



Circular bioeconomy transformation for regions by enabling resource and governance networks

D4.1 Methodology on governance and financing means for a transition from linear fossil-based to a circular bioeconomy

PROJECT ACRONYM: BIOTRANSFORM

PROGRAMME: HORIZON Europe

Grant Agreement: No 101081833

TYPE OF ACTION: HORIZON-CSA

START DATE: 1 October 2022

DURATION: 32 months



Funded by
the European Union

Document Information

Issued by:	ACR+
Issue date:	29/05/2025
Due date:	31/05/2025
Work package leader:	ACR+
Dissemination level:	Public

Document History

Version	Date	Modifications made by
1	15/05/2025	Jean-Benoit Bel
2	26/05/2025	Jean-Benoit Bel

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List of Terms and Definitions

Abbreviation	Definition
CAP	Common Agricultural Policy
CAPEX	Capital Expenditure
CBE	Circular Bioeconomy
CEAP	Circular Economy Action Plan
EC	European Commission
EIB	European Investment Bank
ERDF	European Regional Development Fund
LCA	Life Cycle Assessment
NACE	Nomenclature statistique des Activites economiques dans la Communaute Europeenne
NGO	Non-Governmental Organisation
NRW	North Rhine Westphalia
OPEX	Operating Expenses
R&D	Research and Development
R&I	Research and Innovation
RIS3	Research and Innovation Smart Specialisation Strategy
S3	Smart Specialisation Strategy
SME	Small and Medium Enterprises

Table 1: Terms and Definitions

Executive Summary

The BIOTRANSFORM project comes to fill the current gap in policy guidelines for a successful transition from linear and fossil-based systems to circular bio-based ones. The project analysed and evaluated circular bio-based transition pathways across 6 regions in Europe and capitalised on these results to provide a comprehensive methodology towards an EU-wide transition tailored to policymakers.

BIOTRANSFORM methodology on governance and financing means aims to support local and regional authorities, and more specifically European Regions, with the governance and financing of circular bioeconomy. The guidelines presented in this methodology are based on the BIOTRANSFORM project's findings, and the experience of its 6 pilot regions.

The main sections of the BIOTRANSFORM methodology on governance and financing means are presented below. You can click on the titles below to directly access the sections.

Setting a circular bioeconomy strategy

- Where to start, how to set priorities and a consistent internal governance, how to involve elected officials

Implementing biocircular transition pathways

- How to identify promising transition pathways, assess them, and implement them

Identifying funding and financing for circular bioeconomy

- What are the main funding and financing sources available for circular bioeconomy

Financing the regional transition

- How regions can finance the transition and support local biocircular initiatives

1. Introduction

1.1 The BIOTRANSFORM project

The BIOTRANSFORM project comes to fill the current gap in policy guidelines for a successful transition from linear and fossil-based systems to circular bio-based ones. The project analysed and evaluated circular bio-based transition pathways across 6 regions in Europe: Andalusia in Spain, Northern Burgenland in Austria, Western Macedonia in Greece, Charles Spa Region in Czech Republic, North Rhine-Westphalia in Germany, and Finland. These case studies are described in detail in D3.2. The results obtained in these different demo regions are capitalised on to provide a comprehensive methodology towards an EU-wide transition tailored to policymakers.

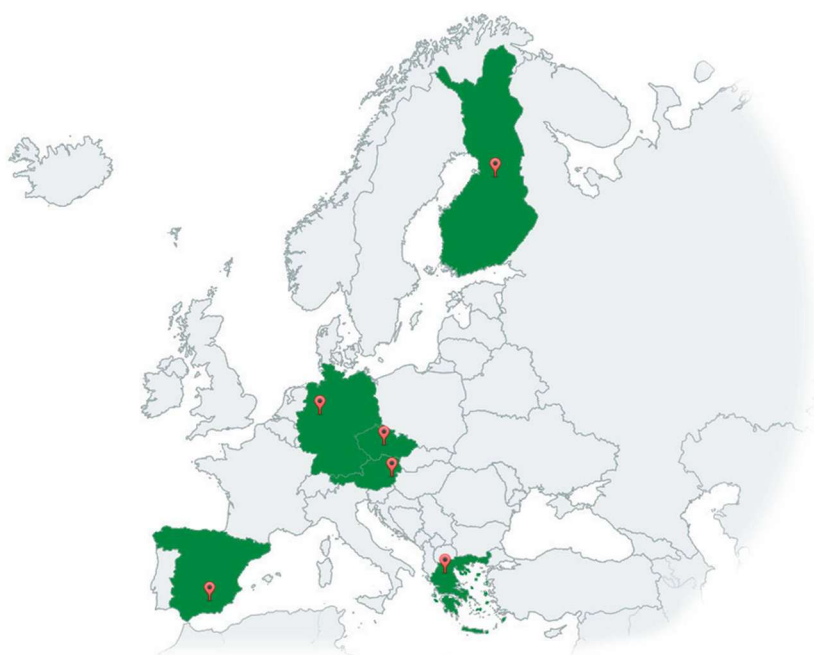


Figure 1: BIOTRANSFORM pilot regions

BIOTRANSFORM equips policymakers with the tools to set informed priorities that serve environmental, economic, and social goals, being actionable, futureproof, and aligned with supply-and-demand trends in related industries and value chains.

1.2 Objective of the document

The BIOTRANSFORM methodology on governance and financing means aims to support local and regional authorities, and more specifically European Regions, with the governance and financing of circular bioeconomy. The guidelines presented in this methodology are based on the BIOTRANSFORM project's findings, and the experience of its 6 pilot regions.

This work is also based on an on-going consultation of local and regional authorities that was organised around three regional working groups, allowing to collect feedback and input on needs and

barriers regarding governance and financing, on needs for assessment methods and indicators, and by involving representatives of the different demo regions as well as other European regions to present their concrete experience with regional governance. Regional authorities from the different demo regions were also engaged over the course of the project, notably through interviews to collect their perspectives on the topic¹. These different meetings helped to define the content of this report so that it is well aligned actual needs from public authorities.

The methodology aims to provide replies to the following questions:

- How to define a regional vision and strategy for circular bioeconomy?
- How to operationalise this vision and support the implementation of biocircular transition pathways?
- How to identify financing for the transition?
- How to provide funding to local players or projects to foster the transition?

The methodology consists in key recommendations to establish such a regional vision and make it happen, supported by more concrete illustrations from the project's outcomes and pilot regions' own experience.

1.3 Circular bioeconomy

Based on the European Commission's definition, **bioeconomy** encompasses the economy that use renewable biological resources from land and sea – such as crops, forests, fish, animals and micro-organisms – as well as their residual streams to produce food, materials and energy.

Circular economy is an economic system in which the value of products, materials and resources is maintained in the economy for as long as possible, and the generation of waste is minimized (EU, 2015).

Circular bioeconomy is the application of the concept of circular economy to bioeconomy. Circular bio-based systems can rely on various feedstocks, both virgin and secondary bio-based materials, yet they must follow circular principles, e.g. the optimisation of resource consumption, the prevention of losses and waste, the optimal re-use and recycling generated waste, as well as the recovery and return of nutrients to the fields.

1.4 European Framework

Circular bioeconomy has been defined by the European Commission as a catalyst for systemic change, with the potential to contribute to all dimensions of the Green Deal by producing fossil-free materials, enhancing the protection of the environment and ecosystems, while also delivering on Europe's economic prosperity and ensuring a Fair and Just transition².

¹ BIOTRANSFORM (2022), D1.1 Report on limits of the linear fossil economies

² European Commission (2020), How the bioeconomy contributes to the European Green Deal

The European Union has been developing a consistent framework for promoting circularity and bioeconomy, aiming to foster sustainability, economic growth, and innovation. Several strategies and pieces of regulation can be listed:

- **The European Bioeconomy Strategy**: initially published in 2012, the European Bioeconomy Strategy has been updated in 2018, and a new version will be proposed in 2025. The current version includes five main goals, including the sustainable management of natural resources, the reduction of our dependency on non-renewable resources, while ensuring food security. It includes an action plan composed of 14 actions to consolidate the biobased sectors, deploy bioeconomy strategies across Europe, and ensure a sustainable bioeconomy that takes into consideration the ecological boundaries. In 2022, a progress report acknowledged the progress achieved in the deployment of strategies and investments but also gaps when it comes to the better management of land and biomass demands to match with the supply and avoid trade-offs, and the need to work more on sustainable consumption patterns.
- **Circular Economy Action Plan**: published in 2020, it is one of the key building blocks of the European Green Deal that calls for sustainable management of resource, waste reduction, and the deployment of more sustainable products and processes, including bio-based products. The CEAP and bioeconomy are closely linked, with bioeconomy providing renewable resources contributing to circularity, and circular economy providing a consistent framework for the deployment of bioeconomy, ensuring that it also integrates the reduction of losses and waste and the development of more sustainable consumption patterns.

Bioeconomy is also connected to many different European strategies and regulations, such as the [Common Agricultural Policy](#) that supports the use of agricultural residues and non-food biomass for bio-based products, and the [Waste Framework Directive](#) that promotes the source separation of bio-waste and the reduction of food losses and waste.

1.5 QuickStart guide for the BIOTRANSFORM methodology on governance and financing means

BIOTRANSFORM methodology's outlines is presented on the following Figure 2. You can click on the titles of the different sections to directly access it from here.

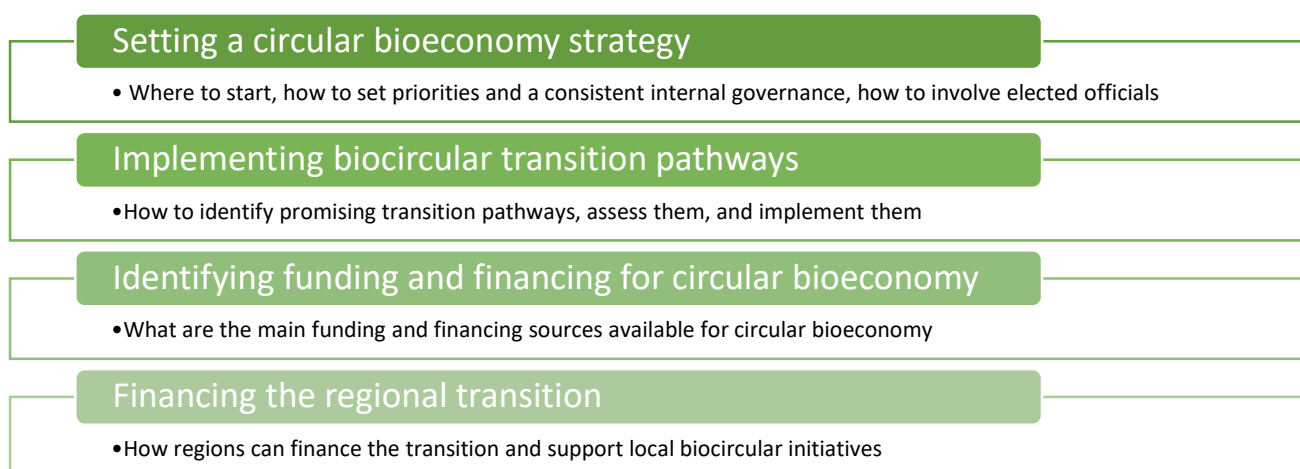


Figure 2: outlines of the Biotransform methodology of governance and financing means

2. Governance of circular bioeconomy

Bioeconomy applies at cross-sector, cross-policy, and cross-border level, and its practical implementation relies on the participation and involvement of a large range of sectors and stakeholders. This requires an integrative and transversal approach when it comes to regional governance. This first section of the BIOTRANSFORM methodology on governance and financing means addresses two fundamental aspects of regional governance: **how to define a regional circular bioeconomy strategy**, and **how to operationalise it** so that it leads to a concrete transition.

2.1 Circular bioeconomy strategy: the backbone for regional governance

Key considerations for circular bioeconomy strategy

Objectives

Establishing a regional circular bioeconomy strategy is an essential step to set a **consistent regional governance for the transition toward a more circular bioeconomy**. Considering the very transversal nature of bioeconomy and the fact that it encompasses many different activities, **purposes** (food, energy, material resources), and **dimensions** (environmental, social, and economic), it is essential to precisely map existing resources and users, to understand where priorities are in relation with overarching objectives, and to identify the most promising transition pathways. Such a strategy also allows to **seize the potential but also the limits of bioeconomy**, by cross-analysing the available resources and end-uses.

A clear bioeconomy strategy also gives the **opportunity to clarify the concept and scope of circular bioeconomy**, with which many players are not familiar. Bioeconomy strategies are the occasion to **secure the involvement of key players and stakeholders**, both within public administration and among the main regional bioeconomy players.

Last but not least, a regional circular bioeconomy strategy aims to establish a **proper regional framework for fostering a sustainable circular bioeconomy**, e.g. by providing technical or financial support to relevant players and activities.

Essential components and considerations for a regional circular bioeconomy strategy

Crafting an effective regional circular bioeconomy strategy involves outlining core content elements while also embedding foundational considerations from the outset. This ensures the strategy is comprehensive, contextually relevant, and aligned with broader policy objectives for a sustainable transition.

Key components and considerations include:

- **Vision and objectives:**
 - Articulate a clear, long-term vision for a regional sustainable, circular bioeconomy.
 - Define specific, measurable objectives, considering economic, environmental, and social dimensions.

- **Situational analysis & resource assessment:**
 - Provide a clear overview of the current regional context, including socio-economic assessments that highlight opportunities and limitations.
 - Conduct a thorough resource mapping of available bio-based resources, particularly secondary materials (e.g., agricultural waste, forestry residues, bio-waste) and by-products.
 - Assess the current state of play of existing bioeconomy activities and related sectors.
 - Evaluate the specific needs within the region, including potential end-users and sectors that could benefit most from a circular, bio-based transition.
- **Sectorial and value chain analysis:**
 - Perform analyses to identify opportunities for rural-urban-industrial symbiosis.
 - Pinpoint potential high-value bio-based products suitable for the region (e.g., construction materials, circular fertilisers).
- **Requirements for implementation:**
 - Identify needs in terms of infrastructure and logistics, such as recycling/circularity hubs, biorefineries, and their required capacities.
 - Determine research and development (R&D) necessities to support the regional bio-based industry.
- **Stakeholder engagement:**
 - Map key stakeholders (from industry, academia, public sector, civil society) to involve throughout the co-creation and implementation process.
- **Policy integration and alignment:**
 - Review existing EU, national, and regional policies (e.g., bioeconomy, circular economy, competitiveness, innovation, agriculture, climate change, energy, tourism strategies) to ensure alignment and integration.
 - This helps foster synergies, prevent gaps, and avoid overlaps with existing support or funding schemes.
- **Governance and financing instruments:**
 - Detail the proposed legal, technical, administrative, and financial instruments to support the creation of new value chains and achieve strategic targets.
 - Assure establishment of the position of an ecosystem enabler / transition broker who knows about resources, technologies, experts, stakeholders, infrastructures, financing with the role to establish the intersectoral governance.

ILLUSTRATION: the Finnish Bioeconomy strategy interfacing with other strategies

The 2022 update of the Finnish Bioeconomy strategy considered many different national and EU strategies, taking the environmental, social, and economic sustainability of bioresources and biodiversity as two starting points. This process contributed to highlight the key role of bioeconomy in the economic growth, and the inclusion of fundamental targets, such as the 2035 target for carbon neutrality and the halting of biodiversity loss as key guiding elements. Moreover, it included the targets set by the Circular Economy Action Plan when it comes to the use of natural resources or on the usability of forest resources set in the National Forest Strategy. All relevant strategies were categorised according to the five strategic priorities of the Bioeconomy strategies. The development of these different strategies will be taken into account during the monitoring of the Bioeconomy Strategy

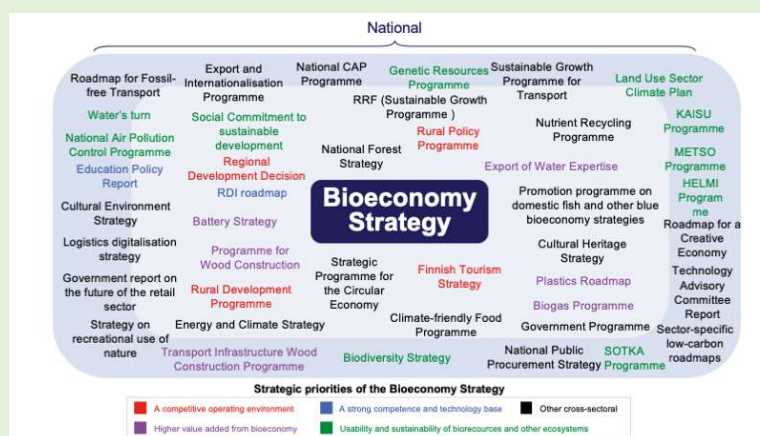


Figure 3: Connection of other strategies with the different strategic priorities of the Finnish Bioeconomy strategy (source: <https://www.bioeconomy.fi/facts-and-contacts/the-finnish-bioeconomy-strategy/interfaces-with-other-strategies/>)

Main steps to set up a circular bioeconomy strategy

Defining a regional circular bioeconomy strategy is an iterative process. However, it is possible to provide key steps to ensure a smooth process:

- 1. Creation of a steering committee bringing together key governmental departments:** considering the transversal nature of bioeconomy, setting an interministerial group bringing together e.g. services on economic affairs, industry, environment, agriculture, employment, etc. will ensure a shared understanding and vision and support the inclusion of key stakeholders.
- 2. Co-creation of a state of the art of bioeconomy,** including resource and infrastructure mapping, an analysis of the regional strengths and challenges, and the identification of organisations who are or could become active in bioeconomy. This state of the art can be based on the previous strategy, existing regional database, or ad-hoc studies.
- 3. Identification and definition of a shared regional vision,** general objectives, and first “transition scenarios” that describe how the management of a specific (secondary) bio-based resource can be optimised, or how an economic activity/sector could transition from a linear fossil-based approach to a biocircular one. This can refer to national and EU strategies, to other relevant regional strategies, and take inspiration from other strategies in Europe, possibly by engaging in peer-learning processes.
- 4. Setting of a collaborative approach** to explore and discuss the identified scenarios, and co-elaborate an action plan, with key stakeholders: local government, businesses, NGOs, academia, etc. This can be done via the organisation of forums, thematic working groups,

bilateral meetings, interviews, or open consultations. The activities should take into considerations the constraints from specific players (lack of time, lack of understanding on the topic or strategy, etc.).

5. **Fine-tuning the vision and scenarios:** following the consultation process, an action plan must be consolidated with clear timelines and measurable objectives. The plan must also include general, overarching targets along with clear methods to be calculated on resource efficiency, reduction of (greenhouse gases) emissions, job creation, and/or economic growth. Conducting **impact assessments** for the identified scenarios can also contribute to prioritising and refining them.
6. **Public consultation** on the first complete version of the strategy, including e.g. online surveys or public meetings presenting the outlines of the strategy and collecting feedback.
7. **Final publication of the strategy**
8. **Monitoring and follow-up:** as with any strategy, it is of utmost importance to proceed to a consistent monitoring, consisting in the monitoring of foreseen action plans and associated KPIs. The involvement of key stakeholders is also essential for this process, to have a better understanding of the impact of the strategy and co-define correction actions in case of deviations. Ultimately, this follow-up will contribute to improve the plan and ease its revision.

Key questions for policymakers

1. What are the most significant untapped or underutilised secondary bio-based resources (e.g., agricultural residues, food industry by-products, forestry waste, urban bio-waste) within our region, and do we possess reliable, up-to-date data on their available quantities, quality, seasonality, and current rates of valorisation or disposal?
2. Which key regional economic sectors generate these potential feedstocks, and what are the current logistical and economic realities of accessing these resources for new circular bioeconomy value chains?
3. What are the critical gaps in our current understanding of regional bioresource availability, characteristics, and flows, and what concrete steps (e.g., targeted studies, data collection initiatives, stakeholder platforms) should be prioritised to establish a comprehensive and accessible baseline?
4. How can we ensure continuous and effective engagement with all relevant stakeholders—including primary producers, industry, SMEs, research institutions, and local communities—to maintain an accurate, dynamic understanding of our region's bioresource potential and the opportunities for their circular management?

Relevant resources

Key resources from the BIOTRANSFORM project:

D1.1: Report on limits of the linear fossil economies: this document analyses the key limits of the linear, fossil-based systems in BIOTRANSFORM pilot regions, based on desk research and interviews with local players. This work leads to the identification of criticalities where circular bioeconomy can play a role.

D1.2. Report on current status of development of EU regional circular bioeconomies: this report presents an overview of the status of circular bioeconomy in the pilot regions, and thus provides **concrete examples of elements worth investigating in a circular bioeconomy (CBE) strategy**, including infrastructure, technologies, R&D, feedstock, stakeholders and viewpoints, etc.

Setting priorities

Setting priorities for circular bioeconomy strategies might prove challenging for many different reasons, stemming from its very transversal nature. There might be different uses competing for the same feedstocks, discrepancies between the economic, environmental, and social impacts of value-chains, or conflicting views from different stakeholders on the objectives (economic development, food security, territorial resilience, etc.). Governing authorities must distinguish the most promising value chains to invest on from the less promising or less sustainable ones. An overview of a possible selection and prioritisation of specific value chains as proposed by the BIOTRASNFORM project is show in Figure 3.

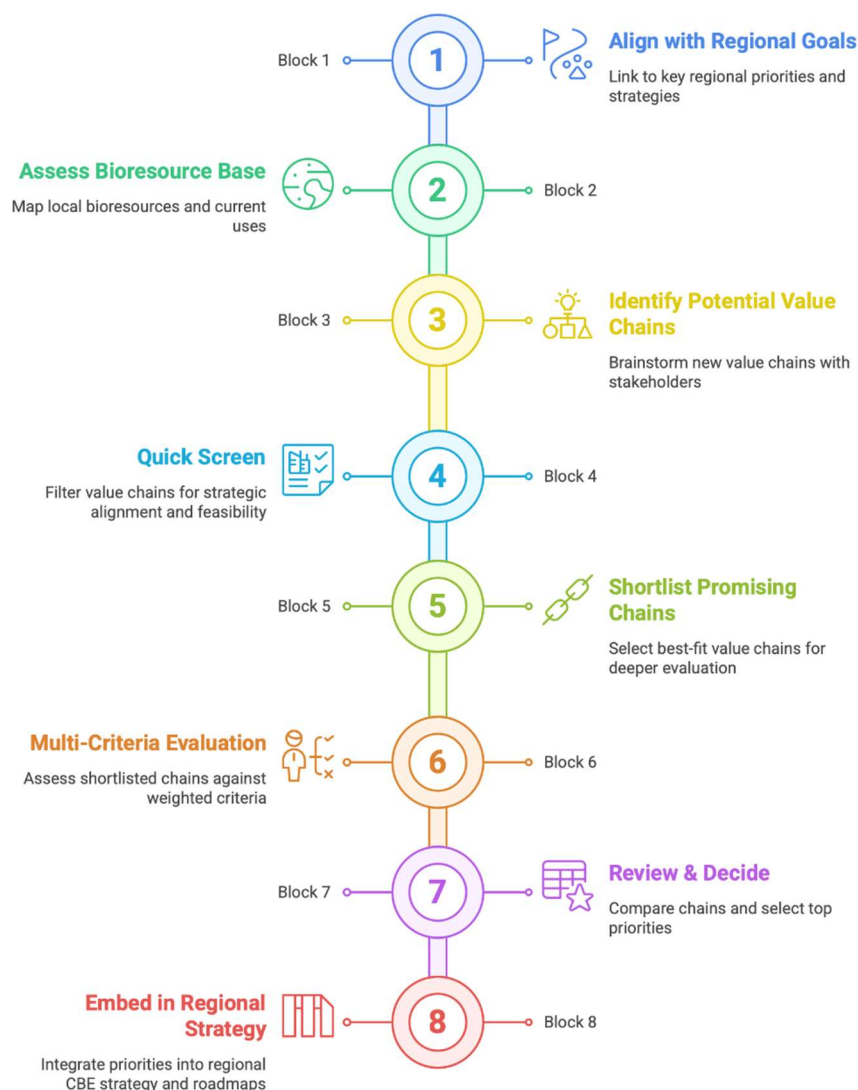


Figure 4: Prioritising circular bioeconomy value chains, (created with napkin.ai)

Starting point

Several prerequisites can be listed to identify the most promising sectors and value chains to be investigated and supported by the CBE:

- **The aforementioned mapping of key (regional) strategies** is a critical step, allowing to identify overarching environmental, economic, social, resource-related targets and objectives that should drive the CBE. These elements will provide relevant criteria to identify the most promising sectors and value chains to investigate;

- This mapping must also allow to **avoid overlaps** with existing strategies: critical bioeconomy sectors such as food production or forestry, or more generally primary production are likely to be tackled by other strategies;
- On the contrary, CBE might be **more relevant to address promising sectors that are less developed** and that will benefit from institutional support to bloom.

On this aspect, it is interesting to acknowledge the **diverse nature of “entry points”** taken by the different circular bioeconomy strategies in BIOTRANSFORM pilot regions: general objectives on material resources (target on the reduction of consumption of non-renewable resources, resource productivity, or valorisation of by-products and bioresidues), the need to address pressing issues such as the phasing out fossil-based system and value-chains or the economic decline of a territory, or contributing to a target for the reduction of greenhouse gas emissions.

Illustration: the scope and objectives of the Andalusian Circular Bioeconomy Strategy

The main objectives of Andalusian Circular Bioeconomy Strategy (ACBE) is to contribute to the sustainable growth of Andalusia by fostering the production of renewable resources and products, by increasing the availability of sustainable biomass and the number of biorefineries and boost the market for bioproducts and bioenergy.

Therefore, its core focus is the economic models based on the production of biological resources and its sustainable transformation into bioproducts, bioenergy, and services. Considering the existence of a regional strategic plan for the agroindustry, the ACBE does not include primary production and agro-industrial transformation of food for human consumption. The focus is put on bioeconomy segments requiring higher institutional support to facilitate their uptake.

Identification of promising value-chains

CBE strategies are articulated around **transition scenarios**, investigating how specific sectors and value chain can benefit from a biocircular approach. To identify the priority sectors, the initial mapping of available (secondary) bioresources, existing value-chains, and potential markets and end-users is critical.

Value chains are described as different successive steps:

- Production of bio-based, secondary materials, including the available quantities (and possible variation), and how it is collected;
- Technological processes: how the raw materials are transformed into the desired end-products
- Physical spaces for resources conversion activities can be sought through underutilised infrastructure mapping
- Final use and consumer markets of the obtained bioproducts or bioenergy obtained.

The first selection of relevant value-chains can be made by using fairly simple criteria, such as the high availability of resources or the existence of markets for potential end-products. On the contrary, chains with limited replicability/scalability, high logistical barriers, or low market interest should be excluded.

However, the mapping and identification of the most relevant value chain highly benefits from participative processes bringing together different departments of the public authorities, along with regional representatives of the quadruple helix players. Such process can be organised around thematic workshops, bilateral meetings, interviews, etc. It is essential to identify appropriate

engagement activities especially for players with low availability, such as the small companies and start-ups.

The identification of promising transition pathways has been achieved by BIOTRANSFORM demo partners over the course of the project. **A summary of the main steps is provided in section “Identifying the most promising transition pathways”**, along with concrete examples of the methods used.

Assessing the value chains

Identified value chains must undergo a comprehensive assessment to understand whether they fit the general objectives set by the strategy. These overarching objectives must be considered as assessment criteria to identify the most relevant sectors to be supported.

Ideally, assessment should balance the different dimensions through multi-criteria approaches:

- **Environmental aspects:** impact on greenhouse gas emissions, resource demand, biodiversity...
- **Economic aspects:** costs/benefits, market potential, existing demand, potential for scalability...
- **Social aspects:** job creation, social inclusion projects, support to rural economies...

Various tools are available to conduct such assessments: life cycle assessment, life cycle costing, and socio-economic assessment provide relevant evidence on the environmental and economic impacts of circular bio-based systems compared to their linear, fossil-based counterparts. However, their application requires both solid scientific methodologies and consistent data, making the participation of researchers and biocircular project developers and solution providers critical. More specific tools can be relevant to consider, such as the MooV tool developed by BIOTRANSFORM partner VITO allow to assess and optimise the logistical aspects of a specific value chains to improve its economic and environmental performances.

The use of expert groups and documented good practices from other regions are relevant complementary approaches that might contribute to better understand how the considered value-chains can positively influence the overarching targets.

Relevant resources

Key resources from the BIOTRANSFORM project:

[D1.1: Report on limits of the linear fossil economies](#): this document analyses the key limits of the linear, fossil-based systems in BIOTRANSFORM pilot regions, based on desk research and interviews with local players. For each region, a review of existing strategies and data allows an overview of the regional, linear, fossil-based economy and its main limits. It also includes the identification of key economic sectors and how a transition to carbon neutrality would impact them. The main environmental pressures (resource consumption, biodiversity, air, water, and soil quality, etc.) are also described. This work leads to the identification of criticalities where circular bioeconomy could play a role, and provides **inspiration for the identification of scenarios for a CBE strategy**.

[D2.1: Report on the framework for assessment and methodology applied in the impact tool](#): this report details the BIOTRANSFORM Assessment Package, which provides a comprehensive framework for evaluating circular bioeconomy transition pathways. It outlines the methodologies for three core tools: Resource Flow Analysis (RFA) using Sankey diagrams to map material flows; the Impact Assessment

Tool (IAT) developed by LIST for multi-criteria sustainability assessment (environmental, economic, and social impacts) incorporating stakeholder weightings; and the Logistics Optimisation tool (MooV) developed by VITO to analyse and optimise supply chain configurations. D2.1 explains how these tools are used synergistically to provide a holistic understanding of the proposed transitions, supporting regions in identifying optimal, feasible, and sustainable pathways by quantifying impacts and highlighting trade-offs. This structured assessment approach is crucial for informed decision-making and the successful implementation of circular bioeconomy strategies

Internal governance

The need of internal governance

For regional authorities, the internal governance of a circular bioeconomy strategy is a critical point. As mentioned previously, the cross-cutting nature of CBE makes it mandatory to involve different services. This serves several purposes:

- **Reflecting the different dimensions in the strategy**, ranging from the circular aspects to the economic development, or the innovation elements.
- **Ensuring the alignment, consistency, and connection with existing strategies** that are under the responsibility of different services or ministries.
- **Securing the involvement of external stakeholders** by taking advantage of existing connections with the different services or ministries.

This internal cooperation requires a proper regional governance aiming to take advantage of the expertise and existing connections of different services or ministries, while reconciling their different perspectives and agendas, and defining a clear leadership and orientation for external players.

Models for internal governance

There is no predefined scheme for internal governance of circular bioeconomy strategies, and many different governance models are implemented by regional authorities³. The ministry/departments taking the lead is quite different from a region to another: it might be either a specific ministry (of Environment, Economic, Development, etc.), or **a steering committee** bringing together key representatives of these different ministries.

Setting such a steering committee has several advantages, to secure the integration with connected regional policies (e.g. circular economy, climate action plans, waste reduction and management, sustainable agriculture, forestry, or regional development plans) and ensure political support from various ministries. It also promotes consistency with other regional policies, and the inclusion of biocircular provisions in relevant policies on topics such as food, agriculture, or waste. Such a steering committee can be mobilised for the elaboration of the regional strategy, but also for its implementation and monitoring.

³ ROBIN Project (2022), D1.1 - Typology of Circular Bioeconomy Governance Models

Illustration: Monitoring Committee (Andalusia)

The Andalusian Monitoring Committee is composed of the Regional Ministries that are part of the Strategy's Drafting Committee, Health Ministry and other public and private stakeholders with a significant role in the bioeconomy. The Monitoring Committee will periodically assess the level of compliance with the strategic lines and measures of the Andalusian Circular Bioeconomy Strategy through the monitoring and control of a set of defined indicators.

Some regions have also set **independent advisory bodies** bringing together experts from various organisations (R&D, private companies, etc.), in order to create and transfer knowledge and support the public authority with the implementation of the strategy.

Illustration: Bioeconomy Council of North Rhine-Westphalia

The Bioeconomy Council was established as an independent advisory body to support the regional government for the development of the bioeconomy strategy. It brings together experts from different backgrounds (research, business, civil society, etc.) and closely works with the Interministerial Working Group on Bioeconomy for the development of the upcoming Regional Bioeconomy Strategy.

The Bioeconomy Councils support the process by contributing to the assessment of the status quo (opportunities, challenges, current and required framework conditions), the identification of promising sectors to tackle based on the current developments of bioeconomy, and the hierarchy and evaluation systems for the potential value-chains to be explored. It also facilitates the alignment of the regional strategy with the national and European ones.

The Bioeconomy Councils also contribute to a larger stakeholder engagement process to ensure the integration of the different perspectives, while providing a solid base of knowledge to enable evidence-based decision-making.

Another possibility is to set **a bioeconomy hub** that brings together the key stakeholders (public authorities, private companies, R&D organisations, potential end-users, etc.), in a collaborative framework, and can contribute to help to secure the involvement of the different key players. Such hubs generally serve as exchange platforms to shape and support the implementation of bioeconomy strategies. This can be a good solution to support regions with little resources to coordinate cross-sectorial dynamics.

Illustration: CLuBE, a cluster of bioeconomy in Western Macedonia

CLuBE is a non-profit organisation bringing together 53 organisations among the key players of bioeconomy in Western Macedonia, Greece: public authorities, research organizations and universities, and the companies including municipal companies, cooperatives, solution providers, etc. It aims to support the transition to a green and circular (bio)-economy, focusing on energy production, utilisation, and saving, and smart cities solutions.

Among its missions, CLuBE aims to foster and disseminate knowledge and innovation, but also connect the local stakeholders, and take advantage of European projects and funds (Horizon Europe, ERDF, etc.) to foster knowledge transfer, replication of good practices, or the implementation of demonstration sites.

Effective engagement of different services requires the establishment of **structured communication channels**, such as interdepartmental workshops and collaborative platforms, to align efforts and monitor progress. Cross-sector working groups will also ensure that the circular bioeconomy targets will be integrated in e.g. the climate, waste, or agricultural policies.

Smart Specialisation Strategies

Smart Specialisation Strategies, including S3 (Smart Specialisation Strategies), and its evolutions S4 (Sustainable Smart Specialisation Strategies) and S4+ (Sustainable and Inclusive Smart Specialisation Strategies) are developed at national and regional levels to foster knowledge-based growth, by taking advantage of each territory's competitive advantage. S4 build upon S3 while including sustainability and social cohesion, and S4+ is an evolution of S4 that emphasises on inclusivity. These strategies can be an effective instrument to foster the development of a regional circular bioeconomy. S3 share strong connection with circular bioeconomy strategies since they rely on a thorough assessment of available resources and assets and on the prioritisation of the most promising sectors and technologies.

Interconnecting S3 with the circular bioeconomy strategy is therefore highly recommended. S3 must incorporate priorities set by the bioeconomy strategy, which can then contribute to unlock funding and regional innovation programmes to support biocircular projects and value chains.

Within the elaboration of a regional circular bioeconomy strategy an existing S3 strategy can also be simultaneously developed to S4 or S4+, which includes a stronger focus on sustainability, societal challenges and systemic innovations.

The role of transition brokers / ecosystem enablers

Transition brokers are systemic intermediaries that are sometimes used to support the governance of circular economy⁴. Considering the multi-stakeholder nature of circular bioeconomy and the fragmentation between policy, innovation, and funding, such players can play a critical role to orchestrate the strategy by securing the involvement of the different key stakeholders, centralising and disseminating knowledge, and supporting the different players to develop circular bioeconomy projects and business models. Albeit essential for circular bioeconomy, these positions do not necessarily exist at regional or local level.

Transition brokers can be appointed by the regional authority or materialised by a regional bioeconomy hub to oversee the coordination and implementation of the Circular Bioeconomy Strategy. Their funding can be supported by specific regional funds such as the European Development Fund (ERDF).

Involving elected officials

Securing the involvement and support of elected officials is an essential element of a successful Circular Bioeconomy Strategy and is likely to strengthen the interservice cooperation required for an impactful strategy. Conversely, failing to obtain political support is likely to limit the interministerial

⁴ Cramer, J. M. (2020). The Function of Transition Brokers in the Regional Governance of Implementing Circular Economy—A Comparative Case Study of Six Dutch Regions. *Sustainability*, 12(12), 5015. <https://doi.org/10.3390/su12125015>

cooperation. Considering the transversal nature of bioeconomy, this will require the involvement of multiple elected officials in charge of different portfolios and pursuing diverse political agendas.

A first important point is to **align the circular bioeconomy strategy with their existing political priorities and agenda**: economic development, job creation, territorial resilience, support to specific sectors, etc. Involving them early in the process allows to build a strong relationship to secure their involvement in the process. Identifying one or several “political champions” who show more interest in circular bioeconomy and get them to advocate for the strategy to the regional council.

A first step can be **the production comprehensive, non-technical communication materials** clarifying the concept of circular bioeconomy and highlighting its potential impact of various dimensions (economic, environmental, and social). If available, providing concrete examples of successful practices or businesses, and documenting their overall impact on these dimensions will contribute to make it more tangible and appealing.

Overall, it is important that **the narrative built around circular bioeconomy is multidimensional and relevant to the many different interests** of the elected representatives. For instance, the scenarios developed within the circular bioeconomy strategy must envision a desirable future aligned with the different political agendas at stake and contribute to the achievement of other regional policies. Conversely, this will contribute to the integration of circular bioeconomy in other regional policies. For this reason, the multi-stakeholder approach highlighted in the previous sections is of utmost importance since it will contribute to include the diverse interests in a shared vision.

The involvement of elected officials must be **a continuous effort** and can be orchestrated with diverse activities: high-level events and public forums where regional stakeholders can voice their opinions, frequent updates on critical achievement documented the actual impacts of the deployed activities, or providing updated key performance indicators reflecting the positive impact of the strategy. Organising field visits showcasing the actual implication and results of circular bioeconomy can also be more effective than technical reports.

Another challenge is to **ensure the continuity of political support beyond political cycles**. The use of transition brokers / ecosystem enablers and/or circular bioeconomy hubs connected to the region can be a way to create a more consistent continuation of the strategy regardless of these possible changes, and to guarantee a longer-term political support of elected officials.

2.2 Operationalising the strategy: how to make it happen?

The implementation and operationalisation of the circular bioeconomy strategy is a continuous effort, whose approach bears many similarities with the establishment of the strategy itself. It relies on the same general steps (initial mapping, collaborative process, definition of an action plan, identification of financing routes, etc.), only applied to specific activities, value-chains, or sectors, and materialising around **the identification and implementation of new “transition pathways”**.

The BIOTRANSFORM project developed and deployed a method, combined with different tools, for the transition toward circular, bio-based systems aiming to make circular bioeconomy a reality. This method was applied in the six pilot regions and is detailed in D3.2 and D3.3. This section provides a short summary of this approach, illustrated with elements from these different pilots.

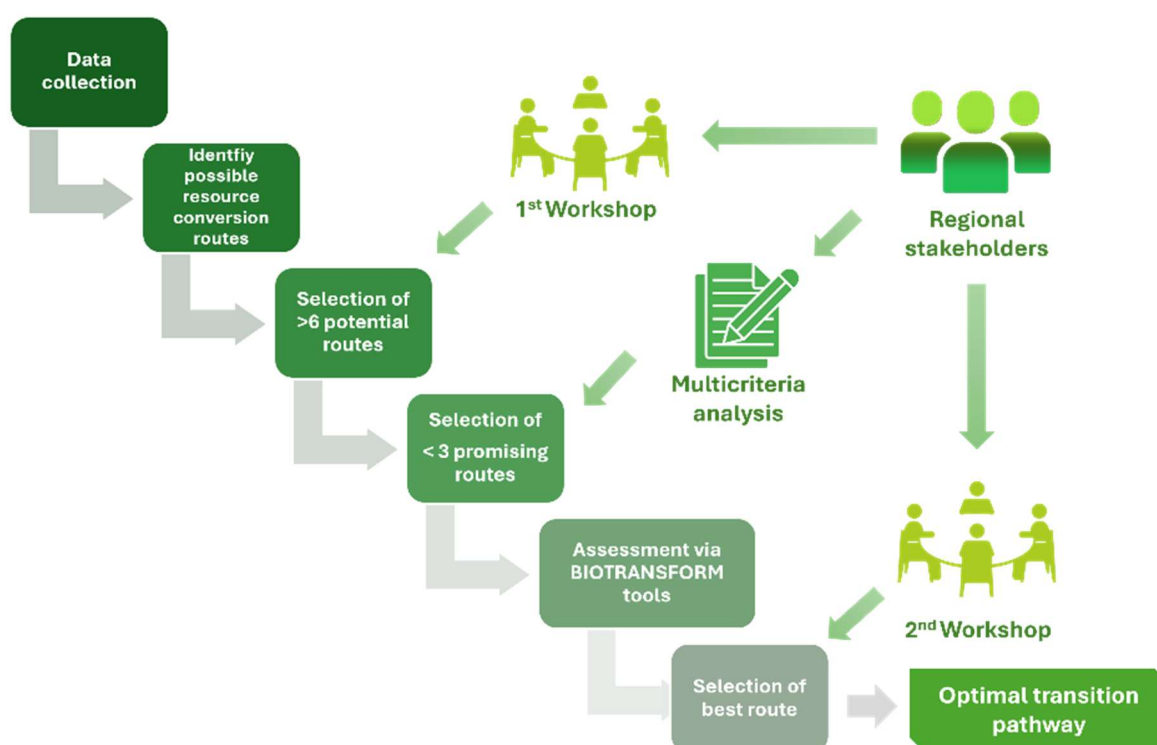


Figure 5: Summary of the BIOTRANSFORM methodology for the definition of transition pathways

Relevant resources

Key resources from the BIOTRANSFORM project:

D3.2 – Transition roadmaps from linear fossil-based to a circular bioeconomy of our case-studies: this report summarises the work achieved by BIOTRANSFORM pilot regions on the identification of optimal transition pathways in their territory, providing concrete illustrations for possible development activities in the region.

D3.3 – Transition guideline overview from linear fossil-based to a circular bioeconomy for general use: this guide provides comprehensive guidance in the form of a leaflet for any territory willing to identify biocircular transition pathways and prepare for their implementation.

Baseline and resources

The identification of transition pathways relies on a good knowledge of available (secondary) biobased materials and existing dynamics around which new valorisation routes can be built. The first step is therefore to identify and document available secondary biogenic resources: agricultural residues, waste and by-products from the food and beverage industries, food waste, etc. This identification implies various activities including data collection from public data sets and interviews with experts and stakeholders.

The starting point of investigations should be the circular bioeconomy strategy. If such a strategy is available at a regional level, it is likely to include a mapping of available and relevant resources that can be considered. If not, the first step is to identify key sectors to investigate, preferably together with local experts and stakeholders:

- **Key sectors directly connected to bioeconomy** (e.g. agriculture or the food industry)
- Significant sectors with **high production of unrecovered or underutilised bio-residues** (e.g. food waste from the tourism industry)
- Priority sectors **linked with overarching strategies** (climate change, resilience, etc.)

Illustration: selection of key sectors in BIOTRANSFORM pilot regions

The different pilot regions used different approaches for the identification of sectors to be investigated, yet **most took as a starting point a key regional economic sector**: the olive industry in Andalusia, tourism in Charles Spa, the forest industry in Finland, and the chemical industry in NRW. The potential value chains to be investigated were identified with the support of regional experts, following a **supply-based approach** and targeting the largest available secondary resources whose current valorisation routes were either non-existent or suboptimal, such as olive pomace, food waste, straw, or lignin. In Western Macedonia and NRW, the value-chains were also identified by taking a **demand-driven approach**, with the objective to reduce the dependency on fossil-based energy and materials for the regional economy (energy consumption, supply for the chemical industry, etc.).

Quantifying the associated quantities might prove challenging, as some bio-residues might not be subject to reporting, or the granularity of data might not allow to pinpoint quantities associated with a specific sector. To document these quantities, several complementary methods can be suggested:

- **National and regional statistics or databases** (managed by the regional government or by chambers of commerce) provide interesting figures on players within different sectors, usually using NACE codes, and possibly quantitative data on biomass.
- **Surveys or interviews with local players** (farmers, industries, etc.) can be an interesting way to get more precise quantitative data on available biomass and its composition.
- **Partnering with local universities and research organisations** to map biomass using Geographic Information System (GIS) and literature data for assessing production ratios constitutes another way to cross-check and complement existing data.

This first assessment shall lead to the identification of several priority sectors for which interesting transition pathways can then be investigated.

Illustration: the Finnish Biomass Atlas

This online database has been developed by the [Natural Resources Institute Finland](#) and gather spatial data on different types of biomasses from forest and fields, along with manure and waste biomasses, together with information on land use in one single, open-access platform.

The Atlas displays biomasses' locations and amounts that are based on various data sources (measurements, register, satellite data, and literature values). The quantities can be displayed on the map by selecting the biomasses and regions of interest.



Figure 6: Screenshot of the Finnish biomass-atlas (accessed on 10/05/2025)

Relevant resources

Key resources from the BIOTRANSFORM project:

D1.1: Report on limits of the linear fossil economies: this document presents the work achieved by the 6 pilot regions to identify the limits of the linear, fossil-based systems. It also includes the identification of key economic sectors and how a transition to carbon neutrality would impact them. The main environmental pressures (resource consumption, biodiversity, air, water, and soil quality, etc.) are also described.

D1.3 Database of suitable circular bioeconomy solutions: pilot regions compiled key information regarding existing technologies, facilities, on-going European projects and regional initiatives connected to circular bioeconomy and to the targeted transition pathways.

Stakeholder engagement and transition brokers

External experts and stakeholders can be involved in the initial mapping of resources. Their input is also fundamental when it comes to the selection of the most promising ones, and to secure their involvement in the different steps of the project, especially for its practical implementation. As for the initial mapping of resource, the existence of a regional circular bioeconomy strategy and of transition brokers strongly eases stakeholder engagement.

The selection of stakeholders depends on the identified priority sectors but generally revolves around the quadruple helix stakeholders. Key considerations are presented in the following table:

Table 2: Key stakeholders to be included, possible input, and motivation to join the project

Category	Examples	Input	Motivation
Public government	Regional authority (different departments) Local authorities Funding agencies and programme managers	Connection with regional strategies Enabling instruments (financing, regulation, authorisations, etc.)	See section “Internal governance”
Academia	Research institutes Universities Innovation hubs	Knowledge on circular bioeconomy (existing technologies, etc.) Input for the environmental, economic, and social assessment of transition pathways Neutral perspective and possible facilitation	Opportunity to share their work Joining the bioeconomy hub Opportunities for funding and projects
Private sector	Farmers Cooperatives Food, forestry etc. companies Solution providers for waste management and biocircular technologies Investors	Holders and/or processors of secondary bio resources Knowledge on current practices, and practical barriers limiting the transition Knowledge on available technologies and solutions Provide financing solutions	Generation of new revenues or reduction of current costs (e.g. for biowaste management) Potential for market expansion Ease compliance with the regulation
Civil society	Local NGOs Local environmental groups etc.	Ensure social inclusion Bring a more environmental perspective on the transition pathways, or considerations on well-being or the living environment	Ensure that the perspective from the civil society is included

It is of utmost importance to carefully select the stakeholders to involve. It is important that all perspectives are represented, also in terms of “size” (large companies, SMEs, small-scale farmers, etc.). At the same time, involving too many different players might slow down the discussions and makes it very challenging to reach a consensus. For each of the sectors covered by the biocircular transition, potential stakeholders should be selected depending on:

- **Their importance for the transition**, e.g. the sectors producing significant quantities of secondary bioresources, the organisations and individuals holding a key expertise on the topics at stake, etc.
- **Their capacity to positively influence the transition**, e.g. opinion leaders, interested elected representatives, local organisations already interested in circular bioeconomy, who are more likely to actively participate and positively impact the discussions.

Several engagement strategies were already highlighted in this report. They range from general communication (e.g. via a website, newsletter, public consultations, etc.) to more targeted interventions: co-creation sessions for the design of transition pathways or their first impact assessment, or direct interviews to collect insight on selected pathways or to validate data. Considering the different constraints and availabilities from the different stakeholders, it is essential

to ensure transparency regarding the decision taken, and the possibility for all of them to provide feedback and ensure that the decisions taken are considering their needs and constraints.

Stakeholder engagement can face several challenges that are summarised below:

Table 3: Stakeholder engagement: challenges and solutions

Challenge	Description and solutions	BIOTRANSFORM case study example
Knowledge gap	Many local players might not be aware of what circular bioeconomy is. It is important to make sure that all participants can take part to the discussion while sharing a common understanding of the concept and the challenges at stake. Organising capacity-building workshops or site visits prior to co-creation events can contribute to ensure this common understanding.	In the Charles Spa Region, initial low stakeholder awareness of bioeconomy concepts was addressed by presenting tangible opportunities and familiar local topics during an Innovation Conference and dedicated awareness sessions.
Low engagement	Certain types of stakeholders might be challenging to involve, such as smaller organisations. Co-creation processes might prove too resource-consuming, or some stakeholders might lack interest in the topic. It is therefore important to try and secure the participation from all key stakeholders either by defining activities matching with their constraints (engaging them in direct interviews, providing them sufficient time to provide feedback, etc.), or by proposing incentives (grants, expert fees, participation opening the possibility to pilot projects, etc.)	The North Rhine-Westphalia case study addressed initially lower engagement from some specific industry/SME representatives in broader workshops by supplementing with targeted bilateral meetings to ensure their input was captured.
Conflicting interests	Engaging various stakeholders generally leads to different perspectives and viewpoints being represented. Participants come from different horizons and different agendas or operate in a competitive environment. To overcome this challenge, appointing a “neutral” facilitator (e.g. transition broker, bioeconomy hub, academia) might contribute to balance the different opinions. It is also important to base the discussions on scientific approaches and consistent data.	Andalusia managed potentially diverse expert opinions on optimal olive residue valorisation pathways by employing the structured multi-criteria analysis developed in the project, where experts individually assessed routes before results were compiled and discussed, facilitating a data-informed consensus.

Identifying the most promising transition pathways

Identifying potential pathways

The identification of the most promising transition pathways bears many similarities with the identification of key priorities for a circular bioeconomy strategy, presented in section “**Setting priorities**”.

In the different BIOTRANSFORM pilot regions, the identification of transition pathways followed the same general approach presented in Figure 5, and heavily relied on a strong connection with local stakeholders. The identification and selection process consists in an iterative process, starting with the identification of promising sectors and available resources, the identification of six to ten potential

routes, narrowed down to three key conversion pathways that were then subject to more detailed assessment to confirm their relevancy.

The first identification of transition pathways is mostly based on resource availability, available technologies, and existing infrastructure. In parallel, indicators should be defined to provide an assessment framework for the identified transition pathways. As mentioned above, investigating key economic sectors is a relevant approach. **Potential transition pathways** can be determined and documented based on the initial mapping when it comes to existing technologies, on-going initiatives, both at regional level and in available literature.

The identification of promising transition pathways greatly benefits from collaborative approaches. Using mind-maps or flow diagram contributes to enhance the understanding of the potential value-chains and also allows participants to share more detailed information on current challenges and opportunities with sticky notes, as presented with the example of the Western Macedonia case study on Figure 7. This first exercise shall narrow down the list of relevant pathways to be investigated.

Possible Pathways - Western Macedonia, Greece

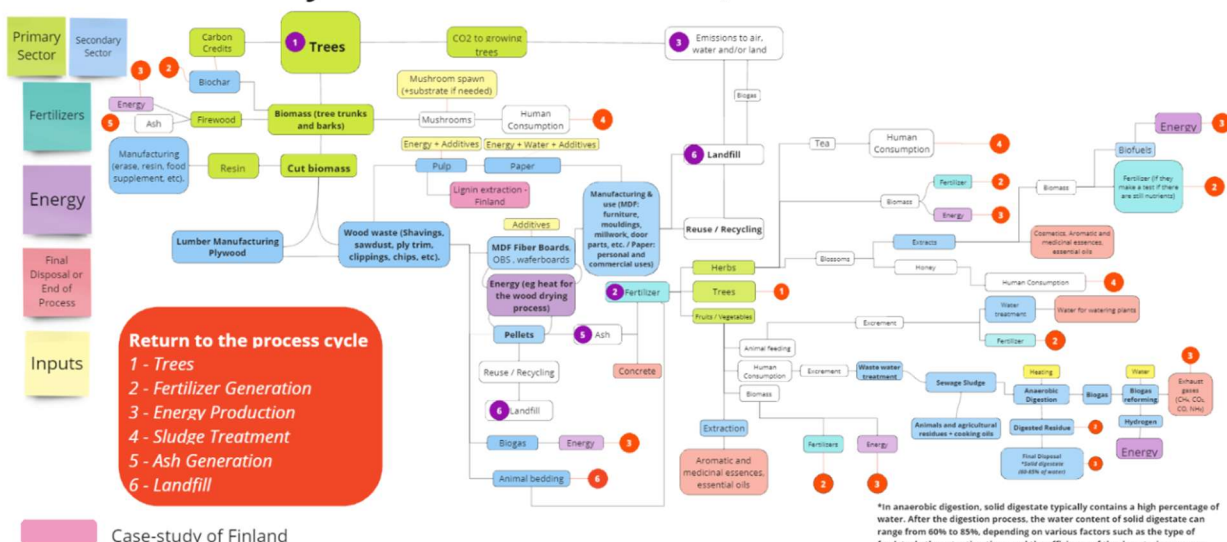


Figure 7: Diagram used to map the possible pathways for the Western Macedonia case study.

The pre-selected pathways must then be documented, by investigating the available valorisation routes for the key secondary resources identified, along with the potential bioproducts that can be obtained. Such conversion routes can be represented with flow diagrams, that allow to represent the different combinations of valorisation routes and potential bioproducts.

Multi-criteria analysis

To determine the **most promising transition pathways**, a multicriteria analysis can be organised along with local experts and stakeholders. This analysis consists in a collaborative assessment of different pathways according to key economic, environmental, and social indicators: availability of resources, impact on climate change and on resource consumption, CAPEX and OPEX, technical feasibility and availability of technologies, etc. Both literature resources and expert knowledge have to be mobilised to provide a transparent assessment of all the targeted value-chains. At this stage, it

might not be feasible to accurately quantify these impacts, so a more qualitative approach can be used, e.g. by assessing the different impact between low, medium, and high.

Table 4: Assessment matrix used in the Andalusia case-study, and applied to different byproducts of the olive industry

Residue	N°	Application	Resource availability	CO2 impact	Circularity potential	Water consumption	Freshwater quality impact	CAPEX	OPEX	Techn. Complexity	Economic relevance/feasibility	TRL	R&D needed
Olive pruning debris	1	Reinforcement of polymeric materials	High	Medium	High	Medium	Low	Medium	Medium	Medium	High	High	Medium R&D requirements to improve chemical conditioning of the pruning wood fibre
Olive pruning debris	2	Polymer production	High	Medium	High	Medium	Low	Medium	Medium	Medium	High	Low	Medium R&D requirement to improve chemical processes
Olive pruning debris	3	Bioethanol production	Medium	High	Medium	High	Medium	Medium	Medium	Medium	Low	Medium	Medium R&D requirements on enzyme development and pentose fermentation
Olive pruning debris	4	Production of lignin	Medium	Medium	Medium	Medium	Low	Medium	Medium	High	Medium	Medio	Medium R&D requirements
Olive stones	5	Xylitol production	Medium	Medium	Medium	High	High	Medium	Medium	Medium	Medium	Low	Medium R&D requirements on microorganism development and purification systems
Olive stones	6	Bioethanol production	Medium	High	Medium	High	Medium	Medium	Medium	Medium	Low	Low	Medium R&D requirements on enzyme development and pentose fermentation
Olive pomaces	7	Antioxidants production	High	High	Medium	Low	Medium	Medium	Medium	Low	Medium	Medium	Medium R&D requirements on green extraction and purification systems

The outcome from this exercise should be a list of priority transition pathways that offer the best compromise in terms of positive impact and feasibility.

Relevant resources

Key resources from the BIOTRANSFORM project:

D2.2 Individual report on each subsystem assessment: this report presents the outcomes from the environmental, economic and socio-cultural impact assessments of the studied transition pathways.

D3.1 Report on the different pathway analysis and selection of optimal transition pathway from linear fossil-based to circular bioeconomy: This deliverable describes the process of co-defining the pathways of the individual case study regions within the BIOTRANSFORM project. It provides insight and the approaches and tools applied to very different contexts, along with achievements and challenges faced.

Other key resources:

[EU Bioeconomy Monitoring System dashboards](#): this online dashboard presents key indicators and data related to various bioeconomy sectors.

Preparing the implementation

The identified transition pathways must undergo further research and assessment prior to the implementation, to clearly identify their potential as well as finetune more operational aspects such as the logistics. The BIOTRANSFORM project developed **an assessment package** that fulfils this objective. Because this assessment package is a partially publicly available solution, it can provide inspiration for such a process.

Resource flow analysis

To better understand and represent the transition pathway, Sankey diagram can be used: they allow to display the different streams from a specific value-chain and to highlight the potential impact of the transition pathways on the use of resources. Building such resource flow requires to break down the value chain in different process and allows to understand where losses or underutilised streams are located. An example of such Sankey diagram is presented on the following Figure 8 presenting the flows associated with olive farming the in the Andalusia demo case.

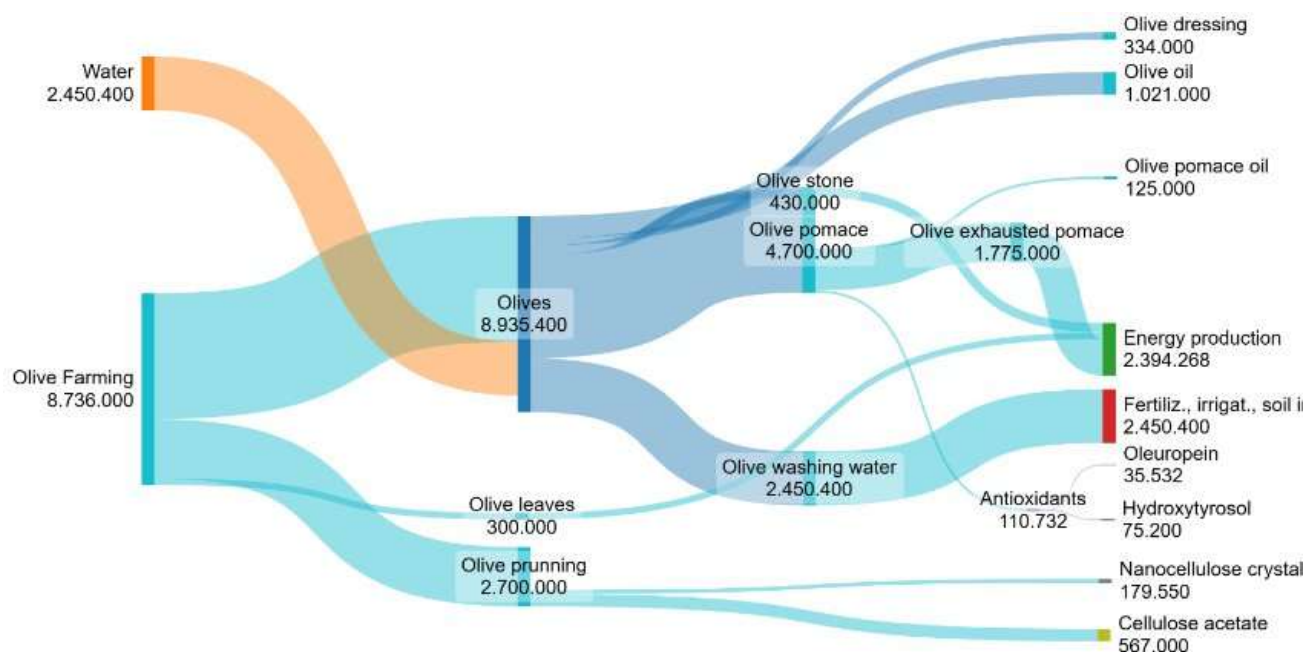


Figure 8: Sankey Diagram applied to olive farming in the Andalusia pilot case (values expressed in tonnes)

Quantifying the impact: Sustainability Assessment

Sustainability assessment allows to quantify the environmental, economic, and social impacts of a transition pathway, by comparing the initial situation with the alternative scenario. It can help to understand which transition pathway holds the most benefits. The BIOTRANSFORM project used the following approach to conduct such an assessment:

- Environmental impact:** Life-cycle assessment was applied to the targeted transition pathways that were well clear from an early stage onwards. The impact of different valorisation routes was assessed by comparing the impact of the bio-based product with its fossil-based counterpart. LCA requires both appointed experts to ensure the consistent application of the method, and solid data that can be obtained via literature search and stakeholder interviews. LCA provides impact assessments on various impact categories (e.g. climate change, ecotoxicity, etc.), and the results need to be carefully interpreted before using them for decision-making, especially when there are trade-offs among the different impact categories. A possible way to use the results is to assess to what extent the targeted transition pathway will contribute to overarching environmental targets such as greenhouse emissions reduction.
- Economic impact:** The economic impact of the new transition pathways might be challenging to assess, due to many uncertainties. The economic impact assessment requires the assessment of both CAPEX (capital expenditures) and OPEX (operational expenditures) of the new system, balanced with the expected revenues from the new recovered resources.

Besides, and as part of the sustainability assessment, the BIOTRANSFORM project also included the economic savings linked to the environmental benefits, such as the decrease of CO₂ emissions associated with biocircular practices.

- **Social impact:** Assessing social impact of transition pathways can prove even more challenging than economic impact. Job creation is often a critical aspect and can be quantified, but other dimensions can be more difficult to assess, such as the improvement of working conditions or well-being. This can be achieved via simple questionnaires where stakeholders can provide a score ranging from 1 to 5.

To make the assessment easier to apprehend to non-expert audiences, it is possible to combine all the different impacts in one single “**sustainability score**”, which requires a weighing of the different impact categories. This weighing can be established to reflect specific local priorities or vulnerabilities, making specific impact categories more important than other in the local context.

Table 5: Example of indicators and weighing criteria used for the sustainability assessment in Andalusia

Main criteria	Weight	Units	Subcriteria	Weight	Sub-Units
Environmental impact	35%	350	Climate change (GWP-total)	20%	70.00
			Particulate matter	15%	52.50
			Land use change	15%	52.50
			Water use	20%	70.00
			Resource use fossil (ADP-fossil)	15%	52.50
			Resource use mineral and metals (ADP-mind&met)	15%	52.50
			Subtotal environmental impact	1%	350.00
Economics	35%	350	Job loss / Job creation	18%	62.93
			Wages	16%	57.53
			Training needs	14%	48.54
			Value Creation	14%	48.54
			Added Value	13%	44.95
			CAPEX	5%	17.50
			OPEX	5%	17.50
			Sizing/scaling	5%	17.50
			Impact on export	5%	17.50
			Impact on import	5%	17.50
			Subtotal economical	1%	350.00
Social aspects	35%	350	Employment	19%	56.98
			Income	17%	52.09
			Work-Life Balance	17%	52.09
			Housing	16%	48.84
			Health	5%	15.00
			Education	5%	15.00
			Governance	5%	15.00
			Environment	5%	15.00
			Security	5%	15.00
			Life satisfaction	5%	15.00
			Subtotal social impact	100%	300.00

However, this approach has also drawbacks: first, the weighing is subjective and can bias the results. Moreover, aggregating impacts related to different pillars of sustainability can be questionable and conceal nuances or trade-offs associated with different scenarios.

Illustration: environmental impact assessment of different applications of lignin in Finland

The BIOTRANSFORM project conducted several Life Cycle Assessments (LCA) for different demo cases. For Finland, the demo case revolves around the recovery of lignin, a forest industry byproduct currently incinerated, to be processed as anode material, adhesives, and concrete plasticiser. Comparisons were conducted between the bio-based products' impacts and their fossil-based counterparts. The main outcomes are presented in the following figure:

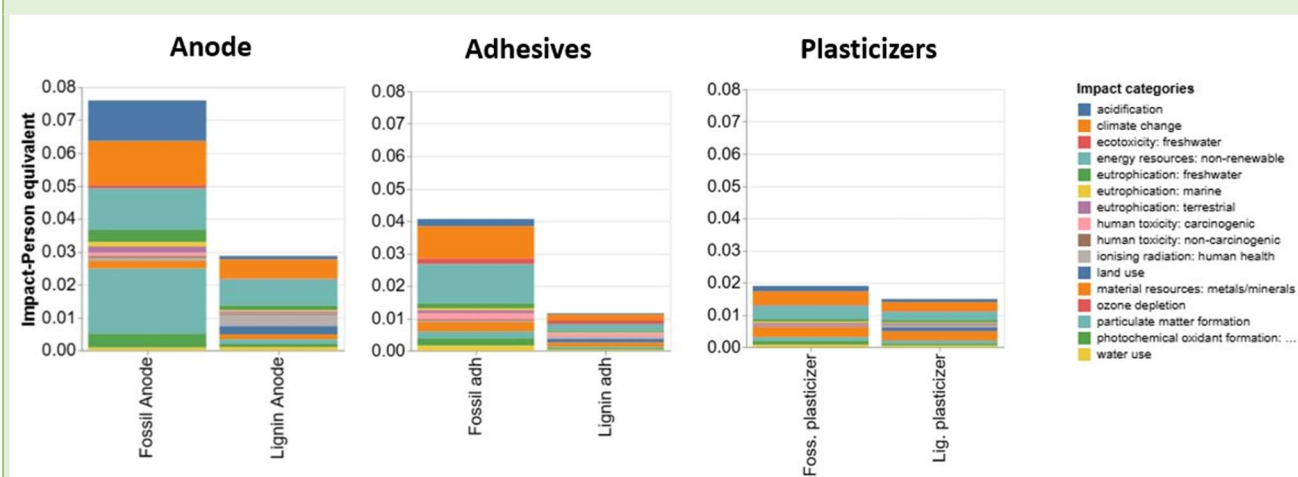


Figure 9: Environmental impact of the production of anode, adhesives, and plasticisers, comparing fossil-based products and lignin-based counterparts

The environmental impacts of the different fossil-based and lignin-based products are presented on Figure 9: the bars represent the addition of environmental impacts expressed in person-equivalent, for the different impact categories used (acidification, climate change); the higher the bars are, the higher the environmental impact is; which means that the product is more harmful to the environment.

The environmental assessments tend to show that the bio-based products have a smaller environmental impact than the fossil-based ones, yet the benefits are much more significant for anodes and adhesives compared to plasticisers. For these two categories of products, using lignin counterparts leads to significant environmental benefits.

Logistics models: the MooV tool

For sectors and value-chains where the logistical routes are already well-established, such assessment might not prove necessary. However, transition pathways might also generate additional streams or might require the collection of scattered secondary resources generated by disperse and remote producers. In those cases, conducting a logistical analysis is a wise approach, considering that transport can yield high costs and significant negative environmental impacts.

The [MooV tool](#) is a supply chain optimisation service provided by BIOTRANSFORM partner VITO. By assessing the different streams of materials, products, or waste of a given circular bioeconomy system, it provides insight on the possible optimisation of logistics and its potential impact on emissions and costs. The MooV tool uses various information, e.g. on the location of the different hubs, travel times, capacity of storage and processing facilities, quantities and characteristics of the

different streams, data on costs, etc., and provides the impact of different scenarios on costs, mileage, and carbon emissions.

The MooV tool can help to identify optimal logistic scenarios, for instance how collection can be optimised, where treatment units can be installed to limit the need for logistics, or whether storage units are required.

Illustration: the application of the MooV tool to the Andalusia demo case

The MooV tool was applied to the Andalusian demonstration case to determine the logistical implications of a new valorisation route for olive tree pruning to be recovered in biorefineries as bioplastics. It processed different scenarios: a first one with one off-site storage and processing in an existing facility (reflecting the current situation in terms of infrastructures), a second one with no off-site storage investigating the impact of multiple biorefineries and multiple off-site storage units, and a third one with a single biorefinery investigating the impact of different off-site storage facilities and multiple decentralised biorefineries.

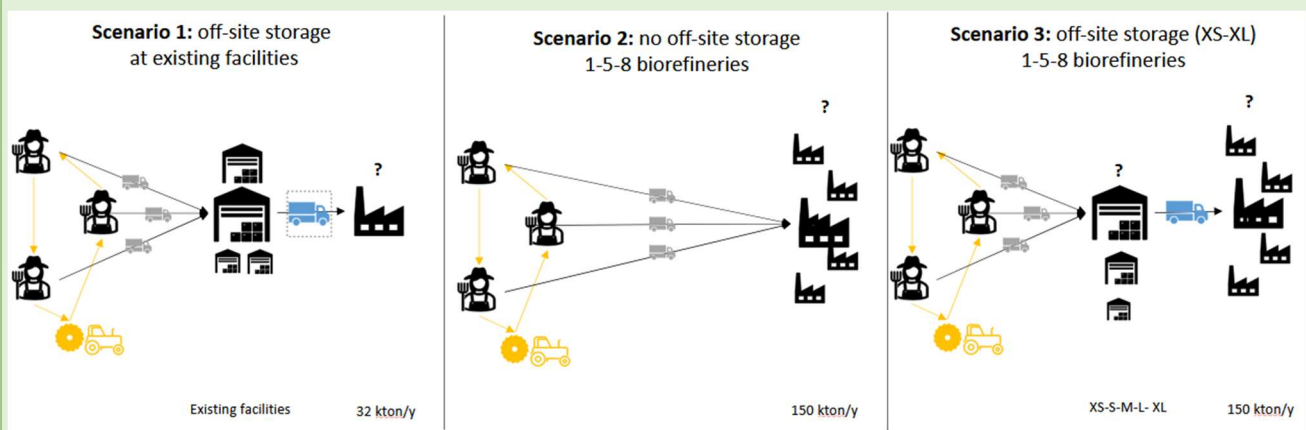


Figure 10: The different scenarios processed by the MooV tool for the Andalusian demo case

The simulations tended to favour the use of one or few biorefineries and smaller-scale off-site storage units, while scenarios including larger storage facilities and more biorefineries presented higher costs and longer distances. Overall, the simulation demonstrated several key points: Decentralised systems are more cost-effective for this value chain, transport of fresh chips from the field to storage facilities or biorefinery is the dominant cost driver, and the optimal design balances both minimal field-to-storage transport and efficient storage sizing. However, it must be noted that the investment costs for the biorefinery were not included in the calculation and might impact the conclusions.

Identifying financing routes

The identification of financing routes also benefits from discussion with regional stakeholders. This requires a proper assessment of the required investments and the development of a circular business model that documents the main costs and potential revenues. More insights on financing and funding routes are presented in section 3.

Indicators to monitor transition pathways.

The assessment of promising transition pathways should be based on consistent parameters that are aligned with the regional objectives and strategies. Co-defining a **set of indicators** with the involved stakeholders aligned with the regional vision is recommended, that can then be used to assess and monitor the identified pathways. These indicators need to be calculable at regional level, but also

relevant and understandable for the stakeholders and decision makers. Thus, the selection of monitoring indicators must involve key stakeholders.

While the exact selection of indicators depends on the targeted sector, several categories of indicators can be listed:

Table 6: Examples of indicators to monitor the transition pathway

Category	Potential indicators	Description and examples
Streams	Production of biomass	Quantities of (secondary) bio resource targeted
	Use of biomass	Biomass consumed by different applications (material, energy, food, etc.)
	Circularity	Substitution of linear, non-renewable resources and products by biocircular ones Recycling rate for specific bioresidues
Economy	Investments	Investment in facilities Investment in workforce
	Revenues	Value-added for the different sectors
Environment	Climate change	GHG emissions generated by the different sectors
	Emissions in the air	Emission of NO _x , SO _x , Ozone, etc.
	Energy use	Use of biomass for energy production
Social	Employment	Employment in the different sectors Employment linked with circular bioeconomy Working hours

Defining an implementation roadmap

After the full assessment confirmed the relevancy of the transition pathway, a roadmap must be established to prepare for the practical implementation of the transition pathways. Roadmaps aim to define the progress of the transition pathway in the coming years and on a longer term. Each BIOTRANSFORM case study defined an implementation roadmap including:

- **The definition of targets** that can be defined at different horizons and focus on quantitative/circularity indicators (increase of collected bioresidues, increase of recycling rate), social and economic figures (number of local jobs created, added value generated, etc.), or more specific aspects such as technological development.
- **A timeline for the implementation of the pathway:**
 - **Short-term activities** focusing on the validation of the concept at stake and include actions such as technological development, pilot units, stakeholder involvement, consolidation of the business model, identification of funding and policy needs.
 - **Mid-term activities** focusing on the scaling-up of the solution and encompassing the development and investment in infrastructure.
 - **Longer-term activities** focusing on full-scale development and projecting the market situation.

The timeline should include various dimensions. To do so, the PESTEL-elements can be used to also keep track of external factors: Political, Economic, Social, Technological, Environmental, and Legal.

Mapping the transition roadmaps on a figure showing both the different development stages of the pathway or the TRL level of the solution, and the timeline, as displayed on Figure 11, provides an interesting illustration that also helps connecting the different dimensions together (evolution of legislation, introduction of economic instruments, technological developments, etc.), and better plan the needs for funding and the associated business model.

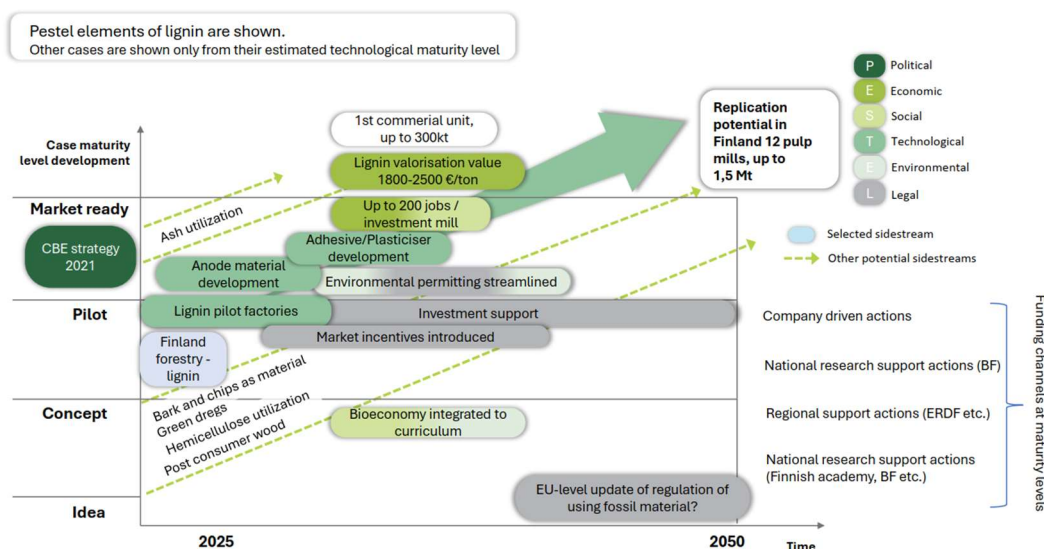


Figure 11: Roadmap for the recovery of forestry byproducts in Finland using PESTEL elements

Relevant resources

Key resources from the BIOTRANSFORM project:

D3.2 Transition roadmaps from linear fossil-based to a circular bioeconomy of our case-studies: This report describes the work achieved by all BIOTRANSFORM demo cases on the design of their transition pathways, providing concrete illustrations for the different steps addressed in these guidelines.

Creating a favourable regional framework

Regional authorities have the capacity to unlock the scalability of circular bioeconomy systems:

- **Implement a centralised overview of regional bioeconomy**, by creating a dedicated regional steering body, developing a regional strategy, appointing transition brokers to ensure the continuation of the strategy.
- **Develop skills and education in circular bioeconomy** by developing training hubs in universities and vocational courses in agricultural and business schools, with training courses aligned with the regional needs.
- **Foster investments in R&D and scaling up of pilot initiatives** by providing technical support to circular bioeconomy entrepreneurs, facilitating access to EU funding, and developing regional grants for innovation, subsidies for acquiring equipment, or fostering applied research in regional institutions.

- **Facilitate logistics for the collection of bioresources** by investigating potential synergies and improving coordination for the collection of specific feedstocks.

Key resources from the BIOTRANSFORM project:

BIOTRANSFORM Assessment Package: the BIOTRANSFORM projects developed an assessment package comprising different tools (MooV, LCA, etc) that were applied to the different demo regions.

D4.3 Final joint policy brief for a transition from linear fossil-based to a circular bioeconomy:

This policy brief presents the main policy recommendations to foster the uptake of circular bioeconomy in Europe, stemming from four EU projects.

3. Financing of circular bioeconomy

3.1 The cost of a circular bioeconomy transition

The cost of the transition

It is challenging to assess the cost of a transition toward a circular bioeconomy. Indeed, such a transition requires an on-going investment that will generate long-term return. While the investments in infrastructure and new technologies might be significant, wise investments shall lead to long-term benefits leading to cost reductions (e.g. linked to the reduction of waste disposal or the reduction of losses and waste in the value-chains) and creation of value (e.g. high-value bio-based materials and products, leading to the creation of new markets). In addition, it is expected to produce significant environmental and social benefits, and to contribute to regional resilience by limiting the dependency on imports of fossil-based resources and materials. A 2020 report assesses that circular bioeconomy represents a business opportunity of \$7.7 trillion (about €6.8 trillion) through an increase in use of biomaterials in different product industries⁵.

The main costs linked with a biocircular transition can be listed as follows:

- **Investments in research and development:** on-going efforts are required for the development of new conversion routes or for the optimization of existing ones. Such investments are also essential to lower the costs of circular biotechnologies.
- **Investments in infrastructure:** biocircular processes require the development of hubs and biorefineries to process the bioresources in new materials and products. Additional costs can materialise, such as land purchase, permit fees, certification, etc.
- **Investments and costs for logistics:** circular bioeconomy systems require the collection and transport of feedstocks. Implementing a cascading valorisation of bioresources requires the creation of new flows for which logistic solutions have to be found.
- **Investments and costs in human resources:** transitioning to a circular bioeconomy requires workers to be trained to new technologies. It also requires the creation of new roles, such as transition brokers, and possibly the evolution of existing roles to include circular practices in

⁵ WBCSD (2020), Circular bioeconomy: The business opportunity contributing to a sustainable world

their current activities (e.g. farmers). Circular economy systems are generally more labour-intensive than their linear counterpart, which might lead to additional costs.

It seems difficult to assess the cost of a regional circular bioeconomy transition, considering the diversity of contexts. For single circular bioeconomy systems, costs will be highly dependent on the existing infrastructure, the needs for logistics, and the technologies at stake. While investments for pilot trials can range between a few tens to a few hundred thousand euros, larger processing units can amount to several tens to several hundreds of millions of euros. As an illustration, a 2024 study estimated that an investment of 100 billion euro per year is necessary to achieve climate neutrality for BIOTRANSFORM pilot territory North Rhine-Westphalia, amounting to over €5,500 per inhabitants per year⁶.

Recent research⁷ tends to show that such a biocircular transition does not only require investments in new technologies, but also enabling policies and economic instruments, such as incentives and taxes that would for instance put a price on environmental externalities.

Circular bioeconomy business model

Circular bioeconomy projects combine both the “circular” and the “bio-based” dimensions, which makes their business models specific. In general, circular businesses can present significant operational costs (e.g. linked to the logistics of collecting scattered second-hand resources or waste) and might face regulatory barriers linked with either a lack of regulation or over-regulation⁸.

Circular bioeconomy business models are mostly characterised by two factors:

- **The availability of secondary bio-based feedstock:** bio-based feedstocks can be subject to significant (seasonal) variations. Moreover, the collection system plays a significant role in the sustainability of biocircular businesses, both in terms of quantity and quality. Besides, there might be competition over the use of the targeted feedstock⁹.
- **The existence of a market for the targeted bioproducts:** market acceptance is influenced by the quality and characteristics of the end-products, but also by the maturity of the applied technology. A major barrier for the marketing of circular products is their competitive price compared to conventional ones.

Several recent studies analysed circular bioeconomy business models, leading to the following observations:

- **Different archetypes:** different types of biocircular business models can be identified, with projects resorting to one or to several types at once. The different business models can be guided by the optimisation of resource use and reducing losses, the recovery of waste to reduce the costs of disposal and substitute virgin materials or products, the production of

⁶ <https://www.fin-connect-nrw.de/studien/wie-hoch-sind-die-investitionsbedarfe-in-die-klimaneutrale-und-digitale-transformation-in-nrw>

⁷ Khanna, M., Zilberman, D., Hochman, G. *et al.* An economic perspective of the circular bioeconomy in the food and agricultural sector. *Commun Earth Environ* **5**, 507 (2024). <https://doi.org/10.1038/s43247-024-01663-6>

⁸ HOOP Project (2022), 4.1 Novel Circular Business Models applied in the value chain of bio-waste valorisation

⁹ Reim, W., Parida, V., & Sjödin, D.R., (2019). Circular Business Models for the Bio-Economy : A Review and New Directions for Future Research. *Sustainability* **11**(9), 1–14. <https://doi.org/10.3390/su11092558>

innovative, local, and renewable products replacing linear, fossil-based ones, the creation of biorefineries to produce different outputs in a cascaded way, etc.¹⁰

- **Drivers and barriers:** reviewed biocircular businesses tend to show low profitability, high operational costs, reliance on public support, and challenges in upscaling projects¹¹. Circular biobased products tend to be not commercially attractive and there is a lack of public knowledge and acceptance of bio-based products, and a lack of analysis of customer demands⁹. Unclear or unharmonized regulation across countries and markets as well as administrative burden tend to negatively impact circular bioeconomy business models¹². On the other hands, factors such as consumption patterns shifting to more environmental-friendly products or technological innovation might act as drivers for biocircular businesses.

Systemic circular bioeconomy transformations often extend beyond individual entities, requiring robust collaborative structures. **Public-Private-People Partnerships (PPPPs)** are vital in this regard, explicitly integrating civil society and local communities alongside public and private sectors. This 'people' dimension ensures co-creation, social acceptance, and equitable benefit-sharing. PPPPs are crucial for de-risking large-scale initiatives like regional biomass hubs or new value chains by pooling diverse expertise, aligning long-term visions, and fostering shared ownership, thereby overcoming significant financial and operational hurdles for a just and inclusive transition.

Before identifying funding opportunities, it is important to understand what the value of the project is, and especially its revenue model. Besides the objectives of the project and its technical and legal feasibility, the economic feasibility must be demonstrated by a clear business model including the expected costs (technical, human resources, etc.), the expected revenues (including the targeted markets), potential sources of capital, the existing competition and the competitive advantages of the project over this competition¹⁴.

¹⁰ R. Salvador, M.V. Barros, M. Pieroni, D.A. Lopes Silva, F. Freire, A.C. De Francisco, Overarching Business Models for a Circular Bioeconomy: Systematising archetypes, *Sustainable Prod. Consumption*, 43 (2023), pp. 349-362, [10.1016/j.spc.2023.11.010](https://doi.org/10.1016/j.spc.2023.11.010)

¹¹ D'Amato, D., Veijonaho, S., & Toppinen, A. (2020). Towards sustainability? Forest-based circular bioeconomy business models in Finnish SMEs. *Forest Policy and Economics*, 110, 101848. <https://doi.org/10.1016/j.forpol.2018.12.004>

¹² Bröring, S., Vanacker, A., Designing Business Models for the Bioeconomy: What are the major challenges?, *EFB Bioeconomy Journal*, (2022), <https://doi.org/10.1016/j.bioeco.2022.100032>

Table 7: transition pathways and business model archetypes foreseen in the different BIOTRANSFORM Demo Regions

Case study region	Pathway example	Predominant business model archetype(s)	Brief explanation/link to project
Northern Burgenland, Austria	Valorisation of lake sediments for construction materials	Creating value from waste; Resource efficiency	Transforms a dredged "waste" stream into useful building products, addressing ecological management needs and substituting virgin materials.
Finland	Lignin (pulp industry by-product) to adhesives	Bio-based product substitution; Industrial symbiosis (by-product valorisation)	Replaces fossil-based phenols with a bio-based alternative derived from an existing industrial side-stream, enhancing resource efficiency within the forestry sector.
Charles Region, Czechia	Food waste (from tourism & households) to biogas and compost	Closing the loop; Waste valorisation; Renewable energy	Converts urban organic waste into local energy and soil conditioners, reducing landfill and creating local resource cycles.
NRW, Germany	Sugar Beet Pulp (SBP) to Lactic Acid	Creating value from by-products; Industrial symbiosis (potential)	Upgrades an agro-industrial side-stream (SBP) into a platform chemical for bioplastics, potentially integrating with existing sugar production infrastructure.
Andalusia, Spain	Olive pruning debris to biocomposites (for automotive/furniture)	Creating value from agricultural residues; Bio-based product substitution	Utilises abundant agricultural residues to produce durable biocomposites, replacing conventional plastics in industrial applications.
Western Macedonia, Greece	Sewage sludge to Hydrogen	Waste valorisation for energy; Renewable energy	Converts urban wastewater treatment by-product into clean fuel for municipal vehicles, addressing waste management and promoting decarbonisation.

Key resources from the other projects:

[HOOP – D4.1 Novel Circular Business Models applied in the value chain of bio-waste valorisation:](#) the report details circular business models for biowaste valorisation along with 15 innovative technologies.

3.2 Funding opportunities for circular bioeconomy

Funding and financing categories

Implementing transition pathways might require significant investments depending on the nature of the project, that can be secured via **funding** provided by governments or institutions based on agreements and "for free", and/or **financing** for which organisations usually expect to be paid back. Funding and financing can be secured via different manners, but options will be conditioned by the level of risk of the project, which is also linked with its maturity. Financing options also differ depending

on the investment needs or the conditions to obtain them. The main categories of funding and financing options are listed below¹³¹⁴:

- **Direct funding or co-funding:** the funding is directly provided by the applicant organisation, or by several parties.
- **Equity:** funders invest money to get a share of the project (e.g. stocks) to get dividends or sell it later at a higher price.
- **Loans, mortgages (debts):** with loans, money is borrowed and expected to be paid back with interest. Mortgages are loans secured by real estate or personal property of the borrower.
- **Guarantees:** funders take over part of the obligations in case of non-payment, and a guarantor assumes the debt obligation if the borrower defaults.
- **Grants and subsidies:** funders provide money without expecting payback.
- **Alternative funding:** there are many different types of funding/financing options, such as crowdfunding where resources of different financiers are pooled against a repayment when/if the project is active (reward, shares, etc.), financial and operational leases (where the lessee become the legal owner of the asset or get a right to use it without ownership), etc.

As mentioned above, these different categories apply to different levels of maturity of projects. For instance, **grants, guarantees, and alternatives fundings** generally apply to projects at **early stages** of development (research and development, start-up level), while **debts** (loans, mortgage) generally apply at **later stages** (scale-up, growth, maturity). **Equity** can apply **from R&D to more mature stages**.

Key funding and financing schemes

There are many different funding and financing schemes that can be applied to circular bioeconomy projects, available at European, national, or regional level. A selection of the most relevant ones is presented in the table below:

Table 8: Non-exhaustive list of financing and funding schemes available for circular bioeconomy projects and organisations.

Name	Description	What can be financed?	Amounts and funding rates
SHARED MANAGEMENT FUNDS			
ERDF	European Regional Development Fund, ERDF. This fund aims to strengthen the competitiveness of EU regions and target several key priority areas including innovation and research and the low-carbon economy. EU regions publish Regional Operational Programme that list the eligible topics, along with Smart Specialisation Strategy (RIS3) documents which outline priority R&I areas such as agriculture, waste processing and biorefineries.	Grant, financial instruments (investments)	It depends on the operational programme.

¹³ HOOP Project (2022), Investment Package Manual for European Cities and Regions – Vol II – European investment package on circular bioeconomy for European Member States, Regions and Cities

¹⁴ HYDROUSA Project (2021) - D8.3 Replicability and associated funding mechanisms

<u>Cohesion Fund</u>	Support investments in Member States whose Gross National Income (GNI) per capita is less than 90% of the EU average. It can support projects related to the environment (e.g. energy, water, and waste). The funds are managed by the national authority	Grant, technical assistance	Funding ranges from 1 M€ to over 20 M€ 85% funding rate
<u>Just Transition fund</u>	It provides investments for SME and R&I for topics aligned with the Just Transition objectives, including green jobs for circular bioeconomy. The funds are managed by national authorities.	Grant, technical assistance	Funding ranges from 1 M€ to over 20 M€ Co-funding depends on the national programmes
<u>European Agricultural Fund for Rural development</u>	The Bioeconomy is included in one of the nine specific objectives of the future CAP 2021-2027 to "promote employment, growth, social inclusion and local development in rural areas, including bioeconomy and sustainable forestry". Member States have to programme bioeconomy related funding in their CAP National Strategic Plans.	Financial instruments (investments)	Depends on the national programmes
<u>European Maritime Fisheries and Aquaculture Fund (EMFAF)</u>	It supports sustainable aquaculture developments and supports coastal communities in diversifying their economies. It funds national operational programmes managed by national authorities that are in charge of the operational programmes	Grant, financial instruments	Depends on national programmes
EUROPEAN FUNDING PROGRAMMES			
<u>Horizon Europe – Pillar II – Cluster 6</u>	The key funding programme for R&I, that includes cluster 6 – Food, Bioeconomy, Natural Resources, Agriculture and Environment. A strategic plan define the priorities, and work programmes including funding opportunities are then published. Calls are published yearly with different specific topics	Grant. Demo, R&D, industrialisation	Different size, ranging from 1 M€ to over 20 M€ depending on the call 70% funding for profit-making entities, 100% funding for the other
<u>Horizon Europe – European Innovation Council</u>	Support for innovations with potential breakthrough and disruptive nature with scale-up potential that may be too risky for private investors. It specifically targets "market-creating innovation" This is 70% of the budget earmarked for SMEs.	Advanced R&I, commercial development	Depends on the work programmes
<u>Circular Bio-based Europe Partnership (CBE)</u>	This joint initiative between the European Commission and the Bio-based Industry Consortium aims to fund research and innovation projects that advance competitive, sustainable, and circular bio-based industries in Europe. It works in a similar fashion than Horizon Europe	Demo, R&D, industrialisation	€2 billion, from EU and private funds combined 60% funding rate for profit-making entities for Innovation actions.
<u>LIFE</u>	LIFE is intended to co-finance projects with European added value. It encompasses several sub-programmes, including one on circular economy and quality of life that supports projects on the recovery of waste and circular business models.	Grant, technical assistance	Several projects on circular economy 60% funding

<u>Innovation Fund</u>	It has a budget of €40 billion of support over 2020-2030 for highly innovative technologies and big flagship projects with European value added that can achieve significant emission reductions in carbon intensive sectors. This includes low-carbon technologies and renewable energy generation projects. the Innovation Fund will share the risk with promoters to help with the demonstration of first-of-a-kind highly innovative projects. Open calls and auctions are open every year	Grants and competitive bidding Highly innovative technologies and flagship projects. Mature projects.	60% for regular grants 100% for competitive bidding Covering capital and operational costs minus revenues over the first ten years of operation
OTHER FUNDING AND FINANCING SCHEMES			
<u>European Investment Bank (EIB)</u>	The EIB provides loans to public and private organisations, but also equity-type products for new businesses developing transformative technologies, securisation, bond purchase, or project guarantee products for large investment projects, as well as advisory services	Different financial instruments Startups and scale ups, small and medium investments, infrastructures and large investments	Loans: above 25M€ (lower amounts in some case), 50% of the project's total costs Loans up to 12.5 M€ for SMEs
<u>InvestEU Fund</u>	Launched by the EC and the EIB, it provides guarantees for funding of economically viable projects and investment with a higher risk profile such as agricultural and bioeconomy projects that would otherwise not be funded by the EIB. The process to obtain financing is largely the same as for a traditional EIB loan.	Sustainable infrastructure, research, innovation and digitisation, SMEs and Social investment and skills.	Not available
<u>Agricultural and Bioeconomy Programme Loans</u>	It supports SMEs and Mid-Caps operating throughout the value chains of production and processing of food, bio-based materials and bioenergy.	Loans, guarantees and equity investments SMEs with investment plans over 15M€, mid-cap cooperatives and larger private enterprises. future capital expenditures and RDI programmes.	Min €7.5 million–max €50 million
<u>European Circular Bioeconomy Fund (ECBF)</u>	It funds bioeconomy projects and companies in the demonstration and commercial development phases, filling the late-stage funding gap to bring products to the markets. Target industries subsectors are: - Circular business models (re-use, recycling, waste stream utilization); - Biorefineries and conversion technologies; biomass production: increased output and reduced footprint; - Bio-based materials: construction, polymers, fibres, composites.	Equity and debt funding Projects and SMEs Technologies, products, processes, business models and newly emerging value chains linked to biobased products derived from renewable resources, higher TRL	The investment size ranges from €2.5-10 millions
<u>Natural Capital Financing Facility (NCFF)</u>	It was established by the European Investment Bank (EIB) in collaboration with the European Commission as a response to biodiversity loss and climate change, as increasing investments in natural capital are urgently needed if persistent trends are to be stopped. This financial instrument supports projects promoting biodiversity and climate adaptation through tailored loans and investments	Loans and grant-based technical support Investment for public building, green and blue infrastructure,	Grants: up to 1M€ Financing up to 75% of project costs for the NCFF components Loan: 1-1.5M€

This list is not exhaustive, since funding and financing schemes are also available at national and regional level. For instance, companies in the Karlovy Vary Region in Czech Republic can take

advantage of the [Innovation Vouchers](#) that are managed by the Business Development Agency. Companies can apply to these Vouchers to purchase a service supporting innovation of their products, processes, or services.

Accessing EU funding

Applying to EU funding

To help projects navigate in the EU funding environment, an [online manual](#) is provided by the European Commission. It guides users to find calls and partners, assess the eligibility of project, and detail the application and grant management processes.

To benefit from EU funding, the first step is to identify the **right funding programme**. As presented in Table 8: Non-exhaustive list of financing and funding schemes available for circular bioeconomy projects and organisations. these programmes all have different scopes, funding rates and conditions, and application processes. Then, it is important to identify the **right call to apply to**. The [online manual](#) helps to effectively go through the available calls. Each call might present specific objectives, eligible actions and eligibility criteria, on top of the ones of the programme it belongs to.

Developing a project is a time and resource-consuming process and should be evaluated with care, as calls can be very competitive, possibly leading to low success rates. To develop a project, a first step is **to define a short concept note** identifying the general objective, the main output, ideal consortium, and a first workplan. The concept note is useful to share the project's idea to potential partners that will then form the consortium.

The drafting of the project proposal can be either done in-house or subcontracted. In general, key criteria for the selection process includes the **clarity of the proposition**, how the **project plans to address the issues at stake**, the **interconnection of the workplan**, and **how the impact will be maximised** through communication, dissemination, and exploitation activities.

Finding investors

EU Taxonomy

The EU Taxonomy is a very relevant tool for sustainable finance. It aims to orient capital flow in sustainable investment by helping investors to identify sustainable activities that significantly contribute to one of the six environmental objectives, including the “transition to a circular economy”.

To be aligned with the EU Taxonomy, a project must meet four conditions:

- The activity has to **be covered by the EU Taxonomy**. Eligible activities are included in the [Taxonomy Environmental Delegated Act](#) and the [Climate Change Delegated Act](#).
- The activity must make a **substantial contribution to at least one of the six environmental objectives**. For circular economy, criteria cover the circularity of products and materials, hazardous content, extension of lifespan, increased use of secondary materials. Besides, it **must not “significantly harm” any other five objectives**. For circular economy, it means for instance that the project must not go against the Waste Hierarchy.
- The activity must **comply with the “minimum safeguards”**, meaning alignment with the OECD Guidelines for Multinational Enterprises and the UN Guiding Principles on Business and Human Rights (e.g. include provisions against forced labour)
- It must follow the reporting requirements as set in the [Disclosure Delegated Act](#).

An [EU Taxonomy Navigator](#) is available to ease its use.

Finding investors

Private investors are very attentive to the risks associated with (circular bioeconomy) project; therefore, a comprehensive risk assessment is essential to convince them. Among the potential risks, the **availability of the feedstock** might be a major concern, so securing the supply with contracts with providers is important. **Increasing the project maturity level** also contributes to reduce the perceived risk. The HOOP project developed a [Project Maturity Level tool](#) that can provide insight into how to do so. A well-defined business model will contribute to attract investors; the elements presented in section “**Circular bioeconomy business model**” must be considered.

Illustration: Western Macedonia financing for its transition to a circular bioeconomy

Western Macedonia has actively pursued funding and support for its transition to a circular bioeconomy and developed the Socioeconomic Transition of Western Macedonia project in October 2023. This was the first project to be funded under the Public Sector Loan Facility that is a blended instrument part of the Just Transition Mechanism combining different grants from the European Commission and loans from the European Investment Bank.

A notable success is the 80-million-euro loan from the European Investment Bank, aimed at transforming the region's economy from fossil intensive activities such as lignite mining to sustainable development. This funding is part of a larger framework involving the Just Transition Mechanism and state or regional budgets.

The project includes 15 projects and 6 municipalities and will contribute to enhance the economic diversification of the region, among other objectives.

Relevant resources

Key resources from other projects:

[HOOP Project - Investment Package Manual for European Cities and Regions – Vol II – European investment package on circular bioeconomy for European Member States, Regions and Cities](#): this manual provides a selection of funding and financing schemes, programmes, instruments and tools for investment projects on circular bioeconomy and bioenergy at European level.

[HOOP Project - Investment Package Manual for European Cities and Regions – Vol III – National and Regional investment package on circular bioeconomy for European Regions and Cities](#): this manual provides a selection of funding and financing schemes available in several EU Member states and regions.

[HYDROUSA – D8.3 Replicability and associated funding mechanisms](#): this report lists funding and financing solutions for nature-based water solutions, that also apply to circular bioeconomy for a large part.

3.3 How to finance the transition?

Regions have the possibility to provide funding and financial support to circular bioeconomy initiatives, or to facilitate the access to funding and financing to both public and private entities located in their territory.

Facilitating access to EU funding

Navigating through the different European funding schemes can be overwhelming for smaller organisations, and the application process can be too resource-consuming for them to manage. Therefore, regions can support the access to EU funding to local players via different initiatives:

- **Capacity building:** organising workshops and training sessions targeting local players on EU and national funding opportunities and application processes. Involving organisations already involved in such projects or having benefitted from the promoted fundings can make the presentation more concrete for participants.
- **Networking:** projects greatly benefit from strong consortium. Enabling organisations from different backgrounds (municipalities, local businesses, research institutions...) to meet and collaborate might enhance co-participation in EU project.
- **Engaging in EU projects:** regions can take advantage of EU funding to join project proposals and engage local organisations, either as funded partners or replicators. In this regard, [Cascade Funding Calls](#), also known as “Financial Support to Third Parties”, is a mechanism developed by the European Commission to distribute public funding to third parties such as startups or SMEs. Specific calls for EU projects include the possibility of using such “cascade funding”, and selected projects get the possibility to issue their own call for projects with associated EU funding.
- **Providing advisory:** creating a regional service dedicated to supporting the access to EU funds, e.g. in collaboration with chambers of commerce or development agencies will contribute to providing more tailored guidance and enhance the chance for local players to access funding.

Collaborating with the national authorities (e.g. the national authorities or agencies managing the different EU operational programmes mentioned in Table 8) shall contribute to a better alignment between local projects and the national priorities and maximise the funding opportunities.

Providing financing and funding to local projects

Some regions defined their own funding and financing mechanisms to foster local initiatives or take advantage of EU funds to do so.

Unlocking regional funds

Regions might resort to their own financial resources or take advantage of shared management funds (such as ERDF) to financially support biocircular projects in their territory. In any case, this funding programme should be carefully defined in order to conciliate the alignment with the regional priority and the needs of local players.

- **Regional priorities:** funded projects must be aligned and possibly contribute to the regional objectives, which means that the funding programme must select the awarded projects accordingly. The pre-existence of a circular bioeconomy strategy or regional roadmap will therefore condition the scope and framing of the funding programme. Otherwise, it is advisable

to define a regional roadmap identifying the main needs and opportunities when it comes to circular bioeconomy prior to setting up a funding programme.

- **Local needs:** different projects require different funding. Depending on their level of maturity and their scope, different financing instruments might be more adequate, as explained in section “**Funding and financing categories**”. The Circular City funding guide defined a [funding applicability table](#) to help programme owners to identify the most appropriate instruments.
- **EU regulation:** to avoid distortion of competition, the EU regulation generally prohibits State aid to private companies. However, exemptions were developed to allow the support of activities bringing environmental benefits, with the main provisions being detailed in these [2022 guidelines](#). Besides, should European funds be mobilised, it is also essential to make sure that the programme is aligned with the specific requirements.

Selecting the “right” projects

The success of the funding programme heavily depends on the selection process. As mentioned above, the main criteria is how much the project contributes to the regional objectives in terms of environmental, social, economic, and circular impacts.

- **Impactful projects:** projects proposition can be required to assess their environmental, social, and economic impacts by using indicators aligned with regional strategies (e.g. climate change, job creation, social inclusion, etc.).
- **Economically viable projects:** a clear business model clarifying the costs and expected revenues can help with the identification of projects with clear market potential.
- **Scalable/replicable projects:** it might be relevant to priorities projects with high scalability (important feedstock, large market potential) or replicability (possibility to adapt to other locations).

The selection process can benefit from **the involvement of experts to assess the proposals**, either from the different regional departments, or from bioeconomy clusters.

Projects in different stage of development are associated with different needs and risks, so it might be appropriate to **define different funding schemes** reflecting these differences. For instance, a funding programme targeting startups and innovations might provide smaller but simpler grants to support demonstration or the development of business model, while another programme might support more advanced initiative, e.g. for the upscaling or entry to market, with more complex but also more substantial financing instruments.

Illustration: CLIB’s Innovator Compass

BIOTRANSFORM partner CLIB published its [Innovator’s Compass “Evaluating Impactful Solutions in Bioeconomy”](#) as part of the Triple-S project. This guide aims to identify criteria for sustainable innovations in the area of bioeconomy, taking stock of successful bioeconomy projects. The guide targets innovation projects by addressing the key questions to consider when moving an innovation to a market-ready solution. Therefore, it is a relevant source of inspiration for regions aiming to define selection criteria for the identification of promising projects to be funded. The guide also includes a chapter on financing solution for innovations.

Monitoring the funded projects

It is also important to ensure that the programme's impact is monitored, by monitoring the funded projects as part of the funding agreement. The monitoring of activities and impact indicators will provide indications on the success of the project or allow to spot deviations and determine supporting activities to overcome challenges. Funding programmes can also be combined with technical or legal supporting mechanisms, e.g. on project management, business development, or intellectual property. Appointing programme managers that follow up several projects and is available for support can be recommended. Such support can also provide guidance for follow-up actions when the funding stops, such as the identification of further financing instruments.

Attracting private investors

Regions can also contribute to attracting private investors to fund local projects and initiatives. As mentioned previously, private investors are interested in projects with consistent financial forecasts and comprehensive risk assessments. Thus, regions can facilitate private investments by:

- **Showcasing regional success stories** demonstrates the viability of circular bioeconomy initiatives and building confidence.
- **Supporting project developers** in presenting well-structured, economically viable projects, and demonstrating clear and quantified environmental benefits.
- **Offering incentives** by utilising tax breaks, subsidies, or co-financing schemes to make investments in circular economy projects more attractive.

Relevant resources

Key resources from other projects:

[The Circular City Funding Guide](#): this guide, developed under the [Urban Agenda Partnership for Circular Economy](#), provides a section targeting local and regional authorities willing to develop a funding programme for circular economy projects.

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