D5.6 Business Models Blueprints and Tools

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Accelerating circular bio-based solutions integration in European rural areas

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Executive Summary

BioRural seeks to establish a pan-European Rural Bioeconomy Network to promote the currently available small-scale bio-based solutions in rural areas and to increase the share of Bioeconomy, giving increased value in such remote areas. BioRural will contribute to bridge the gap between the novel high-end bio-based solutions currently available and the everyday rural life in Europe by:

- evaluating and assessing the current state of the European rural bioeconomy,
- identifying grassroots needs and ideas,
- fostering effective knowledge and information exchange,
- looking into potential opportunities for regional development through the expansion of bio-based solutions integration in rural Europe.

This way, BioRural will develop a transition framework towards a sustainable, regenerative, inclusive, and just circular Bioeconomy across all Europe at local and regional scale and support innovators to scale-up inclusive and small-scale bio-based solutions in rural areas. To do so, the project will:

(i) Assess and evaluate the **current performance of the European rural Bioeconomy** in the EU and identify factors affecting innovation adoption and diffusion of bio-based solutions in rural areas;
(ii) Create four regional Rural Bioeconomy Platforms (RBPs) that will form a **European Rural Bioeconomy Network (ERBN)**;
(iii) Assess and promote **success stories** of bio-based solutions in rural areas;
(iv) Develop and continuously optimise an online open stakeholders' tool, named **BioRural Toolkit**;
(v) Facilitate knowledge exchange and **capacity building** for the European rural Bioeconomy through a series of workshops in local, regional, and European level;
(vi) Create **rural development blueprints** for regional and business scale-up of resilient and circular bio-based solutions in rural areas and
(vii) Disseminate and communicate all activities for maximum visibility and rural Bioeconomy expansion.

The Dissemination, Exploitation and Communication (DEC) plan provides the guidelines for effectively sharing information within the consortium and an extensive strategy for transferring project knowledge and results to the intended stakeholders.

The aim of this document is to provide key knowledge and essential tools to support entrepreneurship in circular bioeconomy. It showcases fundamental terms of business models and market analysis and it goes further by presenting a set of tools, under the lens of bioeconomy ventures.

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List of Abbreviations and Acronyms	
BM(s)	Business Model(s)
BMT	Business Model Tool
CRI	Concentration Ratio Index
CR	Concentration Ratio
DEC	Dissemination, Exploitation and Communication
EEA	European Environmental Agency
ERBN	European Rural Bioeconomy Network
ESG	Environmental and Social Governance
HHI	Herfindahl-Hirschman Index
IP	Intellectual Property
LCA	Life Cycle Assessment
MA	Market Analysis
PaaS	Product-as-a-Service
PESTELE	Political, Economic, Social, Technological, Environmental, Legal, and Ethical
R&D	Research and Development
RBPs	Regional Rural Bioeconomy Platforms
SAM	Serviceable Available Market
SBMC	Sustainable Business Model Canvas
SD	Service-Dominant
SDBM/R	Service-Dominant Business Model Radar
SOM	Serviceable Obtainable Market
SWOT	Strengths, Weaknesses, Opportunities, and Threats
TAM	Total Addressable Market
TBL	Triple Bottom Line
TLBMC	Triple Layered Business Model Canvas
TRL	Technology Readiness Level
USP	Unique Selling Proposition
VPC	Value Proposition Canvas

1 Introduction to BioRural and Circular Bioeconomy

1.1 Project summary

1.1.1 The Challenge

The EU economy is heavily reliant on linear production systems and non-renewable resources and materials. Since the extraction of fossil fuels continues to release more carbon into the atmosphere, it exacerbates already major environmental and climatic issues and the well-known greenhouse effect. Further, climate change has an impact on the entire economy in addition to having an immediate consequence on the environment and humans. The climate change impact over food security, human health, migratory flows, biodiversity loss and rising sea levels, will lead to a decline in productivity and wealth creation. In this context, the bioeconomy has a key role to play.

Strengthening Europe's bioeconomy can significantly accelerate progress towards achieving key EU policy objectives, such as transitioning to a circular economy, becoming climate neutral by 2050, and strengthening the EU industrial base.

BioRural created a pan-European Rural Bioeconomy Network under which related stakeholders cooperate to promote the currently available small-scale bio-based solutions in rural areas to increase the share of Bioeconomy, giving increased value in such remote areas. This framework will contribute to bridging the gap between the available novel high-end bio-based solutions and the everyday European rural life by assessing the existing situation of European rural Bioeconomy, capturing grassroots-level needs and ideas, promoting effective exchange of knowledge and information, and investigating the possible opportunities for regional development through the expansion of bio-based solutions integration in rural Europe. BioRural is built on a three-pillar intervention scheme:

- **Pillar 1 – Knowledge:** The first pillar focused on the creation and sharing of knowledge through a series of activities and a comprehensive overview of the status of the EU Bioeconomy, with more than 440 interviews with end users and experts conducted. Additionally, during this phase, five workshops organised to facilitate knowledge exchange.
- **Pillar 2 – Network:** The second pillar focused on the establishment of the European Rural Bioeconomy networks and the development of the four Regional Rural Bioeconomy Platforms (RBPs) to foster collaboration and capacity building. Moreover, the created network supported by 38 Rural Bioeconomy Success Stories which were identified throughout Europe, the delivery of 42 capacity building workshops, four regional workshops, and the organisation of the European Bioeconomy Challenge.
- **Pillar 3 – Business Models:** The final pillar, focusing on supporting business in bioeconomy, delivered through this report Business Model Blueprints adapted to the five Bioeconomy Themes, and will develop a post-project sustainability plan to ensure the long-term impact and continuation of project's results and outcomes.

1.1.2 BioRural's key activities

During its implementation, BioRural conducted the following key activities:

- Assessed and evaluated the current performance of the European rural Bioeconomy in the EU and identified the factors affecting innovation, adoption, and diffusion of bio-based solutions in rural areas;
- Created the four regional **Rural Bioeconomy Platforms (RBPs)** that form a **European Rural Bioeconomy Network (ERBN)**;
- Identified, assessed and promoted 38 success stories of bio-based solutions in rural areas;
- Developed and continuous optimise the online open stakeholders' tool - **BioRural Toolkit**;
- Facilitated knowledge exchange and capacity building for the European Rural Bioeconomy through a series of workshops in local, regional, and European level;
- Created rural development blueprints for regional and business scale-up of resilient and circular bio-based solutions in rural areas and
- Dissemination and communication of all activities for maximum visibility and rural Bioeconomy expansion.

Figure 1. BioRural's conceptual approach on supporting

1.1.3 The European Rural Bioeconomy Network

BioRural established the four (4) regional "Rural Bioeconomy Platforms (RBPs)", covering all geographic areas in - the EU (North-West, South-West, North-East and South-East), which together form the European Rural Bioeconomy Network (ERBN) (Figure 2). The role of each platform is multiple and can be characterized as a Bioeconomy synergy/cluster hub that structures a community of related stakeholders and facilitates communication, cooperation and collaboration. ERBN assists to address the existing fragmentation between local Bioeconomy actors (inhabitants, private Bioeconomy businesses and policymakers) as well as ensure an inclusive transition to a circular bio-based economy. These 4 geographic quartiles were chosen as they strike a balance between similarities within bioeconomy parameters while maintaining regional relevance.

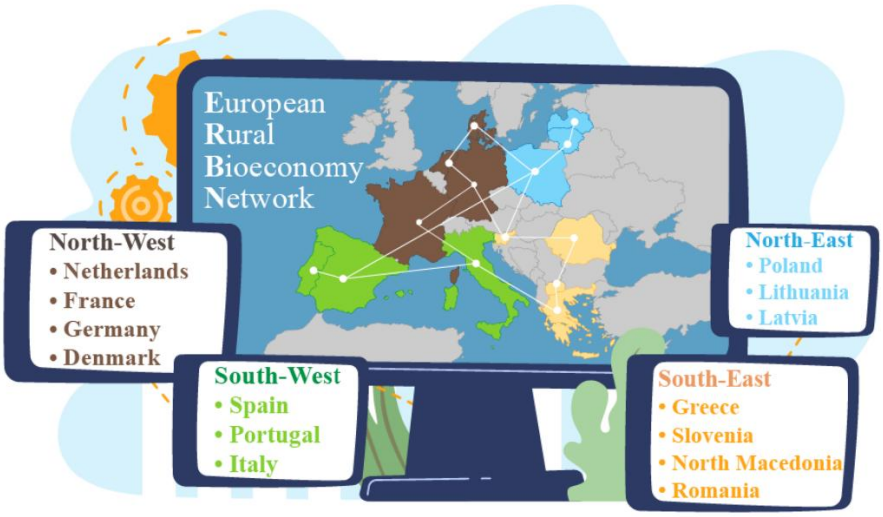


Figure 2. Areas of the European Rural Bioeconomy Network

1.2 Overview of the European Bioeconomy status

As stated in the European Commission's communication to EU parliament (COM/2018/673), *"The bioeconomy covers all sectors and systems that rely on biological resources (animals, plants, micro-organisms and derived biomass, including organic waste), their functions and principles"*. In brief, it is a growing field within the broader economy, research, and policymaking that focuses on sectors relying on biological resources to support the transition to a sustainable European economy. It involves producing food, materials, and energy from renewable biological resources and converting these, along with waste streams, into value-added products. The bioeconomy's innovation potential stems from its use of diverse scientific, technological, and local knowledge.

A key pillar of bioeconomy is the sustainable industrial use of renewable resources—both aquatic and terrestrial biomass—for energy and products that promote economic, environmental, social, and national security benefits. Although current bioeconomy sectors still rely on fossil-based raw materials like petroleum-derived fertilizers and chemicals, the concept is closely linked to sustainability and the circular economy. A sustainable bioeconomy requires not only substituting fossil resources but also sustainable biomass production, conversion, and product development, often achieved by integrating circular economy principles.

Circular Bioeconomy: Efficiency and Sustainability Combined

The circular bioeconomy **combines the goals** of the **circular economy** with the practical methods of the **bioeconomy** to promote efficient resource management of bio-based renewables (Figure 3). It is based on three principles:

- Designing out waste and pollution
- Keeping products and materials in use
- Regenerating natural systems

Figure 3. The transition to a circular Bioeconomy.

Source: Based on Stegman et al. 2020

The EU's Transition to a Circular Bioeconomy

The EU bioeconomy is a major sector that includes agriculture, forestry, fisheries, food, bioenergy, and bio-based products, generating about €2 trillion annually and employing 18 million people. The EU's initial updated bioeconomy strategy (European Commission, 2012) aimed to ensure food security, sustainably manage resources, reduce dependence on non-renewables, combat climate change, and create jobs, with its update on 2018 reframing the main objectives within a more urgent and holistic context of sustainability and circularity (European Commission, 2018).

The European Commission has invested heavily in developing a sustainable bioeconomy, with the 2019 EU Green Deal as a key strategy to reduce greenhouse gas emissions by 2050 through resource-efficient, competitive economies. This plan focuses on restoring biodiversity, reducing pollution, and fostering a transparent circular economy.

To support this shift, the Common Agricultural Policy (CAP) for the period 2014 - 2020 was modernized to prioritize sustainability for European farmers, especially small farms, aligning with the Green Deal's (European Commission, 2019) objectives through ten key goals.

A detailed analysis of the status on European Bioeconomy can also be found in the "Deliverable 1.1 - Currents rural Bioeconomy status".

1.3 Structure and Objectives of this Document

The purpose of this document is to provide a framework and practical tools to support bioeconomy entrepreneurship under the five Bioeconomy themes of BioRural; Aquatic/water systems, Bioenergy, Biomaterials, Food/agriculture, and Forest/natural environments. This report offers essential theoretical knowledge on Business Models (BMs) and Market Analysis (MA), and goes through a set of tools exploring their usage, to equip readers with crucial skills on business modelling and market analysis.

It is structured of six chapters. The first and the last chapters introduce and conclude respectively this document. The following chapters are described briefly below:

Chapter 2: This section defines what business models are, their fundamental components, and their strategic importance for any venture. It provides a high-level overview of various business model types, with a specific focus on those most relevant to our project, such as Circular Business Models and specific Bioeconomy Business Models like resource recovery and biorefineries.

Chapter 3: This chapter presents the fundamentals of market analysis, defining its purpose as a systematic process for understanding market dynamics. It introduces a suite of essential strategic and technical tools for

evaluating the competitive landscape, including Porter's Five Forces, SWOT analysis, PESTELE analysis, and methods for assessing market size and concentration like TAM/SAM/SOM and HHI.

Chapter 4: This chapter provides an in-depth review of various visual tools used to design, analyse, and communicate business models. It details the application of the classic Business Model Canvas, the customer-centric Value Proposition Canvas, and more advanced frameworks like the Sustainable Business Model Canvas and the Triple Layered Business Model Canvas (TLBMC). The chapter concludes by benchmarking these tools and selecting the TLBMC as the most suitable for holistically capturing the economic, environmental, and social dimensions of BioRural's initiatives.

Chapter 5: This chapter offers practical, step-by-step guidance on adapting and applying the Triple Layered Business Model Canvas (TLBMC) to each of the five key bioeconomy themes of the BioRural project. It provides tailored instructions for the economic, environmental, and social layers of the canvas, ensuring that the blueprints are specifically relevant to ventures in Aquatic Systems, Bioenergy, Biomaterials, Food & Agriculture, and Forestry.

Chapter 6: This final chapter summarizes the key findings of the report, emphasizing that the use of comprehensive tools like the Triple Layered Business Model Canvas is instrumental for designing and assessing sustainable ventures within the circular bioeconomy. It concludes that these frameworks enable a holistic approach, facilitate resource efficiency, create new market opportunities, strengthen rural development, and ensure that our bio-based solutions deliver tangible economic, environmental, and social benefits.

2 Introduction to Business Models

Business models are models that aim to map and describe how value can be created, how this value is captured and how it can be profitable and sustainable. Each venture may use a different way to capture value. These ways are the different types of Business Models. To create a business model, different tools and methodologies have been developed, with the brief and visual representations of them dominating.

2.1 Definition and Key Components of Business Models

A business model is the representation of a company's approach on generating revenue while addressing market needs and demands. Key actions to generate a business model are the identification of target markets, value propositions, revenue streams, and cost structures, forming a cohesive strategy for profitability. Business model – as a tool – facilitates a dual role, both as a planning and as a diagnostic tool. Historically, business models were a part of an organisation's strategy. Although, following the digital revolution of mid '90s and early '00 , business models as tools, became essential to startups to attract investors, plan their scale-up, and pivot to adapt on new trends. A business model tool (BMT) represents different fundamental elements of a business and aims to clarify how different aspects of the business are related to each other. The goal of a business model tool is to provide a quick overview of the business model without many details (compared to the traditional business plan). The visual nature of the business model tool should make it easier to refer to and understand by anyone.

Briefly, a Business Model can be defined as:

- An architecture for the product, service and information flows, including a description of the various business actors and their roles
- A description of the potential benefits for the various business actors
- A description of the sources of revenues (Timmers, 2006).

2.2 Methodological Approach to Business Model Selection

Selecting the right business model is a fundamental step in ensuring that research results are effectively commercialized or made accessible to the target audience. A well-defined business model determines how an innovation will create, deliver, and capture value, whether through market transactions, licensing agreements, or public good dissemination. Making this choice requires balancing technological feasibility, financial sustainability, and societal impact.

The business model selection process typically starts with assessing the technology readiness level (TRL) of the innovation. Early-stage research results may not be ready for direct commercialization and may require further development through partnerships, licensing, or open innovation models. More mature technologies, on the other hand, can be introduced to the market through direct sales, platform-based models, or subscription services. Evaluating the innovation's position within the market lifecycle ensures that the chosen model maximizes its potential and avoids premature scaling or misalignment with user needs.

Another crucial aspect of business model selection is analysing the market landscape, including identifying competitors, potential customers, and barriers to adoption. Market gap analysis helps projects understand where their innovation fits within existing solutions and what unique value it offers. Scenario planning, where different business models are tested against various economic and regulatory conditions, is often used to refine the decision-making process. This ensures that exploitation efforts are robust, adaptable, and financially sustainable over the long term.

2.2.1 Overview of Common Business Models

This section explores some of the most common business models relevant to circular bioeconomy ventures, including platform-based models, licensing strategies, and data-driven monetization approaches. Each model has distinct advantages and challenges, requiring a careful assessment of market dynamics, technology readiness, and stakeholder needs. Understanding these models will enable project teams to select the most effective pathway for exploitation and long-term sustainability.

2.2.1.1 Platform business model

A business model that facilitates value exchange between multiple interdependent groups. Platforms act as intermediaries, providing the infrastructure, rules, and mechanisms necessary for interactions. Digital platforms, such as e-commerce marketplaces, social networks, and innovation hubs, dominate this model. Their success relies on network effects, where the value of the platform increases as more users join. The scalability of this model makes it attractive for businesses looking to rapidly expand their reach. Platforms generate revenue through commissions, transaction fees, advertising, or premium subscriptions.

2.2.1.2 Licensing

A business model where intellectual property (IP), technology, or know-how is transferred to another entity under specific terms. Licensing agreements grant rights to use, modify, or commercialize a product while allowing the original owner to maintain control. This model is common in industries such as software, biotechnology, and manufacturing. Companies use licensing to enter new markets without direct investment while ensuring revenue through royalties or lump-sum payments. Effective IP management is crucial to preventing unauthorized use and ensuring long-term profitability.)

2.2.1.3 Data-driven Business Models

A model that monetizes the collection, processing, and analysis of data. Companies leveraging this approach use advanced analytics, machine learning, and artificial intelligence to extract insights from large datasets. This model is increasingly popular in sectors such as digital marketing, healthcare, and agriculture. Organizations can offer freemium models where basic data services are free, with premium features available for a fee. Ethical considerations, such as data privacy and compliance with regulations like GDPR, play a crucial role in sustaining trust and ensuring long-term adoption.

2.2.1.4 Product-as-a-Service (PaaS) Business Models

A business model where customers pay for the use or performance of a product without owning it outright. Companies retain ownership and responsibility for the product, offering ongoing services such as maintenance, upgrades, and end-of-life management. This model is widely used in sectors like manufacturing, mobility, and consumer electronics, supporting circular economy principles. Revenue streams are based on subscriptions, pay-per-use, or performance-based contracts. Critical factors for success include ensuring product durability, optimizing service delivery, and fostering long-term customer relationships.

2.2.2 Circular Business Models

A business model designed to extend the lifecycle of products, materials, and resources by promoting reuse, repair, refurbishment, and recycling. Circular models aim to minimize waste and environmental impact while creating value through regenerative systems. Industries such as fashion, electronics, and construction are increasingly adopting this approach to meet sustainability targets and regulatory requirements. Businesses leveraging circularity often generate revenue through product-as-a-service models, take-back schemes, or

secondary markets. Success in this model depends on efficient resource management, customer engagement, and collaboration across the value chain.

The European Environmental Agency (EEA) in its publication on the framework for enabling circular business models in Europe (EEA, 2021) highlighted key aspects of these models. This framework puts in the centre the circularity goals and around them, they identified key elements for business model innovation (Figure 4). These key elements are:

- **Materials phase:** use of recycled materials, reduced production waste and reduced use of certain materials are crucial for developing a circular business model
- **Product design phase:** circular design is key factor to achieve circular goals, as this determines the reuse, remanufacturing or recycling of materials
- **Production and distribution phase:** efficiency and optimisation of processing can contribute to lower use of resources
- **Use phase:** users' behaviour has a major role in achieving circular goals, with the increase of reuse, longer use, repair being key practices to support these models
- **End-of-life phase:** as one of the main characteristics of linear economy, waste management is crucial for recycling, energy recovery or safe disposal

The aforementioned elements are successfully identified and investigated by using the Tripled Layer Business Model Canvas in Chapter 4.

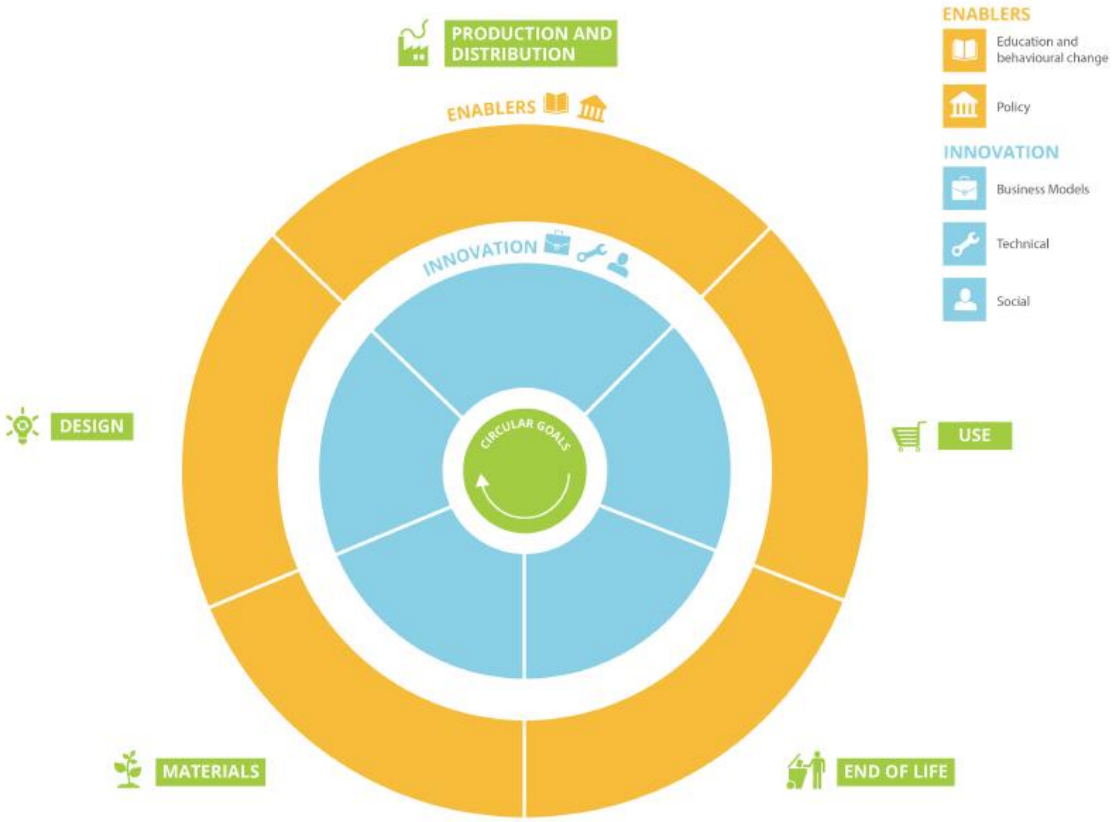


Figure 4. The Circular Economy Framework.

2.2.3 Bioeconomy Business Models

Bioeconomy business models are pivotal in transforming how we derive value from biological resources, steering industries towards sustainability and circularity at the same time. At their core, these models

redefine the architecture for product, service, and information flows, ensuring that the potential benefits for various actors—from primary producers to consumers—are maximised while establishing robust revenue sources. Rooted in the principle of utilizing renewable biological resources such as crops, forests, fish, animals, and micro-organisms, bioeconomy business models aim to produce food, materials, and energy in a way that is economically viable and environmentally sound. They are instrumental in the transition away from a linear, fossil-based economy towards a circular system where resources are kept in use for as long as possible, waste is minimised, and natural systems are regenerated.

The significance of innovative bioeconomy business models lies in their capacity to unlock new opportunities for value creation while addressing pressing environmental and societal challenges. These models often integrate principles of the circular economy, focusing on efficient resource management, waste valorisation, and the development of sustainable bio-based products and services. As mentioned above, the European Environment Agency's framework for circular business models highlights key intervention points across a product's lifecycle, including sustainable material sourcing, circular product design, efficient production and distribution, extended use phases (through repair and reuse), and effective end-of-life management. By fostering innovation in these areas, bioeconomy business models can enhance resource efficiency, reduce greenhouse gas emissions, protect biodiversity, and stimulate rural development, thereby contributing significantly to achieving policy objectives like the European Green Deal.

2.2.3.1 Product Life Extension Models

These models focus on maximising the lifespan of bio-based products through enhanced durability, and by offering repair, maintenance, and refurbishment services. An example is a company offering repair services for high-quality, durable textiles or wooden furniture, thus keeping materials in use for longer and reducing waste.

2.2.3.2 Resource Recovery Models - Waste Valorisation

These business models centre on transforming biological waste streams—such as agricultural residues, food processing by-products, or forestry residuals—into higher-value products. For instance, the Greek company Staramaki utilises cereal straw residues to produce drinking straws, and PHEE uses washed-up seagrass (Posidonia Oceanica) to create innovative panel materials. Another example is the conversion of olive pomace into biochar or energy.

2.2.3.3 Sharing and Access-Based Models

Instead of selling products, these models provide users with access to bio-based goods or services, often through rental, leasing, or sharing platforms. This increases the utilisation rate of products and can reduce overall material consumption, such as in textile leasing services or shared bio-based agricultural machinery.

2.2.3.4 Biorefinery Models

This approach involves the integrated processing of biomass to produce a diverse range of marketable products, including food and feed ingredients, bio-based chemicals, biomaterials, and bioenergy. By converting all components of the biomass feedstock into valuable outputs, biorefineries aim to maximise economic value while minimising waste, representing a cornerstone of advanced bioeconomy development.

To encapsulate, when trying to develop a Business Model it is important to consider **selecting the most appropriate and applicable Business Model** when exploring the economic potential. As indicated above, there is great variety in Business Models and each Business Model considers its value propositions in its own way, scrutinising different elements of the value chain and observing particular interaction patterns. This Business Model exploration is a common enough thing when trying to investigate the added value of an innovation, i.e. this iterative process through which business models are proposed, compared and subjected

to experimentation until a revised and presumably successful business model is reached (Sosna, Trevinyo-Rodríguez, & Velamuri, 2010). This issue will be addressed in a following chapter, where a review of the most suitable Business Models will take place and the most pertinent will be selected.

2.3 Key Components of a Business Model

This chapter provides a primer on the fundamental components of any successful business model. To clearly illustrate universal concepts like value proposition, revenue streams, and customer segments, this section uses examples from globally recognised companies. While these firms are outside the bioeconomy sector, their strategies offer powerful and applicable lessons in creating and capturing value. This foundational knowledge serves as a basis for the subsequent chapters, where these principles will be adapted to create specialised business model blueprints tailored to the unique opportunities within the rural bioeconomy.

2.3.1 Value Proposition - Delivering Unique Benefits

The value proposition is the cornerstone of any business model, articulating why customers should choose a company's offerings over competitors. It answers critical questions about the problem being solved, the benefits provided, and the differentiation strategy. For example, Spotify's freemium model offers free ad-supported music streaming while premium tiers deliver ad-free listening and offline access, effectively balancing accessibility and monetization. A compelling value proposition aligns with customer pain points, whether through innovation (e.g., Tesla's electric vehicles), cost efficiency (e.g., IKEA's flat-pack furniture), or customization (e.g., Nike's personalized sneakers).

2.3.2 Customer Segments - Targeting the Right Audience

Identifying and segmenting customers ensures that resources are allocated to the most lucrative markets. Businesses may target mass markets (e.g., Walmart, Harrods), niche audiences (e.g., Rolex, Ferrari), or multi-sided platforms serving distinct groups (e.g., credit card companies linking merchants and consumers). Misalignment between value propositions and customer segments often leads to inefficiencies; for instance, a luxury brand expanding into budget markets risks diluting its brand equity.

2.3.3 Revenue Streams - Monetisation Strategies

Revenue streams define how income is generated, whether through direct sales, subscriptions, licensing, or advertising. Dynamic pricing mechanisms, such as Uber's surge pricing or hotel room rate fluctuations, optimize revenue based on demand and supply. The razor-and-blade model, exemplified by printer manufacturers selling cheap hardware but expensive ink cartridges, demonstrates how complementary products can drive recurring revenue. Diversifying revenue streams—as seen in Amazon's combination of e-commerce, AWS, and Prime subscriptions—reduces dependency on a single source and enhances financial resilience.

2.3.4 Cost Structure - Balancing Expenses and Investments

A business model's viability hinges on managing fixed and variable costs while investing in growth. Startups often prioritize customer acquisition over profitability, as seen in Uber's initial subsidies to drivers and riders. In contrast, mature companies like McDonald's optimize costs through franchising, transferring operational

expenses to franchisees while collecting royalties. Scalable models, such as software-as-a-service (SaaS), benefit from low marginal costs post-development, enabling rapid expansion without proportional cost increases.

2.3.5 Channels and Customer Relationships - Delivering Value Efficiently

Channels encompass the platforms and touchpoints through which products reach customers, including physical stores, e-commerce websites, and mobile apps. Apple's integration of online sales, retail stores, and app ecosystems creates a seamless omnichannel experience. Simultaneously, customer relationships—ranging from personalized support (e.g., Nordstrom's concierge services) to automated self-service (e.g., Amazon's checkout)—shape brand loyalty and retention.

2.3.6 Key Resources and Partnerships - Leveraging External Capabilities

Critical resources, whether physical (factories), intellectual (patents), or human (skilled labour), underpin operational execution. Partnerships further augment capabilities; for example, Spotify licenses music from record labels, while Airbnb relies on homeowners to supply accommodations. Strategic alliances reduce risk, accelerate market entry, and enable focus on core competencies.

2.4 The importance of Business Models

Business models serve as the foundational architecture that enables organizations to navigate complex markets, align resources, and achieve long-term viability. By delineating how value is created, delivered, and captured, these frameworks provide clarity for stakeholders, mitigate risks, and foster innovation. In an era marked by rapid technological disruption and shifting consumer preferences, the strategic importance of business models cannot be overstated. This report synthesizes insights from academic research, industry case studies, and economic theory to explore the critical role of business models in driving profitability, scalability, and competitive differentiation.

2.4.1 Strategic Direction and Organizational Alignment

2.4.1.1 Clarifying Value Propositions

A well-defined business model forces organizations to articulate their value proposition—the unique benefits they offer to customers. For instance, Spotify's freemium model balances free ad-supported streaming with premium subscriptions, addressing both accessibility and monetization. This clarity ensures that every operational decision, from product development to marketing, aligns with delivering core value. Without such focus, companies risk diluting their offerings or misallocating resources, as seen in Kodak's failure to pivot from film to digital photography despite inventing the first digital camera.

Business models also help identify target markets with precision. For example, Walmart's cost-leadership strategy, which prioritizes rural and suburban areas underserved by competitors, exemplifies how geographic and demographic segmentation can drive dominance. By mapping customer segments to value propositions, businesses avoid the pitfalls of overgeneralization, such as luxury brands eroding equity by expanding into budget markets.

2.4.2 Resource Allocation and Operational Efficiency

Effective business models optimize the use of financial, human, and technological resources. McDonald's franchising model transfers operational costs to franchisees while retaining royalty revenues, enabling capital-light expansion. Similarly, SaaS companies like Salesforce benefit from low marginal costs post-development, allowing them to scale rapidly without proportional increases in expenses. These models highlight how strategic resource allocation reduces waste and enhances profitability.

2.4.3 Financial Viability and Investor Confidence

2.4.3.1 Revenue Diversification and Profitability

Business models delineate revenue streams, reducing dependency on income sources. Amazon's hybrid model—combining e-commerce, AWS cloud services, and Prime subscriptions—illustrates the resilience of diversified monetization. Companies like Gillette employ the razor-and-blade model, selling durable hardware at low margins while profiting from recurring consumable sales. Such strategies stabilize cash flow and insulate businesses from market volatility.

Investors prioritise models with clear paths to profitability. Gross margins and customer lifetime value (CLV) are key metrics; Netflix's subscription model, for example, generates predictable recurring revenue that funds content acquisition and retention efforts. Startups with scalable models, such as platform ecosystems, attract venture capital due to their potential for exponential growth with minimal incremental costs.

2.4.3.2 Cost Management and Scalability

A robust business model balances fixed and variable costs. Tesla's vertical integration—controlling manufacturing, software, and charging infrastructure—initially incurred high R&D expenses but now supports premium pricing and brand loyalty. Conversely, Uber's asset-light platform minimizes capital expenditure by leveraging driver-owned vehicles, though driver subsidies initially strained profitability. Scalability remains critical: Airbnb's global growth without property ownership demonstrates how digital platforms achieve scale without traditional overhead.

2.4.4 Competitive Advantage and Market Differentiation

2.4.4.1 Innovation and Disruption

Business models enable companies to redefine industries. Apple's integration of hardware, software, and services (e.g., iPhone, App Store, iCloud) created an ecosystem that competitors struggle to replicate. Disruptive models, like Tesla's direct-to-consumer sales bypassing dealerships, challenge incumbents bound by legacy systems. By contrast, Blockbuster's reliance on physical rentals left it vulnerable to Netflix's streaming pivot, underscoring the risks of inflexibility.

2.4.4.2 Barriers to Entry and Network Effects

Platform models thrive on network effects, where value increases with user participation. eBay's marketplace gains strength as more buyers and sellers join, creating a self-reinforcing cycle. Similarly, LinkedIn's professional network becomes indispensable as user profiles and job listings proliferate. These effects erect barriers against competitors, as replicating such ecosystems requires significant time and investment.

2.4.5 Adaptability in Dynamic Markets

2.4.5.1 Iterative Innovation and Pivoting

Business models must evolve with market shifts. Microsoft's transition from software licensing to cloud-based subscriptions (Azure, Office 365) revitalized its growth amid declining PC sales. The Lean Canvas framework advocates rapid experimentation, allowing startups like Dropbox to pivot from enterprise-focused storage to consumer-centric freemium models. Continuous iteration mitigates obsolescence, as demonstrated by Adobe's shift from perpetual licenses to Creative Cloud subscriptions.

2.4.5.2 Sustainability and Circular Economy

Modern models increasingly prioritize environmental and social governance (ESG). Patagonia's circular economy approach—repairing and recycling garments—aligns with consumer demand for sustainability while fostering loyalty. Companies like Tesla further integrate renewable energy solutions (e.g., solar roofs, Powerwall batteries) into their core offerings, futureproofing against regulatory changes.

2.4.6 Customer-Centricity and Relationship Management

2.4.6.1 Personalization and Retention

Business models that prioritize customer relationships achieve higher retention rates. Nordstrom's concierge services and Amazon's personalized recommendations enhance loyalty through tailored experiences. Subscription models, such as those used by Dollar Shave Club, build long-term engagement by automating replenishment and reducing friction.

2.4.6.2 Data-Driven Insights

Digital models leverage data analytics to refine offerings. Netflix's recommendation algorithm, fuelled by viewing habits, informs content production and reduces churn. Similarly, Uber's dynamic pricing adjusts fares based on real-time demand, optimizing revenue and driver allocation. These insights enable proactive adjustments to market trends and customer preferences.

In conclusion, business models are indispensable tools for navigating today's volatile economic landscape. They provide the scaffolding for strategic decision-making, financial stability, and competitive differentiation while fostering adaptability and customer-centric innovation. As industries confront challenges from AI-driven automation to climate change, organizations must continually reassess their models to seize emerging opportunities. Future success will belong to those who treat their business models not as static plans but as dynamic frameworks for sustained value creation.

3 Market Analysis

Market analysis is a rigorous and systematic process centred on the interpretation of market-related information. Its main objective is to determine a market's size, growth prospects, constituent audience, and prevailing competitive landscape. This analysis goes beyond rudimentary data collection to encompass a deeper understanding of market structures and dynamics. The process involves the methodical gathering, subsequent analysis, and careful interpretation of information pertinent to a specific market, the products or services intended for that market, and the characteristics of past, present, and potential customers. Fundamentally, market analysis serves as a crucial component in the development of products and services and in the management of customer satisfaction, by examining data related to a particular industry or marketplace that an entity is considering entering. It can be understood as a documented investigation used to inform a firm's planning activities across various operational and strategic domains. Furthermore, market analysis studies the attractiveness and dynamics of a specialized market within a broader industry, positioning it as a subset of industry analysis, which in turn is part of a global environmental assessment.

3.1 Market Analysis Methods and Tools Exploration

The key components of the Market analysis are foreshadowed here with the intend of exemplifying a thorough approach in the analysis of future iterations of this report, however, it should be noted, that not all elements will necessarily be employed, and their enumeration below is indicative of the level of analysis intended.

Key components of the market analysis may include:

Strategic decision-making tools

- **Porter's Five Forces Framework:** This framework analyses the competitive intensity and attractiveness of an industry by examining five key forces: the threat of new entrants, the bargaining power of suppliers, the bargaining power of buyers, the threat of substitute products or services, and the intensity of rivalry among existing competitors. It helps in understanding the underlying drivers of industry profitability and in developing competitive strategy.
- **SWOT Analysis:** This critical evaluation identifies internal strengths and weaknesses, alongside external opportunities and threats, positioning each use case effectively in the competitive arena.
- **PESTELE Analysis:** A thorough examination of Political, Economic, Social, Technological, Environmental, Legal, and Ethical (PESTELE) factors provides insights into market drivers, trends, and potential barriers, aligning the project's objectives with the market's pulse.
- **TAM, SAM, and SOM Assessment:** This approach delineates the total market potential, accessible segments, and the realistic market share each can attain. It's a cornerstone for crafting a scalable and informed market entry strategy.

Market analysis techniques

- **Concentration ratio:** This measures the combined market share of the largest firms (e.g., the top 4 or CR4) in an industry, indicating the level of competition. A low ratio suggests high competition, while a high ratio points towards an oligopoly or monopoly and less competition.
- **Herfirndhal-Hirschman Index (HHI) Application:** The HHI is applied to measure market concentration by summing the squares of the individual market shares of all firms in the market. Regulatory bodies often use it to evaluate the competitive impact of mergers and acquisitions, with higher HHI values indicating greater market concentration and potential antitrust concerns.

3.1.1 Porter's Five Forces Framework

Porter's Five Forces Framework is a robust tool for dissecting the competitive dynamics within an industry. Originating from industrial organization economics, this framework employs five distinct forces to gauge the competitive intensity and the resulting attractiveness of an industry, fundamentally linked to its profitability. In contexts where these forces diminish industry profitability, the sector is deemed "unattractive." The epitome of unattractiveness is an industry nearing "pure competition," where profits are normalized across all firms. Porter's Five Forces framework identifies five key forces that influence a company's ability to compete and its profitability:

- the threat of new entrants, which assesses how easily new competitors can enter the market;
- the bargaining power of suppliers, which measures how much influence suppliers have over pricing and terms;
- the bargaining power of buyers (customers), reflecting how much power customers have to drive prices down or demand more value;
- the threat of substitute products or services, which considers the likelihood of customers switching to alternative solutions; and
- the intensity of competitive rivalry, which looks at how fierce the competition is among existing firms. Together, these forces help businesses understand their strategic position and make informed decisions about entering or sustaining operations in a particular industry.

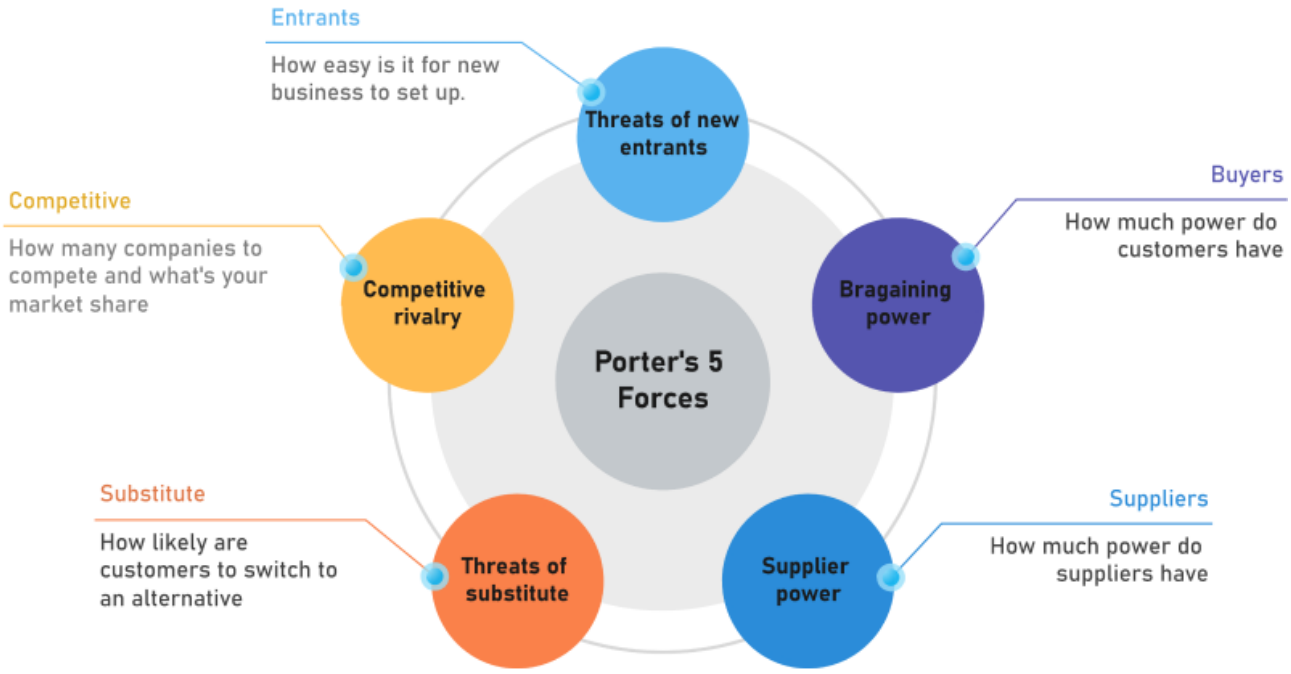


Figure 5. The Porter's Five Forces analysis.

Source: https://www.edrawmax.com/online/en/

3.1.2 SWOT Analysis

This classic strategic planning tool SWOT (Strengths, Weaknesses, Opportunities, and Threats) (Figure 6) allows businesses to assess their internal strengths and weaknesses, while identifying external opportunities and threats. SWOT is particularly useful in defining market positioning, guiding risk mitigation strategies, and identifying the most promising commercialization approaches. Businesses can use SWOT to refine their Unique Selling Proposition (USP) and adjust their go- to-market strategies accordingly.

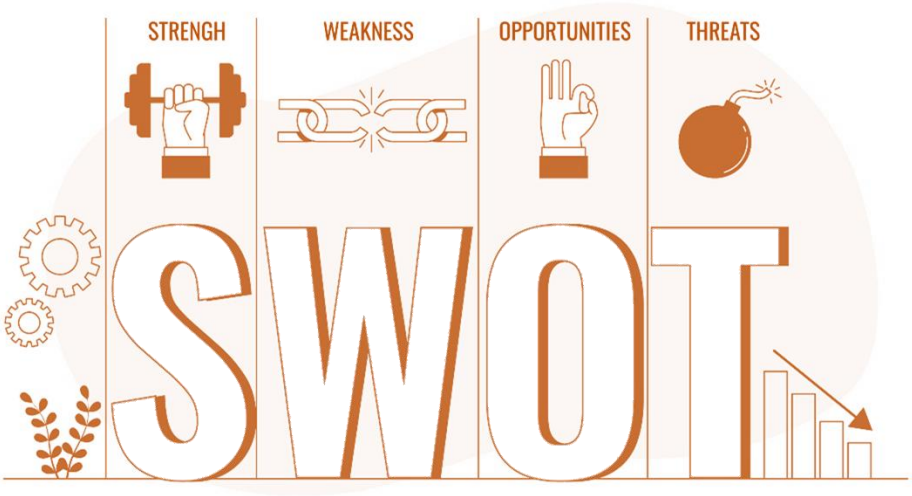


Figure 6. SWOT analysis.

Source: Freepik

3.1.3 PESTELE Analysis

The subsequent phase in market analysis involves a meticulous examination of market drivers. For this purpose, the analysis may employ the PESTELE Analysis, an analytical framework that considers Political, Economic, Social, Technological, Environmental, Legal, and Ethical factors (Figure 7). These factors collectively shape market trends, needs, and barriers, serving as crucial drivers that influence the market landscape.

PESTLE provides a macro-level assessment of factors that may influence the long- term viability of an exploitation strategy. For instance, regulatory changes (Legal), shifts in consumer behaviour (Social), or advancements in enabling technologies Technological) can significantly impact commercialization pathways.

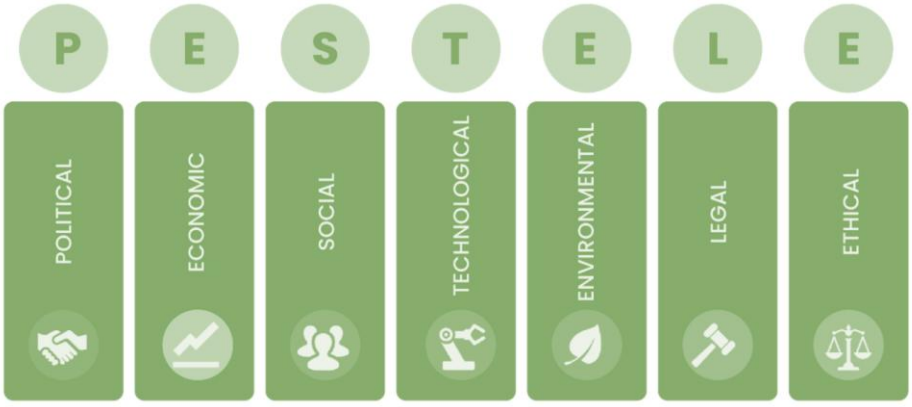


Figure 7. PESTELE analysis schematic representation.

3.1.4 Market analysis using TAM, SAM, SOM

The SAM-TAM-SOM (Serviceable Available Market, Total Addressable Market, Serviceable Obtainable Market) framework provides a structured approach to market sizing.

- **TAM (Total Addressable Market)** defines the maximum potential market size for an innovation.
- **SAM (Serviceable Available Market)** narrows this down to the portion of the market that can realistically be reached given existing resources and infrastructure.
- **SOM (Serviceable Obtainable Market)** further refines the scope to the segment that can be realistically captured in the short term.

This framework is essential for funding proposals and is best exemplified by using this VEN diagram (Figure 8).

Figure 8. TAM-SAM-SOM diagram.

Source: Databox

3.1.5 Concentration Ratio Assessment

In the context of detailed market analysis, the application of the Concentration Ratio (CR) is instrumental in comprehending market dynamics and shaping strategic directions. This analytical measure, pivotal for the formulation of market strategies, discerns the market power held by the largest entities within a specific sector. It is anticipated that subsequent phases of the project will generate the necessary data to facilitate a precise computation of the Concentration Ratio Index (CRI). The Concentration Ratio is computed using the formula:

$$CR_n = \sum_{i=1}^{n} S_i$$

Here, **n** represents the number of leading firms in a given market or industry. The CRI calculates the combined percentage of total industry output accounted for by the largest producers in said industry (**S** stand for turnover), offering insights into the degree of market concentration. Commonly, a CR 4, or the concentration ratio of the top four firms, is deemed adequate for the scope of analyses pertinent to this report.

A high CRI, indicative of a market dominated by a few firms, underscores the need for a robust and proactive Business Model. This is particularly crucial in markets characterized by high entry barriers, where safeguarding innovations and competitive advantages becomes paramount. Conversely, a market exhibiting low concentration and minimal entry barriers suggests a competitive environment where a less aggressive market and BM approach might be preferable, potentially mitigating unnecessary upfront costs.

The findings from the CRI analysis, in synergy with other market analytical tools, will be instrumental in formulating a comprehensive market strategy. This strategy will be intricately tailored to the specific dynamics and characteristics of the industry in focus, aligning with the overarching objectives of each venture. It is through these meticulous analytical processes that a nuanced, data-driven, and strategic approach to market engagement will be crafted, paving the way for informed Business Model development.

3.1.6 Herfirndhal-Hirschman Index (HHI) Application

The Herfindahl-Hirschman Index (HHI) is a recognized tool for analysing market structure, primarily focusing on market concentration and competitiveness. This index complements the Concentration Ratio Index (CRI), offering a detailed perspective on companies' market share in relation to the entire industry and the competitive landscape.

The HHI is computed by summing the squares of each firm's market share within an industry. The formula is:

$$HHI = \sum_{i=1}^{n} S_i^2$$

Where **S** represents the market share percentage of a firm's in each industry as a number and not a decimal and n representing the total number of firms. As is the case with the CRI above, an HHI of the four most dominant firms in the market/ industry is the literature standard and, as such, should be considered sufficient for the analysis of this report.

Squaring the market shares in the HHI calculation emphasizes the impact of larger firms, sharpening the focus on market concentration. The index ranges from near 0 (highly competitive market) to 10,000 (highly concentrated market). Specifically, HHI values up to 1,500 indicate competitive markets, values between 1,500 and 2,500 suggest moderate concentration, and values over 2,500 point to high market concentration.

Precise HHI values are contingent on detailed market data, anticipated from future project deliverables. The subsequent versions of this report will incorporate an accurate HHI, ensuring that market and IPR strategies are based on solid, measurable, and processed data. This approach ensures that strategic decisions are data-driven, matching Business Models with a clear understanding of the competitive dynamics within the industry.

4 Business Model Tools Exploration

"Business model tools are commonly used to describe and communicate business model ideas" (Athanasopoulou & De Reuver, 2020) and are conceptualised, in research, as boundary objects that are meant to make possible the exchange of information between, often disparate in nature, stakeholders (Bouwman et al., 2017). For the purpose of this report an apt definition of Business Model Tools can be found in Bowman et. alia, where Business Model Tools are described as "the use of methods, frameworks or templates (here referred to as tools) to facilitate communication and collaboration regarding Business Model analysis, (re-)design, adoption, implementation and exploitation" (Bouwman, Heikkila, Heikkila, Leopold, & Haaker, 2017). This is of particular importance when addressing the theoretical framework of the Business Model Tools, since it places them in the broader literature of Business Models, a fact that emphasises the coherent nature of the link between the two.

As boundary objects, Business Model Tools must be both "plastic enough to adapt to local needs and the constraints of the several parties employing them, yet robust enough to maintain a common identity across sites" (Star, 2010), i.e. Business Models and, consequently, Business Model Tools must be able to incorporate and convey data for actors across the value chain regardless of how disparate these actors or the information itself may be. As stated above, in research Business Models are often thought of as being composed of different building blocks which, when put together, constitute a business model. A popular such composition is proposed by Osterwalder and Pigneur in 2010, and includes nine building blocks (Osterwalder & Pigneur, 2010):

- Value proposition
- Partner networks
- Customer segment
- Customer relationship
- Channel
- Key resources
- Activities
- Revenue streams
- Cost structure

The fundamental commonality that can be observed across the literature is the necessity for business models to incorporate different data, compromise information from different - and often divergent - viewpoints but to always be then able to integrate this data into a single, coherent message, i.e. the added value of an emergent opportunity. This message can be best communicated through Business Model Tools and must be robust enough to maintain its form and integrity regardless of the receiver's capacity to comprehend.

4.1 The Business Model Canvas

The Business Model Canvas is a Business Model Tool, i.e., it is a visual chart with elements describing an entity's or product's value proposition, customers, infrastructure including its partnerships, and financial aspects. It has been widely adopted in practice for designing business models. However, it often follows an organization-centric approach that renders the model from the perspective of a single entity, as opposed to a network-centric or ecosystem view, which is particularly relevant in the circular bioeconomy. It focuses on the processes controlled by the focal entity and may pay less attention to the active role of various stakeholders (including end-users and other partners in the value web) in value co-creation and circularity.

"The Business Model Canvas is a strategic management and entrepreneurial tool. It allows you to describe, design, challenge, invent, and pivot your business model."

Alex Osterwalder & Yves Pigneur,Inventors of the Business Model Canvas

A particular characteristic of the Business Model Canvas is that its inventors insisted that it should always be a one-page document. The main reason for this is that the Business Model Canvas, being a Tool, should bear a single, robust message: how to implement the strategy of the Business Model. Another reason is the advice

to use graphical icons in business modelling as much as possible in order for the message to be pithy and succinct.

The Business Model Canvas, understandably, incorporates nine (9) building blocks (Figure 9): value proposition, partner networks, customer segment, customer relationship, channel, key resources, activities, revenue streams, and cost structure.

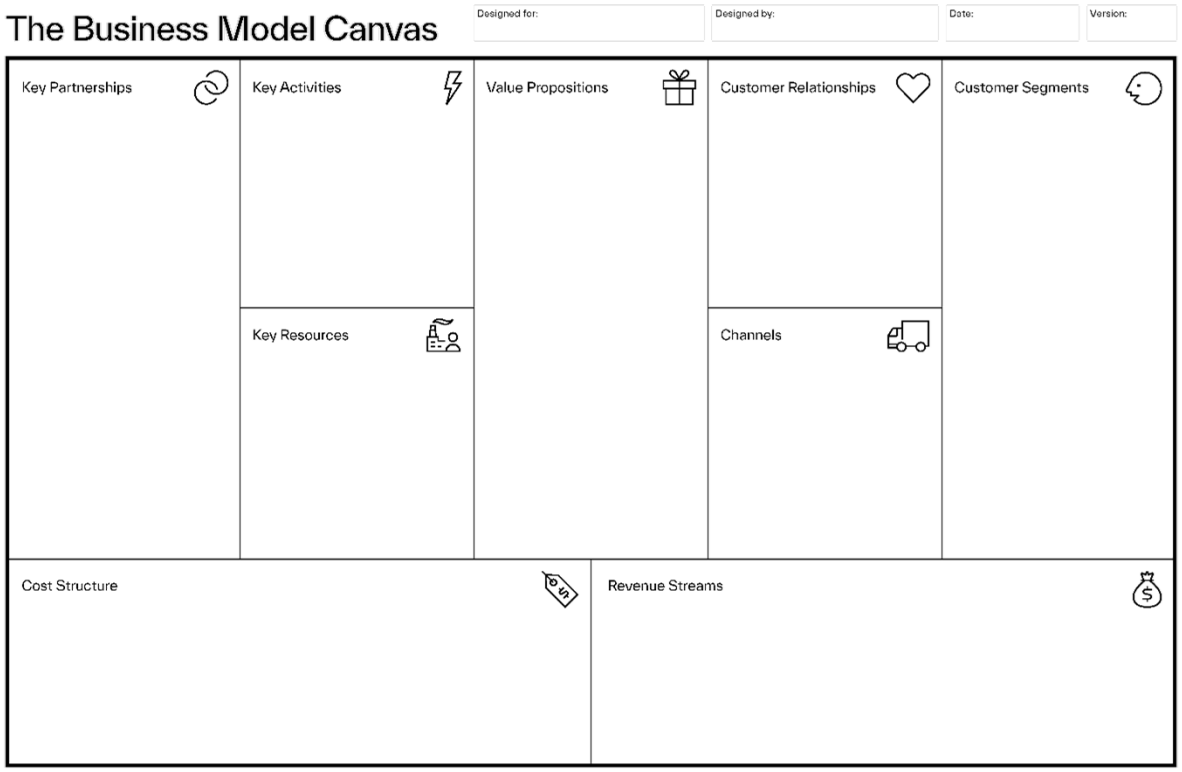


Figure 9. The Business Model Canvas.

Source: Strategyzer

A brief explanation of each block, adapted for a Circular Bioeconomy context, is presented below:

Key activities: The most important activities in executing a circular bioeconomy venture's value proposition. This could include sustainable sourcing of biomass, innovative conversion processes (e.g., biorefining, anaerobic digestion), product design for circularity (e.g., durability, recyclability), developing reverse logistics for material recovery, managing waste streams as resources, and building collaborative networks.

Key resources: The resources that are necessary to create value for the customer and ensure circularity. They are considered assets to a venture that are needed to sustain and support the business. These resources could be human (skilled personnel in biotechnology, circular systems design, supply chain management), financial (investment for green technologies), physical (biorefineries, collection and processing infrastructure, sustainably managed land or aquatic sources), and intellectual (patents on green technologies, proprietary knowledge on biomass conversion, certifications for sustainability).

Key partnerships: In order to optimise operations, reduce risks, and ensure circular flows of a business model, organisations usually cultivate relationships with a diverse set of partners. In the circular bioeconomy, this is crucial and includes suppliers of renewable biological resources (e.g., farmers, foresters, aquaculture enterprises), technology providers, research institutions, waste management companies, industrial symbiosis partners, policymakers, and downstream customers who value circular products. These networks facilitate the exchange of materials, energy, by-products, and knowledge essential for closing loops.

Value propositions: The products and services a circular bioeconomy venture offers to meet the needs of its customers while delivering environmental and social benefits. The value proposition provides value through various elements such as sustainability (e.g., reduced carbon footprint, biodegradability, use of renewable resources), resource efficiency, waste reduction, innovative bio-based products (e.g., bio-plastics, bio-chemicals, advanced biofuels), performance, new functionalities, or a contribution to a regenerative system.

Customer segments: To build an effective business model, a circular bioeconomy venture must identify which customers it tries to serve. These segments could be B2B (e.g., manufacturers seeking sustainable inputs, brands committed to circularity) or B2C (consumers looking for eco-friendly products). It could also include public entities or communities benefiting from environmental services or local resource valorisation. Understanding the specific needs and sustainability drivers of each segment is key.

Channels: A circular bioeconomy venture can deliver its value proposition to its targeted customers through different channels. These include direct sales, distributors specializing in green products, online platforms, or partnerships that integrate the venture's offerings into larger value chains. For circularity, channels must also support reverse logistics for product take-back, reuse, or recycling.

Customer relationships: To ensure the survival and success of any circular bioeconomy endeavour, ventures will have to specify the type of relationship they want to create with their identified customer segments. This could range from transactional to co-creative partnerships, involving customers in product design, feedback loops for improvement, or participation in take-back and recycling schemes to enhance circularity. Building trust through transparency about sourcing, production, and end-of-life management is critical.

Cost structure: This describes the most important monetary consequences while operating under different circular bioeconomy business models. This includes costs for sustainable feedstock sourcing, R&D for green technologies, capital investment in circular processing infrastructure, operational costs for resource-efficient manufacturing, reverse logistics, and managing recovered materials. While some circular practices might increase certain costs, others can lead to savings through waste valorisation and resource efficiency.

Revenue streams: The way a circular bioeconomy venture is expected to generate income from each customer segment. This can include sales of bio-based products, bioenergy, or services (e.g., waste valorisation services, PaaS models). Additional revenue could come from selling by-products, carbon credits, or licensing innovative green technologies. The aim is to create diverse and resilient revenue models that reward circularity.

4.1.1 The Value Proposition Canvas

The Value Proposition Canvas (VPC) (Figure 10) is a strategic tool that helps organisations and businesses to understand and design the value they provide to their customers. It was created by Alexander Osterwalder and Yves Pigneur as part of their Business Model Canvas framework (Osterwalder A. , Pigneur, Bernarda, & Smith, 2014). Clark et al. stated that at the centre of the Business Model Canvas there is the Value Proposition, which represents the value offered to customers (Clark, Osterwalder, & Pigneur, 2012). The Value Proposition Canvas is more than just a graphical representation of customer wants. It focuses specifically on the value a product or service offers to its target customers and how it addresses their needs and pain points. The Value Proposition Canvas can be used when there is a need to improve an existing product or a service offering or when creating a completely new offering.

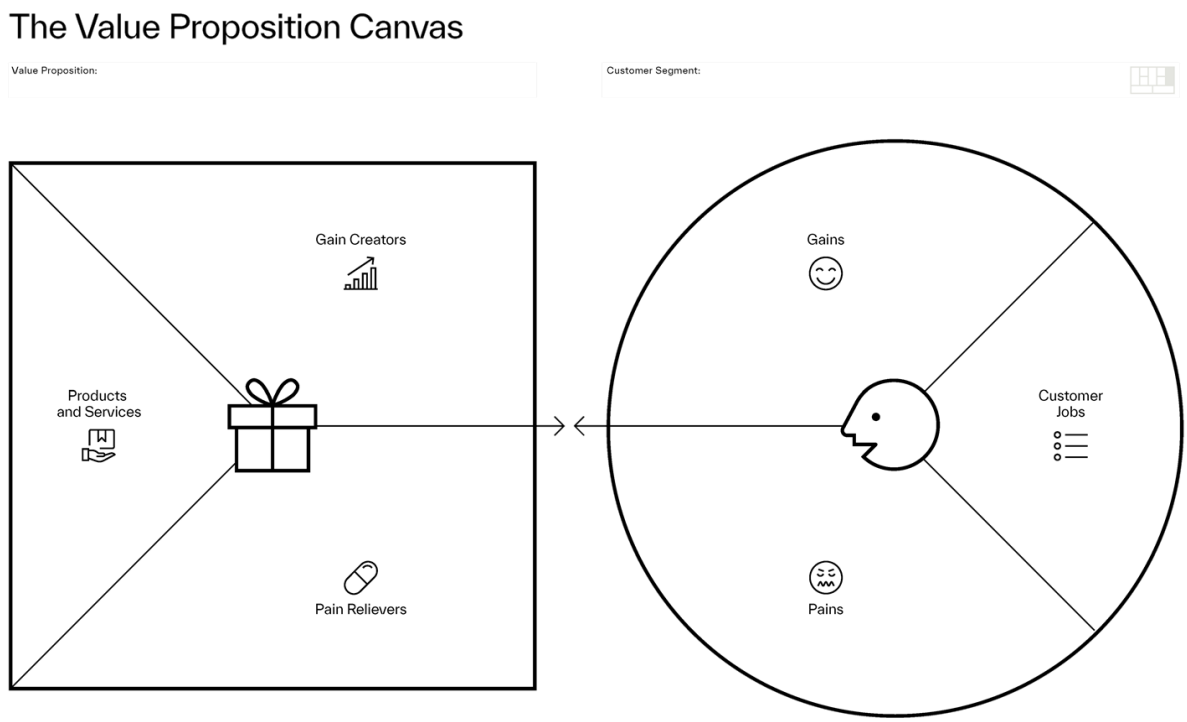


Figure 10. The Value Proposition Canvas.

Source: Strategyzer

The Value Proposition Canvas is a tool to analyse and to define your target customer segments, which are the specific groups of people or organisations you are trying to serve. You can identify their characteristics, behaviours, preferences, and needs. Understanding your customer segments is crucial for tailoring your value proposition effectively. On the other hand, the value proposition contains ways to solve customer problems, relieve concerns and meet expectations. When two canvases align, it indicates that the product and/or service contains the desired values by customers and thus, it helps the company design products and services that their customers want (Osterwalder A. , Pigneur, Bernarda, & Smith, 2014). (Pokorná, Pilař, Balcarová, & Sergeeva, 2015)

As mentioned above, the Value Proposition Canvas is formed around two building blocks (Lindic & Marques da Silvam, 2011): by capitalising the experience in the area of the Customer Segment, ie Customer Jobs, Gains and Pains you are able to create Value Proposition for Products and Services, Gain Creators and Pain Relievers (Pokorná, Pilař, Balcarová, & Sergeeva, 2015). A Company needs to create one profile for each customer segment.

Customer Segment

The Customer Segment (or Customer Profile) breaks the customer down into its jobs, pains, and gains and describes a specific customer segment in a more structured and detailed way.

Gains – Describes the outcomes and benefits that align with customers' expectations and needs. These can range from required, expected or desired to unexpected ones that might pleasantly surprise them. They include functional utility, social gains, positive emotions, and cost savings.

Pains – Describes any sources of frustration that customers experience in the process of getting the job done. Pains also encompass potential negative consequences or risks associated with performing a task inadequately or failing to complete it altogether.

Customer jobs – Describes what customers are trying to achieve in their professional endeavours and personal lives. These customer jobs might be tasks they're striving to accomplish, challenges they're working to overcome, or needs they try to satisfy.

Value Proposition

The Value Proposition breaks your value proposition down into products and services, pain relievers, and gain creators and describes the features of a specific value proposition in your business model in a more structured and detailed way.

Gain creators – how the product or service generates customer benefits and contributes additional value to the customer.

Pain relievers – outlines how your product or service mitigates specific customer pains.

Products and services – include all the products and services a company is planning to deliver. When building this part of a Value Proposition Canvas, one should consider if the product/service can help customers to accomplish any job-to-be-done, how relevant the product/service is, and if it is tangible or digital/virtual, etc.

Overall, the Value Proposition Canvas serves as a practical and user-friendly tool that guides businesses in developing products and services that genuinely address customer needs and create value, leading to more successful and customer-centric outcomes. By tailoring value propositions to specific customer segments, businesses can differentiate themselves in the market and create a competitive advantage.

However, the Value Proposition Canvas does not substitute the Business Model Canvas, it rather complements it. Value Proposition Canvas aims to help a company with understanding its customers better, meaning that it is usually used at the beginning of a startup, when adding a new feature to a product or in case when a company wants to expand its business into a new market or customer segment.

4.2 The Lean Startup Canvas

The Lean Startup Canvas is an adaptation of Osterwalder's and Pigneur's Business Model Canvas which self-identified entrepreneur Ash Maurya proposed in his 2012 book Running Lean: Iterate from Plan A to a Plan That Works (Maurya, 2012). The Lean Canvas promises an actionable and entrepreneur-focused business plan, as it focuses on problems, solutions, key metrics and competitive advantages (Abdoun and Ibrahim, 2018). As is the case with the Business Model Canvas the Lean Startup Canvas is a Business Model Tool, i.e. its purpose is meant to convey a robust message in a succinct way. It shares multiple common characteristics with the Business Model Canvas but it also draws heavily from lean management methodology, the purpose of which is to identify and do away with all non-value added activities which are a potential source of improvement in any kind of business process. The lean perspective is to reduce waste and costs, to improve quality and gain better use of resources in order to deliver higher value to customers (Cabrita, Duarte, Carvalho, & Cruz-Machado, 2016). Maurya's intent was to come up with a Business Model Canvas which would be more actionable and more easily understood than the original but should also be more applicable to start-ups, hence the moniker.

As was the case with the Business Model Canvas the Lean Startup Canvas is also meant to be kept at a single page-length; the concept is, as before, that the message should be apt, concise and succinct. It aspires, however, to prove even more plastic than its counterpart, in the sense that its purpose is to be used by anyone, implying that the Business Model Canvas is largely reserved for those who share understanding of economic and business terminology.

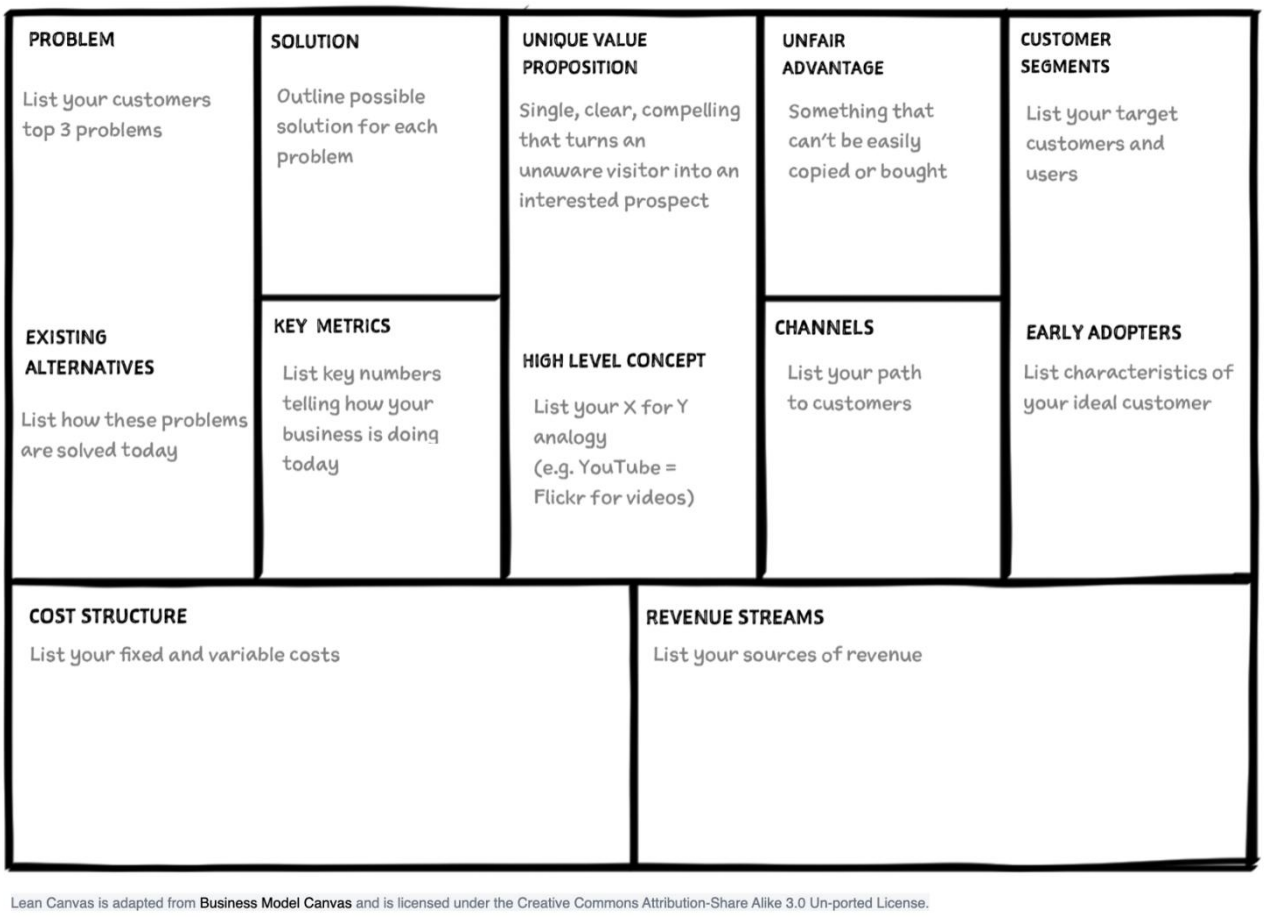


Figure 11. The Lean Startup Canvas.

Source: https://www.leanfoundry.com/articles/what-is-lean-canvas

Since the Lean Startup Canvas draws so much from the Business Model Canvas and has such a similar appearance, it is deemed more useful to briefly number the differences between the two Tools, rather than enumerate, as was previously done, its - also - nine (9) building blocks. The main advantages of Lean Canvas in contrast to Business Model Canvas are:

- ***Intuitive:*** as stated above, Maurya's intent was to deliver a more actionable BMC. Part of this endeavour had to do with the fact that the BMC incorporates economic and business terminology, concepts which are not understood by the layman. The Lean Startup Canvas does away with such language, instead adopting common wording. The purpose behind this is that the Tool becomes more appealing to every stakeholder and not only those with a specific skill-set or know-how.
- ***Customer-Problem-Solution Focused:*** Lean Canvas prioritises customer-problem-solution. This exemplifies why the particular Business Model Tool is particularly geared to facilitate start-ups
- ***Simpler:*** Lean Startup is meant to be used as a stand-alone Tool, not requiring a complimentary Value Proposition Canvas8, as is the case sometimes with the BMC.
- ***Practical/ actionable:*** The rationale behind the development of the Lean Canvas is that it is entrepreneur-focused, making it more practical than a business plan and more actionable than the BMC.

Whether the Lean Canvas delivers on its promise as a more actionable and simpler alternative to the BMC is a question that supersedes the purpose of this Report, however the particular focus of the specific Tool on startups is something that creates advantages but also poses limitations in its applications.

4.3 Business Model Radar

Changes in market dynamics, customer preferences, technological advancements, and competitive pressures are some of the reasons that drive organisations to transition into a service-dominant (SD) business setting. This shift is driven by the recognition that value is co-created through interactions between organisations and customers (Nagle & Sammon, 2017). By focusing on services, organisations can better align with customer needs, adapt to changing market dynamics, and create sustainable competitive advantages in today's rapidly evolving business landscape (Oktay & Grefen, 2017).

The conceptual tool that can be used as a guiding reference for business model design is the Service-Dominant Business Model Radar (SDBM/R)(Figure 12) (Turetken , Grefen , & Gisling, 2019). A Service-Dominant Business model differentiates from the traditional business model by taking a network structure based on the service-dominant (SD) logic rather than the value chain approach of the goods-dominant (GD) logic. SDBM/R has a network-centric design at its core, allowing the composition of service design in multi-party business networks. It defines how the actors in the business ecosystem participate in value co-creation and what the cost–benefits distribution is.

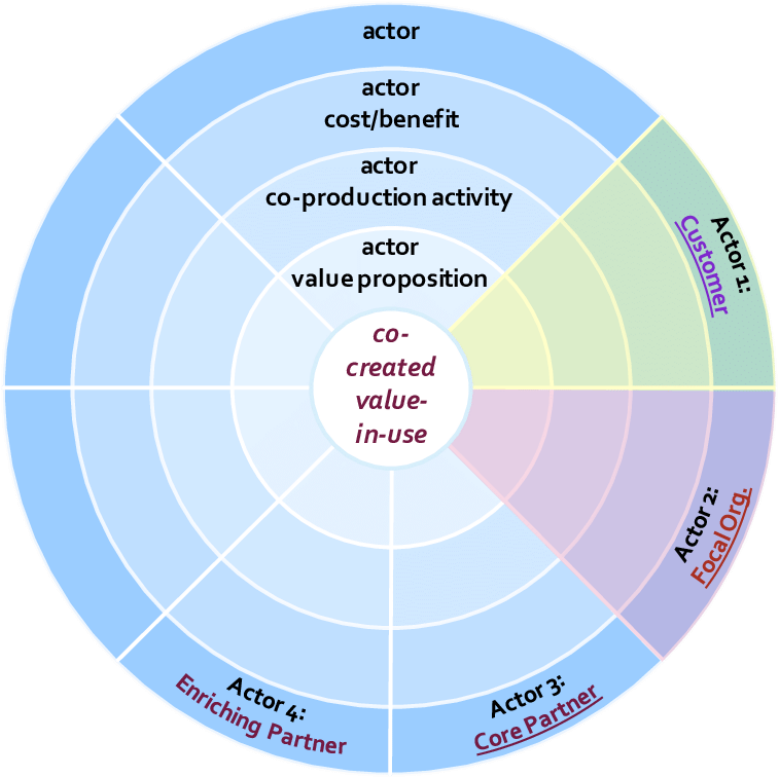


Figure 12.Service Dominant Business Model Radar (SDBM/R) template.

Source: ResearchGate

In a SDBM/R we can distinguish the following main elements (Turetken , Grefen , & Gisling, 2019) as shown in the picture above:

- The co- created value-in-use is the goal of the business model and constitutes the heart of SDBM/R (Luftenegger & Softic, 2019).
- The actor value proposition represents the part of the central value-in-use contributed by a single actor.
- The next layer, co-production activity defines the activities that each actor performs in the business in order to achieve the co-creation of value, in other words its actor value proposition.
- The third frame actor cost/benefit represents the costs and benefits that an actor incurs and gains respectively, by performing co-production activities.

- The fourth and last frame represents the actors and they can be distinguished between Customer (contributes to the production of the value- in-use), Focal Organization (often initiates the setup of the business model and participates actively in the solution), Core partner (contributes to the essentials of the solution), and Enriching partner (enhances solution's added value-in-use).

Designing service-dominant business models using the SDBM/R technique involves an engaging and iterative procedure that requires the direct involvement of the main (Suratno, Ozkan , Turetken, & Grefen, 2018) stakeholders within the business model. Even though SDBM/R models are known for their user- friendly nature, they serve as a robust foundation for translating business models into conceptual business process models. These process models depict the real-world business operations within collaborative networks, facilitating the effective implementation of the intended business strategies (Suratno, Ozkan, Turetken, & Grefen, 2018).

4.4 Prototyping Canvas

Prototyping is the process of creating a preliminary or initial version of a product, system, or concept to test and evaluate its functionality, design, and feasibility before proceeding with full-scale development. Prototyping is widely used in various fields, including software development, product (Hansen , Jensen, Ozkil, & Martins Pacheco, 2020) design, and business strategy (Lauff, Menold, & Wood, 2019), to validate ideas, gather feedback, and identify potential issues early in the development cycle (Hansen , Jensen, Ozkil, & Martins Pacheco, 2020). Developing prototypes is crucial to make value propositions tangible and concrete. However, the process of constructing a prototype is marked by substantial initial investments and a multitude of uncertainties (Lauff, Menold, & Wood, 2019).

Prototypes can take many forms and in many cases the Business Model Canvas (BMC), since it is the most recognizable and successful business design tool in use (Osterwalder & Pigneur, 2010), is influencing the structure of a Prototyping Canvas (Lauff, Menold, & Wood, 2019). The Prototype Canvas tool is recommended to consider after having filled in the Business Model Canvas and/or the Value Proposition Canvas.

Prototyping can be used in many phases of the product design, with different purposes. It can be used to find out if something is technically feasible (an 'engineering' prototype), if your design ideas look good, and satisfies design criteria, or if your ideas resonate with customers (a 'validation' prototype). Figure below shows the validation prototype canvas.

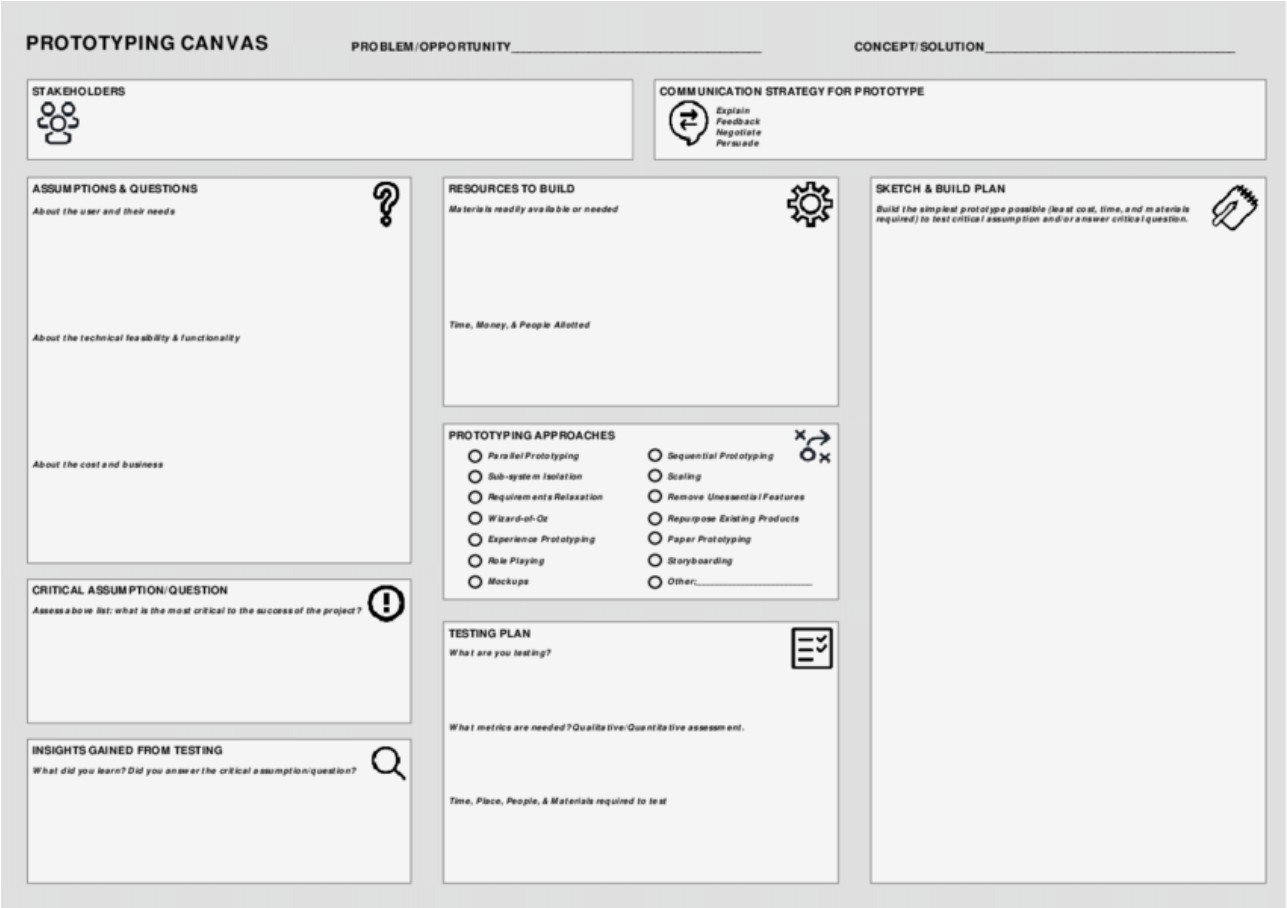


Figure 13. The updated version of Prototyping Canvas.

Source: ResearchGate

The design of the Prototyping Canvas draws inspiration from the well-known Business Model Canvas. While users can approach the canvas flexibly, a structured method typically begins with identifying "Stakeholders" and outlining "Assumptions & Questions," then progressing from left to right, culminating in the documentation of "Insights."

Below follows the breakdown of the sections within the Prototyping Canvas:

Stakeholders: List all the key people and groups involved in or affected by the project. This includes your target users, the project team, clients, investors, or any other influential individuals whose input or support is crucial for success.

Assumptions & Questions: Brainstorm and document every belief or uncertainty you have about the project. Categorize these into questions about the user and their needs, the technical feasibility of the solution, and the business viability or costs involved.

Critical Assumption/Question: From your list of assumptions, identify the single most critical one—the belief that, if proven wrong, would cause the entire project to fail. Frame this as a clear, testable question that your prototype will be designed to answer.

Insights Gained from Testing: This section is filled out after testing. Summarize the most important things you learned from user interactions with your prototype. State clearly whether your critical assumption was validated or invalidated and explain what evidence led to this conclusion.

Resources to Build: Itemise all the practical resources needed to create your prototype. Be specific about the amount of time required, the budget for any expenses (money), and the specific people or skills needed to complete the work.

Prototyping Approaches: Select the most effective and efficient method for building your prototype based on what you need to learn. Options range from simple paper mockups and storyboards to more interactive methods like Wizard-of-Oz or experience prototypes.

Communication Strategy for Prototype: Plan how you will present the prototype to users and stakeholders to get the most valuable feedback. This involves deciding how you will explain the concept, facilitate the testing session, and ask probing questions to uncover deep insights.

Sketch & Build Plan: Visualize your prototype with a simple sketch, wireframe, or user flow diagram. Alongside the visual, create a step-by-step plan that outlines the minimum work required to build a version of the prototype that can effectively test your critical assumption.

Testing Plan: Define the structure for your user test. Specify exactly what you are testing, what qualitative (feedback) and quantitative (numbers) metrics you will measure, and the logistics of who, what, where, and when for the testing session.

4.5 The Sustainable Business Model Canvas

As is the case with the Business Model Canvas which was presented in 4.1 The Sustainable Business Model Canvas is a business model Tool that is meant to convey the Business Model of choice in a single-page format and, in that respect, the mission and the intend of the Sustainable Business Model Canvas is identical to the Business Model Canvas.

The Sustainable Business Model was introduced due to pressures applied to economic actors to address sustainability issues in their operations and every-day practices. As such, the need for a Business Model emerged, one that would address these concerns and attempt to incorporate the sustainable element in it analysis. The most popular and applicable version of the Sustainable Business Model Canvas is a representation of the Osterwalder's and Pigneur's BMC with the addition of two additional elements:

- Social and environmental costs
- Social and environmental benefits.

Even though, it is evident that pattern interactions emerge between the two additional elements and all other elements of the BMC the definition of the elements that are common remain the same. As such their definition from 4.1 are applicable and will not be repeated here. A definition of the two additional elements, however, is required, as follows:

- **Social and environmental benefits:** Social and environmental benefits are the external benefits that the business model produces for the affected environment and the affected groups.
- **Social and Environmental Costs:** The social and environmental costs are additional external costs incurred by the Business Model on the affected environment and on affected stakeholder groups. The Market Analysis methodology proposed in Chapter 3 attempts to ensure that all aspects of the emergent business opportunity of each use case will have been examined to such a depth of analysis that social and environmental costs will be defined to a significant extent.

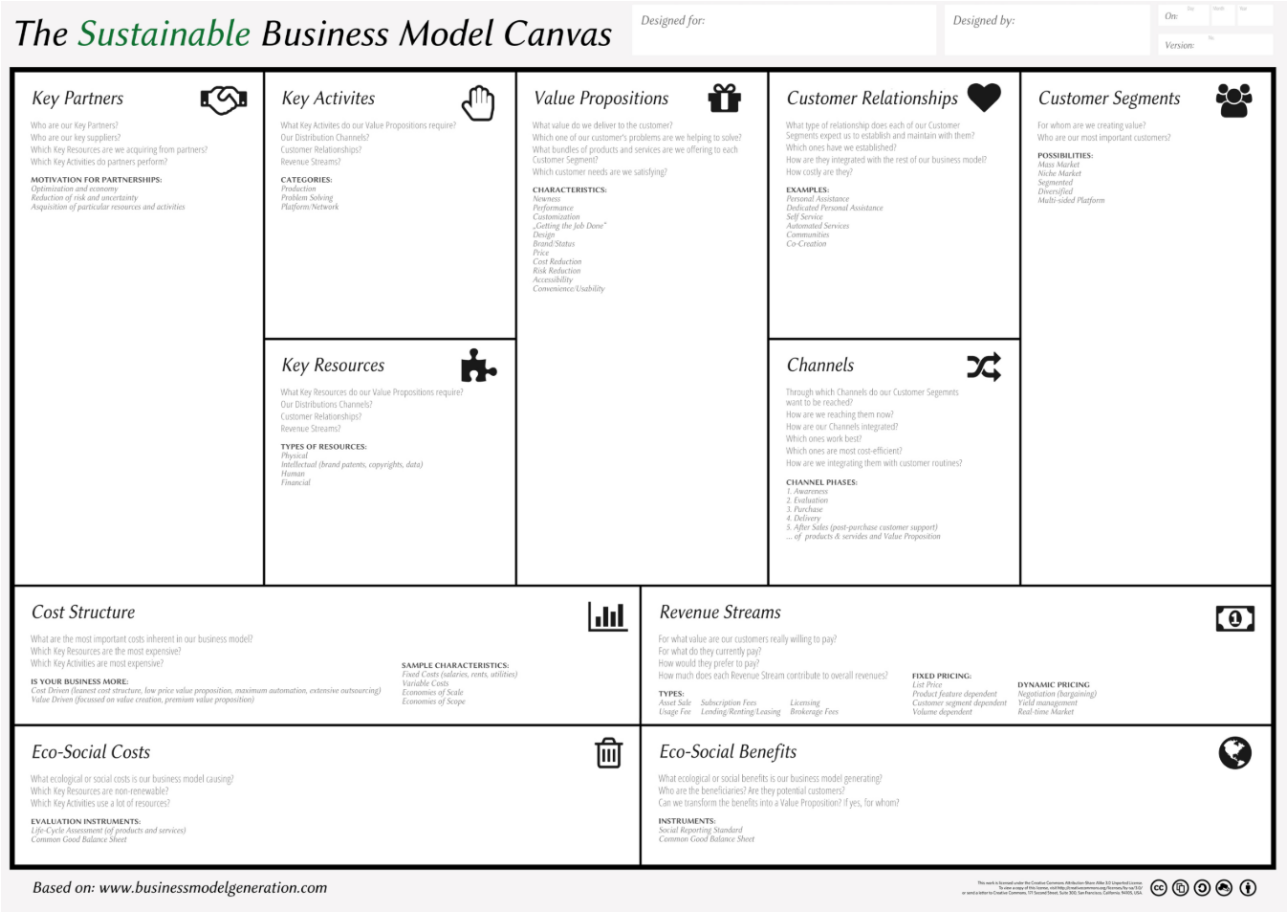


Figure 14. The sustainable Business Model Canvas.

Source: https://www.case-ka.eu/index.html%3Fp=2174.html

It should be noted here, however, that the Sustainable Business Model Canvas is not limited to the example presented above on the contrary more complicated iterations have been studied and proposed, with the most prominent being the one suggested by Fichter & Tiemann in 2015. This Business Model Tool for the Sustainable Business Model proposes, as in the Canvas examined above, interactions between all elements of the Tool, but at the same time introduces sustainability-specific questions to all elements. Understandably, this is a far more integrated approach and one that brings the sustainability concerns at the forefront of the process of building up a business model, rather than adding up the two additional elements as conceptual extensions of the traditional Business Model.

4.6 The Triple Layered Business Model Canvas

The Triple Layered Business Model Canvas (TLBMC) is a Business Model Tool for depicting sustainable business models. Its innovation lies in the fact that it adds two (2) additional layers (after the economic layer): an environmental layer and a social layer. Interaction patterns emerge within each layer of the Tool, but also emerge between the layers. The result is that, when all layers are considered together, the TLBMC makes far more evident how a Business Model may generate different values across the three dimensions – economic, social & environmental. The TLBMC was introduced by Joyce & Paquin in 2016 with the purpose of coming up with a business model tool that, when represented visually, would immediately convey an all-rounded and holistic interpretation of a Business Model (Joyce & Paquin, 2016) .

"As a tool, the TLBMC bridges business model innovation and sustainable business model development to support individuals and organizations in creatively and holistically

seeking competitive sustainability-oriented change as a way to address the challenges facing us today" (Joyce & Paquin, 2016)

4.6.1 The Economic Layer

The TLBMC builds upon the original Business Model Canvas (Osterwalder & Pigneur, 2010), considering the nine (9), interconnected components of the Canvas: Value Proposition, Customer Relationship, Channels, Key Resources, Key Activities, Partners, Costs and Revenues. These elements have been explored in 4.1.1 and the BMC's ability to explore the intricacies of a Business Model have been established. As such, the first layer of the TLBMC, the economic layer is depicted below, and it comes as no surprise that it is inspired by the BMC:

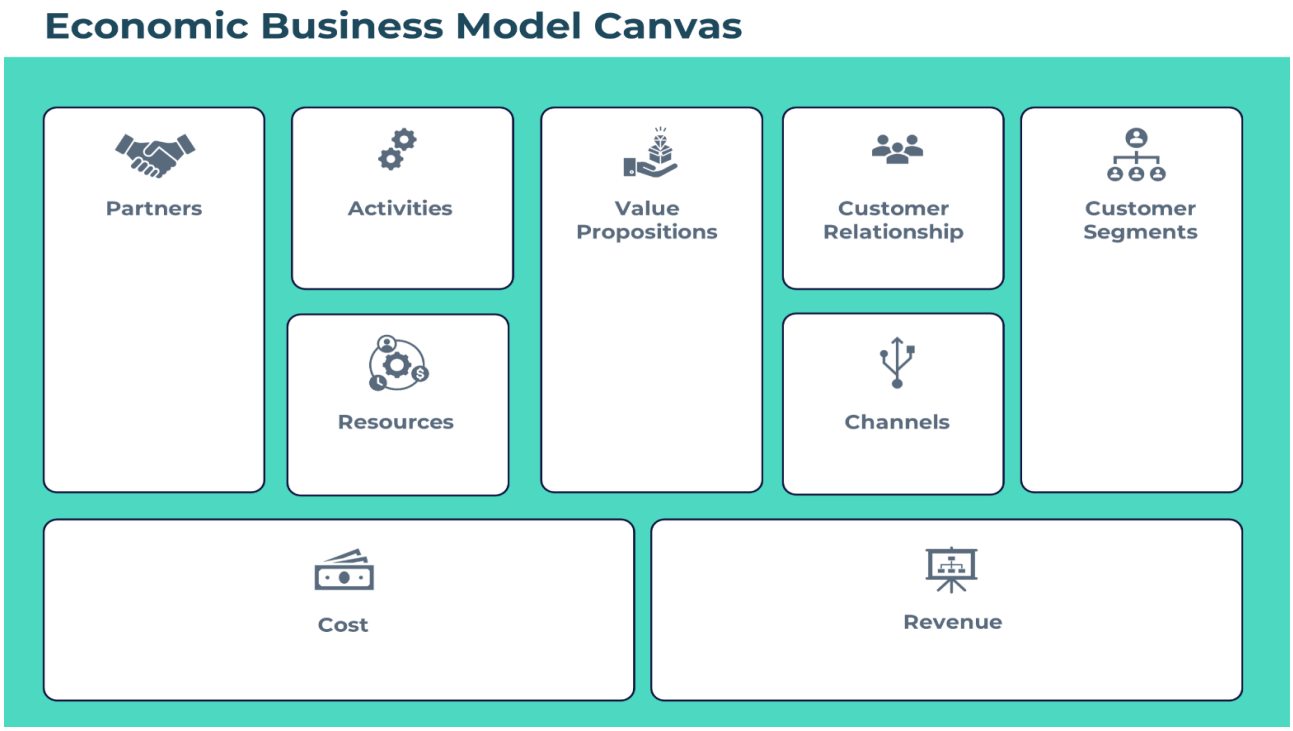


Figure 15. The Economic Layer of TLBMC.

TLBMC makes use of the BMC because it accepts that Osterwalder & Pigneur's Tool allowed for some sustainability elements to be considered during the development of a business model, however the Canvas was found to be more profit-centric, with the environmental or social aspects giving way to a "profit-first" approach. To elaborate further, if a Business Model wanted to emphasize the social or environmental aspect of developing a (sustainable) business model the BMC was deemed a limited tool for the task and a new Tool would need to be employed (e.g. the Sustainable Business Model Canvas). The TLBMC, however, aspires to achieve more than that and give the user the freedom to explore a sustainable or sustainable-oriented business model in a more creative way, than other available BMTs. Osterwalder and Pigneur's BMC is utilised, of course, and its functionality is maximized by employing the model solely on the economic aspect of the value proposition. This liberates the BMC from having to depict environmental and social benefits of the business model, since these are taken care of by the other two (2) layers.

To make everything work together, the TLBMC allows the business model to be depicted using a triple bottom line (TBL), where each canvas layer is dedicated to single dimension and together, they provide the means to integrate pattern interactions across layers. The TBL approach allows for business model actors to consider formally (i.e. by a standardised method) their economic, environmental and social impact (Savitz, 2012).

4.6.2 The Environmental Layer

The environmental layer of the TLBMC builds the Business Model employing a life cycle approach of environmental impact and it is based on Life Cycle Assessment (LCA) for measuring a service's environmental impact overall (Svoboda, 1995). By utilizing LCA approach with business innovation a service's innovation can be explored with environmental characteristics in mind, in contrast to more traditional business innovations.

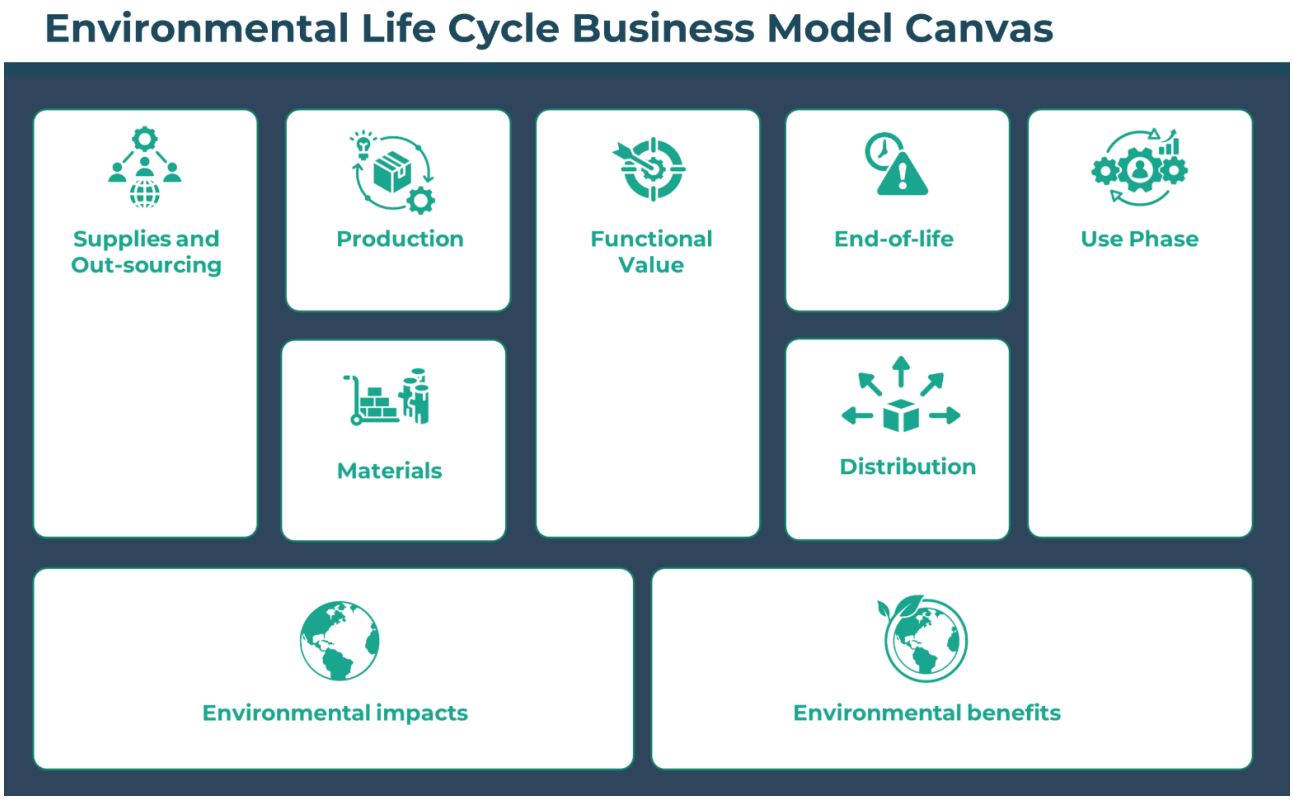


Figure 16. The Environmental Layer of TLBMC.

The rationale behind the Canvas remains much the same: just as BMC is depicting how potential earnings outweigh costs the environmental layer of the TLBMC attempts to ascertain how the business model can incur more environmental benefits than impacts. Employing the LCA approach referenced above the nine (9) components of the environmental layer of the TLBMC are briefly explained below:

- **Functional Value:** The functional value models a service's functional unit in LCA.
- **Materials:** Materials are, of course, the environmental counterpart of BMC's Key Resources element. As it can be impractical, or simply unfeasible, to introduce all key resources into the economic layer so it can be equal impractical to include all physical material in this element. However, the intend is to include those key materials that bare the most environmental impact.
- **Production:** The production element of the environmental layer of the TLBMC is the environmental counterpart of the Key Activities of the economic layer.
- **Supplies and outsourcing:** The environmental counterpart to the economic layer's "Partners", Supplies and Outsourcing, it includes all Production and Material activities that may be necessary to produce the functional value.
- **Distribution:** Following the BMC element-by-element, distribution involves the environmental counterpart of the Channels component.
- **Use phase:** Use phase deals with the environmental impact of the Business Model's functional value; the element may include maintenance and other similar considerations.

- **End-of-life:** End-of-life deals with repurposing or reusing Material or Production elements. The line between Production and End-of-life can become blurry, it should be looked upon as the business model attempt to consider environmental impact of its innovations beyond the scope of service development.
- **Environmental Impacts:** The Environmental Impacts element incorporates all ecological costs associated with the Business Model. While in BMC this element is usually reserved for financial costs, in the environmental layer it may be related with CO2 emissions, resource depletion or misuse etc.
- **Environmental Benefits:** The Environmental Benefits elements is, of course, the environmental counterpart to Revenue, extending the concept of value creation beyond the strictly financial. In essence, this element provides the opportunity for the Business Model developer to reduce negative or increase positive impact by exploring potential environmental innovations.

As mentioned, the environmental layer is meant to provide a comprehensive outlook on the environmental innovation of a business model, to explore more in-depth environmental concerns and provide the opportunity, through vertical pattern interactions, to align sustainability efforts across the whole business model.

4.6.3 The Social Layer

The social layer of the TLBMC is meant to present the opportunity for a dedicated depiction of how Business Model elements interact with all potential stakeholders of the value proposition. When a business model addresses sustainability concerns or when the business model of choice becomes the sustainable business model then there is an increased need to identify how all stakeholder groups interact with all elements of the BMC. The Social Layer of the TLBMC brings into focus these key social impacts that come out of the relationships with the stakeholder groups.

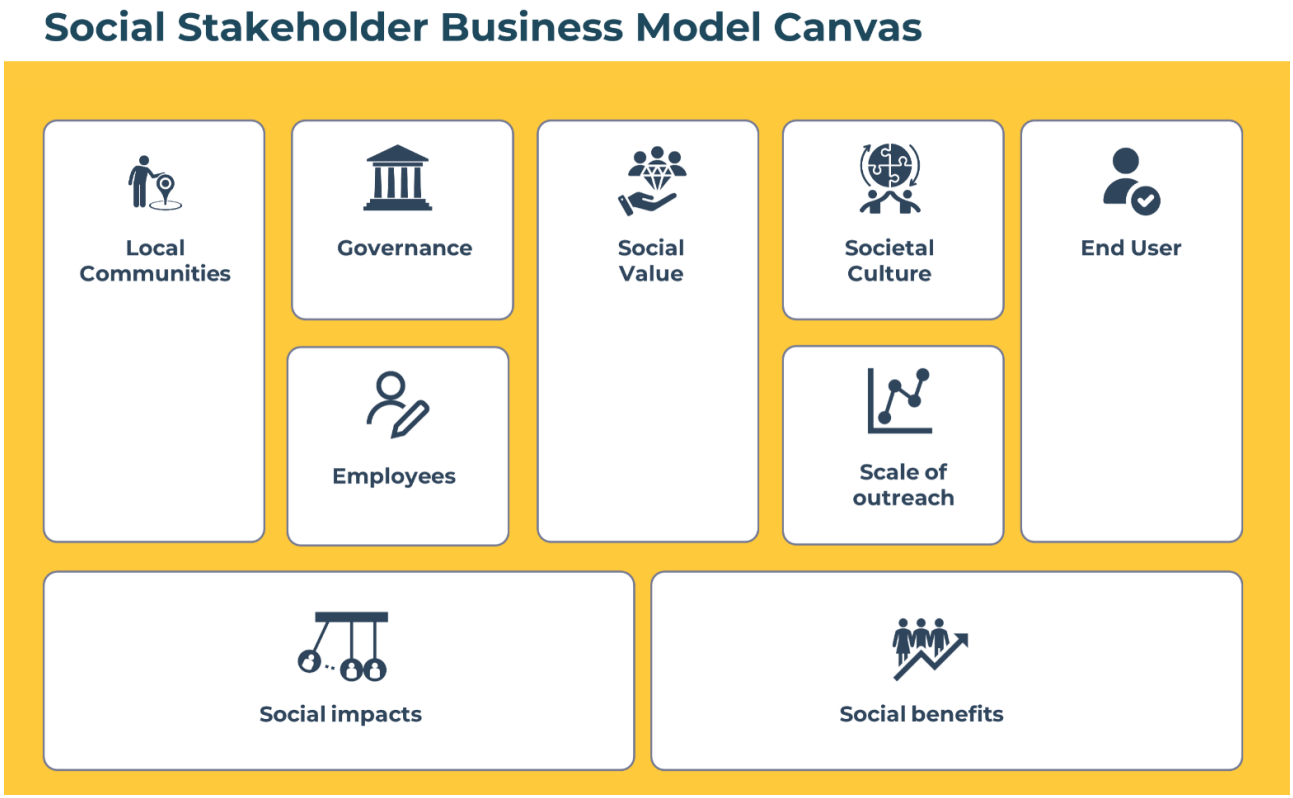


Figure 17. The Social Layer of the TLBMC.

As with the environmental layer the social layer retains the nine (9) element outlook of the economic layer, ensuring that there is robust information horizontally within the canvas but also foreshadowing about the

vertical interactions that can be derived from the multilayer examination. A brief explanation of the elements of the social layer is elaborated below:

- **Social Value:** Social value lies at the heart of the social layer and is dedicated to depicting how the Business Model mission can create benefit for its stakeholders and society in general.
- **Employee:** The employee element is reserved for employees as organizational stakeholders of the business model.
- **Governance:** The governance element depicts the organizational structure and decision-making policy of an organization.
- **Communities:** Communities is the social counterpart of Partners. The social layer of the TLBMC attempts to bring the two concepts together, exploring social relationships that emerge between suppliers and local communities where they are involved. On the social layer, ensuring identification and, consequently, interaction with these Communities can generate mutually beneficial relationships.
- **Societal Culture:** Societal Culture considers the overall potential impact of an organization on society overall.
- **Scale of outreach:** Scale of outreach is meant to explore the strength of the relationships that the project builds with its stakeholders.
- **End-users:** The social counterpart to the End Phase (environmental layer) and the Customer Segments elements, this element depicts how the value proposition attends to needs of the end-user.
- **Social Impacts:** As with their economic and environmental counterparts, Social Impacts assesses the social cost of sustainable or sustainable-oriented business model. It extents the financial costs of the economic layer and the environmental impacts of the environmental layer.
- **Social Benefits:** Social Benefits are those positive aspects of the value creation process, carried out by the business model implementor.

4.6.4 Horizontal and Vertical coherence of the TLBMC

As mentioned in the beginning of the chapter, the innovation of the TLBMC lies in its proposition that it can depict a holistic overview of any given Business Model, considering environmental and social concerns. This, by definition, makes it a tool that was developed out the necessity to better examine sustainable or sustainable-oriented business models and this is the main reason why it seeks to explore the environmental and societal aspect with such alacrity.

As such, Figure 18. Horizontal and vertical coherence of the TLBMC. below exemplifies the Vertical Coherence and the Horizontal Coherence that emerges from the application of the tool.

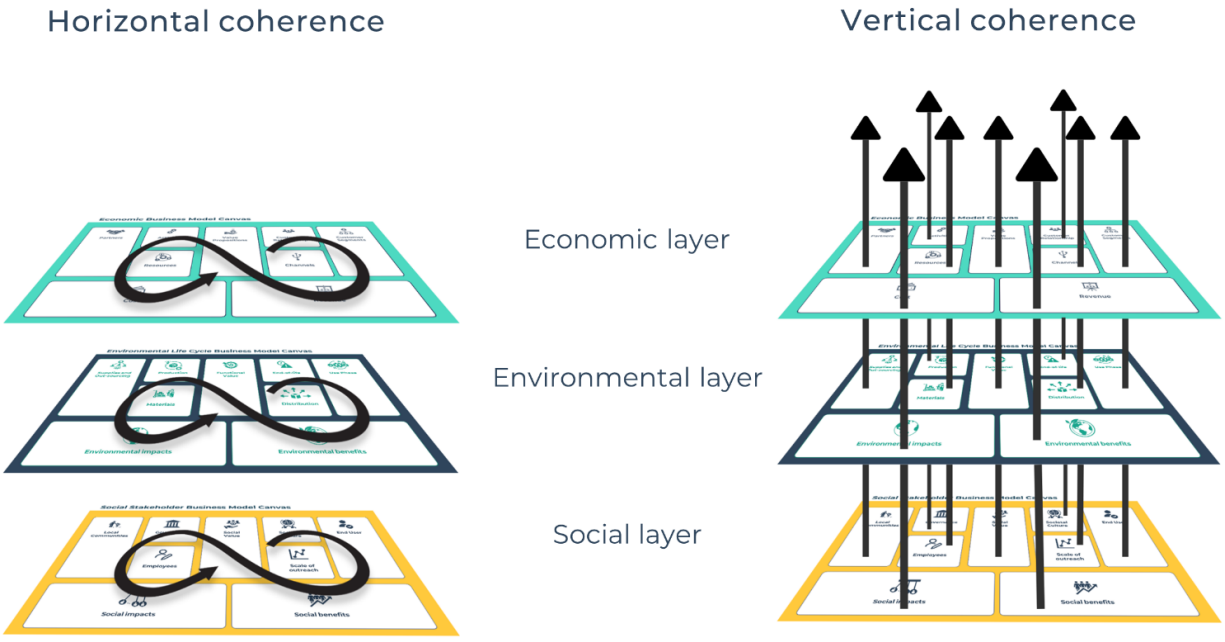


Figure 18. Horizontal and vertical coherence of the TLBMC.

Horizontal Coherence: The Horizontal Coherence of the TLBMC enables the in-depth examination of a Sustainable or Sustainable-oriented Business Model, it encourages the business model developer to address sustainability in a far more elaborate method while it presents succinctly the different type of value creation within the Business Model.

Vertical Coherence: Vertical Coherence is, of course, achieved by the alignment of each layer of the TLBMC – a condition which allows interaction patterns to be examined across different types of value. To that end, Vertical Coherence is essential for producing a Canvas of a much higher resolution that other tools, given that relationships can be observed from one element to the other. Vertical Coherence does not simply "stack" vertically aligned relationships but provide pathways from the vertical to the horizontal, thus always keeping the informational flow going.

4.7 Benchmarking and selection of Business Model Tools

A business model tool provides a quick overview of the business model, including all crucial elements of a business and the existing relations between them. While seeking the best-suited business model tools for BioRural's aim of fostering circular bio-based solutions and developing thematic business model blueprints, we analysed tools that are widely used and can be applied in this context: the Business Model Canvas, Lean Startup Canvas, Value Proposition Canvas, Business Model Radar, and Prototyping Canvas.

Many companies worldwide use the Business Model Canvas as a compact and clear guideline. However, for new ventures and innovative solutions within the circular bioeconomy, which often face high uncertainty and risk, the Lean Startup Canvas can be more suitable. Another tool especially recommended for such initiatives is the Value Proposition Canvas, as it helps ventures create a perfect fit between their bio-based products/services and specific market needs, which is essential for promoting novel circular solutions. The Business Model Radar, with its strong emphasis on services as the core value proposition. This service-oriented approach can be contrasted with traditional product-centered models. When a bio-based solution is still in the development and testing phase, the Prototyping Canvas can help effectively guide stakeholders through the process, facilitating a common language for iterative development crucial for innovation in the circular bioeconomy.

In the context of BioRural's focus on "accelerating circular bio-based solutions integration" and developing a "transition framework towards a sustainable, regenerative, inclusive, and just circular Bioeconomy", the need to examine and promote sustainable business models is paramount.

To that end, both the primary principles of sustainable and circular business models were examined. Two additional Business Model Tools were taken into consideration to expand the selection and fully accommodate the sustainability and circularity elements essential for BioRural's business model blueprints: the **Sustainable Business Model Canvas** and the **Triple Layered Business Model Canvas**.

The **Sustainable Business Model Canvas**, inspired by the original Business Model Canvas, introduces crucial social and environmental elements. This allows for the examination of interaction patterns related to sustainability concerns, which is fundamental for any circular bioeconomy venture. While designs vary, the core idea is to integrate these broader value considerations directly into the business model.

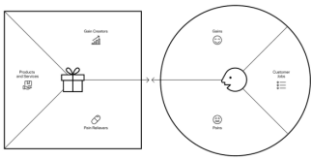
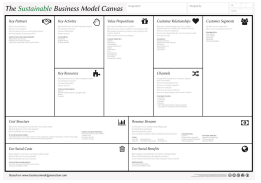
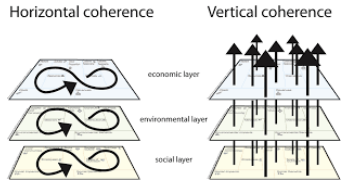
The **Triple Layered Business Model Canvas (TLBMC)** offers an even more comprehensive tool for depicting sustainable business models. Its key innovation is the addition of two distinct layers—an environmental layer (often based on a lifecycle perspective) and a social layer—to the conventional economic layer of the Business Model Canvas. The TLBMC retains the nine interconnected components of the original BMC but expands them across these three dimensions. This allows for a holistic overview of any given business model, explicitly considering environmental impacts (like resource use, emissions, waste generation – all key to circularity) and social impacts (like rural job creation, community engagement, and inclusivity). This, by definition, makes the TLBMC an exceptionally well-suited tool for designing and assessing business models within the circular bioeconomy, a core focus of BioRural.

It becomes readily apparent that the most apt BMTs for examining and developing blueprints for BioRural's targeted bio-based solutions are:

- The **Business Model Canvas** (BMC), for its comprehensive yet concise representation of the core value creation proposition.
- The **Sustainable Business Model Canvas** (SBMC), for its ability to integrate sustainability aspects into a familiar single-page format, useful for ventures prioritizing or needing to communicate their environmental and social benefits clearly.
- The **Triple Layered Business Model Canvas** (TLBMC), which provides the most holistic opportunity to examine and design sustainable and circular business models by explicitly detailing economic, environmental, and social value creation and impacts. This aligns perfectly with BioRural's objective to support "resilient and circular bio-based solutions in rural areas" and the broader goals of a truly circular bioeconomy.

The table below benchmarks the different types of canvases, highlighting their specific relevance to designing and implementing circular bioeconomy initiatives as envisioned by BioRural.

Table 1. Benchmarking of different canvases.

Canvas Type	Design principles	Advantages to use in bioeconomy ventures	
Business Model Canvas (BMC)	A one-page visual chart describing a venture's value proposition, customers, infrastructure, and finances through nine core building blocks. It is typically organization-centric, focusing on the processes controlled by a single entity.	Provides a universally understood and straightforward framework for outlining the fundamental economic structure of a bio-based venture. It is excellent for initial design and for communicating the core business logic to partners and investors.	
Value Proposition Canvas (VPC)	A complementary tool to the BMC that focuses specifically on the fit between the customer's needs (jobs, pains, gains) and the product's value proposition (products/services, pain relievers, gain creators).	Essential for ensuring that a novel bio-based product (like a new biomaterial or bio-fertilizer) genuinely solves a problem for a specific customer segment (e.g., farmers, manufacturers). It validates product-market fit, which is critical for the adoption of new circular solutions.	
Lean Startup Canvas	An adaptation of the BMC for startups operating under high uncertainty. It replaces some of the original blocks to focus on problems, solutions, key metrics, and unique competitive advantages, using more intuitive, entrepreneur-focused language.	Ideal for early-stage bioeconomy startups testing innovative technologies or disruptive business models. Its focus on the "problem-solution" fit helps validate the need for a new bio-based solution before significant investment is made in scaling up.	
Sustainable Business Model Canvas (SBMC)	An extension of the traditional BMC that integrates sustainability by adding two key components: "social and environmental costs" and "social and environmental benefits". It directly incorporates sustainability concerns into the core economic model.	Allows bioeconomy ventures to explicitly map and communicate their positive environmental and social impacts, which is a core part of their value proposition. It helps in quantifying benefits like waste reduction or lower emissions, strengthening the business case for sustainable investors and eco-conscious customers.	
Triple-Layered Business Model Canvas (TLBMC)	A holistic tool that expands the BMC into three distinct but interconnected layers: an Economic layer (the standard BMC), an Environmental layer (based on a Life Cycle Assessment approach), and a Social layer (focused on stakeholder value and governance).	This is the most comprehensive tool for designing truly circular and sustainable bioeconomy ventures. It enables a deep analysis of environmental impacts across the entire value chain (e.g., from biomass sourcing to end-of-life) and maps the social value created for communities and employees, aligning perfectly with the goal of creating a "sustainable, regenerative, inclusive, and just circular Bioeconomy"	

5 Adaptations to Bioeconomy Themes

Across all five thematic areas of the circular bioeconomy – Aquatic systems, Bioenergy, Biomaterials, Food and Agriculture, and Forestry and Natural Habitats – several key considerations emerge, emphasising on a holistic and sustainable approach for development.

Transition from Linear to Circular Models

The fundamental consideration is the transformation of existing production systems and value chains from linear economic models (take-make-dispose) to circular ones. This involves managing the production of renewable biological resources and converting these resources and waste streams into value-added products like food, feed, bio-based products, and bioenergy, while designing out waste and pollution, keeping products and materials in use, and regenerating natural systems.

Holistic Sustainability

Circular bio-based businesses must address all three dimensions of sustainability: environmental, economic, and societal.

- **Environmental Sustainability:** Optimizing the use of biological resources from land and sea to maximize co-benefits, safeguard ecosystems, mitigate climate change, and enhance biodiversity. This includes reducing greenhouse gas (GHG) emissions and fossil energy consumption.
- **Economic Sustainability:** Boosting sustainable innovation, creating solutions for sustainable bio-based products, and generating new markets and job opportunities, especially in rural areas, by reducing costs associated with raw material procurement and waste management.
- **Societal Sustainability:** Developing sustainable business models that promote diligence, sustainable trade, and social fairness, enhancing community resilience and well-being, and supporting local economies through green job creation and reduced urban migration.

Waste and By-product Valorization

A central tenet is the efficient and sustainable utilization of biomass, especially agricultural and forestry by-products, residues, and waste streams. The concept of "biorefinery" is crucial here, aiming to efficiently produce high-value products from diverse feedstocks while minimizing waste and emissions. This includes transforming surplus produce, agricultural residues, and aquatic wastes into valuable products or energy.

Innovation and Technology Adoption

The transition to a circular bioeconomy is underpinned by bio-based innovation, leading to increased energy or material efficiency, new product properties, waste valorisation, and pollution elimination. This involves leveraging a wide range of sciences, enabling technologies (e.g., AI, digitalization), and industrial technologies, along with local knowledge.

Local and Regional Context

There is a strong emphasis on small-scale bio-based solutions and integrated approaches at the local and regional levels. Local sourcing of biomass, strengthening local supply chains, and engaging with local communities, farmers, and technical experts are vital for enhancing resilience and creating new economic opportunities.

Policy and Governance Frameworks

Effective policy frameworks at EU, national, and regional levels are essential to support the transition to a circular bioeconomy. Policies need to improve coherence, resolve trade-offs (e.g., land and biomass

demand), and promote cross-sectoral cooperation. Policy guidelines and recommendations are key exploitable results to support evidence-based bioeconomy policies.

Stakeholder Engagement and Collaboration

Successful implementation requires extensive engagement with a multitude of stakeholders, including primary producers (farmers, foresters, fishers), industries, research centres, public authorities, NGOs, and citizens. Multi-actor approaches and social innovation are encouraged to ensure that solutions are co-created and widely adopted.

Knowledge Exchange and Capacity Building

Addressing knowledge and skills gaps in rural areas is crucial for a successful transition. Providing targeted, accessible, and practical knowledge through workshops and online toolkits (e.g., BioRural Toolkit) empowers stakeholders to apply circular bioeconomy principles.

Monitoring and Data-Driven Decision Making

Developing robust indicators and monitoring systems is important to measure the progress and impact of circularity at various levels (local communities, households, companies, value chains). Tools like Life Cycle Assessment (LCA) are essential for evaluating environmental impacts.

In essence, the circular bioeconomy requires a systemic shift that integrates technological innovation with sustainable resource management, strong governance, and active stakeholder participation to generate environmental, economic, and social value.

5.1 Aquatic water systems

For the aquatic systems theme, the adaptation involved applying the TLBMC to specific examples, such as "Algen, algal technology centre, llc" focusing on aquaculture and water, and the "University of Ljubljana" exploring the use of algae on animal manure to produce biostimulants for plants. The process provided templates with guidelines and examples to help in filling out the various components of each layer of the canvas. This systematic approach supports the project's goal of facilitating knowledge exchange and capacity building for the European rural Bioeconomy, ultimately enabling the scale-up of resilient and circular bio-based solutions.

The Economic Layer	
Value Proposition	What unique products or services are you offering? (e.g., Algae biomass for food, feed, cosmetics, pigments, biostimulants; sustainably farmed fish; wastewater treatment services that produce valuable by-products).
Customer Segments	Who are your target customers? (e.g., Local food markets, agricultural cooperatives, fertilizer producers, aquaculture/aquaponics businesses, restaurants, eco-conscious consumers).
Channels	How do you reach your customers and deliver your value proposition? (e.g., Direct sales to local markets, agricultural cooperatives, social media, e-shops, mobile shops, direct delivery to restaurants).
Customer Relationships	What type of relationship do you build with your customers? (e.g., Direct and personal contact, adaptation to customer timing and needs, building trust through welfare certificates and good aquaculture practice audits).
Revenue Streams	How do you generate income? (e.g., Selling algae for food/feed, selling fish, lowering costs for wastewater treatment, reduced environmental fees, selling biostimulants).

Cost Structure	What are your main expenses? (e.g., Algae system construction and operation, pond/paddlewheel production, electricity, water, operators' capacity building, transport).
Key Activities	What are the most important things you do to deliver your value proposition? (e.g., Production of algae biomass, local fish farming, wastewater treatment, nutrient recycling, design/production/installation/maintenance of systems, R&D, environmental management, social engagement, marketing, partnership building).
Key Resources	What essential assets do you need? (e.g., Water & mineral fertilizers or nutrient-rich wastewater, electricity, algae systems, ponds, paddlewheels, greenhouses, skilled interdisciplinary team, R&D capabilities, technical know-how, innovation funding, aquaculture facilities, processing/storage equipment).
Key Partners	Who are your crucial external collaborators? (e.g., Local food markets, agricultural cooperatives, fertilizer/biostimulant producers, pond/paddlewheel producers, control/sensor system providers, construction workers, universities, research centres, public entities).

The Environmental Layer	
Functional Value	What environmental service or benefit does your product/service provide? (e.g., Wastewater treatment, nutrient recovery, sustainable food production, CO2 consumption, oxygen production).
Materials	What biological and other materials are used? (e.g., Nutrient-rich wastewater/slurry, water, mineral fertilisers, aquatic biomass).
Production	Which are environmental aspects of your production activities? (e.g., Use of water and electricity for cultivation; greenhouse gas emissions if not mitigated).
Distribution	What are the environmental considerations for getting your products to market? (e.g., Transport to local markets, energy consumption during drying/processing).
Use Phase	What is the environmental impact during the use of your product/service? (e.g., For algae as organic fertilizer: higher water retention, lower erosion, and nutrient loss in soil).
End-of-life	How are products and materials managed at the end of their life? (e.g., Recycling of waste substrates, recycling of water substrate until clean for release; ponds and greenhouses can be reused for different biomass production or sold).
Environmental Impacts	What are the negative environmental consequences? (e.g., Energy consumption during drying/processing, water use in cleaning, minor CO2 emissions from distribution, waste from broken stems, greenhouse gases, water/electricity use, nutrient content in water residue if not recycled).
Environmental Benefits	What are the positive environmental outcomes? (e.g., Plastic and paper straw replacement, biodegradability, support for regenerative agriculture practices, use of agricultural residue as raw material, simultaneous wastewater treatment, nutrient recycling, CO2 consumption, O2 production, improved plant resistance and nutrition).
Suppliers and Outsourcing	Which are your dependencies on external entities and to critically evaluate their environmental performance, ensuring alignment with your overall circular bioeconomy goals?

The Social Layer	
Social Value	How does your business create benefits for stakeholders and society? (e.g., Promoting zero-plastic culture, raising awareness on sustainable practices, creating green jobs, diversifying farmer income, strengthening local supply chains, community education).
Employees	How does the business impact its employees? (e.g., Providing green jobs, capacity building for algae system operators, involvement of researchers and staff).

Governance	What is the organizational structure and decision-making policy? (e.g., Audited welfare certificates, good aquaculture practice certificates, multi-actor approaches, partnerships with local communities and public entities).
End-user	How do end-users benefit from and engage with your solution? (e.g., Access to high-quality fish/algae products, increased environmental awareness, access to sustainable products).
Local Communities	How does the business engage with and benefit local communities? (e.g., Involvement in establishing microalgae cultivation systems, supporting local food producers, strengthening connections between producers and consumers, fostering local economic growth, educational trips).
Societal Culture	What broader norms and values does the business shape or respond to? (e.g., Promoting zero-plastic culture, raising awareness on desertification, shifting market norms through partnerships with global players).
Scale of Outreach	What is the extent of your social engagement? (e.g., Local, national, and international markets; partnerships with global players; alliances with other producers).
Social Impacts	What are the potential negative social consequences? (e.g., Competition with traditional practices, need for skill adaptation for new technologies) This category is not explicitly detailed in the aquatic-specific canvases but should be considered generally for a complete TLBMC.
Social Benefits	What are the positive social outcomes? (e.g., Creation of green jobs, diversification of farmer income, strengthening local supply chains, enhanced resilience, improved well-being in rural areas, educational value, social fairness).

5.2 Bioenergy

For the bioenergy theme, the adaptation process involved applying the Triple Layered Business Model Canvas (TLBMC) to diverse case studies, such as the production of biomethane from biogas plants, the creation of solid biofuels like pellets, and integrated solutions for decarbonizing energy production. The methodology provided specific templates with guidelines and examples for filling out the economic, environmental, and social layers of the canvas. This systematic approach supports the project's goal of facilitating knowledge exchange and capacity building for the European rural Bioeconomy, enabling the scale-up of resilient and circular bio-based energy solutions.

The Economic Layer	
Value Proposition	What unique bioenergy products or services are you offering? Examples include integrated energy solutions combining biomass-fueled micro-cogeneration and thermal systems, especially low-temperature small-scale cogeneration. Other examples are bio-methane or Bio-DME production from biogas plants, heat production from local woody biomass and agricultural/forest residues, high-efficiency cogeneration from gasification of residues, solid biofuels like pellets, and advanced biofuels for transportation. Your business could also provide full energy management, including operation, maintenance, and remote monitoring platforms.
Customer Segments	Who are your target customers? This could include public entities with high energy demand (e.g., municipalities managing public pools), the private sector (e.g., hotels and industries seeking efficient and sustainable energy solutions), energy communities, and industrial parks. Farmers and agricultural associations could be customers for biostimulants produced from biomass. Local food markets and agricultural cooperatives could be involved in biomass collection and processing

Channels	How do you reach your customers and deliver your value proposition? Examples include direct sales, connections to the grid for electricity, and direct delivery to customers. Utilising local food markets and agricultural cooperatives can also serve as channels.
Customer Relationships	What type of relationship do you build with your customers? This can involve direct and personal contact, adapting to customer timing and needs, and fostering long-term partnerships, especially with local public entities and bio-based solution providers for infrastructure. Customized engineering services and full energy management, including operation, maintenance, and remote monitoring platforms, can enhance relationships.
Revenue Streams	How do you generate income? This can be from sales of bioenergy (heat, electricity), biomethane, or solid biofuels like pellets. Other revenue sources include selling by-products like biochar to local farmers or for carbon credits, or selling olive pomace oil. Cost savings from internal energy production can also be considered a revenue stream.
Cost Structure	What are your main expenses? These include capital costs for biorefinery plants with integrated CHP, other bioenergy system construction and operation, machinery for wood harvesting and transformation plants, biomass sourcing and handling, operation and maintenance (O&M) of energy plants, electricity, water, and transport.
Key Activities	What are the most important things you do to deliver your value proposition? This encompasses design and development of bioenergy systems, installation and integration of systems in customer facilities, and monitoring and maintenance services. Other activities include production of biomass-based fuels (e.g., pellets), biomass collection, bioenergy production, and R&D. For olive pomace biorefineries, activities include physical oil extraction, gasification, CHP, and drying. Business development and project acquisitions through partnerships are also key.
Key Resources	What essential assets do you need? This includes technological knowledge in micro-cogeneration and other bioenergy processes, an experienced multidisciplinary team (engineering, business development), biomass (e.g., woody biomass, agricultural residues, sewage sludge, olive pomace, manure), and infrastructure like gasification units, CHP plants, biogas plants, and storage/drying facilities. Innovation funding and test sites are also crucial.
Key Partners	Who are your crucial external collaborators? Examples include universities and research institutes for technological support and R&D, biomass centers for fuel logistics and assessments, incubators for networking and business development, public sector and municipalities for project collaborations and as customers, and external consultants for market reach expansion. Suppliers of raw materials (e.g., local olive mills, sheep farmers for wool) and equipment are also key.

The Environmental Layer	
Functional Value	What environmental service or benefit does your product/service provide? This includes reducing CO2 emissions and fossil energy consumption, addressing climate change, and enhancing biodiversity. Bioenergy solutions contribute to sustainable energy production, waste valorization, and nutrient recovery/recycling from waste streams.
Materials	What biological and other materials are used? This includes various types of biomass such as woody biomass, agricultural residues (e.g., cereal straws, coffee bean residues, olive pomace), sewage sludge, and animal manure.
Production	What is the environmental impact of your production processes? This involves energy consumption (e.g., for drying, processing), water use, and potential emissions if not mitigated. High-efficiency cogeneration and biorefineries aim to minimize waste and emissions.

Distribution	What are the environmental considerations for getting your products to market? This primarily relates to CO2 emissions from transport. Optimizing transport to local markets can reduce this impact.
Use Phase	What is the environmental impact during the use of your product/service? For example, using biochar can improve soil fertility, increase water retention, and reduce erosion and nutrient loss. Bio-stimulants can reduce the need for plant protection products and mineral fertilizers.
End-of-life	How are products and materials managed at the end of their life? The aim is to achieve circularity by converting waste into valuable resources. This includes recycling of water substrates until clean for release, and ensuring that waste by-products are valorized (e.g., digestate as biofertilizer, biochar for soil amendment).
Environmental Impacts	What are the negative environmental consequences? These can include energy consumption during processing, water use in cleaning, and minor CO2 emissions from distribution. Improper management could lead to water pollution or nutrient residue if not recycled.
Environmental Benefits	What are the positive environmental outcomes? These include plastic and paper straw replacement (for biomaterials from lignocellulosic biomass), biodegradability, support for regenerative agriculture, and the use of agricultural residue as raw material. More broadly, they include climate change mitigation, reduction of greenhouse gas emissions, increased energy security and autonomy, and waste valorisation.
Suppliers and Outsourcing	Which are your dependencies on external entities and to critically evaluate their environmental performance, ensuring alignment with your overall circular bioeconomy goals?

The Social Layer	
Social Value	How does your business create benefits for stakeholders and society? It contributes to promoting a green transition, supporting local development and energy autonomy in under-resourced areas, creating green jobs and diversifying farmer income, and strengthening local supply chains. It also raises awareness about sustainable practices and addresses waste management challenges.
Employees	How does the business impact its employees? It offers the creation of skilled jobs in energy systems design, operation, and maintenance, and provides capacity building for system operators. Involvement of researchers and staff also occurs.
Governance	What is the organizational structure and decision-making policy? This includes transparent and collaborative governance rooted in academic foundations, engagement with public institutions and incubators to ensure ethical decision-making and compliance, and a multi-actor approach involving diverse stakeholders. Adherence to welfare certificates and good aquaculture practice audits (if applicable to biomass source) can also be considered
End-user	How do end-users benefit from and engage with your solution? They gain access to sustainable and locally produced energy or biostimulants, potentially at lower costs, and their environmental awareness is increased.
Local Communities	How does the business engage with and benefit local communities? It promotes long-term relationships with local public entities, strengthens local supply chains (e.g., biomass sourcing from farmers), and supports local economic growth and well-being in rural areas. Examples include involving local communities in establishing microalgae cultivation systems and supporting educational initiatives. For olive pomace, it facilitates waste management for local olive mills.
Societal Culture	What broader norms and values does the business shape or respond to? It aligns with European values of energy transition, decentralization, and bioeconomy. It promotes zero-plastic culture (if replacing plastic products) and raises awareness about

	environmental issues. It challenges the centralization of the energy market by promoting community-level solutions.
Scale of Outreach	What is the extent of your social engagement? Operations might primarily target local or regional municipalities, with goals to scale to energy communities and industrial clusters, increasing territorial impact. This could also involve national and international markets, especially through partnerships.
Social Impacts	What are the potential negative social consequences? These could include competition with traditional practices, a need for skill adaptation for new technologies, or potential distrust in new initiatives (e.g., if perceived as purely for-profit). Products might be less accessible to customers with lower incomes if they are high-end.
Social Benefits	What are the positive social outcomes? These include the creation of green jobs and diversification of farmer income, strengthening local supply chains, enhanced resilience and improved well-being in rural areas, and educational value through knowledge sharing. Social fairness can also be promoted.

5.3 Biomaterials

In the biomaterials theme, the TLBMC was adapted to guide the development of business models for innovative products like bioplastic compounds, biocomposites, and soluble green packaging solutions. The process provided structured templates for innovators, with specific examples and instructions for completing the economic, environmental, and social dimensions of the canvas. This tailored approach is designed to facilitate knowledge transfer and build capacity among rural stakeholders, empowering them to scale up resilient and circular biomaterial ventures that transform waste streams into valuable products.

The Economic Layer	
Value Proposition	What unique biomaterial products or services are you offering? Examples include bioplastics compounds and biocomposites, soluble green packaging solutions, paper from biomass waste streams, food supplements from wood extractives, or high-end solutions in fungi cultivation. Your business could offer specific solutions (compounds, biocomposites) based on bioplastics tailored to customers' needs across the product's entire life cycle, focusing on bio-based and/or biodegradable solutions.
Customer Segments	Who are your target customers? This could include converters and end-users in the plastics industry, local food markets, agricultural cooperatives, or even consumers for novel products.
Channels	How do you reach your customers and deliver your value proposition? This might involve direct sales, the distribution of pellets packed in bags or big bags, or transport by truck and/or boat. Collaboration with universities and research institutes can also serve as a channel for knowledge transfer.
Customer Relationships	What type of relationship do you build with your customers? This can include developing specific solutions based on customer needs, fostering long-term partnerships, or maintaining direct and personal contact, especially with suppliers like olive mills or biomass/biochar consumers. Offering unique expertise in the whole bioplastics value chain, from production to communication, is also key.
Revenue Streams	How do you generate income? This can be from sales of bioplastics pellets, additives, fillers, and by-products. Other revenue sources might include selling biochar for carbon credits. Cost savings from waste valorisation or internal energy production can also be considered.
Cost Structure	What are your main expenses? These include raw material sourcing (e.g., biomass), production equipment, and subcontracting for analysis and production. For wood

	processing, this includes personnel and machinery for harvesting, and capital costs for transformation plants.
Key Activities	What are the most important things you do to deliver your value proposition? This encompasses the production of bioplastics compounds and biocomposites, research and development (R&D), and expertise provision (e.g., training). For olive pomace biorefineries, activities include physical oil extraction, gasification, Combined Heat and Power (CHP), and drying. Other activities involve the production of algae biomass, or the design, production, installation, and maintenance of bioenergy systems like solar dryers.
Key Resources	What essential assets do you need? This includes expertise (R&D, training), by-products from biomass recovery, production and characterisation facilities (e.g., plastic extrusion and injection moulding equipment, grinders, sieves), or a skilled interdisciplinary and expert engineering team. Access to biomass (e.g., wood, agricultural residues, algae, olive pomace), innovation funding, and test sites are also crucial.
Key Partners	Who are your crucial external collaborators? Examples include raw material suppliers (e.g., local farmers, olive mills), production equipment suppliers, innovative clusters, and subcontractors for analysis and production. Universities and research institutes (e.g., University of Goce Delčev, National Institute of Chemistry) and funding bodies (e.g., Fund for Innovation) are also vital partners.

The Environmental Layer	
Functional Value	What environmental service or benefit does your biomaterial product/service provide? This includes reducing CO2 emissions and fossil energy consumption, replacing conventional materials like plastic and paper straws, and contributing to biodegradability. Other benefits include addressing climate change, improving soil fertility, enhancing biodiversity, supporting regenerative agriculture practices, and the valorisation of waste streams.
Materials	What biological and other materials are used? This includes various types of biomass such as woody biomass, agricultural waste and forest residues (e.g., cereal straws, coffee bean residues, olive pomace), sewage sludge, animal manure, algae, and invasive plants.
Production	What is the environmental impact of your production processes? This involves energy consumption (e.g., during drying), water use (e.g., in cleaning processes), and potential carbon emissions. Biorefining processes aim to minimise waste and emissions, contributing to a more efficient resource management of bio-based renewable resources.
Distribution	What are the environmental considerations for getting your products to market? This primarily relates to CO2 emissions from transport. Optimising transport to local markets can help reduce this impact.
Use Phase	What is the environmental impact during the use of your product or service? For example, using biostimulants produced from algae and manure can reduce the need for plant protection products and mineral fertilisers. Using biochar can improve soil fertility, increase water retention, and reduce erosion and nutrient loss.
End-of-life	How are products and materials managed at the end of their life? The aim is for circularity, converting waste into valuable resources. This can involve recycling, composting, biodegradation (if the product is lost), or incineration for energy recovery.
Environmental Impacts	What are the negative environmental consequences? These can include carbon emissions, water pollution, energy consumption, and land use, which can be difficult to define precisely for complex biomaterials.
Environmental Benefits	What are the positive environmental outcomes? These include a potential decrease in carbon emissions and fossil energy consumption compared to fossil-based alternatives.

	Other benefits include biodegradability, support for regenerative agriculture practices, and the use of agricultural residues as raw materials.
Suppliers and Outsourcing	Which are your dependencies on external entities and to critically evaluate their environmental performance, ensuring alignment with your overall circular bioeconomy goals?

The Social Layer	
Social Value	How does your business create benefits for stakeholders and society? It contributes to promoting a green transition, supporting local development and energy autonomy in under-resourced areas, creating green jobs, diversifying farmer income, and strengthening local supply chains. It also raises public awareness about the impact of plastics on climate change and addresses waste management challenges for local communities.
Employees	How does the business impact its employees? It offers opportunities for training and capacity building, and contributes to employee well-being. It can also create skilled jobs in areas like energy systems design, operation, and maintenance.
Governance	What is the organisational structure and decision-making policy? This includes transparent and collaborative governance rooted in academic foundations, and engagement with public institutions and incubators to ensure ethical decision-making and compliance. A multi-actor approach involving diverse stakeholders is encouraged.
End-user	How do end-users benefit from and engage with your solution? They gain access to sustainable, locally produced biomaterials or biostimulants, potentially at lower costs. Their environmental awareness is also increased.
Local Communities	How does the business engage with and benefit local communities? It promotes long-term relationships with local public entities and bio-based solution providers for infrastructure. It strengthens local supply chains by using local biomass (e.g., from farmers) and working with local technical partners and universities. For olive pomace, it facilitates waste management for local olive mills.
Societal Culture	What broader norms and values does the business shape or respond to? It aligns with European values of energy transition, decentralisation, and the bioeconomy. It promotes a "zero-plastic" culture (if replacing plastic products) and raises awareness about environmental issues. It responds to the growing public awareness about the impact of plastics on climate change.
Scale of Outreach	What is the extent of your social engagement? Operations might involve participation in collaborative projects at a European scale, attending events and trade fairs, and potentially scaling to national and international markets through partnerships.
Social Impacts	What are the potential negative social consequences? These could include sourcing raw materials from countries with lower social standards. There is also a risk that the availability of new biomaterial products could lead to an increase in the overall consumption of plastic products, or that the product might be less accessible to customers with lower incomes.
Social Benefits	What are the positive social outcomes? These include education and potential health improvements (e.g., decrease in microplastics). Broader benefits involve green job creation, diversification of farmer income, enhanced resilience, and improved well-being in rural areas.

5.4 Food and Agriculture

The food and agriculture theme involved applying the TLBMC to a range of innovative solutions, including the valorisation of olive oil pomace, the use of solar dryers to reduce food waste, and the production of biostimulants from algae cultivated on animal manure. The process provided tailored templates with clear

guidelines and examples to assist stakeholders in completing the economic, environmental, and social layers of the canvas for their specific ventures. This structured methodology is essential for the project's objective of exchanging knowledge and building capacity, thereby enabling the scale-up of resilient and circular solutions in the agri-food sector.

The Economic Layer	
Value Proposition	What unique food and agriculture products or services are you offering? This could include: • Cost-effective and energy-efficient solar dryers and air heating systems that reduce food waste and energy costs through digitalisation • Locally produced biostimulant fertilisers from algae cultivated on animal manure, which increase agricultural production's resilience and reduce dependence on market prices • Valorising side streams from olive production to obtain valuable products from olive oil pomace, providing zero-price treatment for local olive mills and producing new products like olive pomace oil and biochar [• Eco-products such as compost, functional food, and algae, alongside nutrition innovation and green employment • Healthy snacks made from upcycled food waste, promoting sustainable dietary habits and providing products without social or ecological guilt
Customer Segments	Who are your target customers? This may include small-scale farmers, agricultural associations, food processors, eco-businesses, gardeners, or food and feed manufacturers. For olive pomace valorisation, customers include local olive mills, biomass and biochar consumers, and local farmers' cooperatives.
Channels	How do you reach your customers and deliver your value proposition? This can involve brand establishment, trade fairs, agricultural advisors, direct contact with suppliers and consumers, and informing customers about the value of your product for the green transition. Digitalisation of drying systems and social media outreach can also serve as channels.
Customer Relationships	What type of relationship do you build with your customers? This can involve adapting to olive mill timings and needs, maintaining direct and personal contact with suppliers (e.g., olive mills) and consumers, and developing specific solutions based on customer requirements.
Revenue Streams	How do you generate income? This can be from sales of biostimulants, olive pomace oil, electricity (from Combined Heat and Power plants), dehydrated olive pomace, or biochar for carbon credits. Savings from reduced costs for plant protection products and fertilisers, or from internal energy production, can also contribute.
Cost Structure	What are your main expenses? These include raw material preparation (e.g., livestock manure), construction of facilities (e.g., greenhouses, pools), running costs, and plant CAPEX for biorefineries (including extraction, gasification, CHP, drying, handling systems). Other costs include transport and handling of raw materials.
Key Activities	What are the most important things you do to deliver your value proposition? This encompasses the preparation of livestock manure, microalgae cultivation, harvesting, drying, extrusion, packaging, and returning nitrogen to the field for biostimulant production. For olive pomace, activities include physical oil extraction, gasification CHP, and drying. Other activities include biomass collection, composting, food processing, straw shaping, solar production, R&D, training, and marketing. Design, production, installation, and maintenance of solar systems, along with digitalisation of drying systems, are also key.

Key Resources	What essential assets do you need? This includes liquid livestock manure or biogas digestate, water, pools, greenhouses, algae culture. For solar dryers, a skilled interdisciplinary team, expert engineering team, R&D capabilities, technical know-how, local materials, innovation funding, and test sites are crucial. For biorefineries, land and ponds for olive pomace storage are needed.
Key Partners	Who are your crucial external collaborators? Examples include local farmers and co-operatives, public bodies, R&D centres, NGOs, health experts, social inclusion organisations, municipalities, solar/grid operators, and universities (e.g., University of Goce Delčev). Funding bodies like the Fund for Innovation, and local SMEs, are also vital.

The Environmental Layer	
Functional Value	What environmental service or benefit does your food and agriculture product/service provide? This includes reducing CO2 emissions, contributing to biodegradability, addressing climate change, improving soil fertility, reducing reliance on plant protection products and mineral fertilisers, and valorising waste streams.
Materials	What biological and other materials are used? This includes agri-food residues, livestock manure, olive pomace, and algae. Waste from broken stems of other materials (e.g., paper straw alternatives) can be used for biomass or compost.
Production	What is the environmental impact of your production processes? This involves energy consumption during drying, water use in cleaning processes, and potential CO2 emissions. Processes like biorefining aim to minimise waste and emissions [D3.1].
Distribution	What are the environmental considerations for getting your products to market? This primarily relates to minor CO2 emissions from transport. Low weight and volume of the product can help reduce this impact.
Use Phase	What is the environmental impact during the use of your product or service? For example, biostimulants produced from algae and manure can reduce the need for plant protection products and mineral fertilisers. Biochar can improve soil fertility, increase water retention, and reduce erosion and nutrient loss.
End-of-life	How are products and materials managed at the end of their life? The aim is for circularity, converting waste into valuable resources. This can involve composting or biodegradation. For olive pomace, the biorefinery supports a closed loop system.
Environmental Impacts	What are the negative environmental consequences? These can include energy consumption, water residues after microalgae cultivation, packaging of the final product, and greenhouse gas emissions. It also includes waste from broken stems.
Environmental Benefits	What are the positive environmental outcomes? These include a potential decrease in carbon emissions and fossil energy consumption compared to conventional alternatives, biodegradability, and the utilisation of agricultural residues as raw materials. Algae consume CO_2 and produce O_2. Using olive pomace avoids its burning and valorises it.
Suppliers and Outsourcing	Which are your dependencies on external entities and to critically evaluate their environmental performance, ensuring alignment with your overall circular bioeconomy goals?

The Social Layer	
Social Value	How does your business create benefits for stakeholders and society? It contributes to promoting a green transition, supporting local development, strengthening local supply chains, and diversifying farmer income. It can also increase local resilience and food sovereignty, empower small producers, foster an innovation culture, and strengthen food self-sufficiency, particularly in underserved rural areas. It addresses waste management challenges for local communities.

Employees	How does the business impact its employees? It offers better chances for non-seasonal work positions, promotes inclusive hiring and equal opportunity values, supports skills development in sustainable food production, and fosters a safe and mission-driven workplace culture. It also offers opportunities for training and capacity building.
Governance	What is the organisational structure and decision-making policy? This includes participatory and transparent governance, working with national innovation ecosystems and academia, and coordinating with local olive oil producers and farmers. It aligns with circular bioeconomy values and supports ethical decision-making.
End-user	How do end-users benefit from and engage with your solution? They gain access to sustainable, locally produced biostimulants, food, and energy systems, which can enable them to reduce losses and improve economic viability. They also receive healthy snacks and information about the circular economy.
Local Communities	How does the business engage with and benefit local communities? It involves local agricultural communities and food markets, strengthens local supply chains by using local biomass (e.g., from farmers), and supports waste management for local olive mills. It fosters the vision of the area as a proactive and adaptable region.
Societal Culture	What broader norms and values does the business shape or respond to? It promotes sustainable dietary habits, aligns with circular bioeconomy values, challenges conventional beauty standards in food consumption, and promotes acceptance of imperfection and resource frugality. It raises awareness of food waste and climate action. It also raises awareness of circular technologies
Scale of Outreach	What is the extent of your social engagement? Operations might involve local production with potential for national and international distribution, and active social media outreach and partnerships with schools, municipalities, and sustainability influencers.
Social Impacts	What are the potential negative social consequences? These could include the product being less accessible to customers with lower incomes, opportunity costs for space/time on the farm for other activities, potential division between farmers willing to acquire products, or distrust in new initiatives perceived as solely for profit.
Social Benefits	What are the positive social outcomes? These include potential for new job creation, reduced use of plant protection products and mineral fertilisers, improved plant resistance and nutrition, and the utilisation of degraded areas for food production. Broader benefits include green job creation, diversification of farmer income, enhanced resilience, and improved well-being in rural areas [D5.7].

5.5 Forestry and Natural Habitats

For the forestry and natural habitats theme, the process involved adapting the TLBMC to initiatives such as the creation of protective wraps for young forest stands from sheep wool and the development of high-value biochemicals from wood by-products. The methodology offered specific templates with detailed guidance and examples for each of the canvas's three layers—economic, environmental, and social. This systematic approach is designed to support BioRural's goal of fostering knowledge exchange and building capacity, ultimately enabling the scale-up of resilient and circular bio-based solutions within the forestry sector.

The Economic Layer	
Value Proposition	What is the value your forestry initiative delivers to its customers and stakeholders? (e.g., Provision of high-quality timber, maximisation of value from by-products, including high-quality fuels, biomaterials, and biochemicals, offering cost-effective and energy-efficient solutions, like solar dryers, which reduce food waste and energy costs, providing protective wraps for young forest stands that decrease reliance on plastic and chemical alternatives)

Customer Segments	What are the specific groups of people or organisations your forestry business aims to serve? (e.g., Secondary processing industries that require timber, local administrations and private forest owners managing land, small-scale farmers, agricultural associations, food processors, and eco-businesses interested in related solutions, forestry organisations and public forest managers, consumers of wood products, bioenergy, and biomaterials)
Channels	How will your forestry products and services reach your customer segments? (e.g., Direct contracts with relevant secondary transformation industries for primary products and biochemicals, utilising organised retail channels for biomaterials by-products, direct sales to forestry organisations, disseminating knowledge via online platforms, conferences, and industry events to reach a wider audience)
Customer Relationships	What types of relationships will you establish and maintain with your various customer segments? (e.g., Direct, long-term partnerships with secondary timber transformation industries, direct contracts with local contractors for the supply of by-products (e.g., for bioenergy), direct collaboration and feedback mechanisms with forestry companies and public forest managers, knowledge sharing through workshops, demonstrations, and online resources for broader engagement)
Revenue Streams	How will your forestry initiative generate income and capture economic value? (e.g., Sales of transformed primary products, such as timber, sales of by-products with maximised value, including high-quality fuels, biomaterials, and biochemicals, sales of wool-based protection products for forest stands, income from consulting and knowledge transfer services, potential funding received from EU grants and sustainability-focused programmes)
Cost Structure	What are the significant expenses incurred in operating your forestry and natural habitat initiative? (e.g., Personnel and machinery costs for wood harvesting operations, capital costs associated with financing machinery and transformation plants, costs related to wool procurement, processing, research and development, labour, logistics, and knowledge dissemination activities)
Key Activities	What are the core actions necessary for your forestry business to function, produce, and deliver its offerings? (e.g., implementing sustainable forestry management practices, primary processing of wood and its by-products, secondary transformation of timber into various products, processing agricultural waste, such as sheep wool, into useful forest products like protective wraps, designing, producing, installing, and maintaining relevant systems, for instance, solar dryers if integrated with agroforestry or bioenergy, sourcing of raw materials, including local materials like sheep wool from farmers, collaborating on product development and testing with partners)
Key Resources	Which are the essential assets and capabilities required to operate your forestry and natural habitat business? (e.g., managed forests with established management plans, necessary financing to support operations and investments, personnel and machinery for wood harvesting and processing, capital to finance machinery and transformation plants, skilled interdisciplinary teams, expert engineering teams, and R&D capabilities, along with technical know-how, local materials, such as sheep wool, as sustainable inputs, innovation funding and access to test sites for new solutions)
Key Partners	Which are the essential external entities to strengthen your forestry initiative's economic viability and reach? (e.g., secondary processing industries, for example, those involved in wood transformation, local administrations and private forest owners, Research institutes, for product development and testing, EU innovation networks, to leverage broader opportunities)

The Environmental Layer

Functional Value	What are the core environmental benefits and functions provided by your initiative? (e.g., Sustainably managed forests that provide timber, biomass, and vital ecosystem services, production of protective wraps for young forest stands, contributing to reforestation efforts)
Materials	What are the key natural resources and raw materials used in your operations? (e.g., Wood and various forest residues, such as small branches, barks, roots, lower parts of trees, and woodchips, sheep wool, as an agricultural by-product)
Production	What are the environmental considerations during the production processes? (e.g., Evaluating energy and water consumption during wool processing)
Distribution	What are the environmental aspects related to the transport and delivery of products? (e.g., Minimising transport emissions through local sourcing strategies)
Use Phase	What are the environmental implications during the active use of your products? (e.g., Assessing the environmental impact of wood utilisation in construction, considering maintenance and other factors related to the long-term use of timber products)
End-of-life	What happens to your products and materials at the end of their useful life? (e.g., Repurposing or reusing materials, such as drone batteries or other add-ons from forest monitoring equipment, if applicable)
Environmental Impacts	What are the potential negative environmental externalities of your activities? (e.g., Main external inputs include energy and water for wool processing, minor emissions stemming from transportation activities, noting no significant negative impact compared to traditional plastic or chemical alternatives for protective wraps)
Environmental Benefits	What are the positive ecological outcomes and contributions of your forestry initiative? (e.g., Forests capturing greenhouse gases through tree biomass and soil carbon accumulation, conservation of biodiversity within privately managed forest areas, reduced plastic waste and chemical usage in forest management, promotion of a circular economy by transforming agricultural waste (sheep wool) into a valuable product, support for biodiversity and soil health by avoiding synthetic residues, prevention of carbon loss from forest ecosystems, substitution effect where wood products replace more fossil-intensive materials)
Suppliers and Outsourcing	Which are your dependencies on external entities and to critically evaluate their environmental performance, ensuring alignment with your overall circular bioeconomy goals?

The Social Layer	
Social Value	What are the broader societal benefits generated by your initiative? (e.g., Acknowledging wood as a crucial material for mountain areas, supporting traditional craftsmanship in building and energy, promoting rural development and creating new job opportunities, especially in depopulated mountain regions, reducing agricultural waste by finding a beneficial use for surplus sheep wool, enhancing social inclusion by engaging small farmers and local businesses)
Employees	What are the impacts and considerations for the workforce involved in your operations? (e.g., Training machine operators for forestry machinery, employing quality managers in processing facilities, hiring marketing employees to highlight environmental values, prioritising the well-being, safety, and ongoing training of forestry staff and workers involved in wool application, promoting diversity and inclusion within project teams and among partners)
Governance	What are the internal and external governance structures influencing your social impact? (e.g., Ensuring social acceptance of processing plants through active involvement of the local population, striving to minimise risks through fair partnership and equitable benefit distribution among all stakeholders, as part of current governance aims)

End-user	Who are the ultimate beneficiaries of the social value created? (e.g., Forestry companies and public forest managers, farmers who may use biochar if integrated with agroforestry practices)
Local Communities	How does the forestry and natural habitats initiative engage with and benefit local communities? (e.g., Supporting rural development and creating new job opportunities, especially in depopulated mountain regions, by valuing traditional craftsmanship, fostering community involvement in managing forest and agroforestry debris for fire prevention and energy production, engaging with local municipalities and forest cooperatives for mutually beneficial collaboration, involving private landowners in biodiversity conservation through voluntary programs that offer advisory and financial support)
Societal Culture	How does your initiative influence and is influenced by broader cultural norms and values? (e.g., Promoting public awareness regarding sustainable forestry and responsible resource use, encouraging ethical consumerism and setting a positive example for other forestry operators)
Scale of Outreach	What is the geographical and social reach of your social impact activities? (e.g., Primarily focused on local communities, actively sharing knowledge and results through workshops, publications, and participation in international networks, engaging with universities, research institutes, and the wider forestry community to foster collaboration)
Social Impacts	What are the potential negative social externalities or challenges? (e.g., Acknowledging the potential for labour-intensive work if not mechanised or adequately supported with training, recognising the risk of uneven benefit distribution among stakeholders if not carefully managed)
Social Benefits	What are the positive social outcomes and contributions? (e.g., Creation of jobs in rural and depopulated mountain areas, boosting the local circular economy)

6 Conclusions

The use of tools such as the Triple Layer Business Model Canvas (TLBMC) in circular bioeconomy ventures, particularly within the BioRural project, leads to several key conclusions regarding their potential and benefits. These tools are instrumental in designing and evaluating business models that integrate economic, environmental, and social sustainability aspects.

The primary conclusions drawn from applying these tools in circular bioeconomy ventures include:

1. Promotion of a Holistic Sustainable Approach: The TLBMC, for instance, allows for a comprehensive overview of a business model, ensuring that environmental and social concerns are considered alongside traditional economic objectives. This leads to the development of "sustainable or sustainable-oriented business models".

2. Facilitation of Resource Efficiency and Waste Valorisation: These tools highlight strategies for optimizing resource use by converting biomass residues and waste streams into valuable products. This is a fundamental aspect of the circular bioeconomy, moving away from linear economic models. For example:

- Algen's model demonstrates the simultaneous treatment of wastewater and recycling of nutrients, utilising degraded areas for food production, saving water, and lowering environmental impact on farms.
- Olive pomace biorefineries enable the local valorisation of olive oil pomace to obtain oil, biochar for soil improvement, and energy, thereby closing the loop and reducing transport of wet waste.
- Staramaki uses agricultural residues (wheat stems) to produce biodegradable straws, which replaces plastic and paper alternatives, supports regenerative agriculture, and diversifies farmer income.

3. Creation of New Market Opportunities and Value Chains: The application of these tools identifies innovative pathways for new bio-based products and services, fostering economic growth even as overall bioeconomy employment may decrease while its value increases. This includes:

- NatruePlast focusing on local biomass to produce bioplastics and biocomposites, aiming for decreased carbon emissions and fossil energy consumption.
- Agro Solar's solar dryers offering cost-effective and energy-efficient solutions that reduce food waste and energy costs in agriculture.
- Gwicker Earthfood creating value from rejected produce, supporting local farmers, engaging regional economies, and raising food waste awareness.

4. Strengthening Local Economies and Rural Development: Many of the evaluated business models demonstrate direct benefits to rural communities by creating local value, fostering cooperation, and generating new employment opportunities, sometimes non-seasonal.

- Sciven's model strengthens local supply chains for biomass sourcing and promotes long-term relationships with local public entities, contributing to decarbonization and reducing energy costs.
- Valorial promotes eco-products, nutritional innovation, green employment, and import substitution through community-based networks and local markets.

5. Enhanced Environmental Sustainability: A core conclusion is the ability to quantify and pursue significant environmental benefits. This includes reducing greenhouse gas (GHG) emissions, decreasing reliance on fossil fuels, enhancing biodiversity, improving soil health, and reducing pollution.

6. Promotion of Knowledge Exchange and Innovation Uptake: The project's emphasis on knowledge exchange workshops and an online toolkit (BioRural Toolkit) aims to bridge knowledge gaps, making scientific and practical information on bio-based solutions accessible to a wide audience, which in turn fosters continuous learning and capacity building for rural stakeholders and innovators.

In essence, using business model tools like the TLBMC in circular bioeconomy ventures provides a structured framework to design, assess, and communicate sustainable value propositions that align with the transition from linear to circular economic models, addressing economic, environmental, and social challenges while leveraging local resources and fostering innovation.

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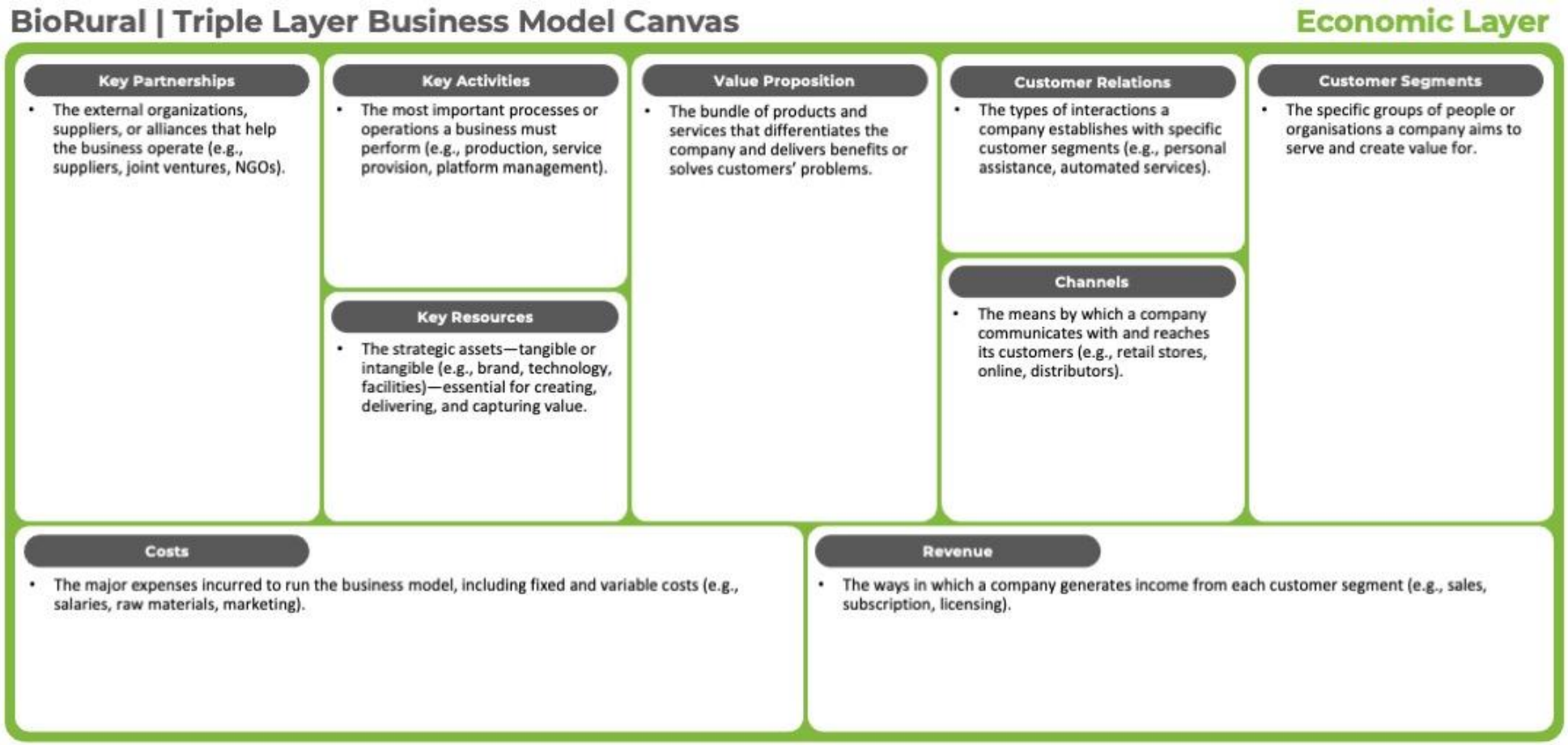
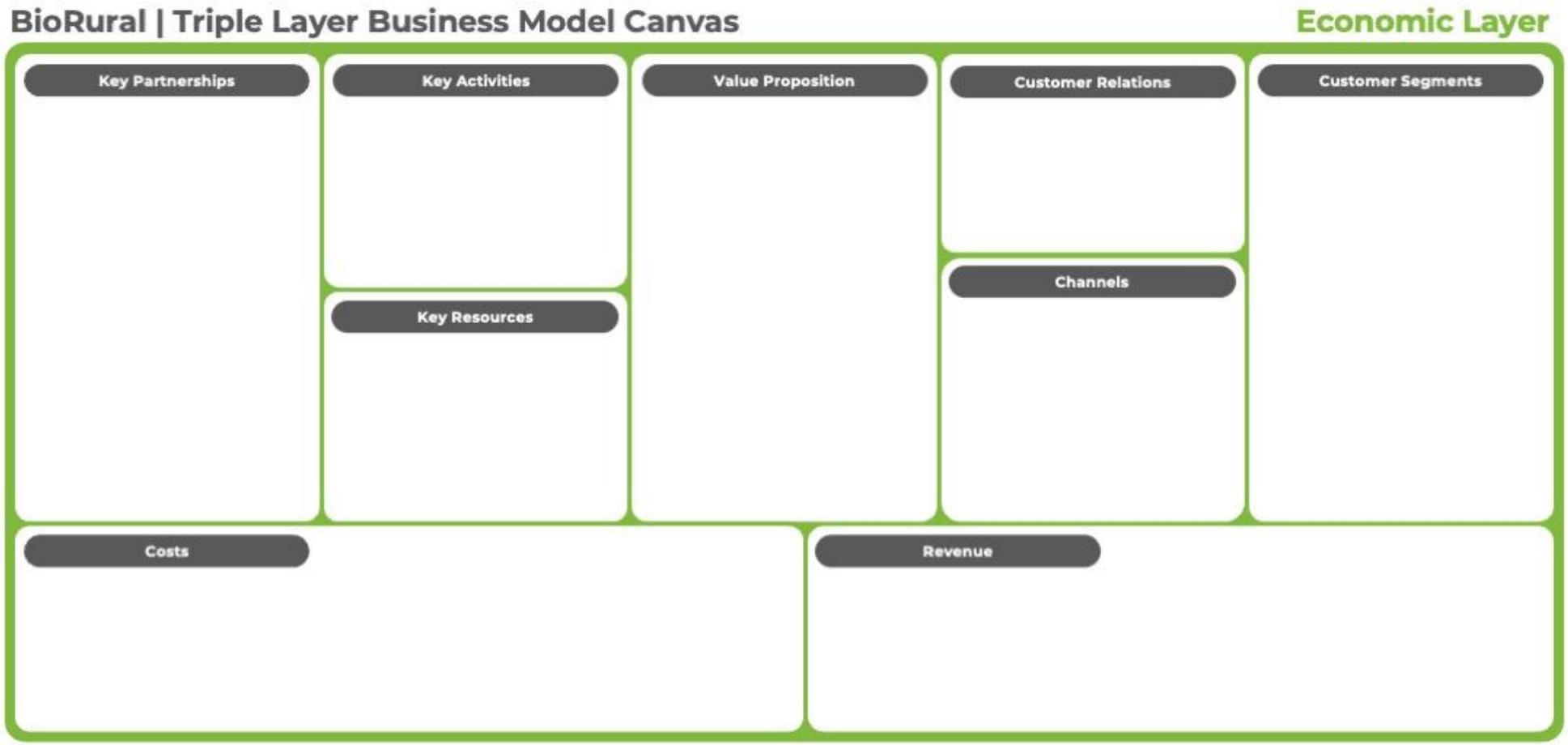
Annex

Annex A. Triple Layer Business Model Canvas tool

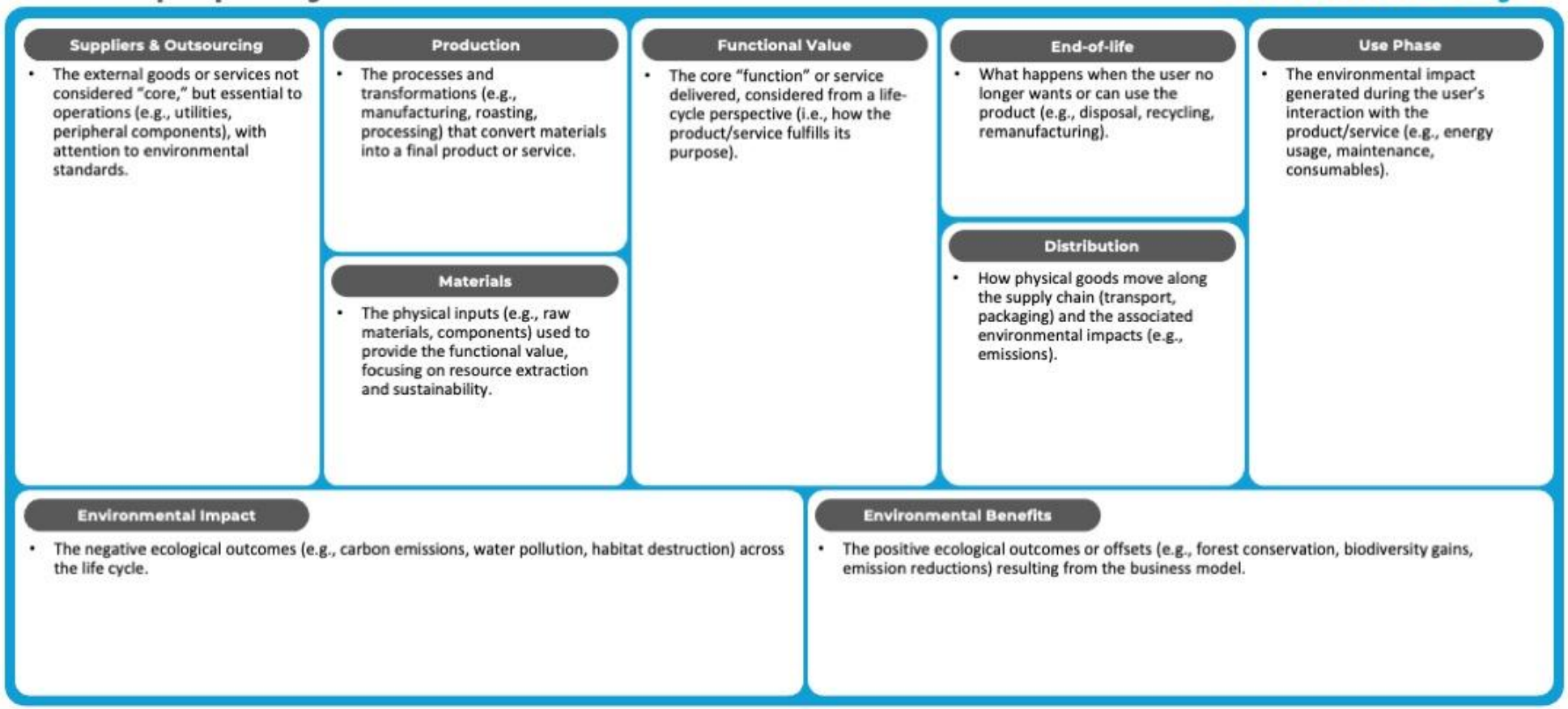
The following Triple Layer Business Model Canvas is going to be available through the BioRural Toolkit, alongside the guiding questions for each section of the three layers of the tool. The first slide provides instructions and the second one for each layer is editable.

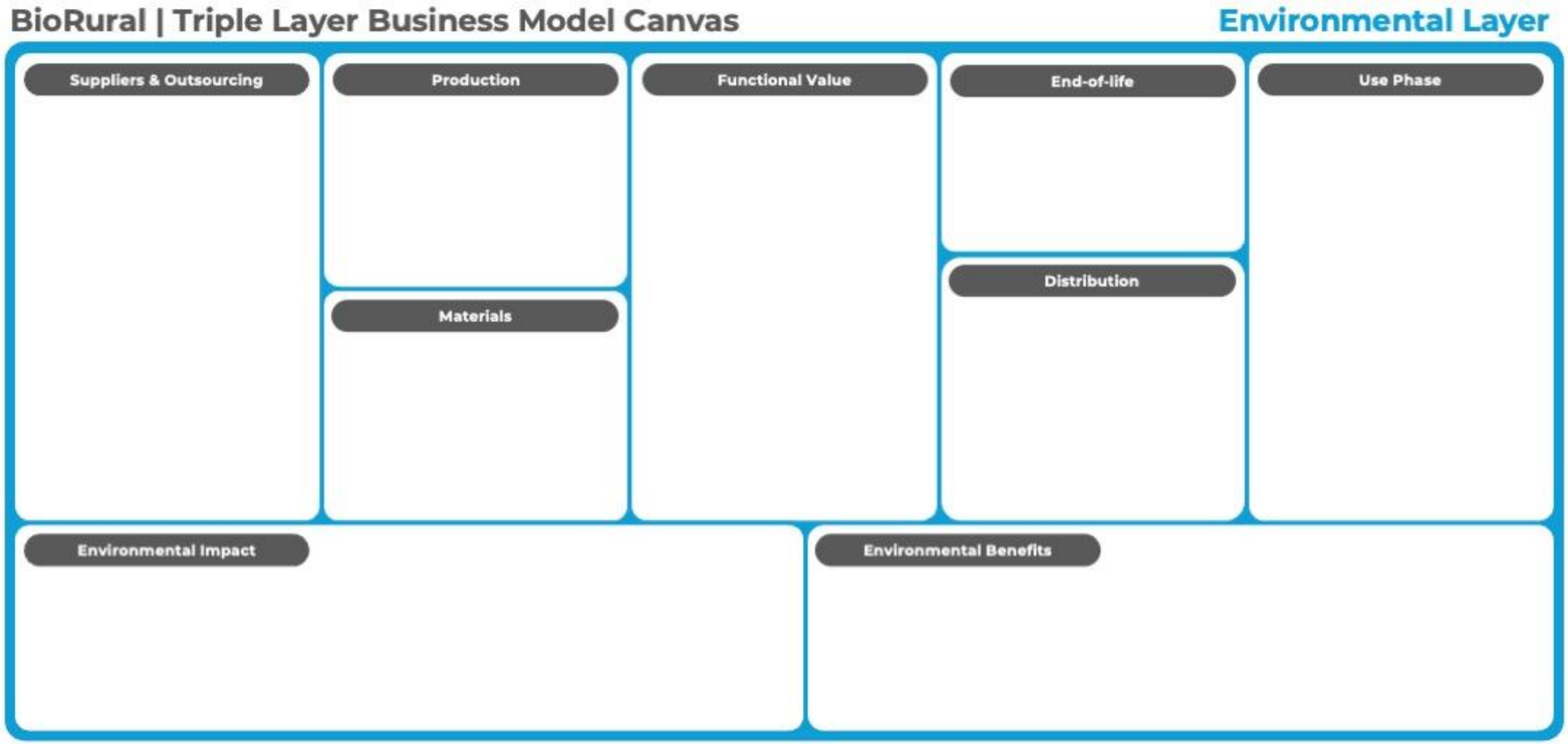



BioRural | Triple Layer Business Model Canvas
Economic Layer
Key Partnerships
Key Activities
Value Proposition
Customer Relations
Customer Segments
Key Resources
Channels
Costs
Revenue

BioRural | Triple Layer Business Model Canvas

Environmental Layer




BioRural | Triple Layer Business Model Canvas
Environmental Layer
Suppliers & Outsourcing
Production
Materials
Functional Value
End-of-life
Distribution
Use Phase
Environmental Impact
Environmental Benefits

BioRural | Triple Layer Business Model Canvas

Governance Layer

Local Communities

- The local or regional populations affected by the company's operations (e.g., supplier villages, neighborhood residents), including social development and collaboration.

Governance

- The organisational structures and policies (e.g., decision-making processes, transparency, stakeholder engagement) shaping social accountability.

Employees

- The internal workforce critical to delivering value (e.g., their well-being, training, wage standards, diversity, and inclusion).

Social Value

- The societal benefits the business promises (e.g., community uplift, social inclusion, fair treatment) that go beyond economic or environmental gains.

Societal Culture

- The broader norms and values the business both shapes and responds to (e.g., public awareness, ethical consumerism).

Scale of Outreach

- The extent of social engagement—from local to global—showing how widely the company influences stakeholders.

End-user

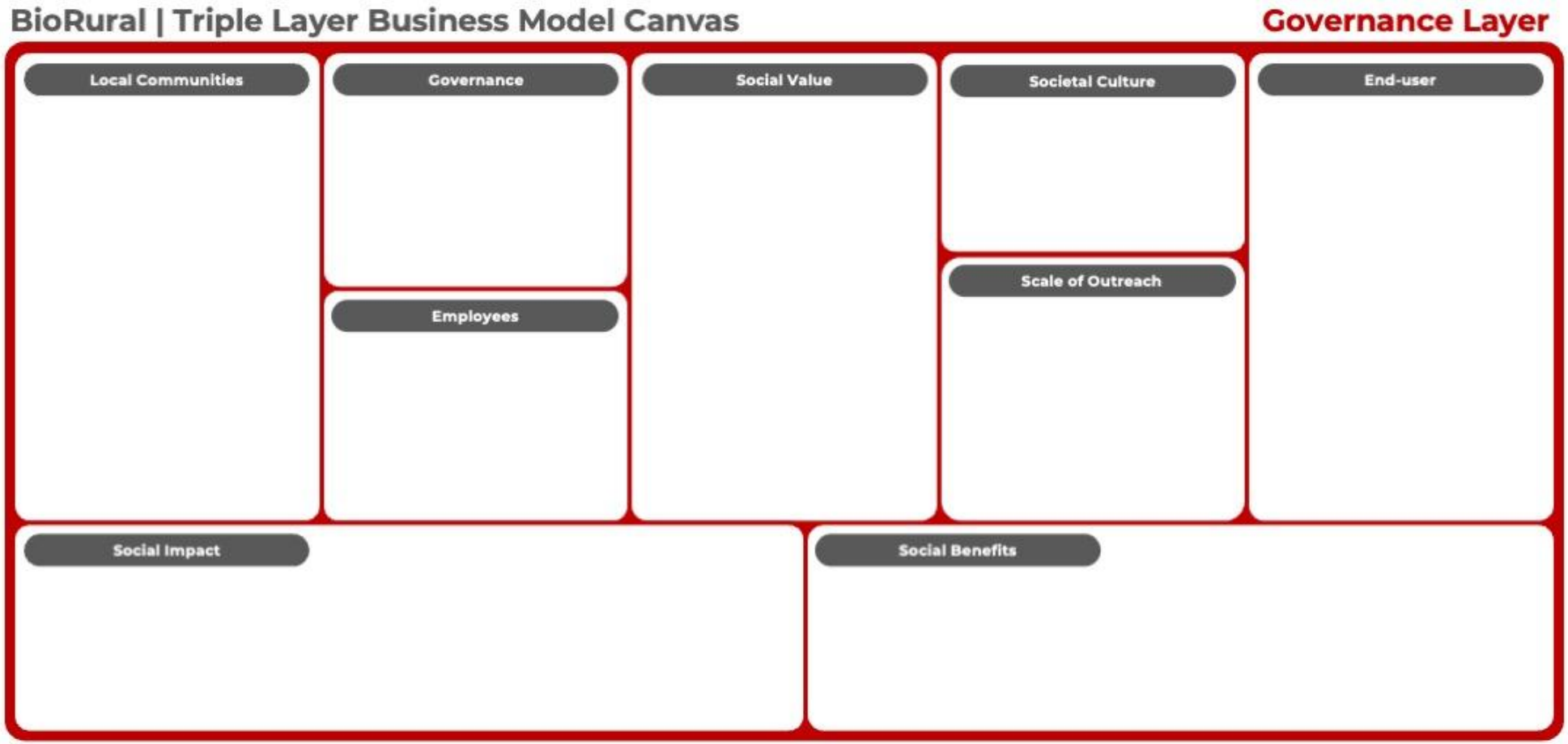
- The stakeholder actually "consuming" the product or service—possibly different from the paying customer—highlighting social effects of usage.

Social Impact

- The negative societal consequences (e.g., labor exploitation, community disruption) that the business model can create if not managed responsibly.

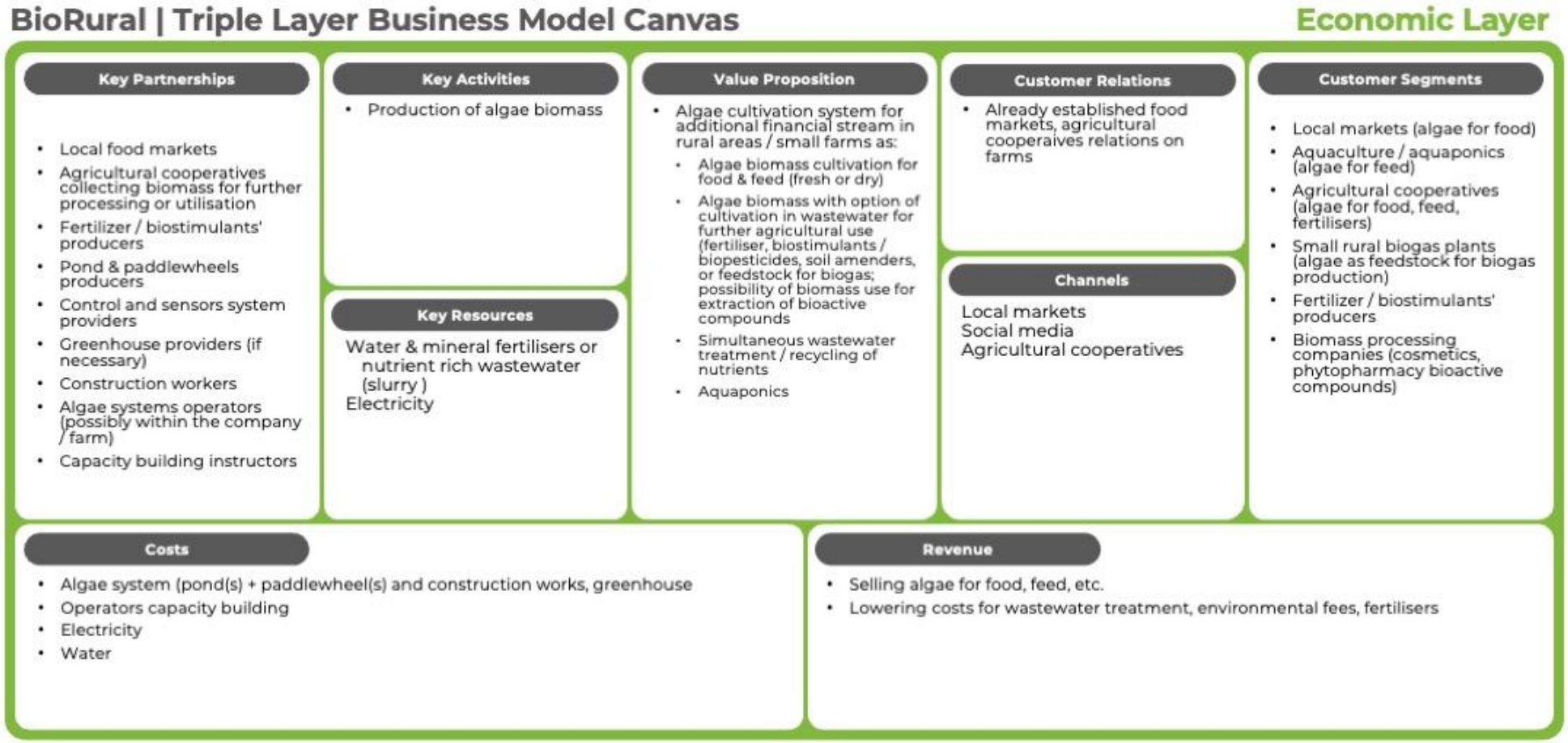
Social Benefits

- The positive societal outcomes (e.g., poverty reduction, education, health improvements) arising from the company's social initiatives and practices.


BioRural | Triple Layer Business Model Canvas
Governance Layer
Local Communities
Governance
Social Value
Societal Culture
End-user
Employees
Scale of Outreach
Social Impact
Social Benefits

Annex B. Examples of Triple Layer Business Model Canvases based success stories on the five Bioeconomy themes

Aquatic Water Systems – Algen Case



BioRural | Triple Layer Business Model Canvas

Environmental Layer

Suppliers & Outsourcing

Production

- Cultivation in algae ponds

Materials

- Fertilisers

Functional Value

- End-of –Waste: Recycling of nutrients from waste streams
- Utilizing degraded area where agriculture is not possible
- Saving water reserves during food and feed production
- Lowering farm load on the environment
- Higher water retention and lower erosion and nutrient loss if algae are used as an organic fertiliser in soil

End-of-life

- Ponds and greenhouse can be always used for production of different biomass or sold to another user as the system is side-stream and is easily added or removed from the core production system.

Distribution

- Transport to local markets / shops as fresh or dried biomass

Use Phase

- Use of mineral fertilisers and water (if wastewater utilisation is not possible, f.e. For food production)
- Electricity

Environmental Impact

- Use of water and electricity
- Water substrate from harvested algae can still have some nutrients

Environmental Benefits

- Recycling of waste substrates
- Recycling of water substrate until the water is clean enough for the release (irrigation of crops)
- CO2 capture by algae photosythesis
- Smell reduction from waste substrates

BioRural | Triple Layer Business Model Canvas

Governance Layer

Local Communities

- Local agricultural communities
- Local energy producers (biogas plants)
- Food markets

Governance

- Regulations regarding biomass safety and quality for each valorisation

Employees

- Pond operators
- Collectors of biomass from farms (like logistic for milk collection)
- Farmers, aquaculturists
- Engineers for biomass processing

Social Value

- Encouraging young people to stay on the farms by new and innovative activities
- New jobs (operators, proceesors of biomass)
- Nice look of the green ponds
- Smell reduction from waste substrate
- CO2 capture - better air quality

Societal Culture

- Algae pond systems encourage nutrient recycling, GHG capture, water recycling, reuse of resources, currently treated as waste, the ponds look nice and could be part of recreation parks

Scale of Outreach

- Influence on farming, fertiliser industry, bioactive compound producers, wastewater treatment plants, biogas plants

End-user

- Local community
- Famers using algae organic fertilisers
- Aquaculturalist and farmers using algae feed additives for more resiliant and healthier (lower antibiotics consumation) farm animals

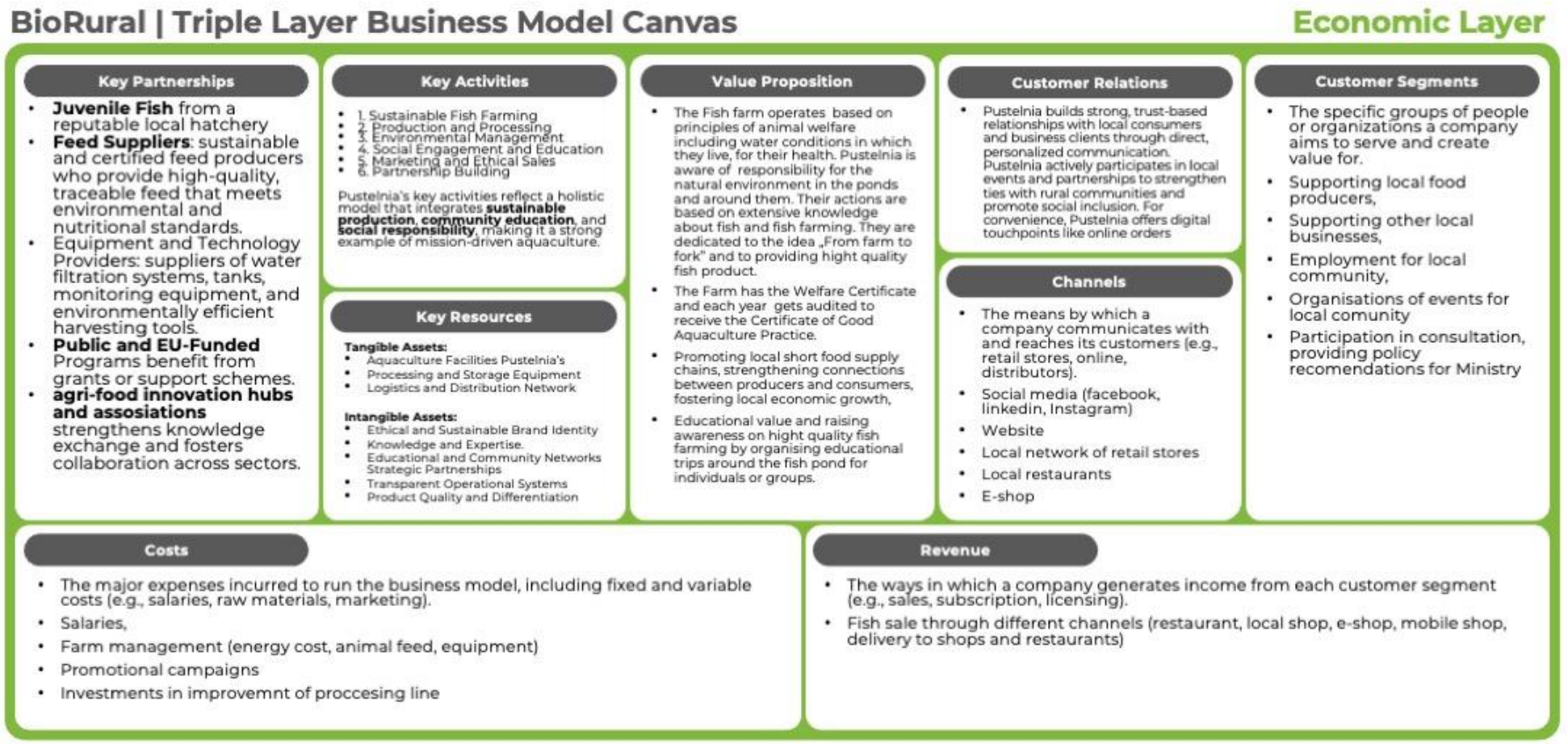
Social Impact

- Ponds / new greenhouses incorporated in the rural area
- Birds gathering in the ponds

Social Benefits

- New jobs, new source of sustainable food, feed or organic fertilisers which reduce water pollution by improving soil structure and nutrients' retention
- Improved air quality (GHG reduction) and smell reduction
- Improved self-sustainability either for food and animal feed, either for energy (local biogas plants) or organic fertilisers for local food production
- Utilisation of degraded areas for food etc. Production
- Wastewater treatment, lowering overload of slurry on the fields

Aquatic Water Systems – Pustelnia Fish Welfare Case



BioRural | Triple Layer Business Model Canvas

Environmental Layer

Suppliers & Outsourcing

- **FISH FARMING:**

Management: includes pumps, filtration systems, and potentially aeration equipment to maintain water quality and flow.

Fish Feed Local Farmers and Input Providers complementary services or materials (e.g., grains, probiotics,

Equipment: items like oxygen meters, seine nets, tools, and potentially vehicles for transportation or maintenance.

- **FISH PROCESSING AND SALE**

Processing & Packaging: equipment for processing (e.g., cleaning, gutting), packaging, and potentially refrigeration.

Production

- Broodstock and Hatchery Care
- Fish Rearing and Feeding
- Health and Welfare Monitoring
- Harvesting
- Processing and Cleaning
- Packaging and Distribution

Materials

- Fresh Fish: from fingerlings and feed to water and packaging. Selected and managed with a strong focus on sustainability, resource efficiency, and environmental responsibility.

Functional Value

- Pustelnia delivers ethically farmed, sustainable fish products to consumers while promoting social inclusion, environmental stewardship, and rural development.
- Pustelnia uses high-quality, traceable inputs with minimal environmental impact. Ensures animal welfare from the start through selective breeding and appropriate feed.
- Promotes local supply chains and short distribution routes to reduce carbon emissions.
- Promotes waste reduction and reuse (e.g., potential composting of byproducts, packaging initiatives).

End-of-life

- What happens when the user no longer wants or can use the product (e.g., disposal, recycling, remanufacturing).
- All left overs are fully biodegradable

Distribution

- The product are sold in the short supply chains through different channels (restaurant, local shop, e-shop, mobile shop, delivery to shops and restaurants)

Use Phase

- The Fish cultivation has low envinronmental ippact due to implementation of sustainable aquaculture practices

Environmental Impact

Nutrient loading can lead to eutrophication, which stimulates excessive algae growth, depletes oxygen, and disrupts aquatic ecosystems. The use of antibiotics, pesticides, and antifoulants in aquaculture may lead to chemical residues entering the environment. These substances can harm non-target organisms, contribute to antibiotic resistance, and alter sediment and water chemistry. Fish farming operations consume energy and contribute to greenhouse gas emissions, particularly through feed production, transportation, and farm infrastructure. **However it is reduced by sustainable farming practises.**

Environmental Benefits

Aquaculture provides an alternative source of seafood, which helps reduce overfishing of wild fish populations. Fish are among the most efficient animals at converting feed into protein. They have a low feed conversion ratio (FCR), meaning less feed is needed to produce a kilogram of fish meat compared to land-based livestock like cows or pigs. Because of their cold-blooded physiology and aquatic environment, farmed fish produce fewer greenhouse gas emissions per kilogram of meat compared to beef or pork.

BioRural | Triple Layer Business Model Canvas

Governance Layer

Local Communities

Close colaboration with local actors:

- Supporting local food producers,
- Supporting other local businesses,
- Employment for local community,
- Organisations of events for local comunity

Governance

The Farm has the Welfare Certificate and each year gets audited to receive the Certificate of Good Aquaculture Practice.

The farm is open to visitors, organises educational trips for their guests. Through open communication and traceability of its practices, Pustelnia builds trust with consumers and stakeholders. This transparency strengthens public confidence in sustainable aquaculture and reinforces its social responsibility.

Employees

Pustelnia employs profesionals and provides regular trainings for the staff. Maintains the gender parity and high employment standards. Offers fair wages, safe working conditions, and employee well-being.

Social Value

The business aims to strengthen rural and local communities by creating jobs and supporting local economies. Pustelnia promotes inclusive employment by offering opportunities to people from different social backgrounds, including underrepresented or vulnerable groups. The initiative appears to foster equality by supporting fair hiring and promoting workplace diversity.

Societal Culture

The business contributes to public knowledge by educating consumers and communities about sustainable fish farming and animal welfare. It raises awareness about responsible aquaculture and the ethical treatment of animals, creating a more informed society.

Scale of Outreach

The owner of Pustelnia is supporting Ministry of Agriculture and Rural Development at national and EU level with recomendation on shaping the acualuture and fisheries policy as representant of fish assosiations .

End-user

- **Individual Consumers (Families and Households)** who consume the fish as food. They benefit from high-quality, ethically farmed fish that support animal welfare and health standards.

Social Impact

If not overseen carefully, the business may engage in unfair labor practices—such as underpaying workers, failing to provide safe working conditions, or relying on seasonal or migrant labor without adequate protection. The development or expansion of fish farming infrastructure may lead to land use conflicts, strain on local resources (e.g., water), or tensions with nearby residents. If aquaculture facilities alter traditional landscapes or limit access to natural spaces, it may lead to cultural erosion.

Social Benefits

Pustelnia supports local economic development by creating stable jobs in fish farming, processing, and logistics. This provides reliable income for rural communities and contributes to reducing poverty, especially in areas with limited employment opportunities. Through workshops, farm visits, and public outreach, Pustelnia educates consumers, schools, and communities about sustainable aquaculture, animal welfare, and environmental stewardship. Sustainable production practices reduce health risks associated with contaminated or industrially farmed seafood. Operating transparently and engaging with local partners, Pustelnia helps build trust and social cohesion.

Aquatic Water Systems – University of Ljubljana Case

BioRural | Triple Layer Business Model Canvas

Economic Layer

Key Partnerships

-Farmers and cooperatives (food and feed producers)

-Biogas plant

-Specialised companies

Key Activities

-Preparation of livestock manure
-Microalgae cultivation
-Harvesting, drying, extrusion, packaging
-Returning nitrogen to the field

Key Resources

-Liquid livestock manure or biogas digestate
-Water
-Pool, greenhouse
-Algae culture

Value Proposition

-Local production of biostimulant fertilisers

-Circular use of raw materials

-Increased resilience of agricultural production (independence from market prices)

Customer Relations

-Informing customers about the value of the product for the green transition

-Locally produced

Channels

-Brand establishment, trade fairs, agricultural advisors

-Producers' cooperative

Customer Segments

-Farmers (food and feed producers)

-Gardeners

Costs

-Preparation of livestock manure or digestate

-Construction of greenhouses and pools

-Running costs

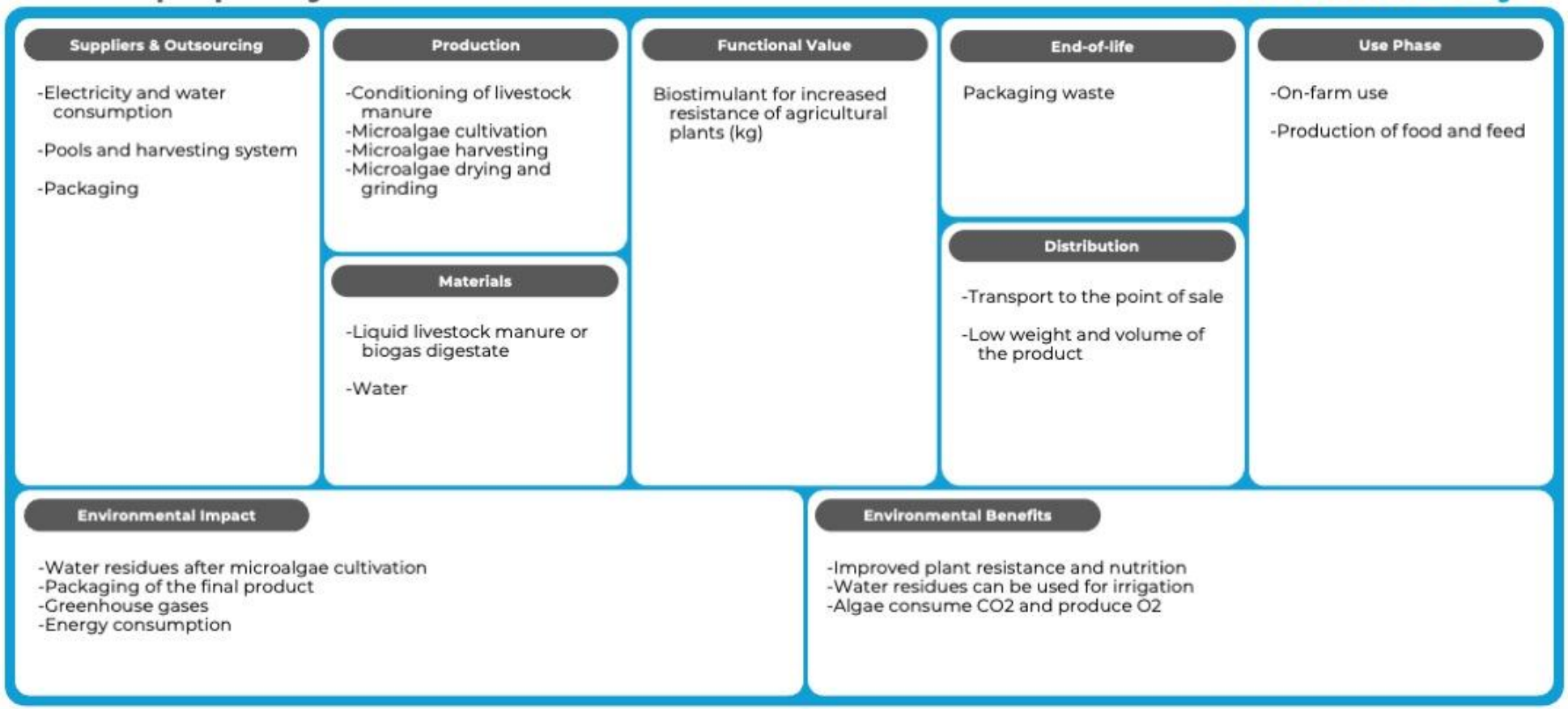
Revenue

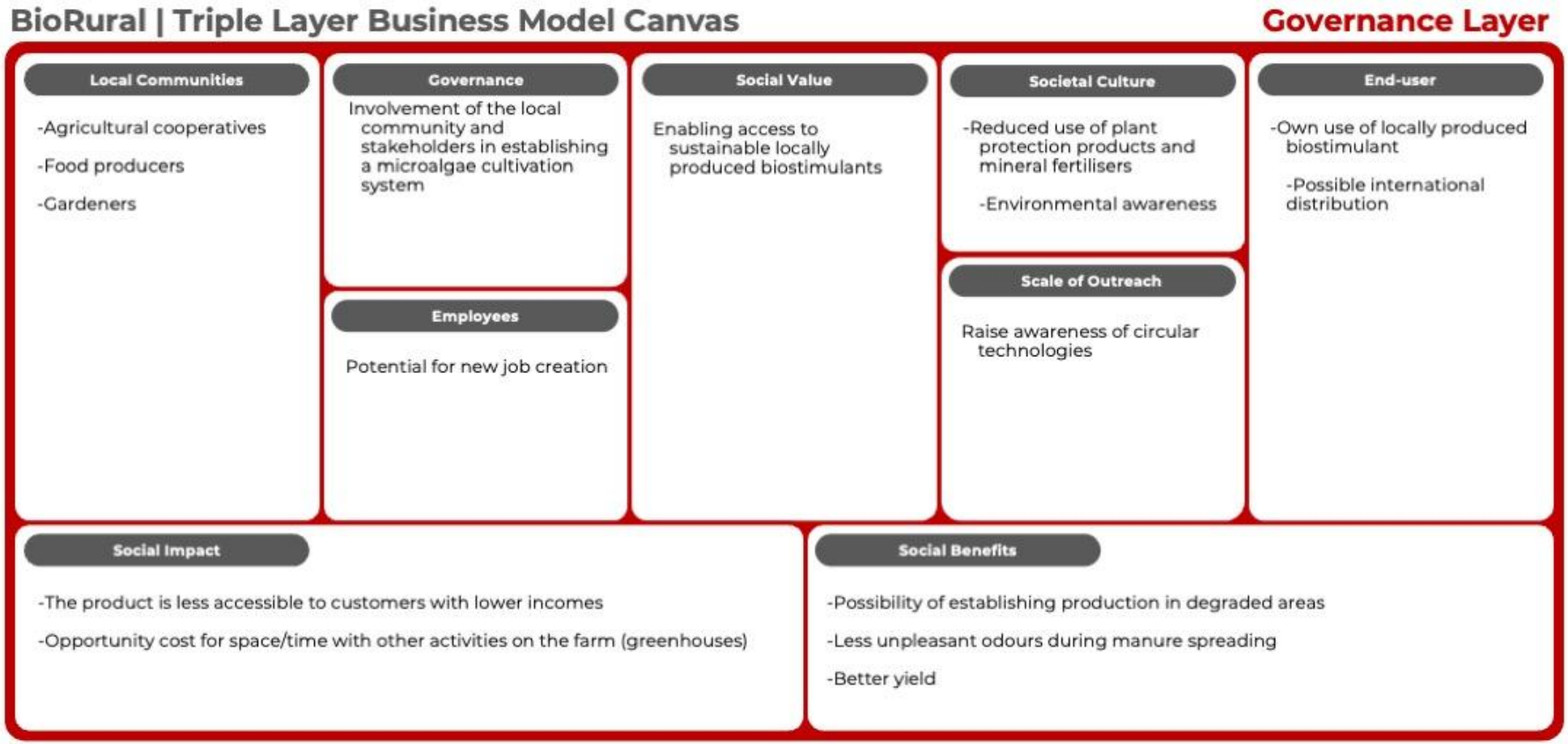
-Additional income from the sale of biostimulants (supplementary activity on the farm)

-Reduction in costs for plant protection products and fertilisers

BioRural | Triple Layer Business Model Canvas

Environmental Layer




BioRural | Triple Layer Business Model Canvas
Governance Layer
Local Communities
-Agricultural cooperatives
-Food producers
-Gardeners
Governance
Involvement of the local community and stakeholders in establishing a microalgae cultivation system
Employees
Potential for new job creation
Social Value
Enabling access to sustainable locally produced biostimulants
Societal Culture
-Reduced use of plant protection products and mineral fertilisers
-Environmental awareness
Scale of Outreach
Raise awareness of circular technologies
End-user
-Own use of locally produced biostimulant
-Possible international distribution
Social Impact
-The product is less accessible to customers with lower incomes
-Opportunity cost for space/time with other activities on the farm (greenhouses)
Social Benefits
-Possibility of establishing production in degraded areas
-Less unpleasant odours during manure spreading
-Better yield

Bioenergy – AVEBIOM Case

BioRural | Triple Layer Business Model Canvas

Economic Layer

Key Partnerships

Suppliers are local olive mills (which are clients to whom the management of olive pomace is facilitated for free, and who will bottle and commercialise olive pomace oil)

Farmers in the area using biochar

Carbon credit business managing company, able to commercialise credits generated by biochar

Local industry / olive mill, to co-share part of the devices: shovels, trucks.

Key Activities

Coordination with olive mills for easing the supply

Trust creation with farmers to facilitate new business on carbon capture credits

Agreement with local oil producers for bottling and commercialising olive pomace oil

Key Resources

Biorefinery plant with integrated CHP

Land and ponds for olive pomace storage and lowering water content

Branding for low carbon footprint olive pomace

Value Proposition

Zero price treatment of olive pomace for local olive mills

Adaptation to olive mill timing and needs

Direct and personal contact

Production of new

Customer Relations

Direct contact with suppliers

Direct contact with biomass and biochar consumers

Channels

In person, phone & whatsapp with olive mills (suppliers of olive pomace)

Phone and email with consumers of dry olive pomace

In person, phone & whatsapp with local farmers using biochar

Customer Segments

Olive mills (who need to dispose important quantities of olive pomace)

Bioenergy plants and energy producers (consumers of dry olive pomace)

Farmers (local, olive providers) to use biochar as carbon capture and soil enhancement

Costs

OLIVE POMACE SUPPLY
- No purchase cost (farmers provide at zero price at plant door)
- Handling (shovel)

PLANT CAPEX (olive pomace extraction, gasification CHP, drying, handling systems)

O&M
- Oil physical extraction (power and heat required)
- O&M of energy gasification plant
- Delivery of oil (or bottling)
- Delivery of biochar and dehydrated olive pomace
- Workers

Revenue

SAVINGS:
- Energy (natural gas 6 electricity) to run the new biorefinery plant

SALES:
- of olive pomace oil obtained in a physical re-processing unit of olive pomace
- of electricity to the grid with CHP plant
- of dehydrated olive pomace to bioenergy plants
- of biochar to local farmers cooperative who commercialise carbon credits

BioRural | Triple Layer Business Model Canvas

Environmental Layer

Suppliers & Outsourcing

Olive mill producers facilitate the olive pomace

Power grid, where electricity is obtained when CHP unit is off.

Local company facilitating share / renting of transport and machinery

Production

Air drying of olive pomace in flat shallow ponds

Gasification producing power and heat for olive pomace dehydration

Pelleting dehydrated olive pomace to be used in gasificator (2500 t)

Materials

Wet olive pomace (circa 15,000 t/year)

Natural gas to support process (start-up, unstable stages during gasification)

Functional Value

Olive pomace delivered in a short distance, to be handled for sustainable purposes

End-of-life

Energy valorisation of non utilised dehydrated olive pomace

Farmers carbon capture using biochar in fields

Distribution

The excess electricity from the cogeneration plant is sent to the power grid.

Delivery of dehydrated olive pomace by trucks to energy consumers (ca. 2500 tons – 120 trucks)

Supply pelletised biochar to farmers (500 t)

Use Phase

New biorefinery runs totally on self- produced renewable energy

Energy companies suffice energy needs with a renewable solid biofuel

Farmers utilise a biochar able to improve soil and capture carbon in soils

Environmental Impact

- Transport of dry olive pomace to energy consumers (> 100 km)
- Air emissions from the gasification unit
- Air emissions from the shallow ponds where wet olive pomace is left for pre-drying

Environmental Benefits

- Transport of wet olive pomace reduced (from 100 km to 10 km)
- Zero emissions utilisation of olive pomace in new biorefinery
- Reduction of fossil fuel consumption by users of the dry olive pomace (2,500 t/year) reducing > 80% CO_2 emissions in comparison to fossil fuels
- Utilisation of 500 t biochar leading to capture of > 1200 t CO_2/year

BioRural | Triple Layer Business Model Canvas

Governance Layer

Local Communities

Increased job positions locally (equivalent 4 persons full time)

Capacity to complement seasonal workers in other sectors with a seasonal work at the biorefinery

Local revenues > 400,000 €/year (salaries, materials, services)

Governance

Company managed by 1 director

Close connection with olive mills. Decision making linked to other territorial actors

Transparency towards local inhabitants

Employees

Better chances for non-seasonal work position

Social Value

More simple management of olive pomace for local olive mills, lower stress, and dependence from far olive pomace oil extraction units

More local value for farmers

Increased interaction of olive oil mills, closer cooperation for waste management

Increased culture of circularity for the community

Societal Culture

Reinforces the vision of the area as one of outstanding olive oil producing zones

Citizens in area considered proactive and able to adapt and survive. Biorefinery support this identity

Scale of Outreach

In coordination with local olive oil producers and farmers

Connected to bioenergy facilities distant in the region

Exporting zero emissions olive pomace oil to international markets

End-user

Olive pomace oil users (restaurants, etc.)

Farmers using biochar

Energy companies using the dry olive pomace

Social Impact

- Differences for olive mills not in the circular loop with the new biorefinery
- Potential division between farmers willing to acquire the biochar
- Potential distrust to the new initiative that could be considered just for–profit of a individual person

Social Benefits

- Reduction of olive pomace ponds around the area
- Lower local odours caused by accumulation in ponds
- Integration of a local business, added value stays in the rural area

Bioenergy – SCIVEN Case

BioRural | Triple Layer Business Model Canvas

Economic Layer

Key Partnerships

- University of Coimbra (UC) (technological support)
- Biomass Centre for Energy (CBE) for fuel logistics and biomass assessments.
- Instituto Pedro Nunes (IPN) for incubation and networking
- Public sector and municipalities, including through project collaborations
- External consultants for expanding market reach.

Key Activities

- Design and development of biomass-fueled micro-cogeneration systems
- Installation and integration of systems in customer facilities
- Monitoring and maintenance services
- Business development and project acquisitions through patnerships.

Key Resources

- Technological knowledge in micro-cogeneration
- Experienced multidisciplinar team (engineering, business development)
- Production and testing facilities at the IPN Incubator
- Strong academic and institutional relationships (UC, CBE, DGEG).

Value Proposition

- Integrated energy solutions combining biomass-fueled micro-cogeneration and thermal systems
- Unique in the European market: low-temperature small-scale cogeneration
- Reducing energy costs while promoting decarbonization
- Costumized engineering services and full energy management, including operation, maintenance, and remote monitoring platforms.

Customer Relations

- Personalized service model: close engagement in design, installation and support
- Long-term partnerships through operation & maintenance agréements
- Focus on building trust and credibility, especially in rural and institutional markets.

Channels

- Direct sales and personalized project development
- Participation in research projects, energy fairs, and public procurement
- Strong networking via University of Coimbra, CBE, and IPN Incubator
- Website

Customer Segments

- Public entities with high energy demand (e.g. municipalities managing public pools)
- Private sector clientes, especially hotels and industries seeking more efficient and sustainable energy solutions
- Potential future markets: energy communities and industrial parks.

Costs

- R&D and technology development (initially high investment)
- Manufacturing and costumization of cogeneration and biomass systems
- Staff salaries (full-time and part-time engineers and technical staff)
- Maintenance and customer support infrastructure
- Marketing and business development costs (dissemination, fairs, demos)
- Operational costs associated with fuel logistics and technical monitoring systems.

Revenue

- Sale of integrated energy systems (cogeneration units and boilers)
- Recurring income from operation & maintenance contracts
- Custom engineering and consulting services for energy optimization
- Participation in funded research and demonstration projects.

BioRural | Triple Layer Business Model Canvas

Environmental Layer

Suppliers & Outsourcing

- Biomass sourcing is often supported by the Biomass Centre for Energy (CBE), ensuring more sustainable, local and traceable fuel supply
- Emphasis on regional networks reduces reliance on complex, globalized supply chains.

Production

- Currently produced in-house or through small-scale suppliers – may not yet be fully optimized for low environmental footprint
- Potential to improve via eco-design, use of renewable electricity during manufacturing, and material efficiency.

Materials

- Utilization of robust, industrial-grade componentes in boilers and cogeneration units
- Biomass used is tipically organic waste or residues, promoting waste valorization.

Functional Value

- Reduction of fossil fuel dependence by using biomass and enabling eficiente energy conversion via cogeneration
- Support of local renewable energy production, contributing to decarbonization.

End-of-life

- Systems likely to have long operational life with maintenance and part replacement, reducing overall material turnover.

Distribution

- Focus on localized installations and regional biomass supply chains minimizes transport distances and associated emissions
- Collaboration with local partners (e.g. municipalities) supports territorial embeddedness and avoids high logistics emissions.

Use Phase

- Energy-efficient systems: by recovering heat from combustion and converting it into electricity
- Designed to be integrated with user needs (e.g. pools, hotels, industries), improving efficiency and reducing waste.
- Use of renewable energy sources to produce electricity and heat.

Environmental Impact

- Emissions from combustion, particulate matter, and transport if biomass is not hyper-local
- Carbon emissions and resource use from metalworking, electronics assembly and on-site testing
- Risk of improper disposal of e-waste (e.g. sensors, controllers) and insulation materials, possibly leading to landfilling of mixed waste.

Environmental Benefits

- Reduction of greenhouse gas emissions through biomass combustion replacing fossil fuels
- Contribution to the circular bioeconomy by using agricultural and forestry residues as biomass
- Enhanced energy autonomy for rural communities.

BioRural | Triple Layer Business Model Canvas

Governance Layer

Local Communities

- Engages municipalities directly
- Strenghtens local supply chains (e.g. biomass sourcing)
- Promotes long-term relationships with local public entities and bio-based solutions for infrastructure.

Governance

- Transparent and collaborative governance rooted in academic foundations
- Engaged with public institutions, incubators, and research partners, helping ensure ethical decision-making and compliance.

Employees

- Small, dedicated team with a mix of full-time and part-time staff
- Strong culture of collaboration, especially with academia and incubators.

Social Value

- Provides cost-effective, clean energy to public services such as pools
- Stimulates rural employment, skills development and energy resilience
- Demonstrates a successful local innovation ecosystem bridging research and entrepeneurship.

Societal Culture

- Aligns with european values of energy transition, decentralization and bioeconomy
- Promotes community-level solutions, challenging the centralization of the energy market.

Scale of Outreach

- Operations take place primarily in Portugal, targeting rural and semi-urban municipalities and expanding to new sectors and regions
- Goals include scaling to energy communities and industrial clusters, increasing territorial impact.

End-user

- Municipalities, industries and hotels benefit from lower energy costs, greater energy security and climate-friendly technologies
- Citizens using public infrastructure indirectly benefit from sustainable energy solutions.

Social Impact

- Negative perceptions around biomass sustainability and system reliability.

Social Benefits

- Creation of skilled jobs in energy systems design, operation and maintenance
- Knowledg sharing through its university ties and public projects
- Supports local development and energy autonomy in under-resourced areas.

Bioenergy – Gwicker Earthfood Case

BioRural | Triple Layer Business Model Canvas

Economic Layer

Key Partnerships

- Local farmers and producers (suppliers of surplus or imperfect produce)
- Packaging suppliers (biodegradable or recyclable)
- Distribution partners (retailers, zero-waste stores, e-commerce platforms)
- Food safety and certification authorities
- Innovation partners and incubators (e.g., EU-funded programs)

Key Activities

- Sourcing and rescuing food waste (fruits and vegetables)
- Processing and production of natural food products (granolas, snacks)
- Packaging and distribution
- Marketing and consumer education
- Product innovation and recipe development

Key Resources

- Food processing equipment
- Proprietary recipes and production know-how
- Human capital (food engineers, sustainability specialists)
- Supplier network of local farmers
- Branding and digital marketing channels

Value Proposition

- Natural, additive-free food made from rescued fruits
- Reducing food waste and promoting sustainability
- Supporting local economies and circular agriculture
- Affordable, nutritious, and eco-conscious products
- Transparency and traceability in sourcing and production

Customer Relations

- Community engagement via sustainability storytelling
- Brand loyalty via ethical impact
- Customer support and feedback collection online
- Collaboration with influencers and educators in sustainability

Channels

- Company website and online store
- Eco-friendly marketplaces
- Retail stores and organic shops
- Events, fairs, and sustainability conferences
- Social media platforms (Instagram, LinkedIn, YouTube)

Customer Segments

- Eco-conscious consumers
- Urban millennials and Gen Z interested in healthy lifestyles
- Zero-waste and sustainable product marketplaces
- Retailers and restaurants focused on sustainable sourcing
- Educational and institutional clients promoting sustainable diets

Costs

- Raw material collection and logistics
- Processing and manufacturing costs
- Sustainable packaging
- Staff salaries and operations
- Marketing and branding

Revenue

- Direct product sales (B2C and B2B)
- Subscription boxes or bundles
- Sales via partner platforms and physical retailers
- Institutional orders or catering for sustainable events

BioRural | Triple Layer Business Model Canvas

Environmental Layer

Suppliers & Outsourcing

- Local fruit and vegetable producers with food surpluses
- Packaging suppliers offering recyclable or biodegradable options
- Renewable electricity and water sources for processing

Production

- Minimal processing to preserve nutrients and reduce energy use
- Batch production aligned with food recovery flows
- Waste valorization (peels, seeds for compost or energy)

Materials

- Rescued fruits and vegetables
- Compostable or recyclable packaging materials
- Avoidance of synthetic additives or preservatives

Functional Value

- Converts food waste into nutritional value
- Extends product life while reducing demand for new resources
- Encourages mindful consumption of rescued food

End-of-life

- Packaging is biodegradable or recyclable
- Edible products result in minimal end-user waste
- Potential for composting remaining organic matter

Distribution

- Emphasis on local distribution to reduce transport emissions
- Recyclable, lightweight packaging
- Use of green logistics where possible

Use Phase

- Shelf-stable, non-perishable food products
- Minimal energy use by end-users (no refrigeration or cooking required)
- Lightweight and compact design for low-impact transport

Environmental Impact

- Reduced methane emissions from diverted food waste
- Reduced agricultural land and water use through resource efficiency
- Carbon savings from circular sourcing and local logistics

Environmental Benefits

- Strong contribution to SDG 12 (Responsible Consumption and Production)
- Reduced landfill burden
- Biodiversity preservation through reduced pressure on industrial agriculture

BioRural | Triple Layer Business Model Canvas

Governance Layer

Local Communities

- Supports local farmers by creating value from rejected produce
- Engages regional economies through decentralized sourcing
- Raises food waste awareness in communities

Governance

- Transparent sourcing practices and ethical certifications
- Compliance with EU sustainability and food safety standards
- Participatory decision-making through stakeholder feedback

Employees

- Inclusive hiring and equal opportunity values
- Skills development in sustainable food production
- Safe and mission-driven workplace culture

Social Value

- Raises awareness of food waste and climate action
- Promotes sustainable dietary habits
- Provides healthy snacks without social or ecological guilt

Societal Culture

- Aligns with circular bioeconomy values
- Challenges beauty standards in food consumption
- Promotes acceptance of imperfection and resource frugality

Scale of Outreach

- Operates in Portugal with vision for EU-wide scaling
- Active social media outreach and partnerships
- Connects with schools, municipalities, and sustainability influencers

End-user

- Health-conscious individuals seeking natural snacks
- Conscious consumers aligned with sustainability values
- Families and young adults interested in ethical purchasing

Social Impact

- May risk elitism if sustainable products are priced too high
- Addresses this with affordable SKUs and inclusive campaigns
- Potential social gap if rural producers lack tech access (mitigated by direct outreach)

Social Benefits

- Empowers producers and communities with added income streams
- Helps build food resilience in the region
- Educates youth and consumers on sustainable food systems

Biomaterials – Nature Plast Case

BioRural | Triple Layer Business Model Canvas

Economic Layer

Key Partnerships
- Raw materials suppliers
- Production equipment suppliers
- Subcontracting and partnerships for analysis and production
- Innovative clusters

Key Activities
- Production of bioplastics compounds and biocomposites
- Expertise (R&D, training)
- By-products from biomass recovery

Key Resources
- R&D engineers and PhD
- Production and characterization equipment

Value Proposition
- Unique expertise on the whole bioplastics value chain, from production to communication

Customer Relations
- Expertise sharing
- Material selling

Channels
- Website, social networks, newsletters, trade fair and events

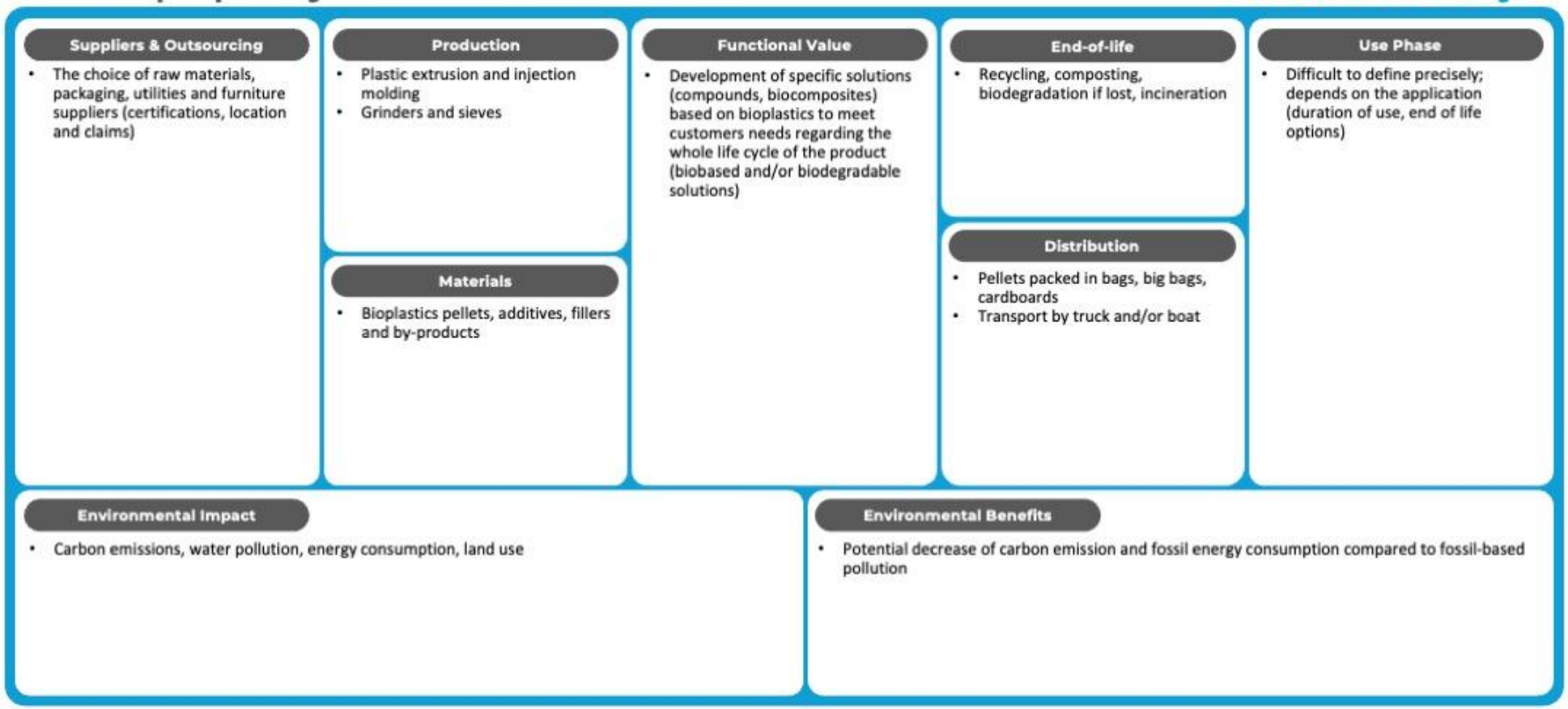
Customer Segments
- Converters and end users involved in plastic industry

Costs
- Salaries, raw materials, equipment, utilities

Revenue
- The ways in which a company generates income from each customer segment (e.g., sales, subscription, licensing)
- Sales of raw materials, compounds, biocomposites and expertise (services)

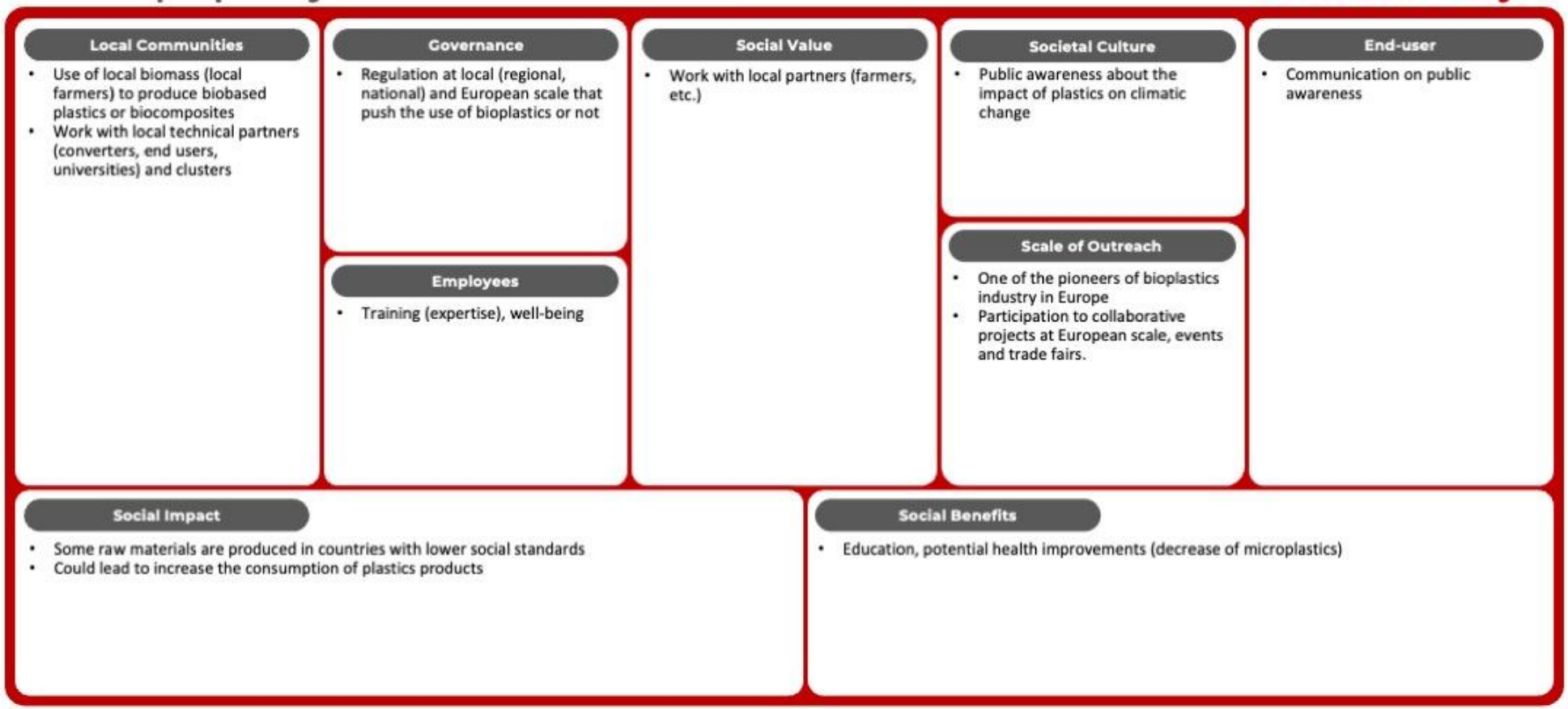
BioRural | Triple Layer Business Model Canvas

Environmental Layer

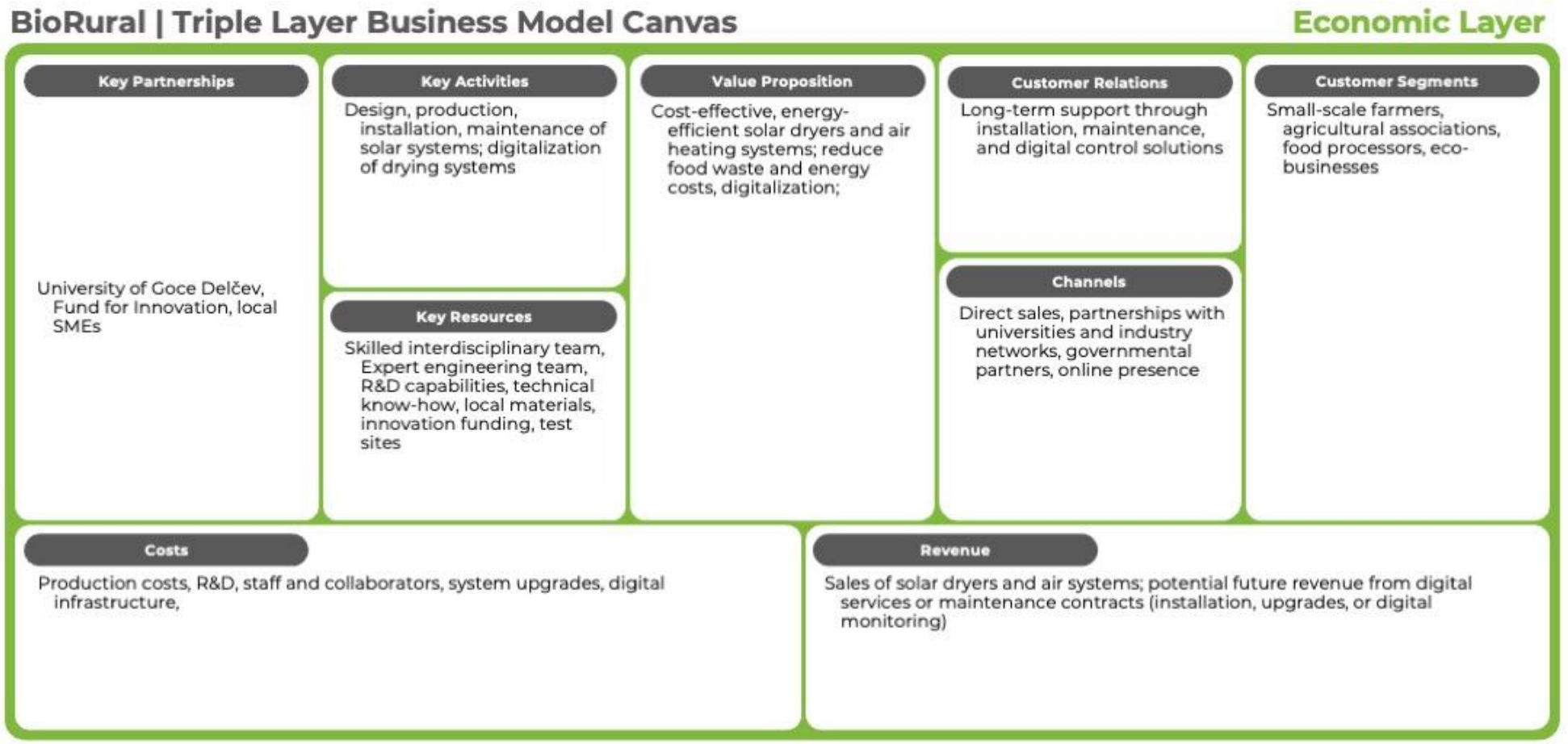


BioRural | Triple Layer Business Model Canvas

Governance Layer

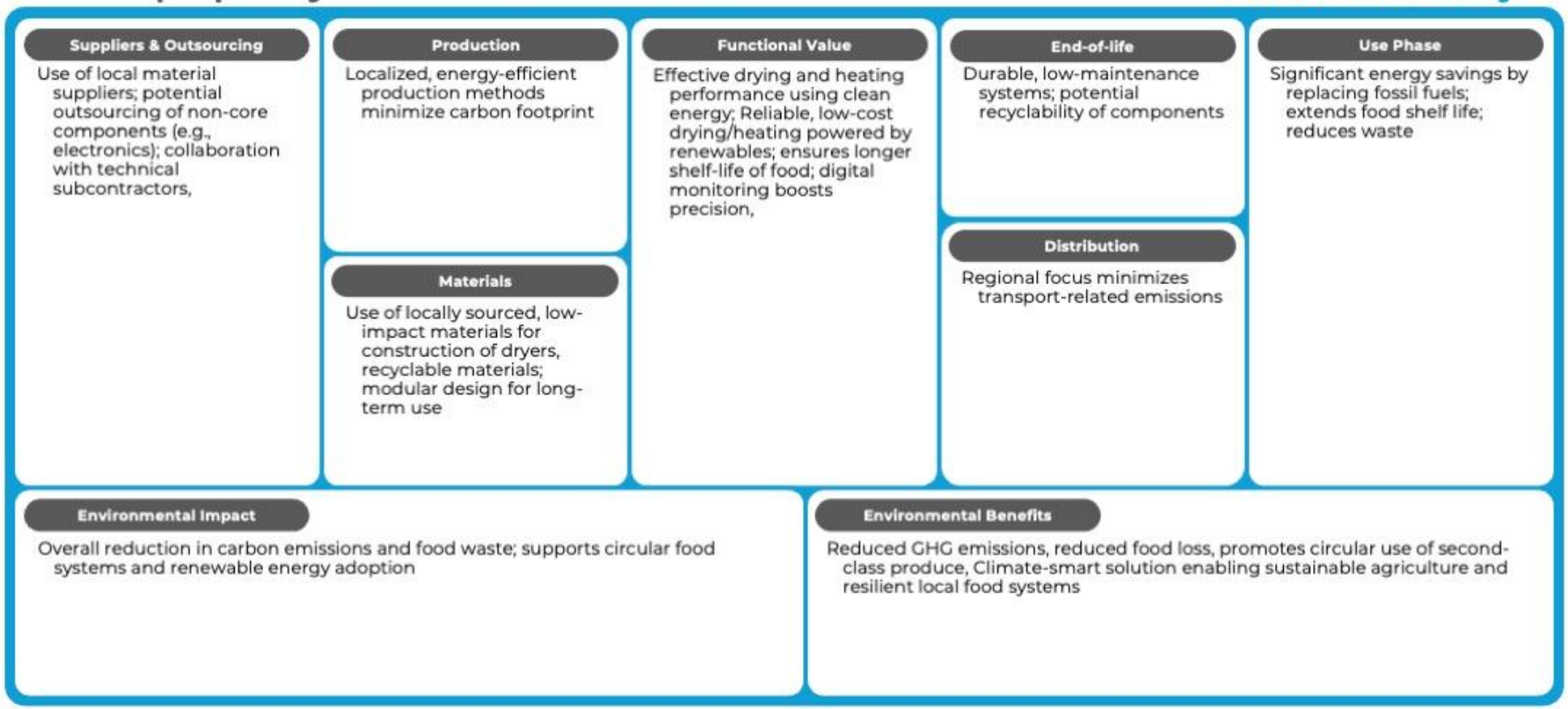


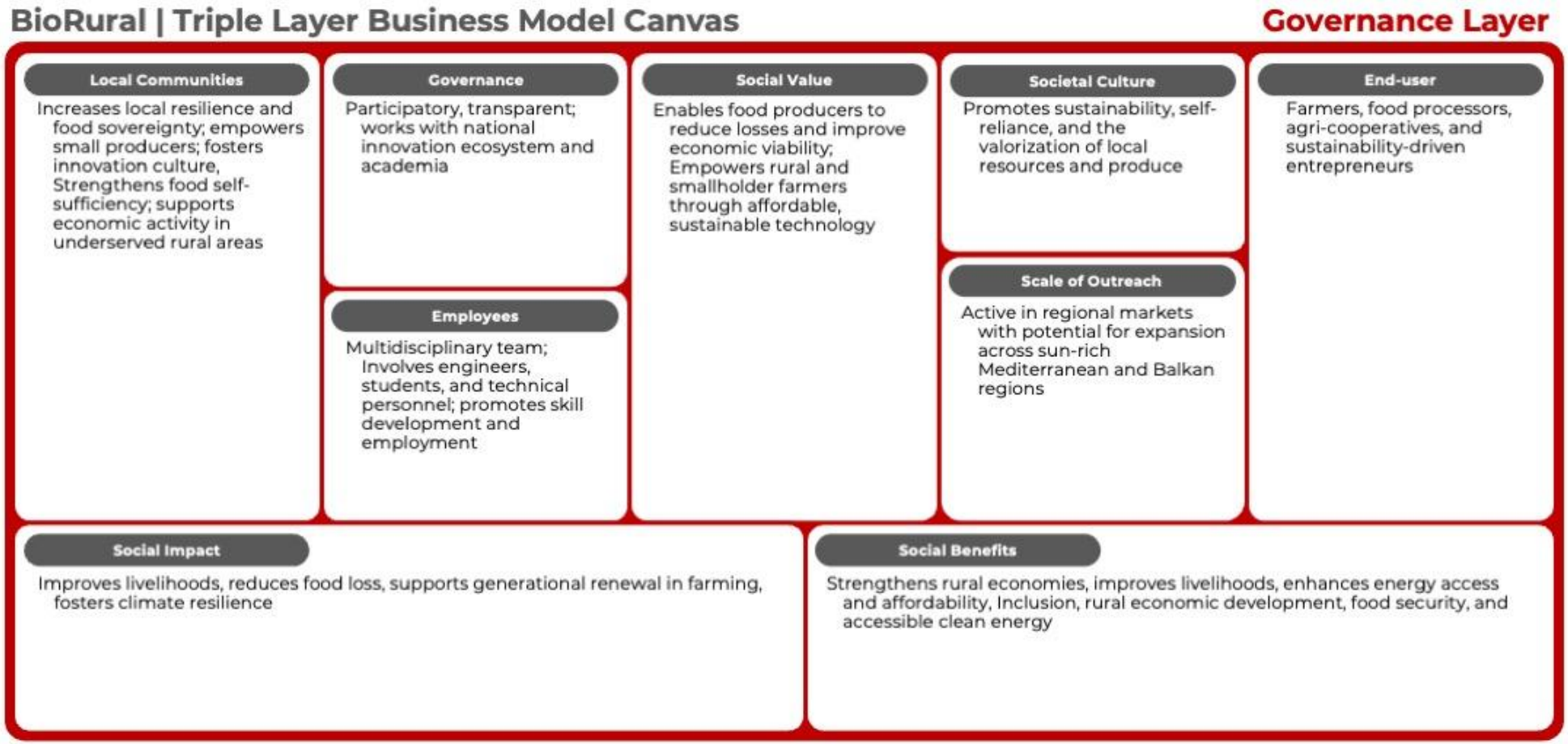
Food and Agriculture – Green Growth Platform Case



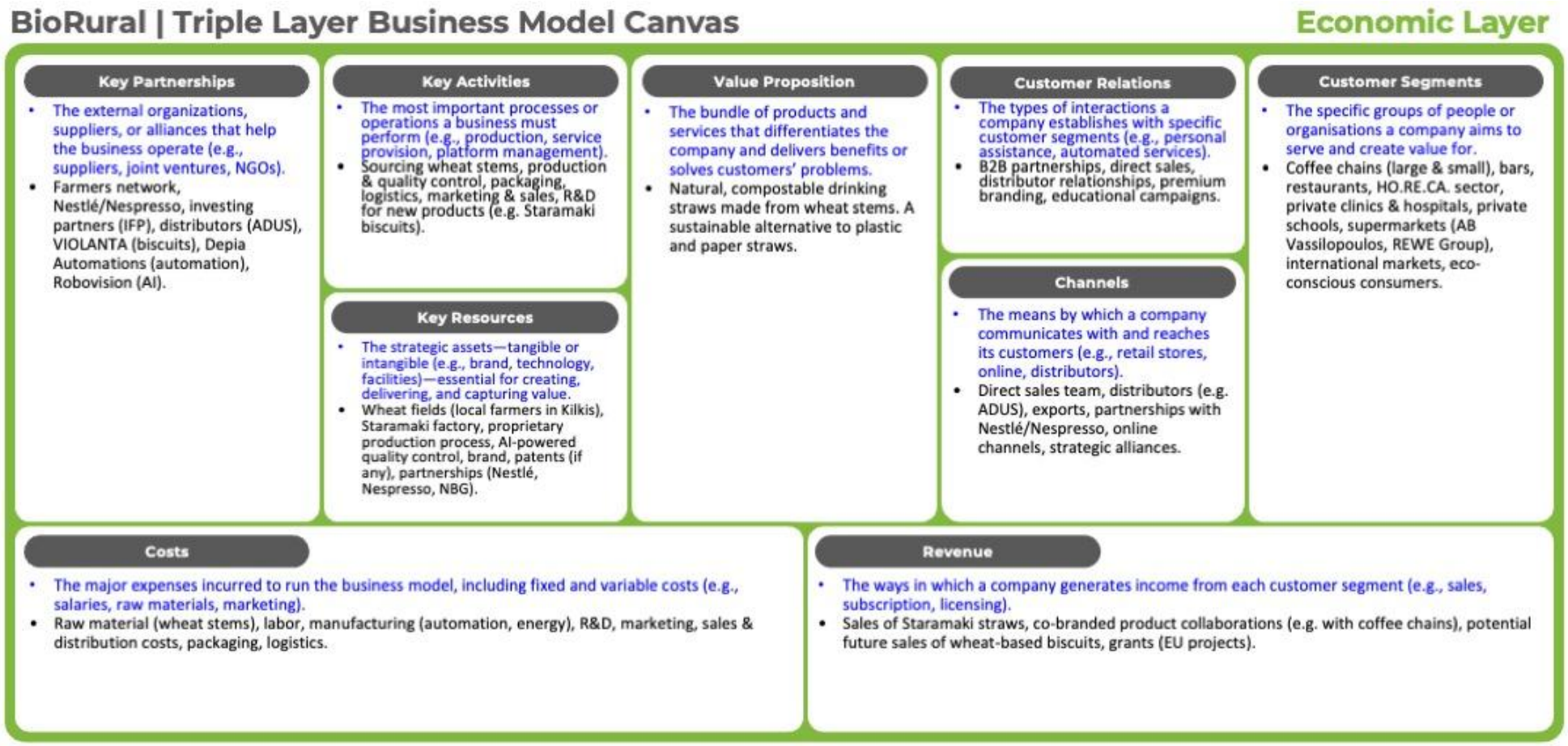
BioRural | Triple Layer Business Model Canvas

Environmental Layer




BioRural | Triple Layer Business Model Canvas
Governance Layer
Local Communities
Increases local resilience and food sovereignty; empowers small producers; fosters innovation culture, Strengthens food self-sufficiency; supports economic activity in underserved rural areas
Governance
Participatory, transparent; works with national innovation ecosystem and academia
Employees
Multidisciplinary team; Involves engineers, students, and technical personnel; promotes skill development and employment
Social Value
Enables food producers to reduce losses and improve economic viability; Empowers rural and smallholder farmers through affordable, sustainable technology
Societal Culture
Promotes sustainability, self-reliance, and the valorization of local resources and produce
Scale of Outreach
Active in regional markets with potential for expansion across sun-rich Mediterranean and Balkan regions
End-user
Farmers, food processors, agri-cooperatives, and sustainability-driven entrepreneurs
Social Impact
Improves livelihoods, reduces food loss, supports generational renewal in farming, fosters climate resilience
Social Benefits
Strengthens rural economies, improves livelihoods, enhances energy access and affordability, Inclusion, rural economic development, food security, and accessible clean energy

Food and Agriculture – STARAMAKI Case



BioRural | Triple Layer Business Model Canvas

Environmental Layer

Suppliers & Outsourcing

- The external goods or services not considered "core," but essential to operations (e.g., utilities, peripheral components), with attention to environmental standards.
- Packaging material suppliers, third-party logistics, equipment suppliers.

Production

- The processes and transformations (e.g., manufacturing, roasting, processing) that convert materials into a final product or service.
- Automated production line for cutting, cleaning, sterilizing, and packaging.

Materials

- The physical inputs (e.g., raw materials, components) used to provide the functional value, focusing on resource extraction and sustainability.
- Wheat stems (by-product of agricultural process), water (boiling, cleaning), energy for drying & sterilization, packaging materials (recyclable / compostable).

Functional Value

- The core "function" or service delivered, considered from a life-cycle perspective (i.e., how the product/service fulfills its purpose).
- Billions of single-use straws replaced by compostable Staramaki straws.

End-of-life

- What happens when the user no longer wants or can use the product (e.g., disposal, recycling, remanufacturing).
- Compostable in home or industrial composting systems; no microplastic pollution.

Distribution

- How physical goods move along the supply chain (transport, packaging) and the associated environmental impacts (e.g., emissions).
- Local & national deliveries via distributors, exports via road/sea freight.

Use Phase

- The environmental impact generated during the user's interaction with the product/service (e.g., energy usage, maintenance, consumables).
- Used by consumers in beverages; fully stable (doesn't degrade in liquid).

Environmental Impact

- The negative ecological outcomes (e.g., carbon emissions, water pollution, habitat destruction) across the life cycle.
- Energy consumption during drying; waste from broken stems (used for biomass or compost); water use in cleaning; minor CO_2 emissions from distribution.

Environmental Benefits

- The positive ecological outcomes or offsets (e.g., forest conservation, biodiversity gains, emission reductions) resulting from the business model.
- Plastic and paper straw replacement; biodegradable; supports regenerative agriculture practices (organic compost, crop rotation); uses an agricultural residue as raw material.

BioRural | Triple Layer Business Model Canvas

Governance Layer

Local Communities

- The local or regional populations affected by the company's operations (e.g., supplier villages, neighborhood residents), including social development and collaboration.
- Kilkis farmer network (supports sustainable farming practices); local community engagement; educational partnerships (private schools).

Governance

- The organisational structures and policies (e.g., decision-making processes, transparency, stakeholder engagement) shaping social accountability.
- Now an S.A. with a governance model reflecting its social enterprise origins; participation of investors; strong advisory board (Nestlé, NBG); transparent governance.

Employees

- The internal workforce critical to delivering value (e.g., their well-being, training, wage standards, diversity, and inclusion).
- All SCE members are employees; fair wages; capacity-building; diverse team; production & R&D teams; commitment to local employment.

Social Value

- The societal benefits the business promises (e.g., community uplift, social inclusion, fair treatment) that go beyond economic or environmental gains.
- Creation of green jobs in a region affected by desertification (Kilkis); inclusive employment (production staff from disadvantaged groups); sustainable rural development.

Societal Culture

- The broader norms and values the business both shapes and responds to (e.g., public awareness, ethical consumerism)
- Promoting zero-plastic culture; raising awareness on desertification; working with partners like Nestlé to shift market norms..

Scale of Outreach

- The extent of social engagement—from local to global—showing how widely the company influences stakeholders.
- Greece + international markets (EU, Middle East); partnerships with global players (Nespresso, Nestlé); alliances with other natural straw producers.

End-user

- The stakeholder actually "consuming" the product or service—possibly different from the paying customer—highlighting social effects of usage.
- Coffee drinkers; bar & restaurant patrons; students in private schools; hospital patients; eco-conscious consumers. Enable adoption of sustainable consumption patterns, green transition of businesses and environmental education

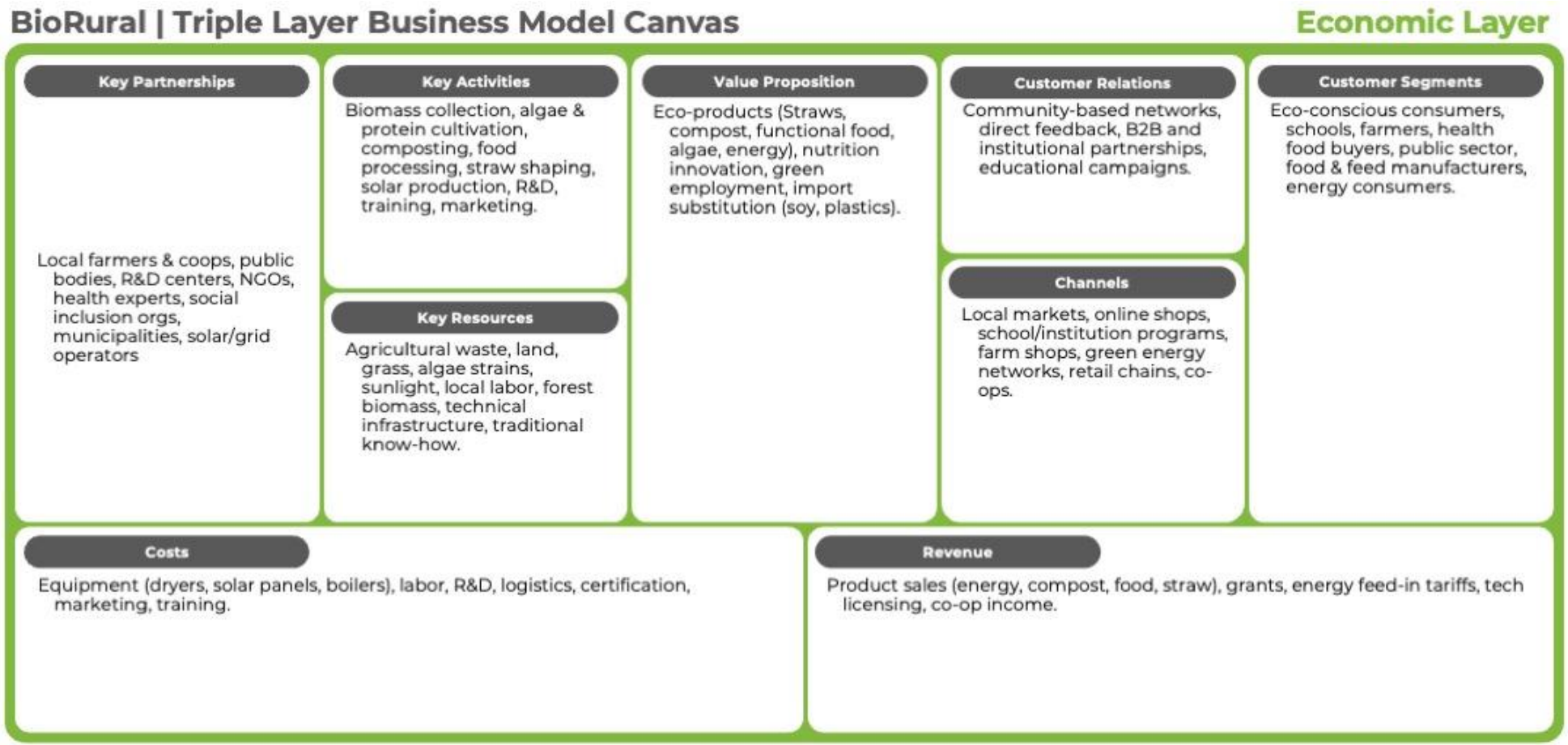
Social Impact

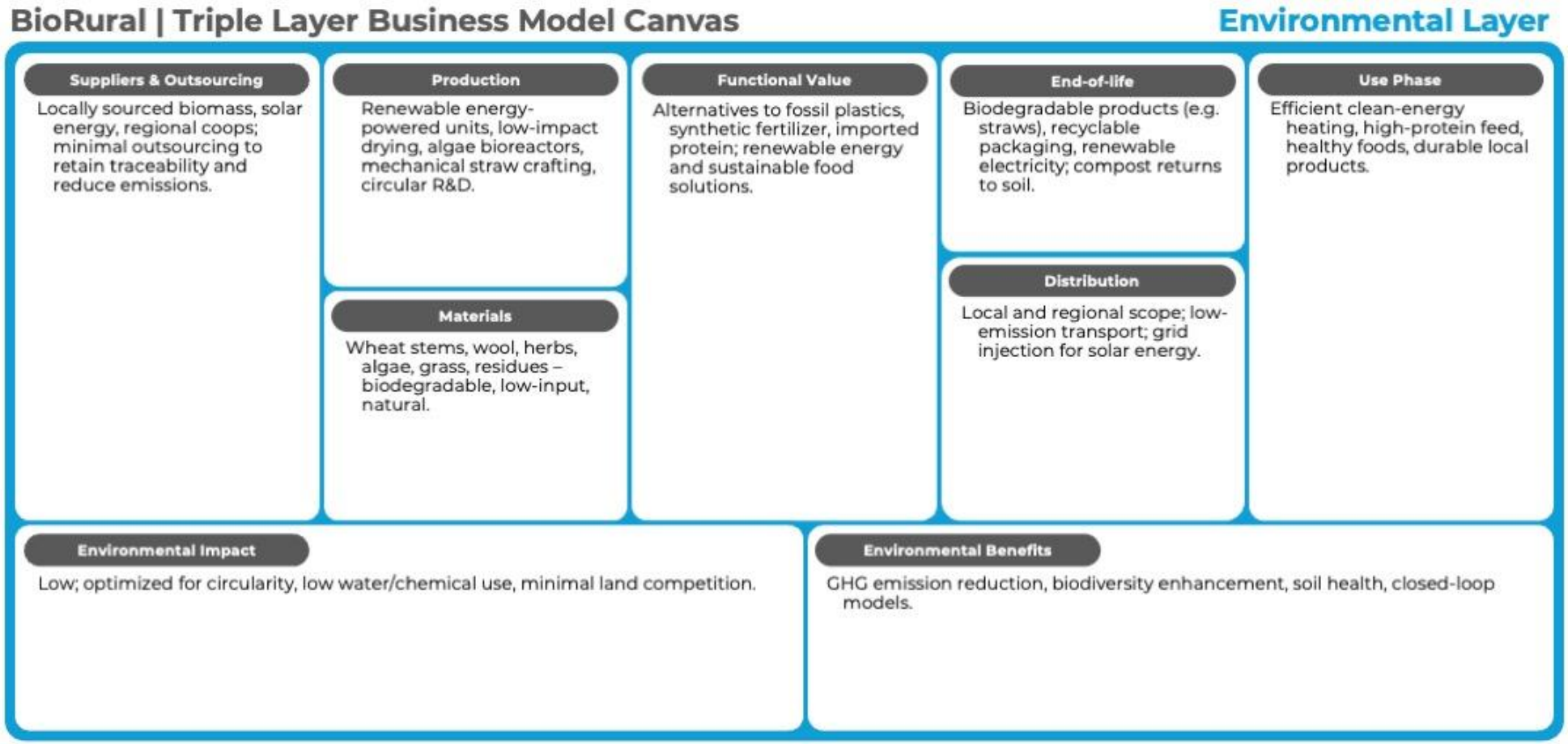
- The negative societal consequences (e.g., labor exploitation, community disruption) that the business model can create if not managed responsibly.
- Employment in a vulnerable rural region; enabling regenerative agricultural practices; providing a visible, everyday symbol of sustainable living

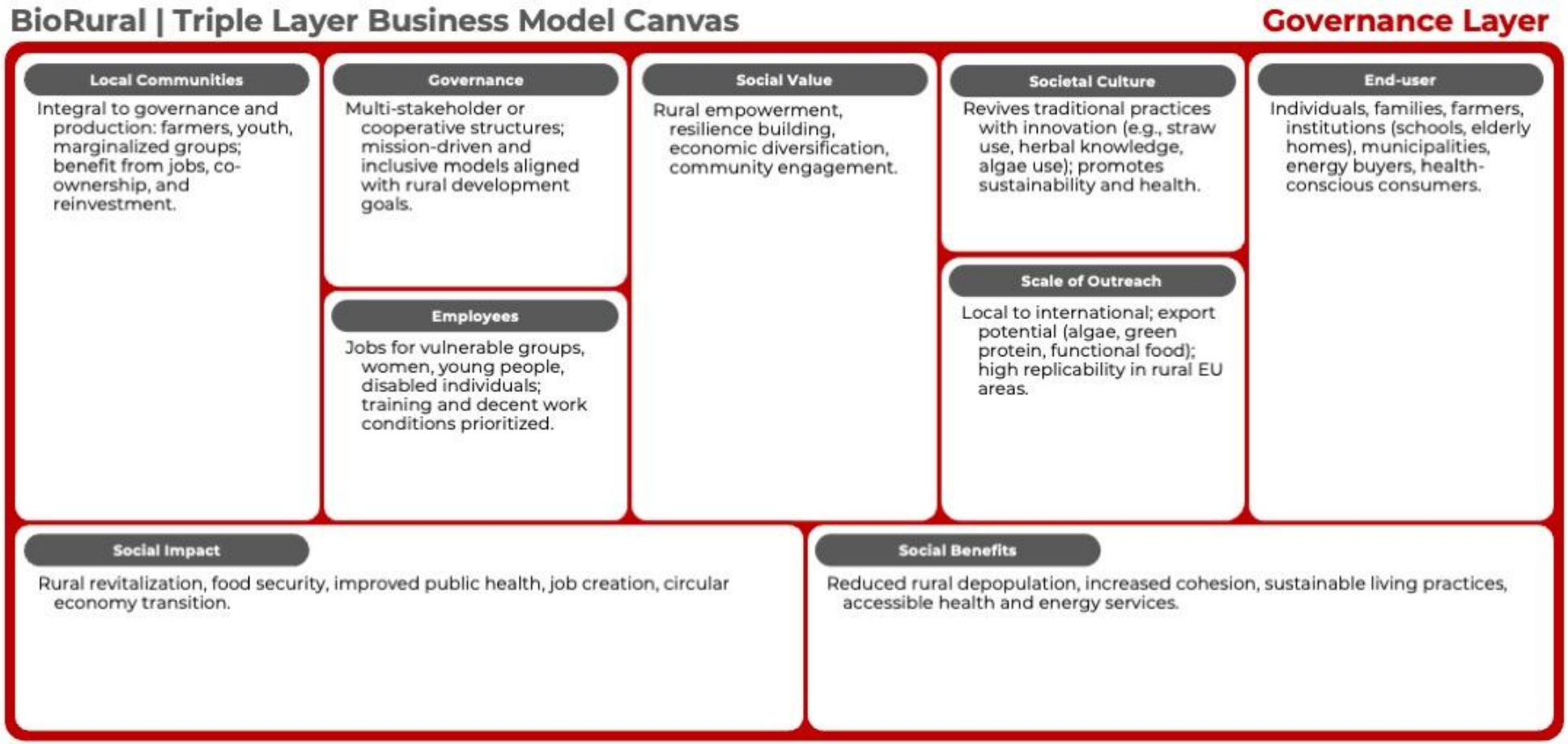
Social Benefits

- The positive societal outcomes (e.g., poverty reduction, education, health improvements) arising from the company's social initiatives and practices.
- Green jobs; farmer income diversification; consumer awareness; contributing to circular economy goals.

Food and Agriculture – VALORIAL Case




BioRural | Triple Layer Business Model Canvas
Environmental Layer
Suppliers & Outsourcing
Locally sourced biomass, solar energy, regional coops; minimal outsourcing to retain traceability and reduce emissions.
Production
Renewable energy-powered units, low-impact drying, algae bioreactors, mechanical straw crafting, circular R&D.
Materials
Wheat stems, wool, herbs, algae, grass, residues – biodegradable, low-input, natural.
Functional Value
Alternatives to fossil plastics, synthetic fertilizer, imported protein; renewable energy and sustainable food solutions.
End-of-life
Biodegradable products (e.g. straws), recyclable packaging, renewable electricity; compost returns to soil.
Distribution
Local and regional scope; low-emission transport; grid injection for solar energy.
Use Phase
Efficient clean-energy heating, high-protein feed, healthy foods, durable local products.
Environmental Impact
Low; optimized for circularity, low water/chemical use, minimal land competition.
Environmental Benefits
GHG emission reduction, biodiversity enhancement, soil health, closed-loop models.


BioRural | Triple Layer Business Model Canvas
Governance Layer
Local Communities
Integral to governance and production: farmers, youth, marginalized groups; benefit from jobs, co-ownership, and reinvestment.
Governance
Multi-stakeholder or cooperative structures; mission-driven and inclusive models aligned with rural development goals.
Employees
Jobs for vulnerable groups, women, young people, disabled individuals; training and decent work conditions prioritized.
Social Value
Rural empowerment, resilience building, economic diversification, community engagement.
Societal Culture
Revives traditional practices with innovation (e.g., straw use, herbal knowledge, algae use); promotes sustainability and health.
Scale of Outreach
Local to international; export potential (algae, green protein, functional food); high replicability in rural EU areas.
End-user
Individuals, families, farmers, institutions (schools, elderly homes), municipalities, energy buyers, health-conscious consumers.
Social Impact
Rural revitalization, food security, improved public health, job creation, circular economy transition.
Social Benefits
Reduced rural depopulation, increased cohesion, sustainable living practices, accessible health and energy services.

Forestry and Natural Habitat – Italian Wood Energy Association Case

BioRural | Triple Layer Business Model Canvas

Economic Layer

Key Partnerships

- secondary processing industry;
- local administrations and private forests owners.

Key Activities

- sustainable forestry management;
- primary processing of the wood and wood byproducts.

Key Resources

- Financing;
- Forests, with management plans.

Value Proposition

- Transformation of the primary product (timber);
- transformation/use of the by products with value maximization (high quality fuels biomaterials and biochemicals).

Customer Relations

- direct relation for long term partnership.

Channels

- Direct contract with relevant secondary transformation industries for primary products and biochemicals;
- Organized retail (OR) for by-products (biomaterials);
- direct contracts with local contractors for by-products (bioenergy);

Customer Segments

- Secondary transformation industries
- Organized retail
- Local contractors

Costs

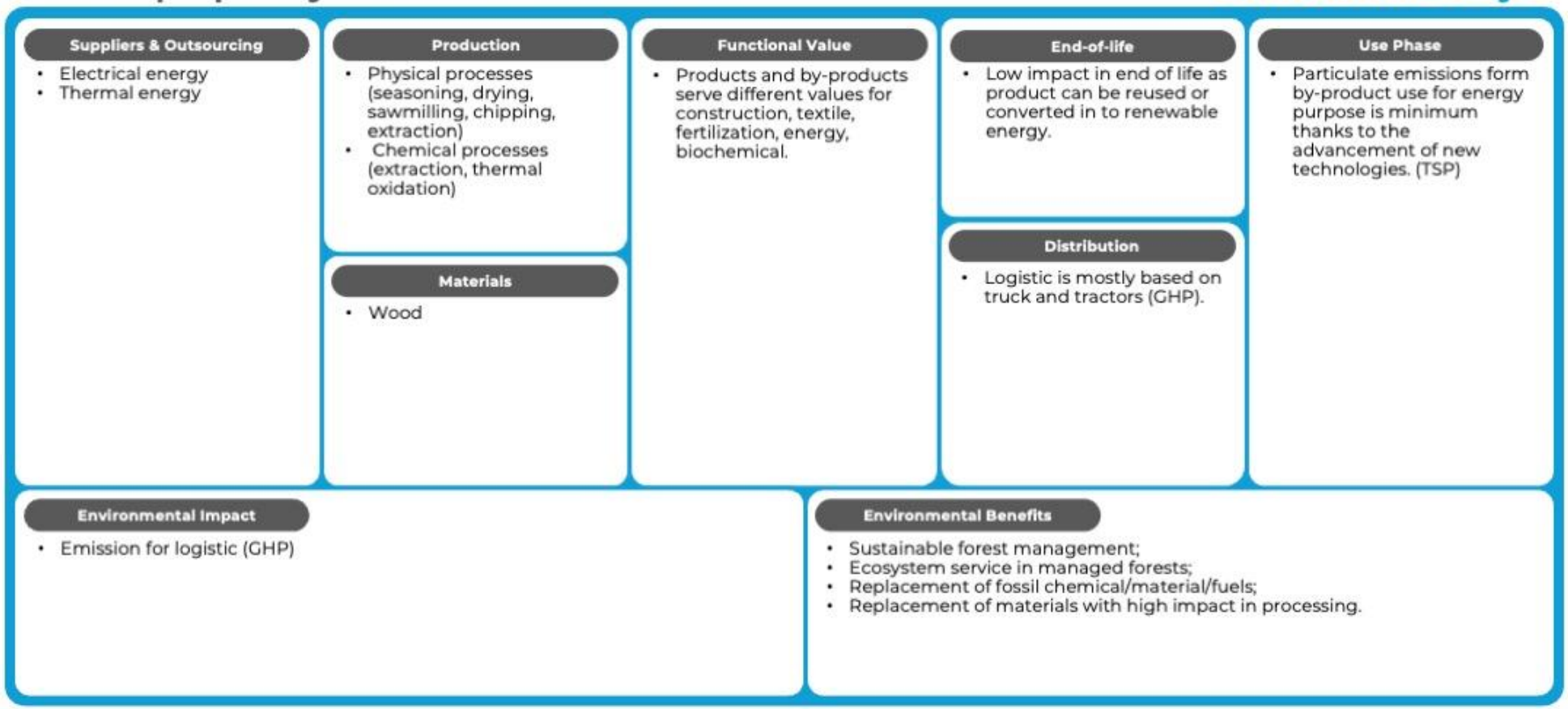
- Personnel and machinery for wood harvesting;
- capital costs for financing machinery and transformation plant.

Revenue

- Contracts with secondary processing industry with valorization of local aspects and ecosystem service.
- Focus on the best valorization of by-product is critical.

BioRural | Triple Layer Business Model Canvas

Environmental Layer



BioRural | Triple Layer Business Model Canvas

Governance Layer

Local Communities
- Participation in local community, sports and event sponsorship

Governance
- Small company with family/ local management

Employees
- Trained machine operators for forestry machinery;
- Quality manager in processing;
- Marketing employee for stressing the environmental values.

Social Value
- Managed forests are less susceptible to forest fires, security for citizens in mountain areas;
- Value is mostly in rural and mountain area create jobs and fight depopulation.

Societal Culture
- Wood is a key material for mountain areas, the use of wood in building and for energy preserve traditional craftsmen.

Scale of Outreach
- Mostly local

End-user
- Citizens for buildings;
- Farmers for fertilizers;
- Companies, local administrations and local communities for heating and district heating;

Social Impact
- Social acceptance of processing plants need involvement of the population.

Social Benefits
- Jobs in rural and depopulated mountain areas and circular economy boost.

Forestry and Natural Habitat – LBTU Case

BioRural | Triple Layer Business Model Canvas

Economic Layer

Key Partnerships

Sheep wool processors (Biolana), sheep farmers (wool suppliers), research institutes (Silava, LBTU), and EU innovation networks.

Key Activities

Sourcing sheep wool, processing it into protective wraps. And applying these to young forest stands for protection
Collaborating with partners (like Biolana) for product development and testing.
Ongoing research and improvement of the wool application process.

Key Resources

Raw sheep wool, processing facilities, forestry expertise, research data, and funding from innovation projects.

Value Proposition

Eco-friendly, biodegradable protection for young forest stands against animal damage.
Adds value to waste sheep wool, creating new income for farmers.
Reduces reliance on plastic and chemical-based protectors.

Customer Relations

Direct collaboration and feedback with forestry companies and public forest managers.
Knowledge sharing through workshops, demonstrations, and online resources.

Channels

Direct sales to forestry organizations.
Knowledge dissemination via online platforms, conferences, and industry events.

Customer Segments

State and private forest managers.
Forestry companies and rural landowners seeking sustainable tree protection.

Costs

Costs for wool procurement, processing, R&D, labor, logistics, and knowledge dissemination.

Revenue

Sales of wool-based protection products.
Consulting and knowledge transfer services.
Potential funding from EU and sustainability grants.

BioRural | Triple Layer Business Model Canvas

Environmental Layer

Suppliers & Outsourcing

Main external inputs are energy and water for wool processing, and transport emissions.
Efforts are made to minimize resource use and source energy sustainability.

Production

Sheep wool is collected, processed, and shaped into wraps for tree trunks in the forest.

Materials

Primary input is sheep wool – a renewable, locally available resource that would otherwise be discarded.
No need for synthetic or imported materials.

Functional Value

The core function is to protect young trees from animal browsing and harsh weather, supporting healthy forest regeneration.
Also helps to reduce the need for fencing and hunting for population control.

End-of-life

Wool wraps are biodegradable – no harmful waste, unlike plastic alternatives.
After serving their purpose, they decompose naturally, returning nutrients to the soil and leaving no plastic or synthetic waste.

Distribution

Wool is sourced locally, reducing transportation distances and emissions.
Simple packaging, often reusable or recyclable, further limits waste.

Use Phase

Minimal impact during use: no chemicals, no microplastics, and no pollution.
Wool acts as a natural barrier, reducing the need for chemical repellents or plastic spirals.

Environmental Impact

Minor impacts from energy and water use in wool processing.
Some emissions from transportation, but these are minimized by local sourcing.
No significant negative impact compared to traditional plastic or chemical alternatives.

Environmental Benefits

Reduces plastic waste and chemical use in forests.
Promotes circular economy by turning agricultural waste into a useful product.
Supports biodiversity and soil health by avoiding synthetic residues.

BioRural | Triple Layer Business Model Canvas

Governance Layer

Local Communities

Rural communities, especially sheep farmers, gain new economic opportunities.
Local populations benefit from healthier forests and reduced environmental impact.

Governance

Latvian State Forests (LVM) operates with a strong focus on transparency and stakeholder engagement.
Decision-making is collaborative, involving forestry experts, researchers, and supply partners.
Policies emphasize sustainable innovation, continuous improvement, and responsible sourcing.

Employees

Focus on the well-being, safety, and ongoing training of forestry staff and workers involved in wool application.
Promoting diversity and inclusion within project teams and among partners.

Social Value

Support for rural development and new job creation.
Reduction of agricultural waste by finding a use for surplus sheep wool.
Enhancement of social inclusion by involving small farmers and local businesses.

Societal Culture

Promoting public awareness of sustainable forestry and responsible resource use.
Values include environmental stewardship, rural empowerment, and ethical innovation.
Encouraging ethical consumerism and setting an example for other forestry operators.

Scale of Outreach

Actively sharing knowledge and results through workshops, publications, and international networks.
Engaging with universities, research institutes, and the broader forestry community.

End-user

Primary users are forestry workers and managers applying wool wraps to young forest stands.
Secondary stakeholders include sheep farmers, who benefit from new income streams.

Social Impact

Potential for labor-intensive work if not mechanized or supported with training.
If not managed, could lead to uneven benefit distribution among stakeholders.
Current governance aims to minimize these risks through fair partnership and transparent practices.

Social Benefits

Poverty reduction and empowerment in rural areas.
Increased environmental awareness and education.
Strengthened local economies and community resilience.