BIO2REG

Regionalization concept for circular and systemic **bioeconomy model regions**

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1 Executive summary

The objective of Deliverable 1.1 is to outline a practical framework for initiating and further developing circular and systemic bioeconomy model regions. These regions are geographically defined areas where circular bioeconomy principles drive innovation, sustainable growth, and community well-being by linking regional resources, stakeholders, and strategies to support systemic transition. They emphasise implementation-oriented approaches, turning bioeconomy concepts into tangible actions to create jobs, foster innovation, and support the local environment. This deliverable presents a regionalization conceptual framework serving as a blueprint for adapting and implementing circular and systemic bioeconomy practices aligned to regions' unique characteristics, needs, and strengths.

The framework provides guidance for regional stakeholders such as regional authorities, businesses, science and the general public to translate high level global, macroregional and national bioeconomy strategies into actionable, region-specific action plans creating tangible impacts at the regional level. The framework supports the development of practical circular bioeconomy strategies and action plans that integrate circular economy principles into regional contexts across diverse sectors.

The blueprint prioritises key objectives such as developing a sustainable regional food/feed sector, replacing fossil-based resources, optimising resource efficiency, reducing environmental impacts, and driving regional quantitative and qualitative sustainable growth. The framework is designed to enable regions with diverse conditions and strengths to tailor implementation measures to their specific needs and strengths, enabling them to set up regional circular bioeconomy strategies and implementation measures fitting to their unique characteristics, making them practical, achievable and relevant.

The regionalization concept is the foundation of BIO2REG's interventions, it serves as a basis in the stakeholder capacity building. It focuses on the understanding and benefits of circular bioeconomy for regional development, adapting the concept to regional conditions and translating it to action plans. The regionalization concept is implemented through targeted activities in different European regions that engage and build capacities in region's key stakeholders enabling them to initiate or further mature their bioeconomy model regions.

2 Introduction

The BIO2REG project, funded by Horizon Europe, aims to accelerate the transition to a sustainable, circular bioeconomy with a focus on regional opportunities. By triggering and supporting the establishment of bioeconomy model regions, BIO2REG enables regions to lead the way in bio-based innovation, regional economic and social growth, and sustainability, supporting the goals of the European Green Deal. The European Green Deal sets out a path to achieving climate neutrality by 2050, aiming to create a fair, inclusive, and sustainable economy that promotes innovation and decouples growth from resource depletion.

When referring to regional activities, BIO2REG focuses on the micro-regional, local level, emphasising regions' role in implementing circular bioeconomy transitions. Although there are interlinkages and strong relations with meso- and macro-regional levels, this concept is designed to address the unique opportunities and challenges at the micro-regional scale. BIO2REG provides these regions with a specific framework that allows them to build region-specific sustainable and circular bioeconomy systems. The project will guide regions on how to identify their strengths, connect regional stakeholders, use their natural resources efficiently and develop a dedicated bioeconomy profile of the region aiming at regional growth. BIO2REG acts as an enabler to help regions turn these strategies into achievable and actionable plans through practical, hands-on capacity building (see also Chapter 3 on target groups and practical

applications). This includes supporting regions with tools, mentoring, on-site exchanges and networking, necessary to foster regional bioeconomic growth.

BIO2REG sees:

(a) the wide diversity of bioeconomy solutions as an advantage, offering different approaches that can be tailored to address specific regional challenges.

(b) regionalization as a tool to tailor bioeconomy solutions to a particular area, making it easier to match solutions to regional available resources and the needs of regional stakeholders.

(c) working with existing regional networks and stakeholders as well as bioeconomy activities as an effective and impactful way to implement sustainable transformation.

(d) bioeconomy as a complementary approach to broader non-bioeconomy sustainable strategies (e.g. renewable energies, circular economy), contributing to sustainable growth and community development.

Our motivation for setting up a framework for bioeconomy model regions is that regionalization of the circular bioeconomy is driven by the need to act regionally – finding solutions within regional boundaries and opportunities – in a global context (addressing planetary boundaries), using the unique potentials of each region to contribute to a sustainable global circular bioeconomy. This concept is initially rooted in the practical experience of establishing a circular bioeconomy model region in the Rhenish mining area, which began with the Bioeconomy Science Center in 2010 and later expanded through BioökonomieREVIER at Forschungszentrum Jülich to drive regional transition as a response to its regions' lignite mining phase-out, fostering sustainable jobs, enhance the region's attractiveness and quality of life (see Chapter 8) As part of the BIO2REG project, the concept was further refined and tailored to needs of regional stakeholders through workshops involving bioeconomy experts and regional representatives, as well as through ongoing dialogue with the BIO2REG consortium and Advisory Board members.

Regions form the foundational context for both regional and global markets, enabling the development and implementation of bioeconomy strategies that are tailored to regional resources, limitations and opportunities. Each region is characterised by a combination of natural resources, knowledge and skills for innovation (innovation landscape), economic and industrial bases (economic profile), and its socio-economic framework. Moreover, institutional structures, encompassing interactions across local, micro-regional, meso-regional, macro-regional, and global governance systems, play a crucial role in shaping how regions develop and implement policies effectively. When we refer to the term "regional" in the following text, we specifically mean the micro-regional level. This "nested approach" allows for regions to capitalise on their strengths while addressing regional and global challenges using tangible, bio-based solutions and technologies in a manner that is both efficient and sustainable (see Chapter 5.4).

This deliverable report is part of Task 1.1[1] of the BIO2REG project, which focuses on developing a regionalization conceptual framework for circular and systemic bioeconomy model regions. The main goal of this task is to create a blueprint of a bioeconomy model region that regions can use to implement bioeconomy strategies into practice. This framework helps regions understand how circular bioeconomy principles apply to their specific regional conditions, strength and challenges and in which fields of activity measures are necessary. By fostering innovation and sustainable development, the framework enables regions in initiating or further developing their bioeconomy model regions. The regionalization concept will serve as foundation for several BIO2REG project interventions to ensure it is practically applied and relevant for different regions in Europe and Associated Countries. Key stakeholders of different regions will be engaged and capacitated through targeted activities supporting them to adapt the concept to their regional contexts in e.g. co-creation workshops and individualised mentoring sessions (see Chapter 6.2). This report

[1] Task 1.1: "BIO2REG regionalization concept for circular and systemic bioeconomy model regions"

serves as a blueprint for regionalization, while the stakeholder guides[2], accessible to BIO2REG network members from Q3 2025, will provide plenty of examples on best-practice transition measures across various fields of action for bioeconomy model regions.

3 Target group and practical application of the regionalization concept

This regionalization conceptual framework for bioeconomy model regions aims to support the broad variety of regional stakeholders to understand and unlock their regions' bioeconomy potential. They can make use of this conceptual framework to apply circular bioeconomy practices to their regional context and understand their regions' interplay of stakeholders. BIO2REG's target groups are stakeholders in European / Associated Countries' regions and particularly in greenhouse gas-intensive regions to unlock their specific bioeconomy potential by designing and implementing concrete transition measures to demonstrate and implement new circular bioeconomy solutions and structures. These include the diversity of e.g.

- Regional policy makers and public administrations/authorities, regional (business) development agencies
- Private sector at regional level – farms, businesses, industries, SMEs
- Science, academia and training (including economy, sociology, vocational training etc.)
- Civil society and civil society organisations at the regional level (also including consumer associations)

Furthermore, the aim is to understand and exploit the regions' unique strengths, to identify growth opportunities and implement bio-based solutions tailored to their specific needs.

Table 1: Stakeholder groups and application example of the regionalization concept for bioeconomy model regions

Stakeholder type	Use cases for the regionalization concept
Regional policy makers and local governments	**Provision of a strategic tool** for understanding the regional bioeconomy system, making informed decisions, setting up policy and infrastructure, planning long-term bioeconomy strategies and setting up action plans to coordinate between municipalities, regional governments, and national frameworks.
Regional development agencies	**Provision of a framework to identify economic opportunities** to attract investment, support job creation and connect local businesses, research institutions, and policymakers in alignment with the concept.
Private sector – e.g. farms, businesses, industries	Supporting the private sector to **explore new bio-based products, technologies** and markets, valorisation of locally available bio-based waste or by-product streams, **capitalising on local resources** and circular practices, adopting circular economy principles and **scaling innovation**.
Investors and funders	**Support to identify and evaluate potential growth regions** with strong bioeconomy foundations – such as access to raw materials, advanced technologies, vibrant innovation ecosystems, markets and enabling framework conditions. This reduces investment risks,

[2] Deliverable 1.4: "Guides for regional stakeholders on transition measures towards bioeconomy model regions (focussing on new bioeconomy solutions and structures) based on best practices", due in June 2025

	facilitates new business models and the scaling of bio-based business models, ensures long-term returns on investment, and contributes to sustainable regional development.
Civil society and communities	Provision of a **framework for communities to engage in circular bioeconomy planning**, ensuring that local needs and values are reflected in bio-based strategies and activities.
Science, academia and training	Helping academic and training institutions to **align their research and education activities toward solving regional challenges**, fostering knowledge transfer and building human capital.

4 Bioeconomy: a pathway to resilient (regional) development

Modern concepts of the circular bioeconomy address a huge variety of challenges: Adapting agriculture, industry and society to climate change while reducing the impact of human activities on the climate, providing high-quality food for a growing human population with increasingly limited agricultural land, creating employment, value and economic diversification in urban as well as rural areas, preserving and using biological diversity or replacing fossil raw materials, improving resource efficiency and developing novel materials, chemicals and pharmaceuticals. The diversity of bioeconomy strategies often confuses stakeholders and blurs the role that a specific bioeconomy implementation can play in addressing transformation. From a conceptual perspective, however, this diversity of options is a strength of circular bioeconomy providing a multitude of tools that address the varied and often region-specific problems in countries and regions. For example, approaches in agricultural regions are different from those in industrialised regions. Supra-regional cooperation can generate a next layer of impact, when regions combine their strength or overcome weaknesses by matching with other regions. However, a general characteristic of future-oriented circular bioeconomy concepts is the need for systemic approaches that link stakeholders and sectors and thereby build sustainable circular economies. At present, not all national strategies fulfil this overarching objective of contributing to sustainable development in economic, ecological, and social dimensions. The systemic approach draws on the generation of technological opportunities, changing regulatory frameworks (e.g. enabling residues to be raw materials for other processes instead of being waste) and enabling societal innovations (e.g. changing consumer behaviour or the perception of the finite nature of natural resources), and combine these to achieve overarching sustainability goals (often in the context of the United Nations Sustainable Development Goals) (see Chapter 5.4).

5 Conceptual framework for bioeconomy model regions

5.1 Key characteristics of bioeconomy model regions

A bioeconomy model region is a geographically defined area in which circular bioeconomy acts as a central transformative narrative, helping the region transition toward a regionally adapted circular bioeconomy by building on its unique strengths. These regional concepts act as innovation nucleus for the entire area by using their natural and human resources efficiently. They foster innovation and enable circular economies through regional bio-based value chains, enabling technologies, research, and policies, ensure sustainable growth and job creation while staying within environmental limits. They can also serve as vibrant network hubs that create added value and jobs, facilitating collaboration across sectors and regions. The development of bioeconomy

model regions and building networks between them is essential for realising the global circular bioeconomy vision, translating global targets into actionable regional adapted solutions.

BIO2REG understands regions as operational units that possess a certain degree of homogeneity in bioeconomy characteristics The bioeconomy profile of a region may include combinations of parameters like natural resources, human resources, market access, or institutional structures. The concept of regionalization in the bioeconomy emphasises the need to "act regionally in a global context," meaning that regions utilise their local strengths to drive regional transformation and contribute to broader global sustainability goals. Therefore, the development of a bioeconomy model region is associated with a nested (governance) approach (see Chapter 5.4), aligning local municipalities, regional governments, and transnational initiatives (allowing for cross-border cooperation) with national and global strategies.

The role of regions in transformation is pragmatic and focused on solving specific challenges. The guiding principle for regions is to ask, "What is this transformation good for?" and "Why is it necessary?" Regions determine their paths in the form of action plans towards the bioeconomy by focusing on:

- Addressing challenges that need regional solutions: Regions provide the space where bioeconomy challenges, such as residue management or resource scarcity, can be addressed through regionally tailored circular solutions.
- Implementing tangible solutions: Regional transformation provides an environment for testing and implementing bioeconomy strategies and action plans, such as circular value chains or innovative bio-based technologies.
- Shaping routes for future bioeconomic growth: Regions define the available dimensions for bioeconomy solutions based on their unique conditions, such as access to biological resources, stakeholder networks, or market conditions.
- Interaction among bioeconomy actors: Regions act as interaction hubs, bringing together stakeholders from industry, government, academia, and civil society to collaborate in bioeconomy initiatives.

Transitioning to a strong regional circular bioeconomy starts with a thorough understanding of the regions' available biomasses, biomass flows, and the use of and knowledge about bio-based materials and technologies. This foundation is crucial to develop impactful regional bioeconomy strategies and action plans based on this. To assess regional bioeconomy potential, we can also make a future reference to Deliverable 1.3, which will provide regional stakeholders guides on how to implement the BIO2REG Multi-Criteria Assessment (MCA)[3] developed in Task 1.3[4]. These guides will support the identification of regions' bioeconomy profiles and help tailor strategies and transition measures to their unique strengths and opportunities and further context specific conditions.

Table 2: Key characteristics of bioeconomy model regions

Systemic approach	Bioeconomy model regions follow a systemic approach, linking diverse sectors and system dimensions such as agriculture, industry, research, regional administration and waste management. By focusing on circular processes, regions aim to maximise resource use, minimise waste, and contribute to economic, ecological, and social growth. This approach helps regions identify and resolve trade-offs, ensuring sustainable development across all dimensions.

[3] Deliverable 1.3: Guide for regional stakeholders to implement regional MCA framework assessment, due in June 2025
[4] Task 1.3: Proofing the concept and adapting the Multi-Criteria Assessment framework for bioeconomy potential assessment

Governance and stakeholder engagement	Success relies on the active and coordinated **collaboration between regional stakeholders** such as businesses, farmers, researchers, local communities, civil society organisations, educators or policy makers. An effective bioeconomy model region integrates **multi-level governance**, aligning local and regional initiatives with broader national, and global policies. It ensures active participation from all stakeholders and encourages knowledge exchange and joint decision-making to promote sustainable and circular bioeconomy practices.
Innovation nucleus	Bioeconomy model regions serve as **innovation nuclei** where new **technologies, business models, policies, education and vocational training approaches** are tested and scaled. These regions are laboratories for addressing pressing issues such as **climate change** and **resource scarcity**, offering practical solutions tailored to the needs of their local economies. Model regions are however not just about business models or single bioeconomy projects. The goal is to build thriving communities where bioeconomic activities enhance the **quality of life** for all residents in which the economic activities are integrated with local suppliers, farmers, the education system, and service providers, ensuring that the circular bioeconomy has an impact on the entire region.
Adapted to regional context	Each bioeconomy model region is **customised to its structural and region-specific context, such as regional resources (quality and quantity of biomass availability), biomass flows, bioclimatic conditions, and market access**. Bioeconomy activities are adapted to the unique characteristics of the region, ensuring a transition path that is both realistic and effective and built on regional strengths. These regions focus on **creating liveable communities** where sustainable employment and vibrant local economies drive social and economic well-being.
Rooted in sustainability and circularity	The bioeconomy model region approach is built on the principles of sustainability, ensuring that bioeconomic development is **environmentally sound, socially inclusive, fair** and **just,** and **economically viable**. Circularity is an inherent part of bioeconomy model regions. Regions focus on practices such as circularity, resource efficiency, biodiversity, conservation and social inclusivity, involving local communities, fostering public participation, and ensuring that just and fair benefits for all. They foster **high-quality living environments** that support regional and local populations, making the region attractive for both current residents and newcomers.
Process and innovation dynamics	Bioeconomy model regions are understood as **dynamic processes** rather than static entities. They continuously evolve, adapting to new challenges and innovations. Model regions are driven by **vibrant networks** that enable them to operate independently, yet in symbiosis with other regions. They are focusing on building strong **value chains** and systemic connections between local and regional stakeholders, ensuring that the circular bioeconomy evolves in response to both local and global needs.
Knowledge and capacity sharing within regions and in	Bioeconomy model regions serve as **platforms for knowledge sharing** and **capacity building**, both within the region and beyond. Lessons learned, best practices, and success stories generated

networks between regions	within these regions are disseminated widely to engage companies, inform decision-makers, inspire replication efforts and catalyse further innovation in the circular bioeconomy domain. It is crucial that knowledge and innovation is shared across regions, even though specific bioeconomy solutions might not always be directly transferrable. Regions benefit from participation in regional networks and collaborations with other regions facing similar challenges.

5.2 Key system dimensions for transitioning to a regional circular bioeconomy

The bioeconomy model region concept builds on the Smart Specialisation Strategy (S3)-concept of Community of Practice for regional development[5] and adopts this into a systemic approach integrating circular bioeconomy principles across a wide range of system dimensions, such as agriculture, industry, public policy, research, education, financing, and civil society (see also Chapter 5.4). The focus is on how regions can set up and make use of interconnected systems that efficiently manage resources, minimise waste, and enhance sustainability. By the promotion of collaboration and innovation, bioeconomy model regions contribute to sustainable development in economic, environmental, and social dimensions. This approach helps to identify and resolve trade-offs, to ensure balanced outcomes across various regional priorities. The following system dimensions (see also Figure 1) are furthermore also based on the impact structure of the 'System Region' developed by the German Federal Institute for Research on Building, Urban Affairs and Spatial Development (BBSR) on behalf of the Federal Ministry of Housing, Urban Development and Building (BMWSB)[6] and adapted to the circular bioeconomy system in a region.

Region's resource availability

A systemic circular bioeconomy approach begins by understanding the region's primary and secondary natural resource base – biological resources such as agricultural products, forestry, marine resources, waste water, solid waste, and soil available within a region as well as its biomass flows. Sustainable management of these resources is key to building an effective circular bio-based economy.

Raw materials and production systems

The circular bioeconomy makes use of raw materials such as residual biomass, biowaste, agricultural and industrial residues, and forestry products, to create valuable outputs through production systems like biorefineries. Efficient production helps to reduce waste and adds value to by-products.

Region's economic structure

The circular bioeconomy is shaped by the region's existing economic structure, which includes elements such as industry, services, agriculture, and sector diversity, investments. For instance, regions with a strong industrial base are advised to focus on industrial symbiosis, where waste from one industry serves as input for another, promoting a circular economy, resource efficiency and reducing environmental impact.

[5] European Commission, without year: S3 Community of Practice – The central knowledge and information hub for Smart Specialisation. Link: https://ec.europa.eu/regional_policy/policy/communities-and-networks/s3-community-of-practice_en

[6] BBSR (German Federal Institute for Research on Building, Urban Affairs and Spatial Development), 2024: Kreislaufwirtschaft im ländlichen Raum – Dimensionen und Einflussfaktoren (Circular Economy in rural areas – dimensions and influencing factors). Link: https://www.bbsr.bund.de/BBSR/DE/veroeffentlichungen/bbsr-online/2024/bbsr-online-02-2024-dl.pdf?__blob=publicationFile&v=4

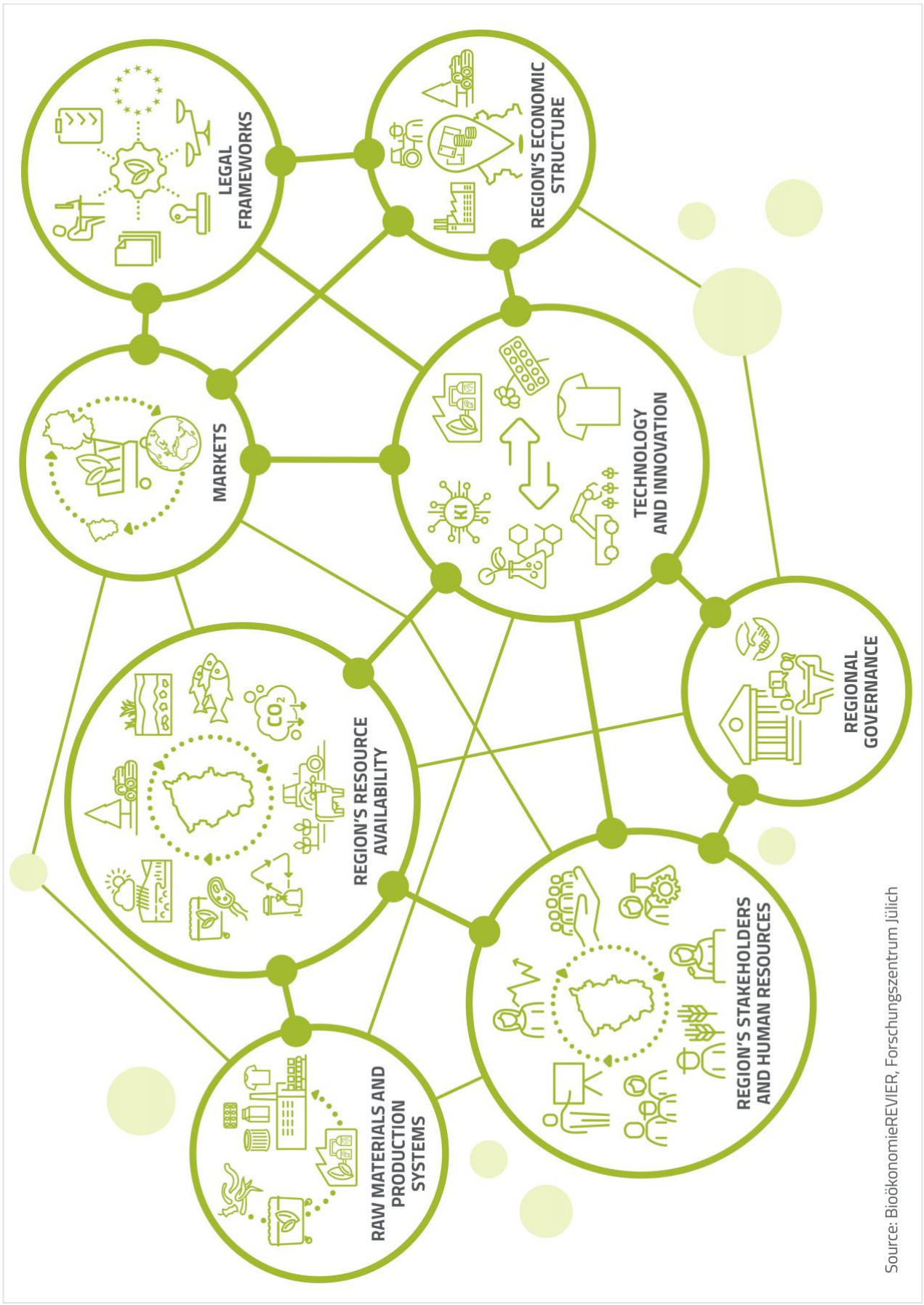

Figure 1: Key system dimensions for transitioning to a regional bioeconomy

Technology and innovation

Regions have to promote innovation ecosystems to support the development of new technologies enhancing bio-based processes and technologies. Close collaboration between research institutions, businesses, and public authorities ensures that innovations are tested, adapted and scaled to meet regional needs.

Markets

For bioeconomy model regions to have an impact on regional development, they have to be connected to and to cover the demand markets on regional, national, and global levels. These markets not only provide outlets for bio-based products, but they also enable regions to access necessary inputs. Circular bioeconomy principles, which are inherent part of model regions, foster trade practices aiming at minimising waste and optimising renewable resource use.

Region's stakeholders and human resources

Collaboration between various regional actors, e.g. companies, civil society, media, (regional) public entities, farmers, research institutions and skilled human resources, is crucial for the success of bioeconomy model regions. The inclusion of human capital is a key factor; for example trained professionals and an educated workforce foster innovation and ensure the sustainable growth of bioeconomy activities within the region. Transitioning to a circular bioeconomy requires alliances between actors who may not have worked together before, aligning diverse, maybe also contradicting perspectives around the shared goal of regional sustainable transition.

Legal frameworks

Successful circular bioeconomy transition depends on supportive regulatory frameworks at local, regional, and national levels and beyond. Regulatory frameworks, typically defined at the EU and national levels, can present barriers to implementing circular bioeconomy practices due to guidelines and limitations. However, regional authorities can have a crucial role in working within these frameworks, to promote initiatives that drive regional bioeconomy transition. Regional authorities are particularly influential through their responsibility for granting permits for key decisions such as location planning, building projects, and infrastructure development.

Regional governance

Strong and effective regional governance structures are necessary to successfully implement circular bioeconomy strategies. A multi-level governance approach links local and regional bioeconomy activities to national, EU, and global goals, ensures that regional needs are met while simultaneously contributing to broader sustainability objectives. Local governance also involves mobilising supportive individuals and stakeholders within regional authorities, who can act as advocates for circular bioeconomy transition. Building strong alliances with these stakeholders – such as policymakers, permitting officers, and decision-makers – support to streamline processes, address challenges, and foster interdepartmental collaboration.

5.3 Role of regions in transformation

In the context of circular bioeconomy transition, a region is understood as an area or division, characterised by definable features but not always with fixed boundaries. As per Wikipedia, regions can be defined by various aspects such as geography or cultural traits. According to the Collins Dictionary, a region is a large area of land that differs from others due to its customs or geographical features. Encyclopaedia Britannica further refines this by explaining that a region, especially in social sciences, is a cohesive area defined by selected criteria, distinguished from neighbouring areas, and shaped by its homogeneity in relevant features. Regional boundaries are flexible, adjusting according to the issues at hand, making regions dynamic spaces for circular bioeconomy transformation. The concept of bioeconomy model regions builds on the understanding that regions are not static, fixed areas but are dynamic operational units that evolve over time. Drawing from regional science, which acknowledges that all economic processes exist

in both space and time, bioeconomy model regions can be defined based on their functional relationships, such as connections between urban centres, peri-urban and rural areas, as well as their specific social, economic, and physical characteristics.

Traditionally, regions have been defined based on some social, economic, or physical characteristic, drawing on the concept of nodality – functional relationships between cities and their hinterlands – or based on administrative or political boundaries. The definitions become murky because it has been applied to a variety of spatial scales, from the very local to the international. Furthermore, regional boundaries are not static: they depend on the research problem in question, and they may change over time[7].

Bioeconomy model regions are based on the concept that material cycles as well as (agricultural) economic innovation ecosystems and social transformation can be implemented most efficiently in explicit regions. At the same time, the extrapolation and adaptation of knowledge gained in one region and shared with another region is particularly effective. As emphasised by the Advisory Council on Global Bioeconomy (IACGB), “Interregional coordination is necessary to share best practices and facilitate knowledge exchange, but also to overcome divergences among different territorial aspects”.[8] Therefore, bioeconomy model regions should

1. make important contributions to the creation and development of jobs and sustainable value creation in regions (regional structural effectiveness), and
2. provide transferable knowledge on how other regions can be transformed into circular bio–economy regions (model for regional transformation).

A region is a multidimensional concept. Regions are defined by more than just physical geography – they are shaped by their culture, natural and human resources, markets, political structures, and connections to global trade and sciences[9] (see also Figure 2). The transformation to a circular bioeconomy requires regions to adapt to these dimensions and utilise their unique strengths to address local and global challenges. Importantly, regional boundaries are not static – they may shift depending on the bioeconomy strategies fostered and the specific challenges or opportunities a region faces. This adaptability is key for bioeconomy model regions, as they must continuously respond to evolving market conditions, stakeholder dynamics, and sustainability goals.

Regions play a pivotal role in the transformation to a circular bioeconomy, acting as operational units that deliver circular bioeconomy structures solutions suited to their specific characteristics. The concept of regions goes beyond simple geographical or administrative boundaries – they represent areas with operational homogeneity, where circular bioeconomy activities can be coordinated effectively. This operational homogeneity refers to how regions make use of their natural resources, human skills, and institutional frameworks to develop circular bioeconomic pathways.

Importantly, bioeconomy model regions are not limited by fixed areal dimensions. They are flexible and can evolve as circular bioeconomy activities develop, adapting to both local needs and global market demands. By focusing on their specific characteristics, regions can shape their own circular bioeconomy transition, offering solutions that are scalable and adaptable to other regions.

[7] Monroe D.K., Biles J.J., 2005: Regional science. In: Kempf-Leonard K (Ed.): Encyclopedia of Social Measurement, Elsevier, Amsterdam

[8] International Advisory Council on Global Bioeconomy, 2020: Expanding the sustainable bioeconomy – Vision and way forward, Communiqué of the Global Bioeconomy Summit. Link: https://gbs2020.net/wp-content/uploads/2020/11/GBS2020_IACGB-Communique.pdf

[9] For a broader discussion on the multidimensional concept of regions, compare with Vujadinovič S., Šabić D., 2017: The importance of regions in geographical research. In: Collection of Papers – Faculty of Geography at the University of Belgrade 65 (1a), 195–208

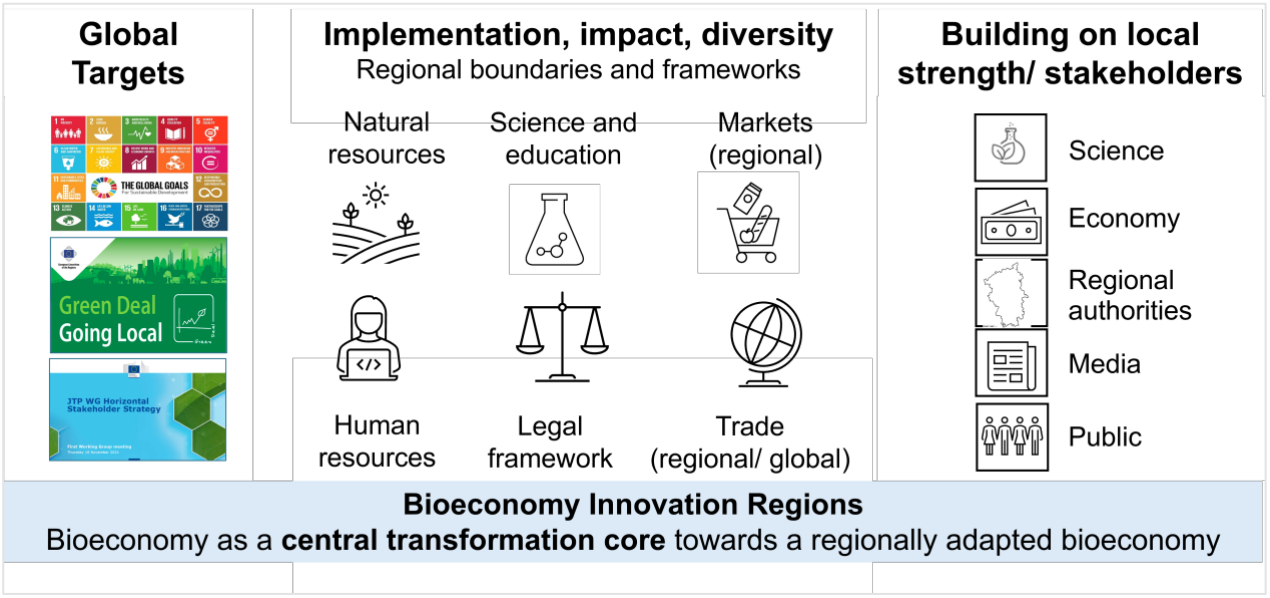

Figure 2: Bioeconomy innovation regions: from global targets to regional transformation

5.4 Regions in a nested (governance) approach

In the transition towards a circular bioeconomy, regions operate within a nested governance structure[10] that spans global, supra-national, national, and regional/local levels (see Figure 3). Each level plays a distinct role, with global and national governance focusing on high-level goal setting – such as sustainability targets and strategic policies –while the local and regional governance levels are responsible for the implementation of these strategies. Local and regional authorities are key players, particularly in Europe, where about three-quarters of EU legislation is implemented at the regional level. BIO2REG focuses on the importance of activities at the micro-regional and local levels, where circular bioeconomy transitions are most tangible and impactful when they are tailored to regional needs and the regional context. Building on the nested governance framework, BIO2REG highlights the distinct roles of macro, meso, and micro levels in circular bioeconomy transitions (Figure 3):

- **Macro level:** Sets strategic frameworks and high-level priorities, providing overarching direction.
- **Meso level:** Bridges macro strategies and local implementation, enabling coordination and alignment and serving between macro-strategies and micro level implementation.
- **Micro level:** Serves as the implementation space, where regional actors identify specific challenges, develop tailored solutions, and execute actions.

Facilitating dialogue and mutual learning across these levels is crucial to enhance synergies, avoid duplication of efforts, and ensuring that circular bioeconomy transitions are impactful. BIO2REG prioritises such multi-level coordination to valorise the unique strengths of regions, enabling effective knowledge exchange and the identification of innovative solutions to shared challenges.

[10] For a broader discussion on the nested governance levels as nested hierarchy, compare with Laribi S., Guy E., 2020: Promoting LNG as a marine fuel in Norway – Reflections on the role of global regulations on local transition niches concept of regions. In: Sustainability 12(22), 9476

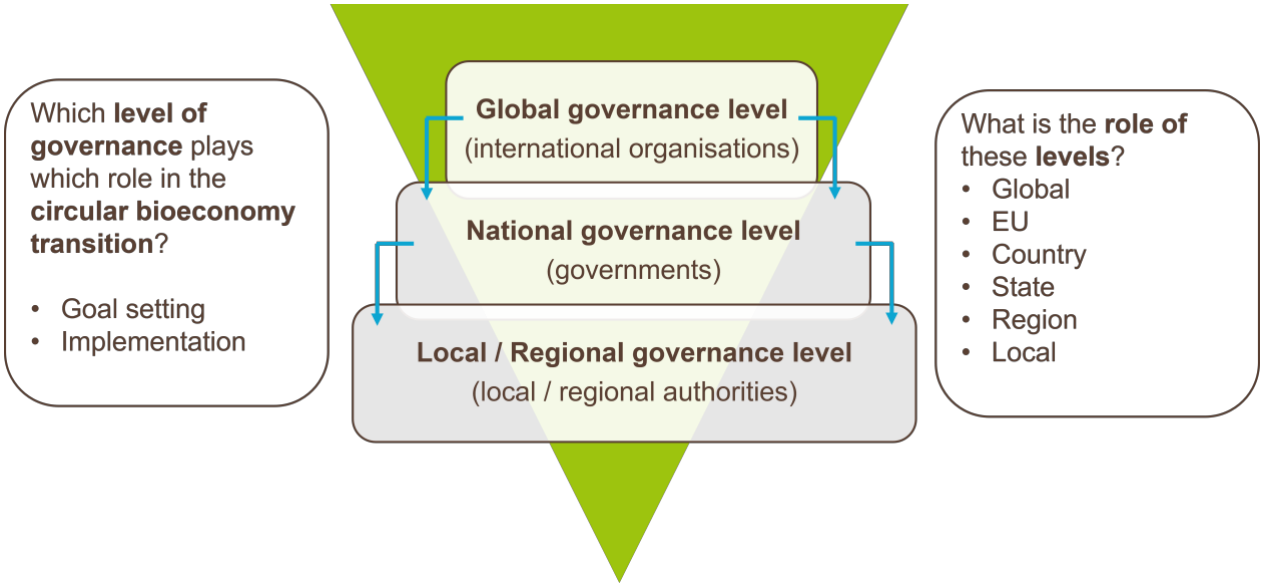

Figure 3: Governance levels as nested hierarchy for circular bioeconomy transitions, elaborated by the authors based on Laribi and Guy (2020), see Footnote 10

The nested approach furthermore emphasises the necessity to align local/regional strategies with broader European frameworks and programmes. The Research and Innovation Strategy for Smart Specialisation (RIS3) is a prerequisite for regions to access funding of the European Regional Development Fund. RIS3 is a strategic framework for regions to identify and foster their unique strengths and resources to promote innovation diffusion, industrial transition, and interregional cooperation to drive sustainable regional growth and improve its competitiveness[11,12]. Based on a study of Prognos and the Centre for Industrial Studies published in 2023, 185 European regions were identified which have Smart Specialisation Strategies in place[13]. These strategies align with circular bioeconomy goals in the way that they identify regional strength and promote innovation in sustainable practices adapted to the regional context. The study identified the bioeconomy as one of the three key priority areas addressed by Smart Specialisation Strategies, next to Information and Communication Technology and renewable energy. We furthermore recommend consulting the RIS3 guidebook of the European Institute of Innovation & Technology highlighing bioeconomy as a key innovation driver within the European food system[14].

To ensure local perspectives are integrated into broader policy discussions, the European Committee of the Regions (CoR) provides a platform for regions, counties, municipalities, and cities to have a direct voice within the EU's institutional framework. Established in 1994, the CoR helps to close the gap between citizens and EU decision-making by involving regional representatives in the legislative process. This ensures that strategies and policies are effectively adapted and implemented at the local level, addressing the unique needs of each region[15].

A similar systemic regionalization approach can be found in the "Innovation for Place-Based Transformations" ACTIONbook, published by the Joint Research Centre of the European

[11] European Commission, 2022: The role of the Smart Specialisation in the Cohesion policy 2021-2027. Link: https://ec.europa.eu/regional_policy/sources/policy/communities-and-networks/s3-community-of-practice/The_role_of_the_Smart_Specialisation_in_the_cohesion_policy_2021_2027.pdf
[12] European Parliamentary Research Service, 2016: Smart specialisation for regional innovation. Link: https://www.europarl.europa.eu/RegData/etudes/BRIE/2016/589813/EPRS_BRI(2016)589813_EN.pdf
[13] Kramer J.P., Galdiga L., Sirtori E., Foray D., Brökel T., 2023: Analysis of key parameters of Smart Specialisation Strategies (S3). Link: https://ec.europa.eu/regional_policy/sources/policy/communities-and-networks/s3-community-of-practice/The_role_of_the_Smart_Specialisation_in_the_cohesion_policy_2021_2027.pdf
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Commission[16]. Although not specifically focused on the circular bioeconomy, the innovation for place-based transformation framework aligns closely with BIO2REG's nested governance approach by emphasising the importance of tailoring innovation strategies to local and regional contexts, addressing specific regional needs and challenges, engaging and involving regional stakeholders, fostering implementation-oriented actions, and adopting a systemic perspective. The framework highlights how systemic and place-based strategies can drive fair green and digital transitions, supporting regions in utilising their unique characteristics to address sustainability challenges and foster resilience.

5.5 What regions can expect from transitioning towards bioeconomy model regions

The regionalization framework developed through the BIO2REG project will help accelerate circular bioeconomy transitions within regions, leading to sustainable economic growth, job creation, and improvements in resource efficiency. However, successfully implementing the framework into practice may present challenges, such as securing sufficient funding, managing complex stakeholder dynamics, and ensuring fair and just benefits for all involved. BIO2REG provides guidance and mentoring to regions on addressing these challenges, ensuring that the transition to a circular bioeconomy brings tangible benefits while navigating potential hurdles.

Below are key dimensions highlighting the potential outcomes for regions transitioning to a bioeconomy model region.

Regional economic outcome and impact

Job and business model creation: The circular bioeconomy can generate new jobs in bio-based industries, agriculture, food industry etc. and through indirect sectors like logistics, research, and support services. These jobs contribute to economic growth and improve regional livelihoods.

Increased investments: Significant investments in infrastructure, innovation, and research highlight a region’s readiness for sustainable growth and attract public and private funding, boosting circular bioeconomy transition.

Economic diversification and resilience: Shifting towards bio-based sectors allows regions to diversify their economies, reducing dependency on fossil-based industries, enabling regions to diversify their economies and enhance long-term stability.

[16] Bianchi G., Matti C., Pontikakis D., Reimeris R., Haegeman K. H., Miedzinski M., Sillero Illanes C., Mifsud S., Sasso S., Bol E., Marques Santos A., 2024: Innovation for place-based transformations: ACTIONbook to build partnerships for fair green and digital transitions. European Commission Joint Research Centre. Publications Office of the European Union, Luxembourg. Link: https://publications.jrc.ec.europa.eu/repository/bitstream/JRC135826/JRC135826_02.pdf

Social outcome and impact

Community engagement: An active participation and involvement of local communities ensures inclusivity in the circular bioeconomy transition process, fostering social acceptance and empowering stakeholders to shape their region's future. It also ensures that all stakeholders benefit from the transition. Social acceptance can also be improved when circular bioeconomy practices lead to more affordable products or services, encouraging producers to adopt sustainable measures and consumers to support them.

Enhanced quality of life: By improving employment opportunities, public health, and social equity, circular bioeconomy transitions have the potential to enhance the overall quality of life in regions. In this transition, working conditions should also be addressed and considered, including aspects such as fair income levels, job stability, workplace safety, and predictable and equitable work hours.

Education and skills development: Transitioning to a bioeconomy model region enhances workforce readiness by expanding education and vocational training opportunities, fostering inclusivity, and opening pathways for underrepresented groups in emerging bioeconomy sectors, such as supporting opportunities for women to access traditionally male-dominated sectors like forest management.

Environmental outcome and impact

GHG emissions reduction: Adopting bio-based practices such as renewable materials, improving agricultural practices and clean technologies contributes to significant reductions in greenhouse gas emissions, supporting climate goals.

Resource efficiency: The bioeconomy emphasises circular practices by maximising the use of renewable resources, keeping materials in circulation, and minimising waste. This can be achieved through measures such as waste reduction, side stream valorisation, and increased reliance on renewables, all contributing to greater environmental sustainability.

Biodiversity and ecosystem services: Protecting biodiversity and ecosystems is crucial for supporting a sustainable circular bioeconomy. Monitoring changes in biodiversity and ecosystem health ensures that bio-based activities align with sustainability objectives and contribute to environmental restoration.

Innovation and knowledge transfer

Collaboration networks: A bioeconomy model region thrives on collaboration. Strong regional partnerships between academia, industry, and regional authorities drive innovation and foster knowledge exchange, improve the region's ability to address shared challenges essential for success.

Regional innovation capacity: Transitioning to a bioeconomy model region strengthens regional innovation capacity by utilising the potential of its research and innovation ecosystem including universities, research centres, and private sector players. The adoption of innovative bio-based solutions and technologies improves competitiveness and ensures that regions are well-positioned for sustainable, future proof development.

Technology transfer: Transitioning to a bioeconomy model region improves the ability to bring new bio-based solutions and technologies to market by utilising regional research and innovation ecosystems and driving sustainable development.

Innovation and research excellence: Advancements in circular bioeconomy practices are driven by outputs such as spin-offs, patents, innovations, and publications from regional living labs, research institutions, and innovative companies.

6 Regional specificities and considerations

6.1 Regional characteristics

Regions across Europe differ widely in their economic, ecological, and social contexts. These specific characteristics must be carefully considered when developing bioeconomy model regions, as each region's potential for bioeconomic development is shaped by its unique attributes. The concept that regionalization helps clarify what circular bioeconomy means locally and aligns more closely with stakeholders' needs.

Below, we outline key considerations that regions should consider, providing practical examples to demonstrate how these factors influence implementation of circular bioeconomy.

Bioclimatic conditions

Bioclimatic conditions such as temperature, precipitation, and growing seasons determine which types of biological resources are available in a region. Regions with warm, dry climates will focus on different bio-based value chains than those with cooler, wetter climates.

Example 1: Mediterranean climate

Regions with a Mediterranean climate having warm and dry conditions can for example focus on bio-based innovations related to drought-resistant crops, optimising water usage and soil regeneration (for example, carbon inputs through compost and soil health enhancement though biostimulants obtained from secondary sugars). Olive production, for instance, can be integrated into bioeconomy model regions by utilising olive waste for bio-based products, addressing both resource scarcity and energy needs[17].

[17] The project Agro2Circular uses fruit and vegetable waste to produce food products and cosmetics and at the same time reduces waste including the Mediterranean region of Murcia in Southeast Spain. Agro2Circular also develops bio-based plastics for agricultural use (e.g., mulching) and packaging, leveraging Archaea cultivated in hypersaline water.

Example 2: Northern European climate

In contrast, Northern Europe's cooler, wetter climates support bioeconomy implementation in e.g. aquaculture, wetland conservation, and flood resilience solutions. Abundant forestry resources also enable circular value chains in pulp, paper, and bio-based materials, alongside sustainable forest management and biodiversity preservation.

Resource availability

The natural resources present in a region, whether agricultural, forestry-based, or marine, frame the opportunities for a circular bioeconomy. The ability to efficiently use both primary and secondary resources is key to regional circular bioeconomy transition.

Agricultural regions

Regions with significant agricultural production can transition towards a bioeconomy model by focusing on secondary resources, such as agricultural and processing waste. For example, residues like straw can be reintegrated into agricultural practices, while by-products from food or processing can serve as raw materials for e.g. bio-based chemicals, materials, contributing to a more sustainable circular economy.

Coastal regions

Coastal regions with access to marine resources may focus on better utilisation of raw materials from the sea as a core aspect of blue bioeconomy innovation. This includes maximising the use of all components of marine biomass, ensuring that nothing goes to waste, while also prioritising the development of high-value products. Initiatives may range from sustainable aquaculture and the harvesting of marine biomass for biofuels and pharmaceuticals to repurposing marine waste, such as fishing by-products, into valuable materials, contributing to a circular and sustainable blue bioeconomy.

Economic structure and stakeholder dynamics

The existing economic structure, including industrial bases and stakeholder networks, greatly influences how circular bioeconomy transition can be brought from the idea and concept level into reality. Regions with strong agricultural or industrial sectors may be more prepared to integrate bio-based innovations into their existing economic activities.

Industrial regions

In regions with a strong industrial base, bioeconomy strategies might focus on industrial symbiosis, in which waste from one industry becomes input for another. For instance, a future vision region with chemical production facilities includes utilising biowaste streams to produce chemical building blocks to replace fossil-based materials and creating more sustainable processes and products. While this remains a technological challenge, it highlights the potential of bioeconomy innovation to transform traditional industries into more circular and sustainable systems.

Rural regions with smallholder agriculture

In rural regions dominated by smallholder agriculture, stakeholder engagement and cooperation are crucial. Small farmers can benefit from bioeconomy activities that focus on sustainable farming practices, cooperative approaches to processing bio-based products, and access to new markets. Here, stakeholder dynamics may involve regional cooperatives, extension services, and local governments playing key roles in facilitating the transition.

Key considerations for all regions

While the examples above illustrate diverse contexts, all regions should also consider governance structures, the knowledge and innovation capacity such as social acceptance and stakeholder engagement (see also Chapter 5.2).

6.2 Tailoring the concept to regional needs

BIO2REG helps regions understand their strengths and tackling their challenges towards circular bioeconomy transitions. By engaging stakeholders through co-creation methods, BIO2REG helps regions to develop a regional circular bioeconomy narrative and translate it into tangible action plans. For example, in regions with agricultural waste, BIO2REG could help set up (example) projects such as processing it into high-value products, facilitate to connect with best-practice initiatives in other regions that already have expertise in this area. In more industrialised areas, the focus might be on using bio-based materials for manufacturing. To assist regions in their transition toward becoming bioeconomy model regions, BIO2REG offers a growing portfolio of tools and frameworks.

To ensure meaningful progress within regional bioeconomy ecosystems, bioeconomy model region place emphasis on the importance of listening to and understanding regional needs. Involving all stakeholders from the very start of the circular bioeconomy transition is crucial. This participatory, needs-based engagement not only fosters community acceptance but also ensures that strategies align with other regional priorities and activities.

These include e.g.:

Regional network events (2025, Work Package 2[18]): The regionalization concept is introduced and will be applied in five regional network events in Spain, the Czech Republic, Greece, Germany, and Sweden through co-creation activities. During these events, regional stakeholders are capacitated to adapt the framework to their regional context contexts. The aim is to identify its unique conditions of the circular economy, its circular bioeconomy potentials and most promising region-specific fields of action. These workshops also serve as platforms for stakeholder engagement, knowledge exchange, and capacity building, enabling regions to assess their current status and identify the development stage of their bioeconomy model region.

Interregional exchange instrument (2026, Work Package 3[19]): The framework is applied during tailored mentoring sessions for each regional transition alliance and on-site exchanges between regions. These exchanges provide opportunities for regions to learn from one another by showcasing best practices, experiencing bioeconomy model regions in action, and collaboratively developing region-specific transition action plans. Stakeholders are further supported in prioritising transition measures based on their unique challenges and opportunities.

Stakeholder guides for transition measures (Task 1.4[20]): Based on the regionalization concept, BIO2REG offers stakeholder guides[21] with best practices, practical examples, and lessons learned on how regions can transition towards bioeconomy model regions. These guides will be applied and validated during the regional network events (Work Package 2, see above) in 2025 and through the interregional exchanges (Work Package 3) in 2026 to better consider regional needs and context-specific conditions.

Multi-Criteria Assessment (MCA, Tasks 1.2[22] and 1.3[23]): The regionalization framework will be included in the MCA, enabling regional stakeholders to identify and evaluate the bioeconomy potential and profile of their regions. This assessment process supports regions in profiling their bioeconomy strengths and culminates in additional guides (Deliverable 1.3[24]), which help

[18] Work Package 2: “Establishment of an interregional network structure on circular and systemic bioeconomy model region transition”
[19] Work Package 3: “Boosting the development of circular bioeconomy model regions by an interregional exchange”
[20] Task 1.4: “Mapping best practices in circular and systemic model regions”
[21] Deliverable 1.4: “Guides for regional stakeholders on transition measures towards bioeconomy model regions (focussing on new bioeconomy solutions and structures) based on best practices”, due in June 2025
[22] Task 1.2: “Designing an initial Multi-Criteria Assessment (MCA) framework for bioeconomy potential assessment”
[23] Task 1.3: “Proofing the concept and adapting the Multi-Criteria Assessment (MCA) framework for bioeconomy potential assessment”
[24] Deliverable 1.3: “Guide for regional stakeholders to implement regional MCA framework assessment”, due in June 2025

stakeholders apply the MCA effectively. These activities are implemented during the regional network events in 2025 (Work Package 2) and onsite exchanges in 2026 (Work Package 3).

An overview of BIO2REG results and services for regions is presented on the BIO2REG website: https://bio2reg.eu/. These consultations and resources not only help regions set up suitable circular bioeconomy transition measures tailored to their specific contexts, but also actively involve local communities and stakeholders in decision-making, while promoting interregional exchange and learning.

7 Maturity level of bioeconomy model regions

Bioeconomy model regions can be distinguished by their maturity levels that reflect the extent to which circular bioeconomy practices have been adopted and integrated: emerging, developing and maturing regions. The type of transition measures and action fields also depends on their maturity levels. Emerging regions might focus on identifying initial bio-based opportunities and identifying circular bioeconomy potential e.g. industry, agriculture, municipal policies, education sector etc., while developing regions work on scaling up successful circular bioeconomy projects and towards long-term structures. Mature regions refine their circular bioeconomy practices, ensuring efficiency and sustainability across all sectors and bioeconomy model region dimensions. BIO2REG will support regions at each stage, providing the tools, a network to exchange and resources necessary to advance through these maturity levels.

7.1 Emerging bioeconomy model regions

These regions are in the early stages of bioeconomy development, starting to understand their regional circular bioeconomy, challenges, gaps, regional strength etc. They set up first structures and capacities to build, fund and execute a bioeconomy strategy. Emerging regions start to build awareness, implement small projects and engage regional stakeholders such as companies, regional authorities and civil society. The focus is on identifying opportunities, e.g. the use of local bio-based resources, and starting the ground for the circular bioeconomy transition process.

Characteristics: Early-stage engagement, small and isolated pilot projects, and exploration of regional bioeconomy potential.

Example: A rural region starting to explore the use and valorisation of agricultural by-products, but without established coordination among stakeholders.

7.2 Developing bioeconomy model regions

These regions have moved beyond the initial exploration phase and are actively implementing circular bioeconomy strategies and action plans. There is active collaboration between regional industries, academia, and policymakers to expand bio-based activities. Regional circular bioeconomy action plans are in place, and the focus is on scaling up bio-based value chains, creating jobs, and ensuring the efficient use of resources.

Characteristics: Growing bio-based industries, increased collaboration, and regional circular bioeconomy action plans.

Example: A region that has demonstrated multiple bio-based value chains, implemented bio-based initiatives (e.g. paper industry initiative exploring innovative solutions for the sustainable paper production or an industry driven initiative to develop sustainable, plant-based fibers for industrial applications) and established a circular bioeconomy action plan and policy incentives with regional stakeholders.

7.3 Mature bioeconomy model regions

These regions adopt a systemic approach and are advanced in their circular bioeconomy journey, with fully integrated bio-based industries, well-established stakeholder networks, and strong governance frameworks. They focus on resource circularity and sustainability across the entire circular bioeconomy system. The integrated approach links agriculture, industry, research, education, regional administration, waste management, and other key system dimensions to promote collaboration and innovation. Mature regions serve as innovation hubs, continuously refining bio-based circular practices and technologies and sharing best practices with other regions.

Characteristics: Fully integrated circular bioeconomy system, strong leadership in innovation, and regional policy frameworks supporting sustainability and resource circularity.

Example: A region with a diverse range of bio-based value chains, advanced biorefineries, education programmes to build local expertise, strong policy support for sustainability, significant private investments and an active role in international knowledge-sharing networks.

8 How we developed the regionalization concept for bioeconomy model regions

This regionalization concept draws from practical experiences of the transformation initiative BioökonomieREVIER at Forschungszentrum Jülich in Germany, which has been developing and applying circular bioeconomy practices in the Rhenish mining region since 2018 as part of its transition away from lignite mining. A crucial foundation for these efforts was initiated in 2010 with the establishment of the Bioeconomy Science Center, which initially focused on integrating regional academic activities and later expanded by BioökonomieREVIER to address the regional economy's innovation needs in response to the challenges of phasing out lignite mining. The approach began by using the regional bioeconomy system to address key challenges and implement solutions for the regions' structural transformation, focusing on creating sustainable jobs and enhancing regional quality of life and maximising the impact on regional development. This regionalization concept can serve as a practical tool for regions in transition, offering an actionable path how to use circular economy implementing solutions to foster innovation, build resilience, and transform the area into a liveable and vibrant community. In the course of the BIO2REG project, this framework for understanding bioeconomy model regions was conceptualised and specifically tailored to meet the needs of regional stakeholders. This framework has further been developed and validated through workshops which brought together bioeconomy experts and regional stakeholders – such as companies, regional authorities, development agencies, and researchers – to ensure that the concept reflects real-world needs and conditions. Key activities included the following workshops and consultations:

- **Project internal regionalization workshop**: Conducted during the Kick-Off meeting in January 2024 on 7 February 2024 in Brussels, Belgium, to establish the foundational framework for the regionalization concept.
- **BIO2REG expert workshop series and expert discussions** between June and September 2025 to collect best practices in bioeconomy model regions (Task 1.3):
    - **4 June 2024**: Online workshop on funding bioeconomy model regions engaging 39 participants.
    - **20 June 2024**: Onsite workshop on bio-based value chains in bioeconomy model regions in Düren, Germany, engaging 24 participants.
    - **14 June 2024**: Online workshop on social issues in bioeconomy transition, engaging 23 participants.
    - **1 July 2024**: Online workshop on bioeconomy education engaging 41 participants.

    - **5–6 September 2024**: Onsite workshop in Reykjavík, Iceland, on research infrastructure and living labs in bioeconomy model regions focusing, engaging 26 participants.
- **Regionalization workshop at the Global Bioeconomy Summit**: Held on 24 October 2024 in Nairobi, Kenya, with participation from over 25 global bioeconomy experts, to exchange insights and to receive feedback on the regionalization concept.
- **Project internal discussions**: Conducted with the BIO2REG consortium and Advisory Board members on 29 October 2024 in an online meeting, followed by a written review phase to refine the regionalization framework and gather feedback.

9 Conclusion and next steps

This deliverable lays the groundwork for the development of bioeconomy model regions across Europe and Associated Countries. With the right tools, support, and collaboration, the BIO2REG project empowers regions to overcome challenges and fully realise the potential of circular bioeconomy transition. The next steps within BIO2REG will involve refining the regionalization concept through continued workshops, stakeholder engagement, and feedback integration in Work Package 2 which focuses on setting up the BIO2REG network and events in 2025 organised in five BIO2REG regions. The conceptual framework delivered by the BIO2REG project will be an essential tool for regions looking into how to implement circular bioeconomy strategies and set up context-specific transition action plans adapted to regional strength that are both sustainable and adapted to the regional context. However, the concept needs and will maintain an agile learning community of regions exchanging on best and bad practices and sharing information.

BIO2REG in a nutshell

A circular bioeconomy is essential for achieving the EU's sustainability goals. However, the implementation of a regional bioeconomy is fraught with challenges. Bioeconomy model regions offer a systemic approach to the transition to sustainable development, based on circular economy concepts. The EU-funded BIO2REG project aims to help greenhouse gas-intensive economies unlock their circular bioeconomy potential by becoming bioeconomy model regions.

The project will promote regional networking, interregional exchange and cooperation, and provide regional stakeholders with a conceptual framework for regionalisation in bioeconomy model regions. This includes mapping best practices in a circular and sustainable bioeconomy, assessing bioeconomy potential, providing mentoring and training, forming transition alliances and making policy recommendations. The project adopts a multi-stakeholder approach, developing tools and guidelines in collaboration with regional stakeholders and engaging with regions through guided exchanges on the ground.

Find out more:

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