step by step. There is demand from USA and South America, but enterprise has to make sure that their production structures could be met there. In the long term, establishment of a second location could be considered. In addition, the enterprise is continuing to work in the area of product development, as enterprise wants to expand their product range to show what can be done with their material in the area of household products and lifestyle.

Funding

Outside funding has not been used. New products and development have been financed from the proceeds of the previous product. The enterprise does not have its processing facilities, but uses a network of partners to do the processing. Thus, there were no investment costs.

What makes this case innovative?

Case represents product innovation for a more circular production and waste utilization, more specifically the innovation has been in the development of the material. Right now it is used in the form of coffee cups, but in the long-term other forms are also planned. Support to fair trade practices and social enterprises adds a social dimension to enterprise’s activity.

Case: Spoontainable – edible ice cream spoons

Name of the company: Spoontainable
Country: Germany
Size of the business: 7 employees
Website: https://spoontainable.com/

Background

The founders met at the University of Hohenheim at the end of 2017 where they were studying plastic alternatives. Whilst eating ice cream they got the idea of the edible spoon, as they realized that it would be super convenient to also be able to eat the spoon. Afterwards, they tested their idea in their shared kitchen, starting with plain cookie dough and developing their first prototypes in that very kitchen. They noticed that the plain cookie dough wouldn't work. After several different trials, the skin of cocoa seeds, the waste created by the chocolate industry, was found to be a suitable option. By baking the 'choco-waste' into their dough they created an alternative to plastic and have contributed to finding a super sustainable use for food waste for a more circular economy.

In the beginning, founders were driven by the curiosity, but as the products were very well received by the clients and there is a great societal interest in sustainability. Additionally, the plastic-ban for 2021 provided a good opportunity for building the business. The entrepreneurs saw their chance to show that small changes can have great impact and therefore they held on to their product. The oat husks are purchased regionally. The processing into fibres takes place in Poland because the supplier is based there, but the purchasing is done regionally.

Main activities

The company's revenue model relates only to the development and sale of edible ice cream spoons.

Market

In the start-up phase, the entrepreneurs sold their products by personal direct sales by visiting and introducing their spoons to ice cream parlours. Through the personal contact, it was much easier to present their new and strange product that required many explanations.

At present, the enterprise has a wide range of customers such as classic ice cream parlours, cafes or food trucks at festivals selling ice cream, frozen yoghurt and bubble waffles. The cafes benefit from offering a sustainable alternative and thus attracting more customers. Many parlours integrate the price of the spoon into the final price. Others take a so-called small 'environmental fee' to be paid extra by the guests if they decide for the more expensive alternative. Therefore, in the end it is the decision of the consumer.

Caterers have also been a very interested segment. They sell their products directly to traders who then include them into their portfolios, which are presented to their restaurateurs. That is how the trading system in Germany works.

Enterprise is currently working on a deal with a big supermarket chain, so they expect to start selling their products through retail chains soon, and with integrating their products into retail, they are trying to reach a larger customer base.

Enteprise also is currently maintaining a website and an online shop, which work more or less automatically. Enterprise is very active on social media, because it is a good way for reaching out to end consumers and raise awareness about the products and sustainability.

Enterprise has applied for patent and has their trademark protected. There are some imitators, but so far those have not offered better products. The enterprise has sustainable value chain and a strong unique selling point with their cocoa skin residues and fibres from food industry.

Challenges and solutions

Their goal is to become the market leader in the area of sustainable plastic-alternatives for the gastronomy sector. Which means working on and launching a bunch of new products. Currently the enterprise is developing stirring sticks for coffee, small forks, a whole cutlery set, which will launch soon. This will need a new production and additional research. Enterprise is already selling the spoons in ten different countries and would like to expand to outside of the EU.

Enterprise is in a very good position thanks to the plastic ban. Since they not only use the skin of the cocoa seed but also oat husks there is no shortage of raw materials. On the one hand, the food industry

is full of wasted peels, husks and skins, which can be processed into fibres that can be used in their products. On the other hand, the market is growing creating demand for this kind of products.

Funding

The entrepreneurs founded the company whilst studying in the university and without having savings or other capital. Therefore, they started a crowd funding campaign, which allowed them to finance the first production of the spoons. For further financing, bank loan was used and later the revenues from selling spoons was used for financing. For further growth and optimization, another investment has been made recently.

What makes this case innovative?

Clever production innovation based on recycling food industry waste. The basis for their edible ice cream spoons is 100% sustainable raw materials as enterprise uses biogenic residuals from the food industry. Therefore, they create a sustainable value chain for our edible spoons that has no food waste, it suitable for vegans and is plastic free.

Sustainable Bio-based Products from Plant-based Biomass

Case: Aloja Starkelsen: organic starch and plant based products for home and industrial application

Name of the company: Aloja Starkelsen, Ltd.
Country: Latvia
Size of the business: 87 employees
Website: www.alojas.lv

Background

The enterprise was established on the basis of a partnership. Aloja Starkelsen was founded in 1991 in cooperation between the employee cooperative “ALOJA” and the farm cooperative “LYCKEBY” from Sweden. It was the first food company with foreign capital in Latvia. The company's largest shareholder is Swedish group Sveriges Stärkelseproducenter.

Production is based on a plant operating in Latvia since 1937 and producing spirits until 1974 and since 1974 producing starch. Organic potato starch production started in 2004 with the first 20 tons, however, only small quantity of it was marketed as organic, while rest was sold as conventional product because at the time the product was not accepted in the market. Organic potato starch production on regular basis was started in 2008, when demand for organic food increased in the world market significantly.

Idea of organic potato starch production comes from Andrejs Hansons, former CEO of the company, who searched for new business niche. Since 2008 volumes of organic potato starch have grown steadily. Since 2013 the company is the second world's largest organic potato starch producer.

While starting organic potato starch production the driving force was necessity to sustain the product (potato starch) in the market, to keep and increase competitiveness of the company. Finding new business niche was one of ways to be in front of other business players, instead of lagging behind.

In a later phase, when increase of demand for organic potato starch was realised, the company decided to focus on organic food and food ingredients production. The new business strategy was developed, and it included measures to build production chain, where starch processor and producers of raw material – potato – are linked by cross-cutting interests. The company strives to satisfy world market demand and to do it, must have access to the raw material – organic potato, meeting certain quality requirements and delivered in volumes, satisfying the company’s production targets. In order to ensure all of the

abovementioned, the company has created a network by joining organic potato growers, breeders and researchers in one chain, and has established an organic potato starch competence centre, whose main objective is to promote knowledge based organic potato breeding and growth in Baltic states. More than 100 Latvian and Estonian farmers are growing and delivering organic potato annually to the enterprise, and due to the world market's growing demand, volumes purchased from farmers are still increasing.

New direction for the company is the products made of from organic brown pea and fava bean. Those have been developed due to two strategic considerations: business interests in developing organic products portfolio, and interest in using legumes, because according to the most effective growing technologies, legumes are excellent pre-crops for potato, thus letting to achieve good yields.

Main activities

The company is producing organic and conventional potato starch. Potato starch demonstrates many valuable characteristics: a superior water binding capacity, the ability to build excellent viscosity, low temperature swelling, lack of taste, transparency, GMO and gluten-free qualities, as well as lack of allergens. Production residues are delivered to farmers - potato juice for fertilizing fields and potato pulp for animal feed.

Besides starch, it is producing packed products: jellies, deserts, spice mixtures, baking powder, and vanilla sugar. The most of them contain starch as one of ingredients. In 2017 the company started development of new business direction – production of flour and protein concentrate from organic legumes - brown pea and fava bean.

The company holds a small laboratory, where it, on demand of customers, develops recipes for different dairy, confectionary, drinks, snacks, meat produce and other products. Each recipe is custom made and unique.

The company is maintaining internationally recognised quality standards and is certified organic producer. It maintains certificates such as: EU organic (LV-BIO-02), Krav (Sweden), USDA Organic (BCS), China Organic (COFCC), JAS Organic, BRC, GMP+. It is certified also to supply ingredients for Kosher and Halal production systems. It is worth to mention that the company is certified as gluten free production site.

Market

The main customers are food industries, supply chains, supermarkets (RIMI, Maxima, LIDL, ALDI COOP etc.). The main destinations are Eastern Europe, Scandinavia, Italy, Taiwan, Japan and USA.

Each year, the company participates in thematic exhibitions such as Food Ingredients, BIOFACH, Snack Expo, Riga Food and other, and takes part in business missions to Asia countries. Here customers are found in many cases. Informative leaflets about the produce are distributed. The company's website, social media (Facebook, YouTube) and organic products and recipes advertising websites www.organicpeaprotein.eu, www.organicpotatostarch.com, https://www.culinar.se/english/) are used.

Challenges and solutions

There are several channels for potential customers who are looking for organic potato starch or pea protein, but still a challenge to reach customers who are not aware of those unique organic ingredients. In future the enterprise's interest is to focus on wider potential customer area. The challenge is that it can take a rather long time before market is familiarised with new products and ready to use them (for example, organic pea).

Company plans to continue with organic product production and sales, to follow worldwide organic product growth. Major investments are planned, including development of pea peeling production unit, dry products mixing and packaging unit and development of pea melting and classification production unit. General target is development of diverse organic products and increase of their specific weight.

Funding

Owners of the company are shareholders and they take decision on use of the profit. Funding used for development measures, especially investment in infrastructure is coming from: the company income; loans, provided by banks; EU funding acquired via open calls for proposals.

Starting production of organic potato starch did not require investments in infrastructures, however it required a lot of management and development measures related to introduction of quality management system, increase of knowledge level of employees, thus enabling them to execute, supervise and monitor production process.

The public sector and EU funding have been used for development of production facilities and increase of energy efficiency and for participation in international exhibition and fairs. For this, EU financing managed by national Rural Support Service (LAD), Investment and Development Agency of Latvia (LIAA), state-owned development finance institution ALTUM, was used. Public funding, such as Estonia – Latvia Cross border programme supported by ERDF, was used for strengthening the network of Latvia's and Estonia's organic potato growers, breeders, researchers, and processor and for development of the organic potato food production chain. The organic pea and bean production require development of new infrastructure and for this purpose EU funding (40% of total amount) was acquired via open calls for proposals and 60% financing comes from bank loan.

What makes this case innovative?

The enterprise is working on product and processing innovation and offering in the market organic plant-based products for industrial application, development of new protein products for customers. Important aspect is development of unique recipes for different dairy, confectionary, drinks, snacks, meat produce and other products with each recipe custom made. The company is certified as gluten free enterprise helping to develop and cater this fast-growing market niche.

Case: Lilli Agro- organic straw pellets for animal bedding

Name of the company: Lilli Agro
Country: Estonia
Size of the business: 3 employees
Website: http://lilliagro.ee/?l=en

Background

The idea to create Lilli Agro arose more than ten years ago, when the owner of the company was engaged in the distribution of straw pellets produced in Lithuania to the Estonian and Finnish markets. As the owner of the business is also a farmer, he started using imported straw pellets as bedding for his animals.

The straw pellets were novel at that time and, according to the company, there were actually the best animal litter on the market so far. The straw pellet has good moisture and urine absorption properties. In addition, the use of straw pellets has a fast and efficient circular economy effect, thus saving the working time and space of the straw pellet user. The straw pellet decomposes quickly compared to other litter (sawdust, planer chips, etc.) and this allows the used straw pellet to be brought to the field immediately after a few months as an organic fertilizer.

Encouraged by the ease of use and good properties of straw pellets, in 2013 the company decided to start producing straw pellets itself. This activity was profitable and the company already had a market for their production from previous distribution and sales activities.

Main activities

The company's main activity is mixed farming. Horses, cattle and grain are raised and feed is produced for own consumption. There is a total of 1,350 ha of arable land. Thus, most of the raw material or straw is obtained from their own fields. The additional raw material is bought from local farmers. Years ago,

the company provided agricultural services, but with the rapid growth of production of straw pellets, over time it is no longer possible to provide agricultural ancillary services.

Straw pellets are mainly produced for bedding for horses. In the past, straw pellets have also been offered for bedding for birds, mulch, heating and pets, etc., which have been praised by customers, but the company decided in favour of the horse breeders' market segment. Thus, the company has found a niche for its production. While in other countries most straw pellets are produced for biofuels, Lilli Agro produces straw pellets primarily for animal litter.

Market

The main and largest segment for Lilli Agro's straw pellets is horse breeders. Prior to the creation of Lilli Agro, the company was an intermediary for straw pellets produced in Lithuania. The pellets were bought in and resold mainly to the Nordic countries (Finland and Sweden). In this way, the company created a market for itself and had previous experience in the horse breeding field.

The sales of self-produced straw pellets are based on the direct contacts that have developed over the years. In order to find new customers, people attend trade fairs, but recently the main emphasis has been on web marketing and direct contacts, i.e., the advertisement is sent directly to the customer's e-mail address or by calling the customer. Customers' own recommendations contribute a lot to sales.

The retail sale of straw pellets is organized by the company itself and the sale takes place directly to the final consumer. The partner uses a logistics company through which direct deliveries are made to the end customer. Intermediate warehouses and intermediaries are not used, because the use of intermediate warehouses makes the product more expensive, which in turn has a detrimental effect on product sales.

Challenges and solutions

Although the use of straw pellets is widespread, the company remains in the equine market segment. One of the biggest challenges is Estonian climate and weather related risks. The unpredictability of weather affects straw collection from the fields and the ability to fulfil the orders. Excessive moisture causes quality problems and, due to the droughty summer, the crop remains low and it is not possible to collect enough straw from the field creating new risks for the enterprise.

There is fierce competition in the straw pellet market, and those whose production costs are low remain competitive. This, in turn, requires a sufficient amount of arable land to produce enough straw and a sufficiently long and suitable harvesting time to obtain straw of sufficient quality. Lilli Agro has a sufficient amount of agricultural land, which gives it an advantage over some other farmers, such as Finnish farmers, for example, who have very small farmland. Farmers in neighbouring countries south of Estonia (Latvia, Lithuania, Poland, Ukraine, etc.) who have better preconditions for straw pellet production (larger production areas and longer harvesting time) have a competitive advantage, which makes the cost of straw pellet production lower. Therefore, in order for production to be competitive, the availability of raw materials and the location of final customers must be carefully considered. It is not worth transporting raw material very far, and since the production weighs a lot, it is not worth selling pellets very far. All raw materials should be available close to production and also customers could be located no further than in a neighbouring country. In addition, straw processing is energy intensive. It is not possible to make a pellet from wet straw, because in this case the granule will mold and product quality problems will occur.

Funding

The company has been financed by creditors' investment loans for the purchase of a production line and, to some extent, support has been received from the EAFRD LEADER measure for the improvement of buildings. For the enterprise, the minimum investment for the optimal production quantity in Estonian conditions and for the acquisition of a new production line for straw pellets, was around 0.5 million euros.

What makes this case innovative?

Case represents use of agricultural residues for circular production and sustainable products. Straw pellets are a pure, unadulterated natural product for animal bedding. The straw pellet has an excellent absorption capacity and is hygienic. Strawberry pellets are also supported by their ease of use and easy disposal.

High-value Products from Knowledge-based Processing

Case: Est-Agar – sustainable enhancement of the red algae *Furcellaria lumbricalis*

Name of the company: Est-Agar
Country: Estonia
Size of the business: 25 employees
Website: http://estagar.ee/

Background

The enterprise is currently owned by three friends who were interested in engaging in the blue economy, namely the cultivation and processing of seaweed on the Baltic coast, on the island of Vormsi. The entrepreneurs studied the value enhancement opportunities offered by algae growing on the Estonian Baltic coast and their uses. They learned that it is possible to extract various useful substances from seaweed growing in Estonian coastal waters with the help of different technologies, which can be used mainly in the food and cosmetics industry. As a result of long research and considerations, it was decided to buy the Est-Agar plant on the largest island of Estonia, Saaremaa, which is the only producer of a unique texture-adding additive produced from the red algae *Furcellaria lumbricalis* – furcellaran. The deal was reached in 2016, when friends bought all the shares of the factory together. With this, they gained an industry working to realize their ideas, access to an algae quota, or raw materials, and market share.

Est-Agar is an industry with a long history. The history of the industry dates back to the 1960s, when Estonian marine scientists established that the stabilizing, thickening and gelling agent furcellaran can be produced from the red algae *Furcellaria lumbricalis* found in the Estonian Väinameri. This discovery was followed up by Kalev, Estonia's largest candy factory, which developed the technology for furcellaran production and in 1966 built the furcellaran industry in Saaremaa. The Kalev candy factory used the industrial production primarily as an input for its production, but furcellaran was also supplied elsewhere - to Russia, Ukraine, Latvia and everywhere else. At the beginning of re-independent Estonia, in 1996, another company bought the furcellaran factory from the candy factory, and in 2016 the industry was bought by its current owners who proceed with working on new R&D.

Main activities

Est-Agar's production is unique because it is the only producer in the world of the texturizing additive furcellaran produced from the red algae *Furcellaria lumbricalis*. It mainly produces fluffy furcellaran, the technology of which dates back to 1974. The company has a pilot plant for the production of small quantities of furcellaran in powder form for the cosmetics industry. The plan is to proceed with design and development of production plant for producing furcellaran in powder form with larger equipment and in larger quantities. Furcellaran in powder form would allow the company to enter not only cosmetics but also further expand in the food industry market and its customer base.

The raw materials used for production are local and the enterprise trawls red seaweed from Baltic Sea and processes it. Although the company has an alga catch quota, in addition to red algae, it is also purchased from local coastal residents, who collect algae drifting ashore from the shores of Saaremaa island. The tradition of collecting algae is passed on in local coast areas.

Market

Most of the production is sold to the confectionery industry, the customer base of the cosmetics industry is growing and there are a few customers in the medical industry. The largest customer in Estonia is the confectionery industry Kalev and 80% of the products are delivered worldwide. The production is sold directly to the customer, i.e. the company does not use intermediaries.

Although the company is the only producer of furcellaran in the world, it competes in the whole market of hardeners, thickeners and hydrocolloids. The company's competitors are producers of gelatin, pectin, carrageenan, alginates, agar-agar and other products. The company consciously tries to make itself more visible and is constantly looking for new customers, including visiting exhibitions and fairs to create direct contacts and communication with potential customers and for direct marketing.

The marketing includes the development of new website to be even more visible, searchable and easier to access than before. The company does not position itself in large markets, i.e. it does not seek large customers, because the company's production volumes are marginal in terms of the world's major producers, depending on the volume of raw materials and plant capacity. Position itself as exclusive, different and for different customers whose products have the same exclusive output.

Today, it is very difficult to find a customer in another industry, because it also requires a lot of recipe development ability by the company. Therefore, Est-Agar sees companies and laboratories that develop formulations for factories and manufacturers and a final mixture consisting of different substances (texturizing agents, emulsifiers, etc.) as their main customers.

Challenges and solutions

One of the biggest challenges is to find new customers, to increase sales and volume. Another challenge is technological developments in order to develop new products and market those. The company has several ongoing cooperation projects with research and development institutions. The Danish University of Technology is studying the technological possibilities of separating substances different from the second growing algae species in Estonia. In co-operation with Estonian universities and biotechnology companies, how to produce a dye from furcellaran and how to add extracted algae residues to fertilizer is being studied. The aim of cooperation projects is to make maximum use of available natural resources. As a side activity of the company, the cultivation of shellfish in the Baltic Sea is being tested. Shellfish farming and enhancement are studied in cooperation with research and development institutions.

Funding

Est-Agar has been funded by using creditors, investment loans and owners' own capital. In addition, public sector opportunities (investment grants from ERDF) have been used. It is planned to continue such a funding scheme in the near future.

What makes this case innovative?

Case represents a unique product from aquatic biomass. Est-Agar is the only producer in the world of a unique texture-adding additive produced from the red algae *Furcellaria lumbricalis* – furcellaran. In order to expand the use of furcellaran, in addition to production, technology and product development are actively pursued in cooperation with research and development institutions.

Case: SatiMed- wellness and health products from the hemp plant

Name of the company: SatiMed
Country: Lithuania
Size of the business: 8 employees
Website: https://www.satimed.eu

Background

SatiMed is a biotechnology R&D company that started with research ten years ago in the field of biochemistry and concentrates on natural herbal remedies such as hemp-based products. The driving force was the trend towards the integrated, personalized medicine and wellness through taking care of personal life and one's health. The enterprise is built on international team working with molecular biotechnologies for innovative solutions. Successful discoveries have become the basis for developing intellectual property in the phyto-biotechnology niche.

Main activities

Activities include R&D and product development for a full spectrum of hemp-based products, production and distribution. SatiMed manufactures organic hemp oil-based products which comprises essential combination of non-psychoactive phytocannabinoids from hemp plant: cannabidiol, cannabidiolic acid, cannabivarin, cannabigerol and other useful compounds including terpenes, omega fattywacids and waxes. The enterprise has four patents and they license intellectual property. In addition, they have specific IPR strategy. They are niche leaders in the specific R&D with the goal that their inventions transfer to the market always step ahead.

Market

The customers for organic hemp oil-based products are persons with interest and knowledge in wellness and living environment. Normally customers are acquired via affiliates. SatiMed exports most of production to the US, so it sees that it is crucial to strengthen their position in the most significant global market further, as well as to seek new markets in the European Union and in the UK. Products and services are marketed at exhibitions, trade shows and by training of affiliates. Participation in international exhibitions is an important investment that promotes enterprise progress, technology deployment and export market development.

Challenges and solutions

The biggest problems for the business development are unsustainable business environment and regulation due to lack of expertise in public authorities. Solution would be an improvement of regulatory environment with inflow of life science expertise and knowledge on hemp products.

Funding

Financing of company has been based mostly on private investment. The public support has been utilised for the R&D, exhibitions, overseas missions and publicity.

What makes this case innovative?

Case represents R&D intensive use of local natural resources as SatiMed focuses on research and development of hemp plant-based full spectrum products, incl. hemp plant-based natural remedies to cosmetic industry, dietary supplements and functional food products that support wellness and a healthy lifestyle. High quality products are manufactured in GMP standards compliant facility. The company employs science to develop process innovation for extracting herbal compounds in the cleanest and most effective ways.

Case: oceanBASIS - natural cosmetics and food from seaweed

Name of the company: oceanBASIS
Country: Germany
Size of the business: 20 employees
Website: https://www.oceanbasis.de

Background

In 1994, CRM – Coastal Research & Management was founded in Kiel, Germany, by experts of marine ecology and economy. The aim of the company is the protection and the sustainable utilisation of the sea and the coastal zone. CRM conducted environmental studies and projects for private and public clients. Different studies about the impact of aquaculture on the aquatic environment has led to the development and establishment of the first seaweed farm in the Baltic Sea followed by the first certified organic mussel farm in the Baltic Sea demonstrating the principles of Integrated Multitrophic Aquaculture (IMTA). In 2000 the first biomass produced was *Saccharina latissima*, the sugar kelp, which served as the basic material for the development of two bioactive extracts for the cosmetics industry and an own natural cosmetics line. A seaweed processing chain was established, including algae-specific adaption of disruption, extraction as well as filtration technologies. Since 2005 CRM has specialised also in investigating marine natural substances, i.e. different seaweed extracts as antiviral and antitumoral agents. Since 2012, bioinformatics research has been established as a new field of R&D and service at CRM exploiting algal genomic resources for bio-industrial purposes.

First successful seaweed cultivation and application of the processing chain initiated the foundation of oceanBASIS GmbH in 2001 aiming at the development, marketing and sales of bioactive skin care extracts and natural cosmetics derived from sustainably used marine organisms. The first skin care products ("Baltic Care") containing a new fermented seaweed extract was launched in 2002. In 2009 the brand name changed to "Oceanwell" and the marketing have been professionalised with the help of a marketing agency. Furthermore, "Oceanwell" received the NATRUE-certification as "natural cosmetics". In 2010 a native collagen could be isolated from a jellyfish, and patented. While the technical development of two medical products on the basis of the jellyfish collagen – a wound gel and a bioscaffold – was successful and oceanBASIS gained valuable knowledge on quality management (ISO 13485), the market introduction failed. In 2012 the brand "Oceanwell" has been expanded by the sub-line "Ocean Collagen", the first skin care on the basis of a native collagen from a marine invertebrate organism. The near-shore IMTA facility was hived off as "Kieler Meeresfarm UG" in 2014, which runs commercially and has been extended by a research module for cultivating microalgae and bladderwrack.

Main activities

Revenue is created by sales of bioactive extracts for the cosmetics industry as well by sales of natural skin care products and food (supplement) products. Main activities are developing, marketing and sales of these products.Side activity is R&D in Marine Biotechnology. Focus of oceanBASIS is the manufacturing cosmetics products and ingredients from sustainably produced marine living resources. The brand "Oceanwell" is the only marine cosmetic brand, which is certified as "natural cosmetics". The company holds two patents on jellyfish collagen and one application on an antitumoral extract.

Market

Customers are distributors of skin care products or directly the end consumers. In case of bioactive seaweed extracts, the manufacturers of skin care products are customers as well. Costumers are reached via the direct offers, online marketing, e-commerce, social media, PR and exhibitions.

Company has also used the "guerilla"-marketing strategy, especially via online channels. The marketing budget is relatively low compared to other cosmetic brands. Marketing is supported by the fact that, natural cosmetics are a growing market in Germany.

Challenges and solutions

The natural cosmetics market is well developed in Germany. The company sees a good potential in further expanding the share of the brand "Oceanwell". In the future they would like to grow in a way that is allowing them to work as a productive, self-determined organisation doing meaningful work fostering a healthy society and environment.

The biggest problems for the business development are: reaching the bioactives market, because there are only a handful of relevant players dominating it; and reaching the customers as a newbie in the natural cosmetics market.

Funding

oceanBASIS is performing its business financially independently. In the beginning, public funding was received in order to establish the seaweed farm and a B2B IT-infrastructure. Support has been received from the public sector for R&D projects and exhibitions.

What makes this case innovative?

The case represents innovative use and R&D in aquatic biomass. As the oceans harbour an immense wealth of natural substances. oceanBASIS specializes on utilizing those in developing marine based natural health and wellness products and marine products for food industry. A team of experienced marine biologists and natural product experts develop and market products for cosmetics and pharmaceutical industries. Natural cosmetics are based on mainly bio degradable compounds and free of microplastics which comes with a lot of environmental benefits. oceanBASIS thereby complies with strict sustainability and quality criteria.

High-value Products from Circular Bioeconomy

Case: Borregaard – production of sustainable and environmentally friendly alternatives to petrochemicals

Name of the company: Borregaard
Country: Norway
Size of the business: 1.1031 full-time equivalent (FTE) employees
Website: https://borregaard.com/

Background

Borregaard is a company with rich traditions with the first industrial plants dating back to the 1600s while modern industrial activities began with the English owned Kellner Partington Paper Pulp Company Ltd in 1889. In 1918 Borregaard was taken over by Norwegian owners. The company built a cellulose factory near Sarpsfossen waterfall. This ushered in the era of modern industry with what would later become one of the largest industrial plants in Norway. Until the Second World War, Borregaard's main products were cellulose and paper. Since then, production has been expanded to include a wide range of chemical products, and Borregaard has engaged in several important activities in other areas. In 1986 the two companies Orkla Industries and Borregaard merged into one company, Orkla Borregaard. When Orkla Borregaard then merged with Nora Industries in 1992, the new company took the name Orkla, while the chemicals business area kept the Borregaard name. Sarpsborg remained the headquarters of Borregaard. On the 18th of October 2012 Borregaard was separated from Orkla and listed on the Oslo Stock Exchange.

Main activities

Borregaard produces advanced and environmentally friendly biochemicals that can replace oil-based products. Borregaard is organised in three business segments:

- Performance chemicals develops, produces and sells lignin-based products used as binding and dispersing agents in a wide range of end-market applications, such as construction, industrial binders, agrochemicals and batteries. In addition, Performance Chemicals includes trading of chemicals which are either linked to lignin-based products or have previously been produced by Borregaard.

- Speciality cellulose develops, produces and sells speciality cellulose mainly for use in the production of cellulose ethers, cellulose acetate and other speciality grades. The production and sale of second-generation bioethanol are also part of the speciality cellulose segment.
- Other businesses consists of ingredients, fine chemicals and cellulose fibrils. Borregaard supplies vanillin products to flavour and fragrance companies, as well as to the food and beverage industry and is the only producer of wood-based vanillin in the world. Fine chemicals are supplied to the pharmaceutical industry and company is the world's largest supplier of intermediates for non-ionic X-ray contrast media. Cellulose fibrils consists of two product ranges; SenseFi for food products and Exilva for industrial applications. Other businesses also includes sales of basic chemicals from the chlor-alkali production.

Company has a biorefinery in Sarpsborg, Norway and seven production sites outside Norway dedicated to producing lignin-based products. The company also has sales offices in 16 countries in Europe, Asia, Africa and the Americas serving its global customer base.

Market

Borregaard sells to industrial customers all over the world and is a world leader in its corresponding industrial markets. The strong market position has been developed through in-depth understanding of its markets, production of advanced and specialised products and local presence in the form of a global sales and marketing organisation. 59% of revenues came from biosolutions, wehre 650 products are sold to around 3,000 customers. 34% revenues are from biomaterials, 7% from fine chemicals. Sales distribution for 2019: Europe 50%, Asia 21%, Americas 28% (USA/Canada 23%, rest of Americas 5%), rest of the world 1%. Approximately 90% of sales are handled through own organisation.

To maintain its leading position, Borregaard has a strong focus on training programmes and cooperation between the various disciplines and R&D. Approximately 13% of Borregaard's revenues come from new products (average in last 5 years).

Challenges and solutions

Borregaard is a publicly traded company, so anything related to strategy and growth intentions is only available on investor updates and the official strategic documents.

Funding

The company has a very long history and is a publicly traded at the Oslo Stock Exchange (BRG).

What makes this case innovative?

The Borregaad case is unique case, not only in the Nordics but in Europe. Unique business model with high value added through full utilisation of raw materials and production of several co-products. Production of sustainable (profit+environment) and environmentally friendly alternatives to petrochemicals. Borregaard's niche products (biopolymers, specialty cellulose, cellulose fibrils, pharma intermediates, biovanillin) have applications in a wide range of end-markets including construction, agriculture, food and beverages, transport and pharmaceuticals.

Case: Emsland Group - sustainability through 'using nature to create'

Name of the company: Emsland Group
Country: Germany
Size of the business: 1.200 employees
Website: https://www.emsland-group.de/

Background

The Emsland Group manufactures vegetable (potato, pea etc.) based innovative products for processing industry. The Emsland Group is not only Germany's largest producer of potato starch, but also the market leader for flakes, granules and specialties. Since 1928, solutions were already being developed that were used worldwide in the processing industry. Since then, more than one hundred products are now used in the food sector, food retailing, in technical applications as well as for animal feed. When the German government changed the fertilizer legislation, the Emsland Group saw opportunity in the starch-based flocculants as a good alternative to synthetic polymers. The starch is renewable and ecologic friendly. The production facilities are situated in seven locations with each site having its own unique core competencies.

Main activities

The main activities are processing of potatoes and peas and modifying the starches and proteins. Enterprise produces pea and potato starch derivatives, potato flakes and granules, pea and potato fibres and proteins. According to the company, they are the only ones in the world which are producing pure starch-based flocculants for waste water, liquid manure and digestate.

Market

The Emsland Group is one of the leading companies in creating innovative product solutions based on renewable raw materials, mainly from potatoes. The Emsland Group's products are used in many industrial branches like food-, adhesives-, textile or paper industry. Products are distributed via agencies located worldwide. Different kind of marketing tools like online marketing, social media, exhibitions, trade shows, advertising activities are incorporated. Company exports 76% of its production and its market includes 120 countries worldwide.

Challenges and solutions

The Emsland Group has plans to further grow in the future. Enterprise has invested a lot into modernization and new equipment as well as new product developments in all kind of segments. The challenge lies in the full utilization of the existing equipment.

The biggest problems for the business development are legislation and its implementation; an adaptation of existing systems to the starch-based flocculants.

What makes this case innovative?

According to themselves, they are the only ones in the world which are producing pure starch-based flocculants for wastewater, liquid manure and dgestate.

Utilization of Municipal Waste and Sewage

Case: Greve Biogass – biogas from agricultural and municipal waste and sewage

Name of the company: Greve Biogass AS
Country: Norway
Size of the business: 12 employees
Website: http://grevebiogass.no/

Background

Greve Biogas is a partnership established by 11 different municipalities in the Western region of Oslo-fjord. The story of company started at 2008 and when, on one hand, the politicians wanted to do something regarding green sector, and on the other by farmers in the region who had problems with too much manure. Establishment of Greve Biogass was one way to keep up the agricultural production and

use the manure and agricultural residues for biogas production. It was decided that all public transport (buses in the region) should be fuelled by biogas and thus a market was established.

Main activities

Greve Biogas produces biogas from household waste and manure from agricultural production. Company has a biogas distribution network.

Market

Company sells biogas directly to local public transportation companies. Company operates its own biogas station and has one selling site and one production site. The digestate is sold directly to farmers.

Challenges and solutions

At the time being, the market outlook is positive. One possible development is the impact of electrification of transport, as the company has to find new ways of using biogas then. The biggest problems for the business development have been how to prepare household garbage before processing into biogas. The future plans are related to the company's expansion. There are plans to invest in one more production line to start processing sewage sludge.

Funding

Total investments were around 50 million EUR of which 20 million are public funding and 30 million are financed by loan.

What makes this case innovative?

Case represents using municipal waste and sewage for biogas and thus developing circular economy by utilizing waste for new product streams.

Case: Pageldynių plantacija - a full scale self-sustainable closed loop circular economy model for large cities' nutrient rich waste

Name of the company: Pageldynių plantacija UAB / NutriBiomass 4LIFE
Country: Lithuania
Size of the business: municipal water supply and waste water treatment plant 650 employees, biomass boiler less than 10 employees, nutrient rich waste management company and biomass supply less than 10 employees
Website: www.nutribiomass.eu

Background

The establishment of company was driven by the need to find solution to utilize problematic nutrient rich waste (waste-water treatment sludge and biomass ashes) and to find solution to increase woody biomass yields while growing biomass on non-fertile marginal lands. Thus, circular economic model to benefit both parties was established to introduce economically and environmentally feasible solution.

The search for solution while combining these two problems started 5 years ago via some research and experimental development – search for fast growing tree clones adapted to local climatic conditions and fertilization trials using nutrient rich waste. The initial research was conducted during EU Eurostars funded project Snowtiger, during which first poplar plantations were established in Lithuania and fertilized with municipal water treatment sludge. During the project frost resistant poplar varieties were tested in Lithuania, Latvia, Estonia and Sweden and fertilization trials with municipal water treatment sludge digestate were performed in Lithuania.

Business partnership (without establishing a legal entity, but via implementation of a project) is formed by private limited liability company (land owner and biomass grower), municipal company (water

supply and waste-water treatment plant), private limited company (biomass boiler), NGO (forest and land owners association) and state research institutions.

Main activities

The main activities are biomass plantation establishment and management, biomass production, waste management (reuse of nutrient rich waste for fertilization purposes), side activities – substantial CO2 sequestration throughout the whole circular cycle, biogas production from sludge and power production from biogas.

Some changes have been made since the start of the project. The project added some missing activities – more biomass plantations were established as large area needed to ensure reuse on municipal waste water treatment sludge of large city according legal regulation and switched activities from linear towards circular mode – nutrient rich waste is being reused for biomass yield improvement and CO2 sequestration in tree biomass instead of use in landfills. The partnership differentiates itself as it provides sustainable solution to nutrient rich waste management through multiple cooperation and this is unique as there are no similar models operating in Lithuania.

Market

There are different customers for different products and services. Biomass can be sold to local biomass boilers and wood processing industry (particle board mills). Municipal water treatment plants and biomass boilers are clients for nutrient rich waste management. Waste water treatment sludge digestate and biomass ashes can be used for fertilization by land owners, farmers, forest owners to grow biomass. Heat produced from biomass is sold to district heating network. Customers are usually reached by direct sales. Biomass is sold via biomass energy exchange, specialized intermediary.

Challenges and solutions

Internally in Lithuania, the partnership considers replication of circular bioeconomy model in other municipalities of Lithuania to reuse their waste water treatment sludge digestate for woody biomass growing. Within implementation of the project, there will be small replications in Sweden and Latvia. The model to use waste water treatment sludge for biomass growing is a local circular bioeconomy concept and can be replicated based on legal framework and existing biomass growers interest in different municipalities, as waste water treatment sludge is available everywhere. At the same time, publicity is needed to promote proposed circular economy model within society.

The major limitations are legal framework and social perception – each country defines its own legal framework for usage of sewage sludge or biomass ashes in agriculture and biomass growing (besides EU Sludge regulation) due to certain contamination risks. Despite unlimited market potential, biomass growing is a very challenging business – market prices may fluctuate over 100%, high initial investment costs usually need subsidies to make this activity feasible. This is particularly challenging as investment into biomass plantations is quite long term – ranging from 4 years to 15 years, when the revenue from harvesting of biomass may be expected, while initial investment is significant.

Up till now the biggest challenge has been unclear legal framework – over time legal framework was changing constantly – stricter regulations are being imposed of nutrient rich waste usage in biomass growing. Climate change introduces new opportunities but also challenges to biomass growers – more summer droughts make biomass growing business more risky, requires more research for drought and frost tolerant biomass crops.

Funding

Circular economy model as demonstration model was financed by EU funding - LIFE program, Ministry of Environment of Lithuania, Swedish Energy Agency and project partners. The total cost of the project Nutribiomass4LIFE is 4 million EUR. In addition, the project has received additional grant from public authorities for demonstration model.

A municipal waste water treatment company and biomass boiler receives benefits via waste management cost reduction immediately, waste management company receives profit after two years of operations, biomass growers 8–12 years after biomass sales.

What makes this case innovative?

The project represents a full scale self-sustainable closed loop circular economy model for large cities' nutrient rich waste - municipal wastewater treatment sludge and biomass ashes – recycling into renewable energy for city's needs via environment friendly biomass plantation filter.

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Project co-funded by the European Regional Development Fund