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D3.3 Policy overview and recommendations Preliminary version

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Glossary of terms

ANRI	Alchemia-nova research & innovation gemeinnützige GmbH
ANTEJA	Anteja ECG D.O.O.
BABEG	Kärntner Betriebsansiedlungs- und Beteiligungsgesellschaft m.b.H.
CMU	Cardiff Metropolitan University
FCTA	Fundación Corporación Tecnológica de Andalucía
GA	Grant Agreement
LGCA	Lombardy Green Chemistry Association
SERN	Startup Europe Regions Network
SYMBIO	Shaping symbiosis in bio-based industrial ecosystems based on circular by-design supply chains



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Executive summary

The SYMBIO project supports the development of circular, bio-based business models in 12 pilot regions across six EU countries (Italy, Belgium, Austria, Croatia, Slovenia, and Spain) by fostering industrial symbiosis. Using big data and AI, it enables scalable value chains and provides tools to monitor their environmental, social, and economic impacts. Within this context, **Task 3.2** focuses on mapping and analyzing the regulatory and institutional frameworks that influence industrial symbiosis opportunities in the bioeconomy. The goal is to identify both barriers and enablers at EU and national levels, particularly those emerging from current and forthcoming regulations related to the European Green Deal, the EU Bioeconomy Strategy, and associated action plans, directives, and legal instruments. Attention is also given to the macro-regional fragmentation of responsibilities and its impact on resource transfers, end-of-waste criteria, and implementation coherence.

The bioeconomy is a cornerstone of the European Union's strategy to achieve climate neutrality, circularity, and resource efficiency, as defined in the European Green Deal and the EU Bioeconomy Strategy. It encompasses the sustainable use of renewable biological resources across sectors to drive innovation, reduce dependency on fossil-based resources, and create economic opportunities—particularly in rural and industrial transformation contexts. Despite its strategic importance, implementation gaps continue to hinder the full deployment of a sustainable bioeconomy. These include a lack of harmonised definitions, fragmented regulatory frameworks across Member States, insufficient data and monitoring systems, and limited targeted funding for scaling up innovations. Additionally, while bio-based solutions are being promoted, regulatory and market barriers persist—especially regarding biomass sustainability, the role of biodegradable materials, and the integration of industrial symbiosis.

This deliverable maps and analyses the European and national regulatory landscapes relevant to the bioeconomy. EU-level policy mapping revealed that although a wide range of policies support circularity, sustainability, and innovation—particularly in agriculture, energy, packaging, and waste—many do not yet fully integrate bioeconomy-specific needs such as cross-sectoral biomass flow management or long-term resource planning. On the national level, the mapping showed highly diverse levels of bioeconomy strategy development, with gaps in regional implementation and policy coordination.

To structure the analysis, policies were clustered into nine thematic industrial areas: Agriculture; Bioeconomy; Chemicals and Textiles; Energy and Climate; Forestry, Land Use and Nature; Industry, Digitalisation and Development; Packaging and Packaging Materials; Waste Management and Circular Economy; and Cross-cutting Policy Instruments. These clusters allowed a clearer comparison of policy impacts and gaps across sectors. A visual mapping of the policies illustrates the bioeconomy's systemic relevance and how it underpins key objectives of the European Green Deal. The findings also underscore the importance of coherent, cross-sectoral governance. Literature-based discussions reveal that harmonisation across sectors and Member States remains a major challenge, and that dedicated bioeconomy policies—especially at national levels—can be effective entry points for enabling cross-sectoral coordination.



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While biomass is a renewable resource, it is not infinite. The increasing demand due to population growth and industrial applications stresses the importance of promoting not only sustainable production, but also a transformation in consumption behaviour. Ensuring efficient use, prioritising residues and by-products, and enhancing circularity are essential to avoid overexploitation and to maintain ecological balance.

Looking ahead, Deliverable 3.4 will build on these insights to analyse the practical implications of the regulatory landscape on the business models developed within SYMBIO. It will further explore enablers and barriers in policy implementation and provide evidence-based recommendations for improving the integration of bioeconomy principles into EU and national governance systems.



1. Introduction

1.1. Context and Objectives

The **SYMBIO project** enables European regions to develop circular, bio-based business models by fostering industrial symbiosis. By using big data and artificial intelligence, SYMBIO supports the creation of scalable and replicable value chains that enhance the uptake of bio-based products across the EU. The project is implemented in 12 pilot regions across six countries (Italy, Belgium, Austria, Croatia, Slovenia, Spain) and engages all supply chain actors to validate methodologies and strengthen local circular ecosystems. It also provides a reporting system to model, measure, and monitor symbiosis and its social, environmental, and economic impacts.

Work Package 3 focuses on identifying, evaluating, and monitoring symbiotic bioeconomy value chains. Building on the BioLinks defined in WP2 using VCG.AI, it applies a multi-criteria approach that compares environmental, social, and economic indicators to identify approximately ten promising business models with high replication potential across Europe. Central to the SYMBIO methodology are multi-stakeholder focus groups, which collaboratively elaborate and discuss the proposed business models to uncover key enablers, barriers, and real-world implementation requirements. The insights gained will directly inform the development of a tailored monitoring framework designed to support industrial stakeholders in adopting, operationalizing, and monitoring circular bio-based business models across diverse regional contexts.

Within WP3, **Task 3.2 Mapping the regulatory framework of SYMBIO opportunities** maps and analyses the regulatory and institutional frameworks that influence industrial symbiosis in the bioeconomy. In this preliminary deliverable, the primary objective is to provide an initial overview of relevant policies, with particular focus on the European Green Deal and the EU Bioeconomy Strategy and to highlight regulatory opportunities that promote a sustainable and circular bioeconomy. This overview lays the foundation for a more in-depth analysis in the following stages of the task, which will focus on the business models developed within SYMBIO. The goal is to identify practical factors that either support or hinder their implementation and replication (e.g. resource exchange, financing structures, regulatory gaps), thereby enabling the development of well-founded policy recommendations.

The deliverable **D3.3, Policy overview and recommendations – Preliminary version** presents an overview of key policy frameworks and funding mechanisms that influence industrial symbiosis in the bioeconomy at EU and national levels. Special attention is given to the European Green Deal and the EU Bioeconomy Strategy, examining their legislative instruments, implementation mechanisms, and sectoral relevance. The deliverable also assesses EU funding programmes and macro-regional governance challenges that may either facilitate or hinder resource sharing, waste valorisation, and end-of-waste applications. A key feature of D3.3 is the categorisation of relevant policies across nine thematic clusters (e.g. agriculture, energy, packaging, waste), alongside a visual regulatory map that illustrates policy interlinkages.

The deliverable forms the basis for the upcoming Deliverable 3.4, which will translate this policy analysis into practical insights for business model implementation and inform future policy recommendations.



1.2. Relevance of Policy Frameworks for Advancing Industrial Symbiosis in the Bioeconomy

1.2.1 The European Green Deal

The European Green Deal is the EU's comprehensive strategy to become the world's first climate-neutral continent by 2050. Legally anchored in the European Climate Law, it commits to reducing net greenhouse gas emissions by at least 55% by 2030 (compared to 1990 levels). The Green Deal is the heart of the EU's strategy to build a fairer, more resilient, and more sustainable European society. It sets a clear direction for future policies, investments, and innovations and is an attempt to foster the environmental transition in the EU and make it irreversible, based on transformative policies that are affecting the whole economy. It defines seven policy objectives, including the following:

- climate neutrality,
- supplying clean, secure and affordable energy,
- promoting sustainable mobility,
- encouraging the transition to a circular economy,
- creating a toxic-free environment,
- preserving Europe's natural capital,
- and designing a fair, healthy and environmentally friendly food system.

In order to achieve substantial progress towards climate neutrality, advancements in all these thematic pillars are essential (1,2). To turn these climate goals into law, the EU has adopted the **Fit for 55** package, a set of legislations aiming to reduce EU greenhouse gas emissions by at least 55% by 2030 (3). The **European Council** is responsible for setting the overall political strategy and launched, in December 2019, stating that "the transition to climate neutrality will bring significant opportunities, such as potential for economic growth, for new business models and markets, for new jobs and technological development (4)".

1.2.2 The European Bioeconomy Strategy

The European Bioeconomy Strategy, first launched in 2012, covers all activities related to the extraction, production, and use of biological resources, as well as the processes and principles applied to deliver essential goods and services across all sectors of the economy. In 2018, the strategy was updated to place stronger emphasis on sustainability, circularity, and climate neutrality as central pillars of EU environmental policy.

The strategy defines five main goals:

- Ensure food and nutrition security
- Manage natural resources sustainably
- Reduce dependence on non-renewable, unsustainable resources
- Mitigate and adapt to climate change
- Strengthen European competitiveness and create jobs



The strategy is not only contributing to the European Green Deal, but also supports innovation in the industrial, circular economy, and clean energy domains and is implemented through the bioeconomy action plan consisting of 14 specific measures (5,6). The transition to a circular bioeconomy represents a central element in this strategy, as it supports decarbonisation, fosters the sustainable use of renewable resources and aims to reduce the EU's dependency on fossil-based inputs and imported materials. It further contributes to climate change mitigation, rural development, and sustainable production models (7).

A **new Bioeconomy Strategy** is expected by the end of 2025. Its goal is to reinforce the EU's leadership in this field by advancing innovation and enabling the market uptake of bioeconomy solutions, generating green jobs and fostering sustainable growth. The updated strategy will promote circular use of biomass and long-term competitiveness, positioning the EU in the market for bio-based materials, investment security to improve conditions for startups, entrepreneurs, and emerging business models, as well as strengthening the role of primary producers in rural areas to contribute to the decarbonisation of the EU economy. Its development is being aligned with major EU initiatives, including the **Competitiveness Compass**, the **Clean Industrial Deal**, the forthcoming **Life Science Strategy**, the **Ocean Pact**, and the **Biotech Act** (8,9).

The 2022 progress report (10) on the EU Bioeconomy Strategy by the European Commission highlights some key achievements. Many Member States and regions have adopted dedicated bioeconomy strategies, fostering cross-sectoral collaboration and investment in innovation. The deployment of bioeconomy solutions has notably increased in Central and Eastern Europe, supported by EU funding and new networks. Additionally, there is growing mobilisation of private investment, especially in food and bio-based industries, where Europe holds a strong global position in biochemicals and biomaterials.

Despite this progress, the report also identifies several critical gaps that must be addressed to fully realise the bioeconomy's potential:

- **Land and biomass management** must be improved to balance environmental and economic demands.
- **Sustainable consumption patterns** need to be promoted to protect ecosystems.
- **Workforce transformation** is required to equip people with skills for a green and circular economy.
- **Policy coordination and harmonisation** across sectors must be enhanced to resolve competing demands.
- **Data gaps** in monitoring hinder effective assessment and policy design.
- **Infrastructure and investment** need to be scaled up to support the market deployment of bio-based innovations.

Bioeconomy policies are one of the key measures to close these gaps and take a trans-sectoral approach to increase policy coherence and address trade-offs, particularly in relation to land use, biomass demand and resource efficiency. They contribute to sustainability in three key dimensions:

- by promoting the **sustainable management of natural resources** within their planetary boundaries,
- by enabling **circular and climate-neutral value chains**, and
- by supporting **social fairness and just transition** measures (10).

According to the **EU Horizon project BioRural**, which supports circular bio-based solutions in rural areas, significant progress has already been made toward these objectives, particularly in recent years. However, challenges remain. While the bio-based sector benefits from private and EU funding, and actions promote



R&D, scale-up, and networking across Europe, regulatory barriers and limited market access for end-user products still hinder the development of large-scale alternatives to fossil-based production. Although funding opportunities exist, they are unevenly distributed across EU regions. Strengthening cooperation between Member States, sharing best practices, and developing regional action plans are critical next steps. In particular, targeted investment in infrastructure is needed to bridge the gap between research, startups, scale-ups, and policy implementation (11).

Over the past two decades, bioeconomy-related policies have emerged as a priority field at EU level, addressing multiple sustainability goals. These include the reduction of petrochemical use, strengthening local economies, and the development of alternative production and consumption systems. Even where explicit bioeconomy strategies are not in place, governments have often embedded bioeconomy-related objectives in agricultural, innovation, or climate strategies (7).

Currently, 194 regions within the EU-27 have either already adopted or are in the process of developing a bioeconomy strategy. Italy leads with the highest number of such regions, followed by Sweden, France, Spain, Finland, and Poland. These countries actively promote regional bioeconomy development through dedicated strategies and action plans. Still, it is increasingly clear that aligning the bioeconomy with societal grand challenges will require stronger, national and international coordination and governance. The success of future bioeconomy strategies depends on their ability to integrate policy fields and scale efforts beyond regional boundaries (12,13).

1.2.3 Relevance of the Bioeconomy in the EU Green Deal

As already stated above, the bioeconomy affects all sectors that produce, use, process, distribute or consume biological resources, including ecosystem services. Therefore, it is an integral part of the European Green Deal and essential to reach its objectives.

The bioeconomy addresses climate change policy, circular use of biomass resources, biodiversity conservation, pro-environmental behaviour, and technological change, which are also included in the European Green Deal policy. Liobikiene et al. analysed the role of the bioeconomy and its contribution to the European Green Deal (6). However, for the bioeconomy to reach its full potential, a more coherent and coordinated policy landscape is required - one that addresses sectoral overlaps, regional disparities, and regulatory fragmentation (6).

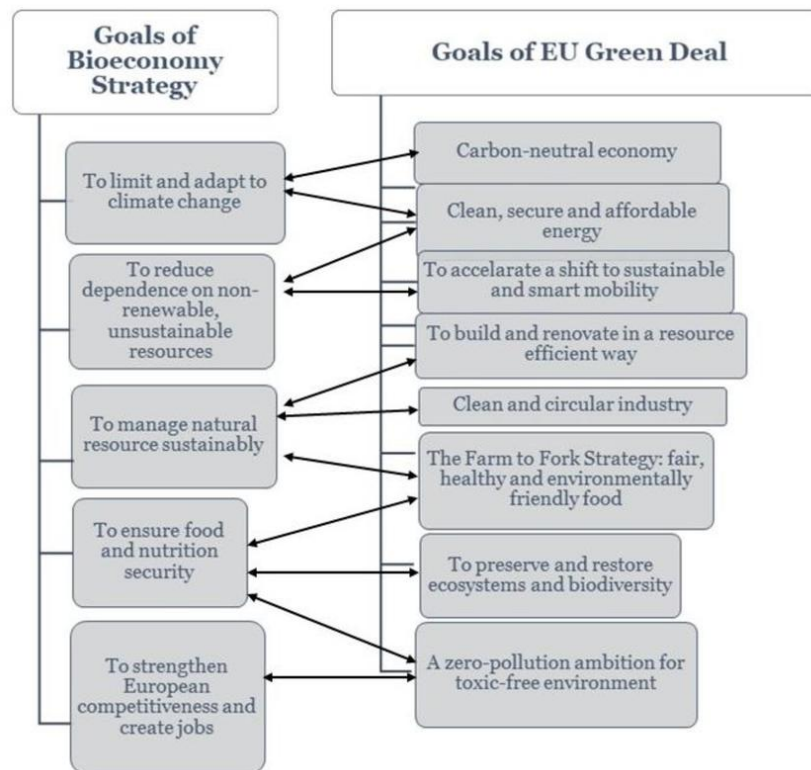


Figure 1: A comparison of the goals of the European Bioeconomy Strategy and the European Green Deal (Liobikiene et al. 2023).

As illustrated in **Figure 1**, the objectives of the Bioeconomy Strategy are closely aligned with those of the European Green Deal. Reaching the targets set out in the Bioeconomy Strategy is therefore essential to achieving broader EU ambitions, including climate neutrality, resource efficiency, and ecosystem resilience. Therefore, the idea of the bioeconomy could be found in various policies related to agriculture and forestry as the Common Agricultural Policy, Forest and Biodiversity Strategy, Farm to Fork Strategy and in the circular economy and waste management directives.

One of the most significant contributions of the bioeconomy lies in achieving a carbon-neutral Europe by 2050. Bio-based resources and products typically have a lower carbon footprint than fossil-based alternatives and can contribute to greenhouse gas reduction through the use of biomass and carbon sequestration. However, land use changes and biomass sustainability must be carefully managed to avoid unintended environmental impacts.

In the area of clean and secure energy, bioenergy plays a growing role by reducing fossil fuel dependence. Nevertheless, biomass is a finite resource, making its sustainable extraction and use a central concern within both the Green Deal and the Bioeconomy Strategy.

The bioeconomy also supports the EU's **zero-pollution ambition** by promoting the use of natural materials and reducing environmental contamination from harmful chemicals, particularly in sectors like food and forestry. Moreover, it contributes to the **preservation of ecosystems and biodiversity** by advocating for



sustainable land use and production practices—although unsustainable bioeconomy development can pose risks, particularly in agriculture and forestry.

In terms of **clean and circular industry**, the bioeconomy fosters the use of biodegradable materials, bio-based plastics, and biorefinery technologies, thereby supporting zero-waste objectives and the replacement of non-renewable raw materials.

It further contributes to **sustainable construction**, for example through the use of bio-based insulation materials and timber in buildings, which can significantly lower greenhouse gas emissions in the construction sector.

In the context of **sustainable mobility**, biofuels derived from renewable biological sources offer an alternative to fossil fuels, though their production must be balanced against environmental and food security concerns.

Finally, the bioeconomy is closely tied to the **Farm to Fork Strategy**, promoting a fair, healthy, and sustainable food system. It seeks to reduce food waste, limit environmental pollution from agriculture, and address long-term food security challenges in a resource-efficient way (6).

To track progress in this area, the EU Bioeconomy Monitoring System (EU-BMS) was developed by the Knowledge Centre for Bioeconomy (KCB). It provides a conceptual framework to measure the performance of the EU (14). One of the most significant challenges in realizing these goals is the competition between food and non-food uses of biomass. Monitoring tools play an important role here, as they can identify the availability, distribution, and use of biological resources. In particular, waste biomass such as agricultural residues and food waste holds significant future potential. Such streams are crucial to increase resource efficiency, reduce environmental pressures, and promote circularity in the bioeconomy. Regional approaches are particularly important for tailoring bioeconomy strategies to local contexts. Bio-based production can leverage existing biomass resources such as forests, agricultural land or marine environments — complemented by municipal waste streams. Therefore, regional-level planning is vital to identify opportunities and foster local job creation and innovation (7).

The concept of the circular bioeconomy builds on the integration of circular economy principles into the bioeconomy. It promotes cascading use of biomass, valorisation of residues and waste, and systemic efficiency. However, this transformation requires not only technological innovation but also structural changes in production systems, value chains, and consumer behaviour. Key concerns such as land use, ecosystem impacts, and social inequalities must be addressed as part of a just and inclusive transition (15).

The aim of this deliverable is to provide a comprehensive overview of all relevant policies derived from the European Green Deal and the Bioeconomy Strategy, including national policy frameworks. This overview serves as a foundation for understanding the current policy landscape and for identifying synergies, barriers, and opportunities that will be further explored and assessed in Deliverable 3.4.

1.3 Key Definitions of the European regulatory framework

Clear understanding of the terminology used in the European regulatory and policy landscape is essential for navigating and interpreting the wide range of instruments that are used by the European Commission. This section provides definitions of the most relevant policy types and instruments, distinguishing between legal acts, strategic frameworks, and soft governance tools within the EU.



EU law is structured into several distinct categories, each with a specific legal function and scope of application. The framework consists of **three main categories**:

1. **Primary law** includes the EU treaties (binding agreements between EU member countries, which set out EU objectives, rules for EU institutions, how decisions are made and the relationship between the EU and its member countries (16) which define the EU's institutional framework, competences, and legal principles.
2. **Secondary law** is based on the treaties and includes:
 - Regulations are legal acts that are binding directly applicable in all Member States, as soon as they entered into force without the need to be transposed into national law.
 - Directives are binding in terms of results but allow Member States flexibility in how to achieve them. They must be transposed into national law by a set deadline, usually within two years and reported to the European Commission.
 - Decisions are binding for those specifically addressed.
 - Recommendations are set of recommended actions without being legally binding.
 - Opinions are non-binding and allow the EU institutions to make a statement.
 - There exist also other soft law instruments that are not legally binding but can influence national laws, such as Guidelines, Declarations, Conclusions etc.
3. **Supplementary law** includes case law from the Court of Justice, general legal principles, and international agreements. These complement and clarify the written legal rules (17).

EU policies are developed through a structured process that ensures transparency, evidence-based decision-making, and public involvement. Before proposing new policies and initiatives, the European Commission consults stakeholders via the "[Have Your Say](#)" platform, evaluates existing measures, and conducts impact assessments. Regarding the new bioeconomy strategy, all stakeholders were encouraged to participate in the online consultation for 12 weeks until 23 June 2025. Citizens can also propose new policies through the **European Citizens' Initiative**. Active participation in these processes is essential to ensure that the future strategy reflects practical needs, regional realities, and innovative perspectives (18).

A Deal such as the European Green Deal or the Clean Industrial Deal is not a legal term or legislative act in itself. Instead, it is a **high-level political initiative** or vision adopted by the European Commission and supported by other EU institutions. It sets a broad political direction and acts as a **transformative roadmap** that brings together goals, guiding principles, and planned actions. A deal usually leads to the development of strategies, action plans, legislative proposals, funding instruments across sectors and Member States.

A strategy is a comprehensive policy framework or plan of action adopted by EU institutions (usually the European Commission) to guide and coordinate efforts across member states toward long-term objectives in a specific policy area. A Strategy usually includes goals and objectives, policy actions, implementation tools, monitoring and evaluation (19).

An Action Plan is non-binding but lays out priorities, objectives, and concrete proposals for better regulations, funding, and knowledge. They contribute to shaping or revising EU legislation and instruments (20).



2. Methodology

2.1 General Approach

The methodology for this deliverable is based on a structured desk research approach to identify, map and analyze relevant EU, national, and regional policy frameworks that influence or support industrial symbiosis in the bioeconomy. The focus is placed on policies that govern the use, trade, valorization and transfer of bio-based resources, with particular attention to those that enable or hinder **circularity and cross-sectoral cooperation** in bio-based value chains. It should be noted that local initiatives, hubs, and support programmes without formal legal or strategic character were not included in the scope of this deliverable, but will be analyzed in more depth in Deliverable 3.4, where additional policy-related enablers will be evaluated in relation to the specific SYMBIO business models.

The research targeted policies are directly linked to, or aligned with, the **European Green Deal** and the **EU Bioeconomy Strategy**, either as implementing instruments or as sectoral frameworks with implications for the bio-based economy.

To ensure a comprehensive and consistent approach, the policy mapping was structured around three levels of governance:

1. European (EU regulatory frameworks and strategies)
2. National (bioeconomy-related strategies and legislative frameworks)
3. Regional (strategies and policies in selected SYMBIO pilot regions)

Thematic search phrases and key words included the following terms, often in combination with specific country names:

European Green Deal, bioeconomy strategy, policy, bioeconomy, industrial symbiosis, circular economy, resource efficiency, waste, packaging, bio-based economy, (national) regulatory frameworks, national strategy, national policy.

The following websites served as the main sources for identifying the relevant policies:

- [The Knowledge Center for Bioeconomy](#)
- [Strategy of the EU-Commission for Environment](#)
- [Homepage of the European Commission](#)
- [Homepage of the European Union](#)
- [FAOLEX database](#)
- National and regional government websites

Policies were screened for their thematic alignment and subsequently mapped by sectoral focus. Through qualitative analysis, the scope and relevance of each policy to industrial symbiosis within the bioeconomy were identified and systematically analyzed.



2.2 Analysis of the EU Regulatory Framework

2.2.1 Scope and selection criteria

The identification of relevant EU policies was guided by thematic relevance to:

1. Bio-based raw materials and value chains
2. Trade and use of biological resources
3. Industrial symbiosis and circularity in the bio-based industry

Only policies clearly linked to the European Green Deal and/or the EU Bioeconomy Strategy were included—either as direct implementations or as sectoral frameworks with impact on the bioeconomy.

2.2.2 Desk research process

The desk research was carried out systematically, starting from the official websites of the European Commission and the European Union, and complemented by the FAO (Food and Agriculture Organization of the United Nations). For the European Green Deal, the official European Commission Green Deal website served as the entry point. Each policy listed on the page includes links to detailed legislative packages and related strategies. The completeness was cross-checked with a [regulatory map by CircuLaw](#). For the EU Bioeconomy Strategy, relevant legislative and non-legislative documents were mostly found directly within the official EU bioeconomy portal. All sources are listed directly in Chapter 3.1 in Table 1.

2.2.3 Clustering and presentation

To improve clarity and facilitate navigation, the selected policies have been clustered by thematic industrial areas. These clusters include: Agriculture; Bioeconomy; Chemicals and Textiles; Energy and Climate; Forestry, Land Use and Nature; Industry, Digitalisation and Development; Packaging and Packaging Materials; and Waste Management and Circular Economy.

Each cluster has been assigned a consistent colour code, which is used throughout the deliverable—including in the visual policy map and the section on national policies—to identify interconnections and maintain a clear structure. This visual categorization aims to support a better understanding of how EU policies relate to different sectors within the circular and bio-based economy.

Colour-coding according to categories:

- **Brown:** Agriculture
- **Greenish Blue:** Bioeconomy
- **Blue:** Chemicals and Textiles
- **Yellow:** Energy and Climate
- **Green:** Forestry, Land Use and Nature
- **Grey:** Industry, Digitalisation and Development
- **Purple/Pink:** Packaging and Packaging Materials
- **Orange:** Waste Management and Circular Economy



Additionally, a visual policy map was developed using MIRO (<https://miro.com>) to support a comprehensive systemic overview of the interconnections between the EU Green Deal and the Bioeconomy Strategy. The result is illustrated in Figure 2 and follows the same color-coding rules as mentioned above to ensure consistency.

2.3 Analysis of National and Regional Strategies and Policies

The analysis of the national and regional policies was likewise carried out by desk research. The [bioeconomy country dashboard](#) by the [Knowledge Center for Bioeconomy](#) served as a starting point to gain an overview of national strategies and initiatives supporting the bioeconomy, specifically in the countries where SYMBIO pilot regions are located. The supplementing research for policies was based on the keywords outlined in section 2.1 *General approach* and led primarily to official websites of national ministries, complemented by information from the FAO. The findings are presented in chapter 4. *Analysis of Policy Frameworks supporting the bioeconomy and industrial symbiosis in SYMBIO Pilot Regions*. The tables follow the same clustering and colour coding as applied in the EU policy overview for consistency and comparability.

National bioeconomy-related strategies and policies were analysed for the countries hosting SYMBIO pilot regions (Austria, Italy, Slovenia, Croatia, Spain and Belgium). At the regional level, policies were assessed specifically for the selected pilot regions. For Slovenia and Croatia, where the whole country functions as pilot region for SYMBIO, a short reflection on regional distinctions is included.

To overcome language barriers, documents and websites with English versions or built-in language selection options were used where available. In cases where no official translation was provided, online tools such as the Google Translate browser extension, DeepL, and ChatGPT were applied to support the translation and interpretation of policy documents and web content.

2.4 EU Funding Instruments supporting the Bioeconomy

Funding programmes were identified through desk research based on official EU sources, beginning with the European Commission's bioeconomy financing overview provided by the Knowledge Centre for Bioeconomy (21). Building on this source, the listed funding instruments were cross-checked against the official websites of the respective programmes to ensure up-to-date and accurate information. Additional research was conducted using targeted keywords such as *funding, bioeconomy, EU, grant, biobased resources* to identify further funding opportunities relevant to the bioeconomy. Additionally, the EU Funding and Tenders Portal by the European Commission (22) was used to identify potential funding programmes, using the same key words as above.

European funding instruments that support research institutions, small and medium-sized enterprises (SMEs), and companies through non-repayable grants or other finance mechanisms such as equity or loans were compiled in **Table 9: Overview of European Funding Instruments supporting the Bioeconomy**. The listed programmes provide support for research and development, infrastructure, or highly innovative projects relevant to advancing the bioeconomy.



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3. Analysis of the EU Regulatory Framework

3.1 Overview of EU Regulatory Framework impacting on Industrial Symbiosis

Table 1 – 8 present an overview of the selected EU policies that directly or indirectly influence industrial symbiosis within the bioeconomy, categorized into the following clusters:

1. Agriculture
2. Bioeconomy
3. Chemicals and Textiles
4. Energy and Climate
5. Forestry, Land Use and Nature
6. Industry, Digitalization and Development
7. Packaging and Packaging Materials
8. Waste Management and Circular Economy

The selection is based on their potential to support or regulate the exchange, reuse, or valorization of bio-based resources and by-products across sectors.



Table 1: Overview of relevant European policies for the Bioeconomy in the category “Agriculture”. Color-coding: Darker shade = legally binding; lighter shade = not legally binding.

Name of policy	Scope	Relevance	Reference
Agriculture			
Fertilizing Products Regulation (EU) 2019/1009	<ul style="list-style-type: none"> • Expansion of EU-marked fertilizing products (now including organic, organo-mineral and recycled materials) • Categorization of fertilizing products into material components and function • Strict limits for contaminants • Voluntary harmonized standards • CE-marking for compliant products 	<ul style="list-style-type: none"> • Turning industrial by-products and waste streams into valuable fertilizer inputs • Boost cross-sectoral partnerships and close nutrient loops through collaboration • Foster investments in circular technologies and encourages sustainable nutrient cycles • Legal clarity for recovered materials 	REGULATION (EU) 2019/1009 Summary of Regulation (EU) 2019/1009
Industrial and Livestock Rearing Emissions Directive (2010/75/EU) amended by Directive 2024/1785	<ul style="list-style-type: none"> • Emission limits • Pollution reduction and prevention (from industrial activities and livestock farming) • Implementation of BAT 	<ul style="list-style-type: none"> • Support resource optimization and efficiency (with BAT) • Waste prevention • Possible guidelines for biorefineries and biomass-processing industries 	DIRECTIVE 2010/75/EU IED 2.0 Overview



<p>The Common Agricultural Policy (CAP) 2023-2027 (Reform)</p>	<ul style="list-style-type: none"> ● Securing the future of agriculture and forestry ● Direct support of (smaller) farmers and rural bioeconomy ● Enhancement of sustainable practices ● 10 key objectives ● National CAP Strategic Plan from each EU country 	<ul style="list-style-type: none"> ● Encourages the use of agricultural by-products and the development of biorefineries ● Promotion of cross-sectoral collaborations (e.g., between farmers, researchers and industries) ● Fosters waste reduction and nutrient recycling ● Funding for sustainable agriculture and innovation 	<p>REGULATION (EU) 2021/2115</p> <p>Common Agricultural Policy Overview</p> <p>28 CAP Strategic Plans at a Glance</p>
<p>Regulation (EU) 2018/848 on organic production and labelling of organic products and repealing</p>	<ul style="list-style-type: none"> ● Defines requirements for organic production, labelling, control, and certification ● Supports environmentally-friendly farming practices and product integrity 	<ul style="list-style-type: none"> ● Encourages organic feedstocks in bio-based production ● Supports sustainability and traceability of bio-resources ● Promotes the integration of organic residues into industrial processes 	<p>REGULATION (EU) 2018/848</p> <p>Regulation (EU) 2018/848 Overview</p>
<p>Farm to Fork Strategy (2020)</p>	<ul style="list-style-type: none"> ● Fair, healthy and sustainable food systems with minimal environmental impact as main goal ● Promotion of sustainability across the entire food supply chain 	<ul style="list-style-type: none"> ● Reduction and reuse of food waste ● Support bio-based solutions (e.g. for sustainable agriculture) and the use of by-products ● Support collaboration between different industry sectors and multi-stakeholder engagement 	<p>FARM TO FORK STRATEGY</p> <p>Farm to Fork Strategy (2020) Overview</p>
<p>Organic farming – action plan for the development of EU</p>	<ul style="list-style-type: none"> ● Focus on expansion of organic farming ● Increasing investment and innovation in sustainable farming ● Support the demand for and consumer interest in organic food 	<ul style="list-style-type: none"> ● Waste reduction and encouraging by-product utilization ● Foster closing material loops and cross-sectoral collaborations (between farmers, research institutions and industry) 	<p>Summary & Overview of the Organic farming – action plan for the development of EU organic production</p>



organic production			
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The analysis of EU agricultural policies shows a clear alignment with the goals of the circular bioeconomy by integrating circular economy and bioeconomy principles, such as preventing waste through the use of by-products, optimizing resource efficiency, and promoting bio-based solutions over fossil-based ones. Key instruments (see **Table 1**) such as the *Common Agricultural Policy (CAP)*, the *Fertilising Products Regulation*, and the *Farm to Fork Strategy*, promote sustainable farming, climate-neutral food systems, and resource efficiency. A recurring focus across these frameworks is the efficient use of biological resources, the reduction of environmental impacts, and the valorization of waste and by-products, which are core principles of industrial symbiosis in the bioeconomy. Initiatives such as the Organic Farming Action Plan and the Regulation on Organic Production further strengthen these goals by enhancing traceability, consumer trust, and increasing the integration of organic feedstocks into bio-based value chains.

Effective monitoring and evaluation of implemented policies are essential to ensure that these ambitions achieve their respective goals. For example, the Common Monitoring and Evaluation Framework (CMEF) plays a key role in assessing the effectiveness of CAP interventions. It helps identify where adjustments are needed, which contributes to more targeted, evidence-based policy development in the agricultural sector (23). Nonetheless, several studies point to persistent implementation gaps, especially regarding the CAP’s contribution to the Green Deal and bioeconomy goals. Key challenges include **limited integration of climate targets, uneven implementation across Member States, and a lack of reliable data** for evaluating impacts. Addressing these issues requires improved policy coordination, stronger monitoring systems, and closer alignment between EU and national frameworks (24–26). According to the OECD’s Agricultural Policy Monitoring and Evaluation 2024 report, the agricultural support needs to be reoriented, or reformed, as global agricultural productivity growth is slowing and also the share of government support going to innovation is declining, suggesting that governments should invest in the capacity to measure results, to be able to adjust policies to ensure the sustainability goals are achieved (27).

As already outlined in the introduction and listed in **Table 2**, the EU Bioeconomy Strategy and its corresponding Action Plan (2018) provide a comprehensive and cross-sectoral policy foundation for advancing the transition to a circular, innovative and sustainable economy promoting the sustainable use of renewable biological resources across all sectors. It places strong emphasis on closing material loops, reducing dependency on fossil inputs, and fostering regional development through innovation and bio-based industries.

Table 2: Overview of relevant European policies for the Bioeconomy in the category “Bioeconomy. Color-coding: Darker shade = legally binding; lighter shade = not legally binding.

Name of policy	Scope	Relevance	Reference
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Bioeconomy			
EU Bioeconomy Strategy (2018)	5 Goals: <ul style="list-style-type: none"> Assurance of food and nutrition security Sustainable management of natural resources Decreasing dependence on non-renewable resources Limitation and adaption to climate change Bolster European competitiveness and job creation 	<ul style="list-style-type: none"> Resource efficiency and circular economy (encourages the use of waste and by-products, closing material loops, reduction of waste and primary materials) Promotion of innovation and bio-based industries Support of regional and economic development 	BIOECONOMY STRATEGY (2018)
EU Bioeconomy Action Plan (2018)			BIOECONOMY ACTION PLAN (2018)
			Bioeconomy Strategy Overview

Despite the broad scope of the current EU Bioeconomy Strategy, its practical implementation across sectors remains fragmented as in many Member States, bioeconomy policies are developed within isolated administrative sectors, leading to a lack of coordination between agriculture, industry, energy, and other environmental policies. This fragmentation was also evident in our analysis of national and regional policies across the SYMBIO pilot regions, as discussed in chapter 4. This sectoral divide limits the full potential of the bioeconomy. In general, there is no legally binding policy that comprehensively addresses the bioeconomy across all relevant sectors. The Horizon Europe project ShapingBio highlights the need for stronger horizontal coordination among ministries to overcome policy silos and enable more integrated governance structures (28). The European Commission also emphasises, in its progress report of the Bioeconomy Strategy 2018, the need to improve policy coherence and systematically address trade-offs, for example between the use of land for food production versus biomass cultivation for bioenergy or bio-based materials, which can lead to competition for arable land and impact food security (10).

Currently, the strategy is undergoing a revision process, with an updated version expected by the end of 2025. This update aims to better align bioeconomy policy with evolving environmental, technological, and geopolitical challenges, while further strengthening its role in achieving the goals of the European Green Deal.

The EU's *Chemicals Strategy for Sustainability (EU CSS)* and the *Strategy for Sustainable and Circular Textiles* listed in **Table 3** both aim to advance a toxic-free, climate-neutral, and circular economy. They emphasize reducing reliance on fossil-based and hazardous materials, promoting sustainable bio-based alternatives, and designing products for circularity, meaning they are intended to be reused, repaired, remanufactured, or recycled at the end of their life, thereby minimizing waste and the need for virgin resources. A strong focus lies on enabling safe use of secondary raw materials and fostering the substitution of hazardous chemicals across supply chains, including in textiles, where bio-based alternatives can play a key role.



Table 3: Overview of relevant European policies for the Bioeconomy in the category “Chemicals and Textiles”. Color-coding: Darker shade = legally binding; lighter shade = not legally binding.

Name of policy	Scope	Relevance	Reference
Chemicals & Textiles			
REACH Regulation (Regulation (EC) 1907/2006)	<ul style="list-style-type: none"> • Registration, evaluation, authorisation and restriction of chemicals • Ensures safe use of chemicals in the EU • Applies to all chemical substances (industrial and consumer use) • Addresses substances of very high concern (SVHCs) 	<ul style="list-style-type: none"> • Promotes the substitution of hazardous chemicals, supporting safer bio-based alternatives • Encourages transparency and traceability • Facilitates use of secondary raw materials • Regulates recycled chemicals 	REGULATION (EC) 1907/2006 REACH Regulation Overview
Chemicals Strategy for Sustainability (2020)	<ul style="list-style-type: none"> • Protection of citizens and the environment • Promotion and Innovation for safe and sustainable chemicals • Restrict harmful chemicals in consumer products • Minimizing the use of PFAS in the EU • High standards • No export of EU-banned chemicals 	<ul style="list-style-type: none"> • Assurance of safe (and sustainable) secondary materials compliant with health and environmental regulations • Facilitates the use of secondary raw materials • Addresses barriers and regulations that prevent the use of recycled chemicals and industrial by-products 	CHEMICALS STRATEGY FOR SUSTAINABILITY Chemicals Strategy Overview
EU Strategy for Sustainable and Circular Textiles	<ul style="list-style-type: none"> • Inspects the entire lifecycle of textile products • Aims for durable, repairable and recyclable textile products across the EU • Control and restrict fast fashion • Supports sustainable materials innovation and bio-based materials 	<ul style="list-style-type: none"> • Possible sharing for businesses of chemicals and water • Encourages innovations in bioproduct development (exchange of synthetic textile with bio-based alternatives) 	EU STRATEGY FOR SUSTAINABLE AND CIRCULAR TEXTILES Textiles Strategy Overview



The textiles strategy complements this approach by targeting fast fashion, supporting durability, reparability, and circular material flows. While the strategy primarily focuses on controlling and limiting fast fashion through measures such as the *Digital Product Passport*, it places comparatively less emphasis on promoting alternative bio-based materials from a regulatory perspective. Although the strategy encourages material innovation, with initiatives like [CBE JU](#) funding projects for bio-based textile solutions, the development and market readiness of such materials remain limited. Additional policy support may therefore be necessary to fully realise the role of bio-based textiles in the market (29–31). Currently, the only regulation specifically targeting textiles is the *Textile Labelling Regulation (EU) 1007/2011*, which focuses on fibre composition labelling. This regulation is scheduled for revision as part of the *EU Strategy for Sustainable and Circular Textiles*. Other EU regulations such as the *Ecodesign for Sustainable Products Regulation*, *REACH*, and the *Waste Framework Directive* also apply to the textile sector but address it only partially. This fragmented regulatory landscape makes it difficult to gain a comprehensive overview of the requirements applicable to the textile value chain. Since January 2025, EU Member States are required to establish separate collection systems for textiles under the *Waste Framework Directive*. However, these systems currently focus primarily on reusable textiles. When textile waste is discarded, the majority – 73% – is incinerated or landfilled, only 12% is recycled, and just 1% is reused (as of 2019). To significantly increase the circularity rate of textiles, it is critical that sorting and recycling capacities are urgently scaled up (32,33).

The *EU CSS* mainly focuses on one area of risk assessment, namely, the harm to humans from individual chemicals, while failing to consider the environmental exposure of chemicals, which constitutes a critical risk for the environment and thereby indirectly to humans. For example, the environmental problems caused by plastics are not adequately addressed. Furthermore, the strategy lacks scientific justification in key areas and does not sufficiently tackle critical sustainability issues, which is also reflected in the *Registration, Evaluation, Authorisation, and Restriction of Chemicals Regulation (REACH)* and represents a window for future policy development. *REACH (Table 3)* remains primarily focused on chemical safety, with limited integration of broader sustainability criteria. However, it does offer specific exemptions that could benefit bio-based manufacturers, especially SMEs, even though bio-based chemicals are treated equally under the regulation (“a chemical is a chemical”) (34,35).

The analyzed policies for the sector Energy and Climate in **Table 4** form a robust legislative foundation for the EU’s transition to a sustainable, climate-neutral, and circular economy. They offer clear targets, for example the binding renewable energy target of 42,5 % (compared to the previous aim of 32%) until 2030 through the in 2023 revised *REDII Directive* (36), and other mechanisms to reduce GHG emissions, promote resource efficiency, and foster cross-sectoral collaboration. All share a common objective of achieving net-zero emissions by 2050, where the circular bioeconomy is positioned as a central enabler.

Table 4: Overview of relevant European policies for the Bioeconomy in the category “Energy and Climate”. Color-coding: Darker shade = legally binding; lighter shade = not legally binding

Name of policy	Scope	Relevance	Reference
Energy & Climate			



<p>European Climate Law (Regulation (EU) 2021/1119)</p>	<ul style="list-style-type: none"> • Commitment of EU and binding targets for climate neutrality by 2050 (and 55% reduction by 2030) • Framework guaranteeing all EU policies align with the committed climate goals 	<ul style="list-style-type: none"> • Encouragement of circular economy and resource efficiency • Foster waste and carbon reduction and therefore strengthening cross-sectoral collaborations 	<p>REGULATION (EU) 2021/1119</p> <p>European Climate Law Overview</p>
<p>Effort Sharing Regulation (ESR) - Regulation (EU) 2023/857</p>	<ul style="list-style-type: none"> • Binding targets for EU-member states for reduction of greenhouse gas emissions by non ETS-sectors (e.g., domestic transport, buildings, agriculture, small industry and waste) 	<ul style="list-style-type: none"> • (Industrial) Waste reduction • Optimization of resource use and resource efficiency 	<p>REGULATION (EU) 2023/857</p> <p>Effort sharing 2021-2030: targets and flexibilities</p>
<p>Renewable Energy Directive (REDII & REDIII) (2023)</p>	<ul style="list-style-type: none"> • Renewable energy as the main driver for a clean energy transition • Sustainable use and targets for biomass and renewable energy • Definition of sustainability criteria for bioenergy and biomass 	<ul style="list-style-type: none"> • Tightened sustainability criteria for biomass • Focusing on lifecycle emissions and forest carbon accounting • Increasing scrutiny in the use of primary vs. secondary biomass 	<p>DIRECTIVE (EU) 2023/2413</p> <p>Renewable Energy Directive Overview</p>
<p>EU Emissions Trading System (ETS)</p>	<ul style="list-style-type: none"> • Reduction of greenhouse gases in ETS sectors (energy sector, industry, aviation) • Cap-and-trade system with decreasing emission caps over time • Buy, sell, or trade emission allowances (EUAs) 	<ul style="list-style-type: none"> • Reduction of emissions by resource sharing and using of by-products • Reduction of company's need for allowances by cutting emissions through industrial symbiosis • Encouragement of waste as a resource 	<p>EU ETS</p> <p>About the EU ETS</p>



<p>Zero Pollution Action Plan (2021)</p>	<ul style="list-style-type: none"> • Targets reduction of pollution of water, air and soil to improve their quality to a non-harmful level • Compass for main pollution prevention 	<ul style="list-style-type: none"> • Waste reduction • Resource efficiency (reusing non-toxic by-products) 	<p>EU ACTION PLAN: 'TOWARDS ZERO POLLUTION for Air, Water and Soil'</p> <p>Zero Pollution Action Plan Overview</p>
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For the bioeconomy, these frameworks present important opportunities by encouraging the use of bio-based resources and supporting innovation in renewable energy and circular material flows. However, several critical challenges remain that may limit their long-term effectiveness and coherence with bioeconomy objectives. One major concern is the sustainability and availability of biomass, which is essential to bioenergy production. Although bioenergy is a renewable source that contributes to climate mitigation and energy security, biomass is a finite resource. This makes the cautious promotion of biomass and careful prioritization of biowaste (e.g. forest residues) critical. In line with the European Bioeconomy Strategy, the sustainable production and consumption of biomass must be a top priority.

Moreover, current frameworks still face significant gaps in accounting for land-use change and carbon emissions related to bioenergy. While carbon sequestration is a core strategy in meeting climate goals, measuring emissions from land-use shifts remains challenging and uncertain, complicating the accurate integration of biomass into climate commitments. As already discussed above on Table 1 regarding the agricultural sector, without comprehensive land-use accounting, national climate targets risk being undermined. Although zero pollution is a central policy objective, it remains difficult to achieve, particularly when utilizing low-value biomass. Technological upgrades often come with high costs, which can exceed the economic returns of production. Additionally, the use of biomass directly for energy generation limits its potential for recycling and reuse, posing challenges for maintaining resource value and circularity. Given these limitations, the pursuit of a sustainable bioeconomy must go beyond closing loops, it must focus on optimizing resource flows in ways that enhance natural biogeochemical cycles and environmental quality.

In summary, while the climate and energy policy cluster supports the transition toward a sustainable, low-emission Europe, its effective contribution to the bioeconomy will depend on stronger safeguards for sustainable biomass use, monitored land-use and land-use shifts and carbon accounting, integration of biobased resources trade-offs in policy implementation, and a systemic shift toward regenerative and optimized resource flows (6,37).

Table 5 presents an overview of relevant policies in the category Forestry, Land Use and Nature and are advancing the EU's climate neutrality, biodiversity protection and circular bioeconomy objectives.



Table 5: Overview of relevant European policies for the Bioeconomy in the category “Forestry, Land Use and Nature”. Color-coding: Darker shade = legally binding; lighter shade = not legally binding.

Name of policy	Scope	Relevance	Reference
Forestry, Land Use & Nature			
Land Use, Land Use Change and Forestry Regulation (LULUCF) (EU) 2018/841 amended in 2023	<ul style="list-style-type: none"> • Binding targets for carbon removal in land and forestry • Encourages sustainable land use practices, biomass use, carbon sequestration, decreasing deforestation, and ecosystem restoration 	<ul style="list-style-type: none"> • Foster sustainable biomass use • Involving biomass-based waste streams • Strengthened synergies between different sectors by by-product exchange 	REGULATION (EU) 2018/841 LULUCF Overview
Nature Restoration Regulation (EU) 2024/1991	<ul style="list-style-type: none"> • Key element of EU Biodiversity Strategy • Binding targets to restore degraded ecosystems, habitats and species across the EU’s land and sea 	<ul style="list-style-type: none"> • Promotion of sustainable land use • Emphasizing resource efficiency and waste reduction • Encouragement of innovative resource utilization • Possible affection of biomass sourcing from natural areas (wild ecosystems) rather promoting sourcing from managed landscapes 	REGULATION (EU) 2024/1991 Nature Restoration Regulation Overview
Regulation (EU) 2023/0228 on Production and Marketing of Forest Reproductive Material	<ul style="list-style-type: none"> • Establishes rules for the production and marketing of forest reproductive material to ensure genetic diversity, traceability, and high-quality forest regeneration 	<ul style="list-style-type: none"> • Ensures sustainable and quality biomass sourcing critical for long-term bio-based industries • Encourages circular forest management and supports supply chain resilience 	2023/0228 (COD) Production and marketing of forest reproductive material - Overview



(status: tabled)			
EU Biodiversity Strategy for 2030	<ul style="list-style-type: none"> Restoration of degraded ecosystems Reversion of biodiversity loss Protection of 30% of land and sea areas Reduction of pesticide use Increase in organic farming Promotion of nature-based solutions 	<ul style="list-style-type: none"> Waste reduction and optimization of material flows Adoption of nature-positive models Reduction of industrial emissions and land-use expansion through resource-sharing Support of green, sustainable innovation 	EU BIODIVERSITY STRATEGY 2030 Biodiversity Strategy for 2030 - Overview
EU Forest Strategy for 2030	<ul style="list-style-type: none"> Focus on sustainable forestry, its guidelines and the role of forests Assurance of sustainability, afforestation and biodiversity preservation Balance forest use and conservation 	<ul style="list-style-type: none"> Support circular economy practices by promoting the reuse of wood- and forest-based residues in other industries Foster sustainable bioeconomy applications and bio-based materials 	NEW EU FOREST STRATEGY FOR 2030 Forest Strategy for 2030 - Overview
EU Soil Strategy for 2030	<ul style="list-style-type: none"> Framework and concrete measures for soil protection, restoration and sustainable use Healthy and resilient soil in the whole EU by 2050 	<ul style="list-style-type: none"> Soil health and resilience essential for bio-based industries depending on biomass (influencing biomass quality) Encourages repurposing industrial byproducts and waste reduction 	EU SOIL STRATEGY FOR 2030 Soil Strategy for 2030 - Overview

The *LULUCF Regulation*, the *Nature Restoration Regulation* and the *EU Forest Strategy for 2030* promote the multifunctionality and resilience of ecosystems, with a shared focus on sustainable biomass use and long-term ecological stability. These strategies foster cross-sectoral synergies, for example by encouraging the reuse of forest residues, and integrate land use management with broader bioeconomy and climate goals. Complementary instruments like the *EU Biodiversity Strategy* (Table 2) and the *Soil Strategy for 2030* (Table 1) strengthen this approach by promoting ecosystem restoration and improved soil health, both of which are vital for producing high-quality biomass. Moreover, the proposed EU monitoring framework for resilient forests will play a critical role in improving data availability and supporting evidence-based policy implementation across Member States.



However, significant implementation challenges remain. Conflicting priorities, such as biodiversity conservation versus biomass mobilization for the bioeconomy, highlight the need to prioritize biomass residues from managed landscapes and avoid pressure on protected areas. Stakeholder feedback on the *Forest Strategy* further revealed calls for clearer definitions, such as old-growth forest and sustainable forest management, improved coordination between climate and biodiversity goals, and measurable sustainability criteria. A crucial element for enhancing policy coherence is the harmonization of biomass flows into common units across sectors. This enables a cross-sectoral perspective and allows trends in biomass usage to be more easily tracked, helping to inform more integrated policy development (38). While these policies set an ambitious agenda, effective national-level implementation, harmonized monitoring systems and integrated biomass accounting are essential to fully realize their potential (39–41).

The policies in the cluster "Industry, Digitalisation and Development" (**Table 6**) play a central role in driving Europe’s transition towards a green and circular economy.

Table 6: Overview of relevant European policies for the Bioeconomy in the category "Industry, Digitalization, and Development". Color-coding: Darker shade = legally binding; lighter shade = not legally binding.

Name of policy	Scope	Relevance	Reference
Industry, Digitalization & Development			
EU Industrial Strategy (2020/2021)	<ul style="list-style-type: none"> Focus on green and digital transition to get closer to the goal of climate neutrality Decrease dependency on external suppliers for fair global competition Focus on value chains and critical raw primary materials and strategic dependencies 2021 update: industrial ecosystem approach 	<ul style="list-style-type: none"> Promotion of circular economy and their business models Support industrial alliances by cross-sectoral collaborations Encourage symbiotic practices in specific sectors (e.g., chemicals) Support and funding for small and medium businesses 	<p>A NEW INDUSTRIAL STRATEGY FOR EUROPE</p> <p>European Industrial Strategy - Overview</p> <p>A new Industrial Strategy for a globally competitive, green and digital Europe</p> <p>Updating the 2020 New Industrial Strategy</p>



<p>Smart Specialization Strategies (S3)</p>	<ul style="list-style-type: none"> • Focus on specific characteristics and varying innovation capacity of each region • Involvement of stakeholders to develop demand-driven and (region) tailored strategies • Identification of areas with no to little possibility for development so far, as well as regional strengths and weaknesses • Aims to bridge the gap between research and market application (collaboration among universities, research institutions, and businesses) 	<ul style="list-style-type: none"> • Encourage cross-sectoral innovation and collaborations • Focus on regional needs (targeting of specific industrial synergies based on local industrial ecosystems and resources) • Boost rethinking and reevaluating of existing value chains and resource flows 	<p>S3 - Overview</p>
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The *EU Industrial Strategy* supports cross-sectoral collaboration and promotes circular business models and industrial symbiosis. It also provides targeted support for small and medium-sized enterprises, which are important actors in advancing bio-based innovation. *Smart Specialisation Strategies* aim to strengthen regional innovation by building on existing economic structures and identifying promising areas for future development. However, their success depends on how well they align with local knowledge capacities and governance conditions. In many regions, especially those with weaker institutional frameworks, implementation remains difficult. A more regional-based and adaptive policy approach is needed to ensure these strategies deliver their intended impact (42).

Despite these efforts, key policy gaps remain. The bioeconomy is not yet sufficiently integrated into industrial strategies. The mobilization of bio-based resources, the scaling of biorefineries, and the coordination of sustainable biomass flows require more explicit support. Industrial symbiosis also faces practical barriers, such as **inconsistent definitions, limited data sharing, and a lack of dedicated funding mechanisms**. Closing these gaps is essential to unleash the full potential of industrial innovation for a sustainable European bioeconomy (15,37,43). The EU introduced two major initiatives in early 2025, which we have deliberately not included in Table 6, as they were not developed within the framework of the Green Deal or the Bioeconomy Strategy, which were our main focus: the Competitiveness Compass and the Clean Industrial Deal, to address some of these gaps. The Compass emphasizes the upcoming Bioeconomy Strategy and Biotech Act as key to boosting bio-based sectors and rural development. The Clean Industrial Deal mobilizes €100 billion to support industrial decarbonization, promote recycled and bio-based materials, and strengthen circular resource use across European industries (44).

The policies deriving from the EU Green Deal on packaging and packaging materials is pivotal in advancing the transition towards a circular and bio-based economy. Key legislative instruments listed in **Table 7**, such as the *Packaging and Packaging Waste Regulation (PPWR)*, the *Regulation on Recycled Plastic Materials in Food*



Contact, and the *Single-Use Plastics Directive* aim to minimize environmental impacts, improve recyclability and reuse, and stimulate innovation in sustainable packaging solutions. The *EU Policy Framework on Biobased, Biodegradable and Compostable Plastics (2022)* further contributes by setting clear sustainability requirements and ensuring that bio-based plastics do not compete with food systems.

Table 7: Overview of relevant European policies for the Bioeconomy in the category “Packaging and Packaging Materials”. Color-coding: Darker shade = legally binding; lighter shade = not legally binding.

Name of policy	Scope	Relevance	Reference
Packaging & Packaging Materials			
Packaging and Packaging Waste Directive 94/62/EC & Packaging and Packaging Waste Regulation 2025/40	<ul style="list-style-type: none"> Regulation of packaging, packaging waste management and prevention measures Targets for recyclable and reusable packaging 	<ul style="list-style-type: none"> Minimizing packaging and waste quantities, therefore reducing the use of primary materials (transition to a circular, sustainable economy) Boosts the use of sustainable and bio-based materials 	DIRECTIVE 94/62/EC REGULATION (EU) 2025/40 Packaging Waste Overview -
Regulation (EU) 2022/1616 on recycled plastic materials and articles intended to come into contact with foods	<ul style="list-style-type: none"> Establishes strict rules for the safety, traceability, and use of recycled plastics in food-contact materials, ensuring consumer protection 	<ul style="list-style-type: none"> Promotes high-value recycling, boosting the use of bio-based and recycled materials in packaging Encourages industrial symbiosis via integration of food-grade recycling into bioeconomy value chains Supports innovation in bio-plastic alternatives 	REGULATION (EU) 2022/1616
Single-Use Plastic Directive (EU) 2019/904	<ul style="list-style-type: none"> Prevention and reduction of the impact of single-use plastics Most effective measures for each specific, targeted product (e.g., plastic bags, etc.) 	<ul style="list-style-type: none"> Promotion of innovation and sustainable alternatives (bio-based materials) Waste and plastic reduction Encouragement of cross-sectoral collaborations for 	DIRECTIVE (EU) 2019/904



	<ul style="list-style-type: none"> ● Exchange of targeted products with bio-based alternatives or limitation of usage if not available 	developing eco-friendly packaging	Single-use Plastics - Overview
EU Policy Framework on biobased, biodegradable and compostable plastics (2022)	<ul style="list-style-type: none"> ● Clarification of the terms biobased, biodegradable and compostable plastics ● Promotion of truly sustainable biobased plastics that is noncompeting with food production ● Strict conditions for biodegradable plastics ● Guidance on consumer communication 	<ul style="list-style-type: none"> ● Resource efficiency and waste valorization ● Promotes the creation of new value chains ● Process integration to maximize material recovery and minimize landfill/incineration ● Promotes innovation networks and cross-sectoral collaboration 	EU POLICY FRAMEWORK ON BIOBASED, BIODEGRADABLE AND COMPOSTABLE PLASTICS Biobased, biodegradable and compostable plastics - Overview
Plastics Strategy (2018)	<ul style="list-style-type: none"> ● Transformation of plastic design, production, usage and recycling in the EU ● Reduction of marine litter, GHG emissions and dependence on fossil fuels ● Support of sustainable and safer consumption and production patterns for plastics, as well as innovation and investment 	<ul style="list-style-type: none"> ● Encourages innovation in bio-based and biodegradable plastics ● Company and cross-sectoral collaborations for alternative plastic material development and optimization of resource use ● Establishment of closed-loop supply chains 	Commission Communication - PLASTICS STRATEGY Staff Working Document - PLASTICS STRATEGY Plastics Strategy - Overview
EU Algae Initiative	<ul style="list-style-type: none"> ● Increase sustainable algae production across the EU ● Boost algae in food, feed, pharma and materials ● Strengthen innovation, research, and technology transfer – Encourage product 	<ul style="list-style-type: none"> ● Cross-sectoral collaboration ● Waste-to-Resource Synergy which fosters waste reduction ● Waste utilization from other industries for algae production and growth 	TOWARDS A STRONG AND SUSTAINABLE EU ALGAE SECTOR About the EU Algae Initiative



	development and industrial applications <ul style="list-style-type: none"> Harmonize regulations and safety standards 	<ul style="list-style-type: none"> Algae as input for bio-based products (e.g. bio-based plastic alternatives) 	
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Recent analyses indicate that bioplastics are often regulated with the same restrictions as fossil-based plastics, despite their lower environmental risks (45). This signals a misalignment between scientific evidence and precautionary regulation. While bioenergy is increasingly supported, bio-based materials and products continue to face regulatory and market disadvantages. Without incentives such as fair pricing for fossil resources or targeted support for bio-based innovations, the bio-based sector risks stagnation, undermining key principles of the Green Deal, such as decoupling growth from resource use and reducing greenhouse gas emissions (46,47).

Ensuring the competitiveness and development of the bioplastics industry requires guaranteed access to affordable, high-quality feedstocks and biomass. This calls for an integrated EU policy approach that levels the playing field for industrial biomass use. To accelerate the shift towards a sustainable circular bioeconomy, further measures are essential: harmonized sustainability criteria, tailored *Extended Producer Responsibility (EPR)* schemes, improved eco-design guidelines, and clear end-of-life standards and labelling. Without these, the deployment of biodegradable bioplastics and circular value chains will remain inconsistent and limited (48).

The policies listed in **Table 8** on Waste and Circular Economy forms a cornerstone of the EU's broader transition to a resource-efficient and climate-neutral economy. They share a common objective: to prevent and reduce waste, promote high-value recycling, and strengthen markets for secondary raw materials, all of which are essential enablers of the circular bioeconomy.

Table 8: Overview of relevant European policies for the Bioeconomy in the category "Waste Management and Circular Econom". Color-coding: Darker shade = legally binding; lighter shade = not legally binding.

Name of policy	Scope	Relevance	Reference
Waste Management & Circular Economy			
Ecodesign for Sustainable Products Regulation (ESPR) (Regulation (EU) 2024/1781)	<ul style="list-style-type: none"> Sustainability criteria for products improving their circularity, energy performance, recyclability and durability Framework for ecodesign requirements Development of a strong, well-functioning single market for sustainable products in the EU 	<ul style="list-style-type: none"> Enhanced resource efficiency (by using secondary raw materials, by-products and waste as input) Support of material exchange between businesses Introduction of DPP (Digital Product Passport) making identification of potential by-product uses easier 	REGULATION (EU) 2024/1781 Ecodesign for Sustainable Products Regulation - Overview



<p>Landfill Directive (EU) 2018/850</p>	<ul style="list-style-type: none"> • Prevention and reduction of landfill waste (especially biodegradable waste) • Encourage the separate collection of waste to improve recycling rates • Upgraded waste management practices • Monitoring and reporting landfill data of member states 	<ul style="list-style-type: none"> • Waste reduction forcing industries to find alternative methods and foster innovation • Cross-sectoral collaboration enhancing material efficiency and using waste as a resource 	<p>DIRECTIVE (EU) 2018/850</p> <p>Landfill Directive - Overview</p>
<p>Waste Framework Directive (2008/98/EC)</p>	<ul style="list-style-type: none"> • Basic Principles of waste management • 5-step waste hierarchy • Introduction of “polluter pays principle” and “extended producer responsibility” 	<ul style="list-style-type: none"> • Definition of end-of waste criteria and by-products (e.g., possible reclassification of biomass) • Encouragement of the recovery and reuse of (biomass) residues • Prioritization of high-value applications before energy recovery 	<p>DIRECTIVE 2008/98/EC</p> <p>Waste Framework Directive - Overview</p>
<p>Circular Economy Action Plan (2020)</p>	<ul style="list-style-type: none"> • Initiatives along the entire life cycle of products • Transformation and modernization to a circular economy • Sustainable product design 	<ul style="list-style-type: none"> • Waste reduction and resource efficiency • Support of sustainable, circular, bio-based materials and innovations 	<p>A NEW CIRCULAR ECONOMY ACTION PLAN</p> <p>Circular Economy Action Plan - Overview</p>

The *Waste Framework Directive* remains the foundation of EU waste legislation, emphasising waste prevention and the prioritization of recovery and reuse. As of 2024, only 26% of the theoretical bio-waste potential is captured across the EU Member States, revealing a significant gap in practice. The *Bio-based Industries Consortium* and others are calling for binding EU targets for both the quality of collected bio-waste and residual waste limits per capita to improve this performance (49). Similarly, the *ESPR* brings significant progress in promoting circular design but has been criticized for not explicitly including renewability of raw materials as a design criterion, despite its importance for bio-based value chains. Stakeholders such as the Swedish forest industry argue that omitting renewability disadvantages sustainable bio-based products like fibre-based packaging and wood-based textiles (50). Moreover,



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challenges such as the low cost of virgin fossil-based materials, an underdeveloped single market for secondary materials, and weak enforcement across Member States hinder the systemic impact of the current policy mix. Eurocities (2024) stresses that stronger legislation and better enforcement of existing directives are needed to bridge this gap and boost innovation and infrastructure for sustainable waste systems (51). Lastly, effective waste and resource governance must be multi-level and cross-sectoral. The sustainable transition of bio-based systems depends on aligning local strategies, product design, and EU-wide regulations through integrated governance approaches, not on isolated measures (52).

In conclusion, while the EU waste and circular economy policies provide a strong foundation, realising their potential for the bioeconomy requires enforceable quality standards and collection targets for bio-waste; stronger emphasis on renewable resources in ecodesign; and systemic coordination across all levels of policy to unlock synergies and promote sustainable, circular material flows.

3.2. The European Green Deal and the Bioeconomy Strategy – Regulatory Map

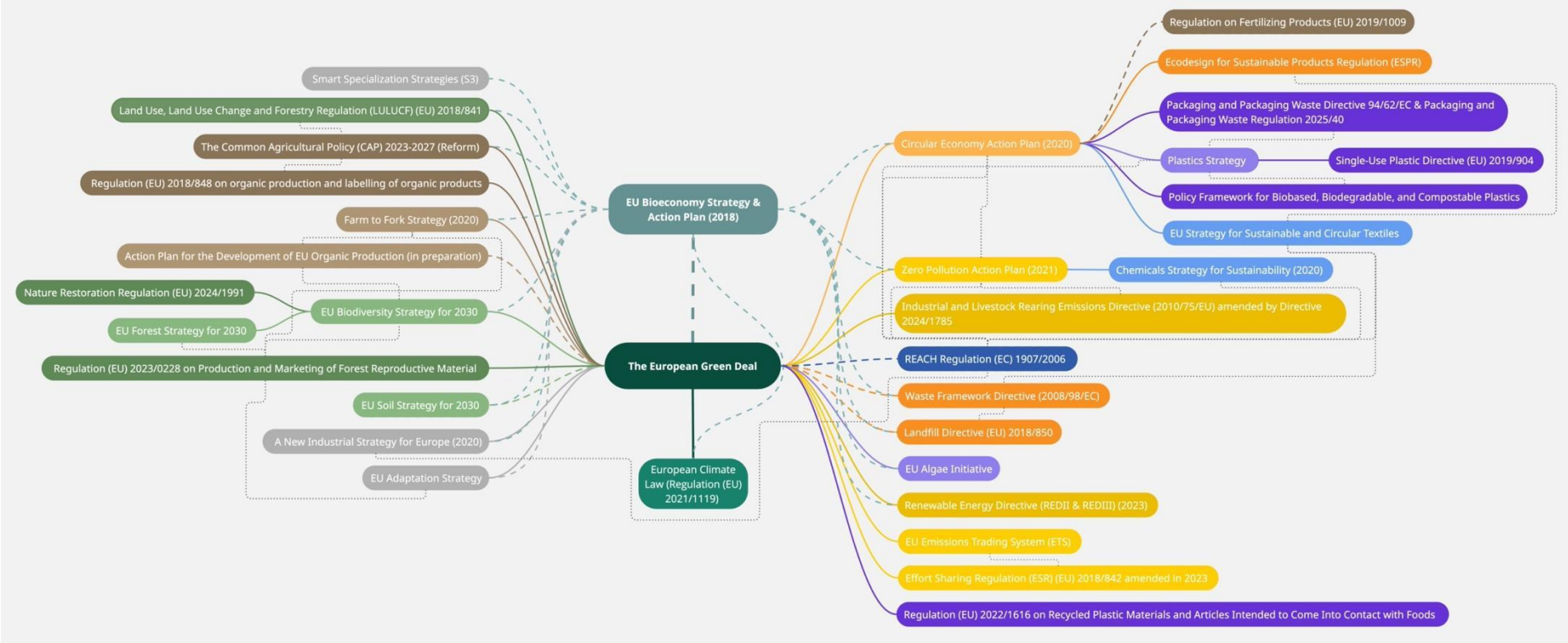


Figure 2: Regulatory Map of the European Green Deal and the Bioeconomy Strategy relevant for the Bioeconomy: Colour-coding according to categories in the EU policy table. Brown = Agriculture, Greenish Blue = Bioeconomy, Blue = Chemicals and Textiles, Yellow = Energy and Climate, Green = Forestry, Land Use and Nature, Grey = Industry, Digitalisation and Development, Purple/Pink = Packaging and Packaging Materials, Orange = Waste Management and Circular Economy; Darker shade = legally binding (mostly Directives & Regulations); Lighter Shade = not legally binding (mostly Strategies and Action Plans); continuous lines = policies directly connected (also possible: one policy originating from the other) and often mentioned each other in their scope; dashed line = contributing to each other's goals or somewhat/not directly connected policies; dotted lines = policies influencing each other.



Our regulatory map (**Figure 2**) offers a comprehensive visual overview of the EU policies influenced by the European Green Deal and the Bioeconomy Strategy that shape the framework for industrial symbiosis in the bioeconomy. It consolidates the diverse policy instruments discussed in *Chapter 3.1* and organizes them according to sectoral relevance, making interlinkages and thematic overlaps more readily apparent.

The clustering by thematic areas reflects the multifaceted nature of bio-based value chains and underscores the importance of cross-sectoral policy coherence. It also visualizes the synergies between different thematic areas. For example, the *Farm to Fork Strategy*, the *Fertilising Products Regulation*, and the CAP highlight how agricultural policy can support resource efficiency, nutrient recycling, and circular practices. Similarly, policies such as the *Renewable Energy Directive* and the *EU Emissions Trading System* reinforce the contribution of bio-based systems to emission reduction goals.

What is also apparent is how the Circular Economy Action Plan serves as a crucial basis for several legislative acts that strongly influence other policy areas, particularly those related to textiles, plastics, and chemicals.

The regulatory map clearly demonstrates the central importance of the bioeconomy for the European Green Deal. This visual interconnection reinforces the bioeconomy’s role as a systemic enabler of sustainability transitions, as already discussed in *Chapter 1.2*. This again confirms that industrial symbiosis is not confined to a single sector but relies on coordinated governance across environmental, economic, and social dimensions. At the same time, the visualization brings to light areas where integration is still limited. Notably, fragmented implementation and the absence of a single, binding regulatory framework for the bioeconomy present challenges for harmonization and systemic uptake.

In summary, the regulatory map serves as a valuable tool to identify policy synergies and gaps, laying the foundation for the more targeted assessment of enabling and hindering factors in SYMBIO’s upcoming deliverables.

3.3. EU Funding Instruments supporting the Bioeconomy

Public and private investments are essential drivers for advancing the bioeconomy and scaling sustainable, circular solutions across Europe. The European Union recognizes funding as a critical enabler for the transition towards a climate-neutral, resource-efficient economy and has embedded this priority in both the European Green Deal and the EU Bioeconomy Strategy.

Table 9 provides an overview of key EU funding programmes relevant to the bioeconomy based on our desk research, grouped by type of activity and funding mechanism.

Table 9: Overview of European Funding Instruments supporting the Bioeconomy

Type of activity	Funding programme	Programme description	Type of Funding	Reference
Research and Innovation	Horizon Europe	Cluster 5 - Climate, Energy and Mobility: Supports research and innovation	Grant	Horizon Europe Cluster 5: Climate, Energy and Mobility



		to accelerate the green transition by fostering climate action etc. Cluster 6 - Food, Bioeconomy, Natural Resources, Agriculture and Environment: Focuses on sustainable resource management, resilient food systems, biodiversity protection, and the transition to a circular bioeconomy.		Cluster 6: Food, Bioeconomy, Natural Resources, Agriculture and Environment
Research and Innovation	CBE JU - Circular Bio-based Europe	funds projects advancing competitive circular bio-based industries under Horizon Europe	Grant	Circular Bio-based Europe - Joint Undertaking
Implementation	LIFE	supports environment and climate action projects, including biodiversity and circular economy	Grant	LIFE Programme
Breakthrough Innovation and Development	Innovation Fund	supports deployment of net-zero and innovative technologies e.g. transition of energy-intensive industries to renewable energies deriving from biomass	Grant	INNOVATION FUND
Development of breakthrough innovations from mainly start-ups and SMEs	European Innovation Council	supports game changing innovations throughout the lifecycle from early stage research, to proof of concept, technology transfer, and the financing and scale up of start-ups and SMEs	Grant / Equity / Blended finance	EIC Funding opportunities
Investment	European Agricultural Guarantee Fund (EAGF)	direct income support to farmers under CAP; managed via national strategic plans	Grant	The Common Agricultural Policy: an overview
Investment	European Agricultural Fund for Rural Development (EAFRD)	funds socio-economic and environmental interventions. Managed in the national CAP strategic plan	Grant	Common agricultural policy funds
Investment	European Maritime,	supports innovative projects that contribute to the sustainable	Grant	European Maritime, Fisheries and



	Fisheries and Aquaculture Fund (EMFAF)	exploitation and management of aquatic and maritime resources. Funds are managed by the national authorities.		Aquaculture Fund (EMFAF)
Investment	European Investment Bank Group	invest in projects that develop innovative, sustainable agricultural practices and technologies, make food production more sustainable and efficient, as well as enhances access to finance for farmers, micro-enterprises and small businesses	Loan/Equity	European Investment Bank Group - Agriculture and the bioeconomy
Investment	Cohesion Fund	supports investments in the field of environment and trans-European networks in the area of transport infrastructure (TEN-T) for less developed countries. For the 2021-2027 period, the Cohesion Fund concerns Bulgaria, Czechia, Estonia, Greece, Croatia, Cyprus, Latvia, Lithuania, Hungary, Malta, Poland, Portugal, Romania, Slovakia and Slovenia. The Member States' administrations choose which projects to finance.	Grant	Cohesion Fund
Investment	European Circular Bioeconomy Fund	investing in growth-stage companies in the European bioeconomy, including the circular bioeconomy. Supported by the European Investment Bank (EIB), the fund aims to make sustainable investments in our future and speed up the shift from a fossil-based to a bio-based circular economy.	Equity	ECBF European Circular Bioeconomy Fund (ECBF)



According to the EU Horizon project [ShapingBio](#) (53), EU funding programmes such as Horizon Europe, CBE JU, and the European Circular Bioeconomy Fund have played a key role in supporting early-stage bioeconomy innovations and cross-border cooperation. National and regional schemes also support local bioeconomy needs, but there is still a lack of support for scaling innovations and bringing them to market. At the same time, private investment in areas like synthetic biology is growing, but faces barriers such as regulatory fragmentation, unclear definitions, and high-risk perceptions. The following eight gaps were identified:

1. **Long time spans between development of funding programmes and project implementation** which affects efficiency and importance of funding for bioeconomy ventures. For example, the timeline of Horizon Europe considering its proposal in 2018 to the adoption in 2020 shows these extensive delays in developing important funding mechanisms.
2. **Administrative and regulatory burden for public funding** often hinders both investors and companies in applying for European or national funding programmes. Complex and time-consuming funding procedures further discourage smaller startups from accessing available public support.
3. **A lack of alignment between public and private funding** persists, as public support primarily targets long-term research and development, while private investors focus on scalable opportunities with short-term return potential.
4. **Biobased products face difficulties entering markets** due to competition from cheaper, fossil-based alternatives, due to high financial support for the fossil-based industry.
5. There is a **lack of sufficient early-stage financing for start-ups and SMEs**, which are often seen as high-risk due to uncertainties in technology readiness and market potential.
6. The European funding mechanisms face a significant **gap between innovation and market deployment** hindering large-scaling and commercialization of biobased products.
7. There is a **shortage of skilled workers and targeted support** for developing entrepreneurial capacity within bioeconomy companies, limiting their growth potential.
8. A **gap in follow-up funding for the same project**, even when further development is needed, hindering continuous innovation across maturity phases (53).

In the [EU Funding and Tenders Portal](#) (54) the main search engine provided by the European Commission for funding opportunities) the results for “bioeconomy” were mostly limited to Horizon Europe and two closed calls under the Maritime and Fisheries Fund. This highlights a structural limitation: There is currently no centralized EU tool that offers a complete and user-friendly overview of all funding instruments relevant to the bioeconomy, regardless of applicant type. As a result, stakeholders must rely on prior experience or conduct time-intensive online research.

In addition to the challenges already outlined above, professional funding advisory services are often crucial to successfully securing EU grants. However, such services are frequently unaffordable for smaller companies and early-stage innovators, creating further barriers to equitable access to funding. An important leverage point in this context are the [National Contact Points \(NCPs\)](#) (55) of the Member States, which can play a key role in supporting stakeholders throughout the application process, by offering guidance, clarifying eligibility criteria, and helping navigate administrative requirements. Strengthening the capacity of these NCPs could significantly improve access to funding, particularly for less experienced applicants.



4. Analysis of Policy Frameworks supporting the bioeconomy and industrial symbiosis in SYMBIO Pilot Regions

This chapter provides an overview of the national and regional policy frameworks relevant to the bioeconomy and industrial symbiosis in the SYMBIO pilot regions. The analysis follows the same structure and thematic clustering as used in the EU-level regulatory overview in *Chapter 3.1*.

To ensure thematic focus, the mapping of national policies concentrated primarily on those regulations and strategies that are directly relevant to the bioeconomy and industrial symbiosis. Particular attention was given to legal frameworks related to waste management, including end-of-waste regulations, as well as policies explicitly addressing resource sharing, circularity, and the bio-based economy. This targeted approach allowed for a structured identification of enabling and hindering factors specific to material flows, cross-sectoral use of by-products, and systemic circularity, while avoiding dilution through broader environmental or economic legislation with only indirect relevance to SYMBIO's objectives.

To facilitate navigation within the tables, the same colour-coding system (explained in Chapter 2.2) is applied used in the EU policy overview. Policies related to agriculture are marked in brown, bioeconomy in greenish blue, chemicals and textiles in blue, energy and climate in yellow, forestry, land use and nature in green, industry, digitalisation and development in grey, packaging and packaging materials in purple, and waste management and circular economy in orange. The intensity of the colour reflects the legal character of the policy: darker shades indicate legally binding instruments, such as directives and regulations, whereas lighter shades stand for non-binding frameworks like strategies and action plans.

4.1. Italy

Italy demonstrates a particularly strong and consistent focus on the bioeconomy at the national level. Its bioeconomy strategy is among the most advanced and frequently updated in Europe, reflecting a clear political will to position bio-based innovation and circular resource use as key drivers of sustainable development. National policy coverage is broad, addressing nearly all relevant thematic areas with particular emphasis on the bioeconomy, industry, innovation, and waste management.

However, while Italy's national strategies show a high level of ambition and are rich in content, not all of them are yet anchored in legally binding frameworks. Several important instruments, particularly in the areas of bioeconomy and circular economy, remain at the level of strategies or non-binding action plans. This may limit their enforceability and create uncertainty in implementation, especially at regional and local levels.

Looking at the regional perspective, a clear contrast becomes visible. While national frameworks are highly developed, the regional landscape is more fragmented. The SYMBIO pilot regions in Italy show considerable variation in terms of policy development and implementation. Some regions actively support industrial innovation and waste valorisation, while others still lack dedicated strategies addressing circular bio-based value chains. Among them, Emilia-Romagna stands out as the most ambitious. For instance, the region has adopted a Law dedicated to circular economy and provides a legal foundation for advancing circular economy models in waste management. Notably, no region has a dedicated bioeconomy strategy,



indicating that the topic is currently approached in a top-down manner, driven primarily by national initiatives.

Overall, Italy’s policy landscape reveals a strong commitment to the principles of the Green Deal and the bioeconomy. The existence of comprehensive national strategies provides a solid foundation, but more consistent legal anchoring and stronger regional engagement will be essential to translate ambition into practice.

4.1.1 National Policies Supporting the Bioeconomy and Industrial Symbiosis

Italy demonstrates a particularly advanced and structured approach to the development of the bioeconomy at the national level. Over the past decade, it has adopted multiple strategies and policy instruments that explicitly promote the sustainable use of biological resources, the development of bio-based value chains, and the transition towards a circular economy. The national bioeconomy strategy is one of the most mature in Europe and is regularly updated, reflecting strong political commitment and institutional awareness of the sector’s transformative potential.

Table 10 presents the main national-level policies in Italy relevant to SYMBIO’s objectives, highlighting their scope, relevance, and legal status.

Table 10: National policies supporting the bioeconomy and industrial symbiosis in Italy.

Name	Publishing Year	Scope	Reference
CAP Strategy Plan Italy (2023-2027)	2021	Promotes sustainable farming, innovation, and rural development. Supports biobased products and resource efficiency. Ensures income support and social inclusion.	At a glance: Italy's CAP Strategic Plan
Strategic Action Plan on Innovation & Research in Agriculture, Food and Forestry Sectors (2014-2020)	2015	Focuses on sustainable innovation, climate action, and food system integration. Supports biorefineries, local products, and traceability. Encourages research, knowledge exchange, and stakeholder networks.	Strategic Plan for Innovation and Research in the Agricultural, Food and Forestry Sectors
National Strategy for Bioeconomy – BIT I (2019-2030)	2019	Promotes circular economy and aims for growth in the bioeconomy sector. Targets public awareness, local engagement, and environmental regeneration. Builds alignment with EU goals.	BIT I – Bioeconomy in Italy
National Strategy for Bioeconomy – BIT II	2019	Establishes Italy’s vision for a sustainable and circular bioeconomy. Emphasizes resource efficiency, biowaste valorization, and stakeholder engagement. Aligns with EU strategies and includes a roadmap with regulatory and financial frameworks.	BIT II – Bioeconomy in Italy



Implementation Action Plan (2020-2025) for the National Bioeconomy Strategy BIT II)	2021	Translates the strategy into action via pilot projects in key bioeconomy sectors. Promotes ecosystem regeneration and identifies flagship initiatives like biowaste valorization and industrial site reconversion. Strengthens awareness, education, and entrepreneurship.	IMPLEMENTATION ACTION PLAN (2020-2025) FOR THE ITALIAN BIOECONOMY STRATEGY BIT II
Updated Implementation Action Plan (2025-2027) for the National Bioeconomy Strategy BIT II	2024	Focuses on employment, innovation, and ecosystem restoration. Emphasizes sector integration, flexible regulation, and market creation for bio-based products. Aligns with circular economy principles.	UPDATED IMPLEMENTATION ACTION PLAN (2025-2027) FOR THE ITALIAN BIOECONOMY STRATEGY BIT II
Integrated National Energy and Climate Plan (2021-2030)	2019	Sets targets for GHG reduction, renewables, and energy efficiency. Improves energy infrastructure and supports research & development in clean technologies. Coordinates national and EU climate policies.	INTEGRATED NATIONAL ENERGY AND CLIMATE PLAN
National Law on Forests – Legislative Decree No. 34 of 3 April 2018	2018	Ensures sustainable forest management and biodiversity conservation. Recognizes forests in climate policy and promotes rural economic development. Sets governance and monitoring frameworks.	LEGISLATIVE DECREE 3 April 2018, n. 34
Marine Environmental Strategy – Legislative Decree 190/2010	2010	Implements the EU Marine Strategy Framework Directive to achieve good marine environmental status. Involves monitoring, target setting, and cooperation with EU states. Focuses on biodiversity and marine ecosystem health.	LEGISLATIVE DECREE 190/2010
National Biodiversity Strategy (2011-2020)	2010	Aims to stop biodiversity loss with a cross-sectoral approach involving agriculture, tourism, and urban planning. Promotes governance and stakeholder cooperation. Aligned with EU and UN biodiversity goals.	NATIONAL BIODIVERSITY STRATEGY 2020
National Biodiversity Strategy 2030	2023	Aims to halt biodiversity loss by restoring ecosystems and expanding protected areas. It aligns with EU and global goals (e.g., EU Biodiversity Strategy 2030), integrating biodiversity into key policies. It promotes cross-sectoral collaboration, involving various stakeholders and governance bodies for effective implementation.	NATIONAL BIODIVERSITY STRATEGY 2030



National Recovery and Resilience Plan (2021-2026)	2021	Aims to digitalize, decarbonize, and modernize Italy's economy. Includes circular economy, green mobility, and bioeconomy investments. Targets territorial cohesion and innovation.	DECREE-LAW 6 May 2021, n. 59
National Smart Specialization Strategy (SNSI)	2016	Encourages regional innovation aligned with priorities. Focuses on governance, cooperation, and territorial development. Supports inner areas and smart specialization.	THE NATIONAL SMART SPECIALIZATION STRATEGY
National Strategy for Sustainable Development (2017-2030) (Strategia Nazionale di Sviluppo Sostenibile)	2017	Anchored on five pillars: People, Planet, Prosperity, Peace, and Partnership. Includes governance reforms and sustainability monitoring. Integrates SDG's and EU strategies.	STRATEGIA NAZIONALE DI SVILUPPO SOSTENIBILE National Strategy for Sustainable Development - Overview
Environmental Code - Legislative Decree 152/2006 (Codice dell'Ambiente)	2006	Core environmental law covering waste, air, water, and end-of-waste criteria. Defines by-products and promotes circular resource flows. Reflects and enforces EU environmental directives.	DECRETO LEGISLATIVO 3 aprile 2006 , n. 152 Decree 152/2006 - Overview Circular Economy Platform
Law No. 221/2015 - Environmental Provisions to promote green economy measures and to limit the excessive use of natural resources	2015	Supports green innovation, by-product use, and sustainable resource use. Introduces environmental criteria in procurement and education. Encourages citizen involvement and eco-innovation incentives.	LAW 28 December 2015, n. 221
Green Public Procurement (GPP) National Action Plan (NAP)	2013	Promotes resource efficiency and green procurement through mandatory environmental criteria. Includes stakeholder engagement and training. Supports national law and EU directives.	GPP NAP
National Strategy for Circular Economy	2022	Supports industrial symbiosis, resource efficiency, and circular production. Emphasizes innovation,	STRATEGIA NAZIONALE PER



		SME support, and legislative tools. Integrates bioeconomy with agriculture and food systems.	L'ECONOMIA CIRCOLARE National Strategy for the Circular Economy
Towards a Model of Circular Economy for Italy	2017	Advocates for a national shift to circular models in production and consumption. Proposes fiscal instruments and public sector reforms. Supports waste as a resource and indicator development.	Towards a Model of Circular Economy for Italy

4.1.2 Regional Policies Supporting the Bioeconomy and Industrial Symbiosis

In Italy, regional authorities play a critical role in shaping and implementing bioeconomy-related policies, particularly in areas such as waste management, industrial development, and research and innovation. This decentralised governance model allows regions to tailor their strategies to local resource endowments, industrial structures, and socio-economic priorities. However, it also leads to significant heterogeneity in policy development and implementation across territories.

The analysis of the SYMBIO pilot regions—Lombardy, Piedmont, Veneto, Friuli-Venezia Giulia, and Emilia-Romagna—reveals a diverse landscape of regional initiatives supporting the bioeconomy and industrial symbiosis. While some regions have adopted advanced frameworks and dedicated funding schemes to promote circularity and the valorisation of bio-based resources, others remain at a preliminary stage of strategic planning or integrate bioeconomy objectives only indirectly through broader sustainability or innovation agendas.

This section provides a comparative overview of the most relevant regional policy instruments across the selected territories (**Table 11-15**).

Lombardy

Table 11: Regional policies supporting the bioeconomy and industrial symbiosis in Lombardy, Italy.

Name	Publishing Year	Scope	Reference
Regional Strategy for Sustainable Development	2021	Aligns Lombardy's development policies with the UN 2030 Agenda, promoting sustainability across economic, social, and environmental dimensions. It aims to integrate SDGs into regional planning with specific goals for green transition, social inclusion, and innovation. Key priorities include	STRATEGIA REGIONALE PER LO SVILUPPO SOSTENIBILE



		climate resilience, circular economy, and reducing inequalities.	
Smart Specializations Strategy – S3 (2021-2027)	2014	Focuses on concentrating resources in innovation and technology domains where the region has competitive advantages. It supports economic transformation through research and development, digitalization, and industrial modernization. Key areas include advanced manufacturing, health, agrifood, and sustainable mobility.	Summary of Lombardy Region’s Smart Specialisation Strategy
Waste Management and Remediation in Lombardy Region – Plan “Toward the Circular Economy”	2022	Promotes sustainable waste management and the transition to a circular economy. It sets quantitative targets for waste reduction, recycling, and energy recovery. The approach integrates environmental protection with economic development and citizen engagement.	WASTE MANAGEMENT AND REMEDIATION IN LOMBARDY REGION

Piedmont

Table 12: Regional policies supporting the bioeconomy and industrial symbiosis in Piedmont, Italy

Name	Publishing Year	Scope	Reference
Regional Programme ERDF Piedmont (2021-2027)	2022	Finances innovation, energy transition, and urban regeneration to boost regional competitiveness. It focuses on SME development, digital skills, and climate resilience. Resources are prioritized for sustainable infrastructure, smart cities, and inclusive growth.	The Regional Programme ERDF Piedmont 2021-2027
Regional Strategy for Sustainable Development	2021	Supports the implementation of the 2030 Agenda through integrated policies targeting environmental, social, and economic sustainability. It identifies strategic areas such as biodiversity, energy transition, and social equity. The framework also emphasizes local stakeholder participation and monitoring.	STRATEGIA REGIONALE PER LO SVILUPPO SOSTENIBILE DEL PIEMONTE
Rural Development Complement (CSR) (2023-2027)	2023	Complements EU rural policy by enhancing competitiveness, environmental stewardship, and rural quality of life. It supports innovation, climate action, and sustainable farming. Measures include agro-environmental	Complemento Sviluppo Rurale (CSR) della Regione Piemonte



		practices, digital transition, and generational renewal in agriculture.	
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Veneto

Table 13: Regional policies supporting the bioeconomy and industrial symbiosis in Veneto, Italy.

Name	Publishing Year	Scope	Reference
Regional Strategy for Sustainable Development	2020	Aligns regional planning with the 2030 Agenda, integrating environmental, economic, and social sustainability. It prioritizes climate change mitigation, resource efficiency, and social equity. Public engagement and monitoring are core elements of the implementation framework.	la STRATEGIA REGIONALE PER LO SVILUPPO SOSTENIBILE
RP Veneto ERDF (2021-2027)	2021	Supports economic, social, and territorial cohesion through innovation, digital transformation, and green transition. It funds projects on SMEs, energy efficiency, and urban regeneration. The plan emphasizes balanced development and environmental sustainability.	RP Veneto ERDF 2021-2027 - Overview
Smart Specialization Strategy - S3	2014	Promotes regional innovation by focusing resources on sectors with strong competitive potential. It aims to strengthen entrepreneurial discovery, research collaboration, and industrial modernization. Key domains include smart agrifood, sustainable living, creative industries, and sustainable manufacturing.	S3 Strategy

Friuli-Venezia Giulia

Table 14: Regional policies supporting the bioeconomy and industrial symbiosis in Friuli-Venezia Giulia, Italy.

Name	Publishing Year	Scope	Reference
Regional Strategy for Innovation and Smart Specializations - S3 (2014-2020)	2015	Enhances regional competitiveness through research and development, sectoral innovation, and stakeholder engagement. It identifies key areas such as life sciences, marine technologies, and green chemistry. Smart governance mechanisms guide investment choices and priority setting.	Strategia regionale di ricerca e innovazione per la specializzazione intelligente del Friuli Venezia Giulia



Regional Law 5/2016 - Organization of functions relating to the integrated water service and the integrated urban waste management service	2016	Defines the institutional organization for integrated urban waste and water services. It ensures transparency, efficiency, and environmental responsibility in public service management. Roles and responsibilities are clarified for local authorities and service operators.	REGIONAL LAW 15 April 2016, n. 5
Regional Law 34/2017 - Organic discipline of waste management and principles of circular economy	2017	Introduces principles for waste reduction and circular resource use. It supports reuse, extended producer responsibility, and innovation in waste management. The law guides the transition from linear to circular systems.	REGIONAL LAW 20 October 2017, n. 34
Regional Urban Waste Management Plan	2016	Addresses urban waste collection, processing, and recovery, ensuring service efficiency and environmental impact reduction. It integrates circular economic principles with infrastructure development. The strategy includes authority coordination and technological upgrades.	REGIONAL URBAN WASTE MANAGEMENT PLAN. UPDATE 2022
Regional Waste Management Plan	2006	Sets the regulatory and operational framework for waste treatment, disposal, and recovery. It focuses on minimizing landfill use and optimizing recycling and composting. Environmental protection and compliance with EU directives are central goals.	Regional Waste Management Plan
Regional Waste Prevention Program	2016	Aims to reduce waste generation by promoting reuse, eco-design, and awareness campaigns. It establishes quantitative targets and fosters sustainable consumption models. Prevention measures support the shift toward a circular economy.	Regional Waste Prevention Program

Emilia-Romagna

Table 15: Regional policies supporting the bioeconomy and industrial symbiosis in Emilia-Romagna, Italy.

Name	Publishing Year	Scope	Reference
Approval of the Project "Ecological	2022	Operationalizes the region's carbon neutrality goals by integrating ecological transition across	Administrative Act Detail n. 581



Transition through the Path to Carbon Neutrality before 2050"		all public planning tools. It includes tools for monitoring emissions and coordinating multilevel governance. Education, innovation, and green jobs are strategic levers.	
Approval of the Strategic Document "The Path to Carbon Neutrality before 2050" of Emilia-Romagna Region	2024	Defines the roadmap to achieve net-zero emissions before 2050 in Emilia-Romagna. It includes sector-specific actions for energy, transport, agriculture, and urban planning. Climate adaptation, carbon capture, and behavioral change are key components.	Administrative Act Detail n. 1610
Climate Change Mitigation and Adaption Strategy of the Emilia-Romagna Region (Proposal of the Regional Council dated 30 July 2018, n. 1256)	2018	Outlines a framework for adapting to and mitigating climate change impacts across Emilia-Romagna. It addresses sector vulnerabilities, promotes ecosystem services, and supports carbon reduction. The proposal includes targets, timelines, and cross-sector policies.	LEGISLATURE X - RESOLUTION no. 187 of 20/12/2018
PAIR 2030	2024	Sets emissions reduction goals to improve air quality and reduce health impacts. It covers energy, mobility, agriculture, and industry with measures like low-emission zones and renewable energy promotion. Monitoring and citizen engagement support its implementation.	PAIR 2030
Regional Regulation 3/2018 - Approval of the regional forestry regulation in implementation of ART. 13 of LRN 30/1981	2018	Implements national forestry law to ensure sustainable management of forest resources. It introduces criteria for biodiversity conservation, logging permits, and community forestry planning. The regulation balances economic use and environmental protection.	REGIONAL REGULATION 1 August 2018, n.3
Environmental Action Plan	1999	Established early regional environmental policies on air, water, waste, and biodiversity. It emphasized coordination between environmental protection and development. It laid the groundwork for subsequent sustainability initiatives.	Environmental Action Plan



Regional Strategy “2030 Agenda for Sustainable Development”	2018	Integrates the UN SDGs into regional policy, focusing on environmental resilience, social inclusion, and responsible innovation. It aligns regional programming with long-term sustainability goals. Education, participation, and territorial equity are foundational principles.	Agenda 2030 - Project Description
Smart Specialization Strategy - S3 (2021-2027)	2020	Identifies priority areas for research and innovation to support regional growth and competitiveness. It emphasizes digital transition, climate action, and health sectors. Collaborative innovation ecosystems and public-private partnerships are core to implementation.	Smart Specialisation Strategy (S3)
#PlasticFreER Strategy	2019	Aims to reduce plastic waste and promote sustainable alternatives throughout Emilia-Romagna. It supports local communities, companies, and schools in adopting plastic-free practices. Awareness campaigns, regulatory tools, and incentives are used to shift behaviors.	#PlasticFreER Strategy
Regional Law 16/2015 - Provisions in Support of the Circular Economy, the Reduction of Municipal Waste Production, the Reuse of Goods at the End of their Life, Separate Waste Collection and Amendments to Regional Law 31/1996 (Regulation of the Special Tax for the Storage of Solid Waste in Landfills)	2015	Provides a legal foundation for advancing circular economy models in waste management. It promotes separate collection, reuse, and eco-design to minimize environmental impact. It also modifies prior legislation to enhance resource efficiency and product lifecycle extension.	REGIONAL LAW 05 October 2015, n. 16
GPP Action Plan	2009	Promotes sustainable procurement practices across public administrations in Emilia-Romagna. They include criteria for	GPP Action Plans



		environmentally preferable products and services. The GPP supports market transformation and circular economy goals.	
The Regional Plan for Waste Management and Remediation of Polluted Areas 2022-2027	2022	Sets targets for reducing landfill dependency and increasing recycling rates. It integrates pollution remediation actions with circular economy goals. Key tools include investment in infrastructure, innovation, and stakeholder collaboration.	Waste and Remediation Plan 2022-2027

4.2. Austria

Austria’s policy landscape shows a clear emphasis on waste management and circular economy, both at the strategic and legislative levels. Notably, the country was among the first of all SYMBIO pilot nations to adopt comprehensive national policies in these areas, including early implementation of packaging waste legislation and the development of a national waste management plan. These policies are well-aligned with the goals of industrial symbiosis, focusing on resource efficiency, closed material loops, and regulatory clarity for waste streams.

In contrast to this strong foundation in waste-related policies, Austria’s bioeconomy strategy is comparatively less advanced. While a national bioeconomy strategy exists, it has not been updated for several years. This indicates a need for strategic renewal to reflect current EU priorities and technological developments. Further gaps become visible in other thematic areas. For example, no national policies were identified that explicitly address industrial development, digitalization, or climate-related aspects of the bioeconomy in a targeted way. The national biodiversity strategy is also outdated and would benefit from revision to align with the new European targets. This suggests that Austria, while having a solid environmental policy tradition, faces challenges in updating and integrating its strategies to reflect emerging priorities. Dedicated regional bioeconomy policies in Carinthia could not be identified.

Overall, Austria presents a clear strength in traditional environmental regulation and waste management but currently lacks strategic commitment to circular bioeconomy and innovation. Bridging this gap will require both an update of existing strategies and a stronger connection between national and regional policy instruments.

4.2.1 National Policies Supporting the Bioeconomy and Industrial Symbiosis

Austria has adopted several national strategies that address key aspects of the bioeconomy, with particular strength in waste management and circular economy. Early legislative efforts in these areas—such as the Packaging Ordinance and the national Waste Management Plan—demonstrate Austria’s leadership in establishing clear frameworks for resource efficiency and closed material loops. However, some of the country’s core strategies, including the national bioeconomy and biodiversity strategies, are outdated and in need of revision. Updating these frameworks will be essential to reflect recent EU policy developments



and to integrate emerging priorities such as digitalisation, industrial innovation, and climate-related bioeconomy goals.

Table 16 provides an overview of national-level strategies and policy instruments relevant to advancing the bioeconomy and industrial symbiosis in Austria.

Table 16: National policies supporting the bioeconomy and industrial symbiosis in Austria.

Name	Publishing Year	Scope	Reference
CAP Strategic Plan Austria (2023-2027)	2021	Focuses on sustainable agriculture, rural development, and bioeconomy integration. Encourages renewable energy, innovation, and knowledge transfer. Aligns with the European Green Deal and supports small farms.	At a glance: AUSTRIA'S CAP STRATEGIC PLAN
Bioeconomy - A Strategy for Austria	2019	Focuses on reducing fossil resource dependence and promoting innovation for a sustainable economy. It emphasizes interdepartmental collaboration and stakeholder involvement. The strategy aligns with EU climate policies.	Bioeconomy Strategy for Austria - Overview
Bioeconomy Action Plan	2019	Defines actions across 11 thematic areas to reduce emissions and resource dependency. Supports stakeholder collaboration, innovation, and public awareness. Includes ongoing monitoring and evaluation	Aktionsplan für Bioökonomie
The Austrian Forest Program	2007	Promotes sustainable forest management through ecological, economic, and social balance. It covers climate, biodiversity, forest health, and more across seven key areas. The program defines clear principles, goals, and measures developed with broad stakeholder input.	THE AUSTRIAN FOREST PROGRAMME Austrian Forest Strategy 2020+ - Overview THE AUSTRIAN FOREST PROGRAMME SUMMARY



Biodiversity Strategy Austria 2020+	2014	Aims to conserve the country's biological diversity by halting the loss of species, genetic diversity, and habitats. It outlines five fields of action with twelve specific targets, addressing areas such as sustainable agriculture, pollution reduction, and spatial planning. The strategy supports global biodiversity goals through national and regional cooperation.	BIODIVERSITY STRATEGY AUSTRIA 2020+
Austrian Packaging Ordinance (Verpackungsverordnung)	1996 (last update 2020)	Regulates all packaging in Austria with recycling and reuse targets. Promotes material recovery and bans harmful plastics. Encourages eco-friendly packaging innovations.	VERPACKUNGSVERORDNUNG 2014 Verpackungsverordnung 2014 - Overview and Links
Austrian Waste Management Act (AWG - Abfallwirtschaftsgesetz)	2002 (last update 2021)	Sets legal framework for waste prevention, recycling, and sustainable disposal. Emphasizes separate collection, recovery, and the use of by-products. Supports circular economy and public participation.	ABFALLWIRTSCHAFTSGESETZ 2002 AWG 2002 - Overview and Links
Austrian Circular Economy Strategy (until 2050)	2022	Aims to establish a sustainable, climate-neutral circular economy. Sets specific goals for resource use and outlines regulatory, financial, and digital support tools. Encourages multi-level governance and innovation.	The Austrian Circular Economy Strategy - Overview and Links
The Austrian Sustainable Public Procurement (GPP) Action Plan (Aktionsplan nachhaltige öffentliche Beschaffung)	2010 (last update 2021)	Promotes sustainable procurement aligned with SDG's, focusing on eco-friendly materials and local sourcing. Legally binding for federal institutions. Supports market demand for bio-based products and innovation.	The naBe action plan
Federal Waste Management Plan 2023	2023	Sets Austria's strategy for sustainable waste handling and circular economy goals. It includes waste data, shipment rules, and prevention measures for key sectors. The plan was shaped through public input and supports resource efficiency.	Federal Waste Management Plan 2023 - Overview and Links



4.2.2 Regional Policies Supporting the Bioeconomy and Industrial Symbiosis

Carinthia does not currently have a dedicated regional bioeconomy strategy; however, several environmental regulations and programmes contribute indirectly to the promotion of bio-based and circular practices. The focus lies predominantly on waste management, environmental consulting, and the sustainable treatment of organic materials such as sewage sludge and compost. These regional instruments provide a regulatory foundation for industrial symbiosis by encouraging resource efficiency, safe material reuse, and eco-innovation across sectors.

Table 17 summarises key regional policies and programmes relevant to Carinthia’s contribution to a circular bioeconomy.

Carinthia

Table 17: Regional policies supporting the bioeconomy and industrial symbiosis in Carinthia, Austria.

Name	Publishing Year	Scope	Reference
Regional Program Ökofit Kärnten	2010	Provides efficiency consulting services for businesses, municipalities, and non-market-oriented organizations to promote sustainable practices. The program supports participants in implementing environmental measures, enhancing resource efficiency, and adopting eco-friendly technologies. It aims to foster sustainable development across various sectors in Carinthia.	Regionalprogramm ökofit Kärnten
Carinthian Sewage Sludge and Compost Ordinance (Kärtner Klärschlamm und Kompostverordnung)	2000 (last update 2004)	Sets regulations for the treatment and application of sewage sludge, biogenic waste, and green waste on agricultural land. It defines quality requirements, treatment processes, and conditions for the use of such materials to ensure environmental safety and soil health. The ordinance includes provisions for bringing treated waste into circulation and enforcement measures.	KÄRNTER KLÄRSCHLAMM - und KOMPOSTVERORDNUNG
Carinthian Waste Management Law (Kärtner Abfallwirtschaftsordnung)	2004	Establishes comprehensive waste management provisions in Carinthia, detailing guidelines for waste collection, disposal, and treatment. It covers various waste types, including domestic, industrial, sewage sludge, and compost, and outlines responsibilities of waste management associations. The law also specifies fees, penalties, and cooperation mechanisms for effective implementation.	K-AWO 2004



4.3. Slovenia

The strongest policy focus in Slovenia lies in the areas of industry, digitalisation, and development, as well as waste management and the circular economy. These themes are well reflected both in the national strategies and in the overall regional policy landscape. Particularly in the context of a circular economy, Slovenia shows a proactive approach: regional and national initiatives promote resource efficiency, waste reduction, and closed-loop systems, providing a favourable starting point for future integration of bioeconomy-specific actions.

However, this momentum is not equally distributed across all relevant categories. Policies explicitly linked to the bioeconomy are largely absent in the fields of forestry, land use, and nature conservation, despite the country’s significant forest coverage. Similarly, the integration of bioeconomy principles into energy and climate policy frameworks remains minimal or indirect at best. Slovenia currently lacks a dedicated bioeconomy strategy, both at the national and regional levels. Although the development of such a strategy has been announced, it has not yet been formalized or publicly published. As a result, policy efforts in support of industrial symbiosis and bio-based innovation remain embedded in broader frameworks, without a cohesive guiding vision specific to the bioeconomy. In summary, Slovenia shows a solid foundation in circular economy thinking and industrial innovation, but the bioeconomy remains an emerging topic without a clear strategic anchor. Moving forward, the planned development of a national bioeconomy strategy represents a key opportunity to build on existing strengths and address current gaps, particularly by linking circularity more directly with land-based resource use, forestry, and climate action.

4.3.1 National Policies Supporting the Bioeconomy and Industrial Symbiosis

Slovenia has developed a relatively broad and future-oriented policy landscape that supports the bioeconomy and industrial symbiosis through strategic alignment with EU objectives. While a dedicated national bioeconomy strategy is still under development, the country actively contributes to the BIOEAST initiative and integrates bioeconomy goals across multiple national plans. These include climate and energy strategies, industrial development frameworks, and circular economy roadmaps. Particular emphasis is placed on cross-sectoral collaboration, smart specialisation, and the green transition. However, bioeconomy policy implementation remains partly fragmented, and some regulatory instruments—especially in waste management are in need of revision to ensure full alignment with EU directives.

Table 18 summarizes key national strategies and legal frameworks relevant to advancing the bioeconomy in Slovenia.

Table 18: National policies supporting the bioeconomy and industrial symbiosis in Slovenia.

Name	Publishing Year	Scope	Reference
CAP Strategic Plan Slovenia (2023-2027)	2021	Directs EU Common Agricultural Policy funds towards sustainability and rural development. Supports climate-smart agriculture and	Slovenia – CAP Strategic Plan - Overview



		biodiversity. Enhances bioeconomy through smart resource use.	At a glance: SLOVENIA'S CAP STRATEGIC PLAN
BIOEAST - Central and Eastern European Initiative for knowledge-based agriculture and forestry in the bioeconomy	2016	Strengthens bioeconomy through cross-sector knowledge exchange and stakeholder engagement. Emphasizes sustainable biomass use and circularity. Contributes to a national bioeconomy action plan by 2026.	BIOEAST Initiative BIOEAST Slovenia
Integrated National Energy and Climate Plan (2021-2030)	2020	Aligns with EU 2030 climate targets and promotes renewable energy and energy efficiency. Invests in low-carbon technologies and regional innovation ecosystems. Supports circular bioeconomy and cascading use of biomass.	INTEGRATED NATIONAL ENERGY AND CLIMATE PLAN OF THE REPUBLIC OF SLOVENIA
Recovery and Resilience Plan: Circular Economy Component - Resource Efficiency (2021-2026)	2021 (last update 2024)	Supports economic recovery post-COVID-19 with a strong green and digital focus. Prioritizes resource efficiency, bioeconomy innovation, and infrastructure improvements. Faces challenges related to fragmentation and regulatory barriers.	NAČRT ZA OKREVANJE IN ODPOORNOST RRP - CIRCULAR ECONOMY
Slovenian Development Strategy 2030	2017	Aims to ensure balanced socio-economic and environmental development. Focus areas include circular economy, sustainable resource use, and cross-sector collaboration. Promotes bio-based innovations and infrastructure development.	STRATEGIJA RAZVOJA SLOVENIJE 2030
Slovenian Industrial Strategy 2030 (2021-2030)	2020	Aims to build a green, innovative, and creative economy, emphasizing circularity and innovation. Supports digital transformation and sustainable production. Implements financial tools and aligns with EU climate neutrality goals.	SLOVENSKA INDUSTRIJSKA STRATEGIJA 2021-2030 Slovenian Industrial Strategy 2021-2030 - Overview
Slovenia's Smart Specialization	2022	Supports the green and digital transition by fostering innovation in the smart industry,	SLOVENSKA STRATEGIJA



Strategy (2021-2027)		sustainable food, and health. Encourages cross-sectoral collaboration, especially among bioeconomy sectors. Emphasizes research, education, and triple helix cooperation to align investments.	TRAJNOSTNE PAMETNE SPECIALIZACIJE S5 S5 upgraded and published - Overview
Decree on Packaging and Packaging Waste	2021	Regulates packaging and promotes efficient waste management systems. Aims to improve recycling and circular practices in packaging. Supports EU directives on reducing packaging waste.	DECREE on PACKAGING AND PACKAGING WASTE Decree on packaging and packaging waste - Overview More efficient implementation of the packaging waste management system
Decree on Single-Use Plastics	2021	Prohibits certain single-use plastics and mandates proper labelling. Encourages transition to reusable and recyclable alternatives. Contributes to reducing plastic pollution in line with EU directives.	DECREE on SINGLE-USE PLASTICS Decree on Single-use Plastics - Overview
Decree on Landfilling of Waste (Official Gazette 108/2013)	2013	Regulates landfill operations and environmental protection measures. It seeks to minimise landfilling and enhance waste reuse and recycling. Ensures compliance with EU waste directives.	OFFICIAL GAZETTE 108/2013 Decree on Landfilling of Waste - Overview
Decree on Waste (Official Gazette 102/2011)	2011	Provides a legislative framework for waste management in Slovenia. Aims to reduce environmental impacts and promote	OFFICIAL GAZETTE 102/2011



		sustainable practices. Includes rules on collection, transport, and disposal of waste.	Decree on Waste - Overview
Framework Program for the Transition to a Green Economy	2015	Outlines a systemic approach to achieving a green economy through efficiency and circularity. Encourages cross-sectoral cooperation and green innovations. Includes financial and regulatory support mechanisms for sustainable development.	Transition to a Green Economy in Slovenia - SUMMARY
Roadmap Towards the Circular Economy in Slovenia	2018	Provides a national vision for transitioning to a circular economy. Promotes resource optimisation, bio-based value chains, and cross-sectoral innovation. Integrates education and policy mechanisms for implementation and monitoring.	ROADMAP TOWARDS THE CIRCULAR ECONOMY IN SLOVENIA

4.3.2 Regional Policies Supporting the Bioeconomy and Industrial Symbiosis

As no specific pilot region was selected for SYMBIO in Slovenia, our analysis primarily focused on national policies. In general, Slovenia has regional policies that further support the previously mentioned national strategies on the bioeconomy and industrial symbiosis. During our research, the two Slovenian regions of Podravje and Ljubljana particularly stood out for their bioeconomic efforts and commitment. Podravje is intensively engaged in the field of circular economy and has developed one of the first regional strategies for a circular bioeconomic transition. Ljubljana is also committed to the circular economy but focuses more closely on zero waste and aims to become a pioneer in Europe with its related strategy.

4.4. Croatia

Croatia currently has no dedicated bioeconomy strategy at either the national or regional level. The topic is still in an early phase of development across the country, with only initial steps visible toward integrating bio-based approaches into policy frameworks. In terms of thematic focus, Croatia's strongest policy areas are waste management and the circular economy, agriculture, forestry, land use and nature, and climate and energy. These categories are well covered through national strategies, many of which align with EU directives. Especially in agriculture and forestry, the country's policies promote sustainable resource use and environmental protection, creating a potentially favourable context for future bioeconomy integration. Additionally, climate and energy policies reflect growing awareness of sustainability challenges.

However, the connection between these sectoral efforts and a broader bioeconomy vision remains weak. There is a lack of cross-sectoral coordination, and bioeconomy-relevant policies are rarely framed as part of an overarching transition pathway.



Overall, Croatia’s policy landscape reflects a country in transition: while certain environmental and resource-related policies are in place and aligned with EU objectives, a coherent bioeconomy agenda has not yet emerged. Establishing a national bioeconomy strategy would be a crucial next step in consolidating existing efforts, fostering intersectoral collaboration, and unlocking the potential of Croatia’s natural resource base in line with circular and bio-based principles.

4.4.1 National Strategies Supporting the Bioeconomy and Industrial Symbiosis

Table 19 provides an overview of Croatia’s main national-level strategies, plans, and legal frameworks relevant to the bioeconomy and industrial symbiosis highlighting their scope and relevance. While a dedicated bioeconomy strategy has not yet been developed, a relatively high number of existing policies, particularly in agriculture, energy, forestry, and waste management address sustainability, circularity, and innovation in sector-specific contexts. These documents reflect Croatia’s effort to align with EU directives and to modernize its environmental and resource management systems.

Table 19: National policies supporting the bioeconomy and industrial symbiosis in Croatia.

Name	Publishing Year	Scope	Reference
CAP Strategic Plan Croatia (2023-2027)	2021	Focuses on modernizing agriculture, improving rural areas, and ensuring environmental sustainability. Supports eco-schemes and climate-resilient practices- Aligns with the EU’s Green Deal.	At a glance: CROATIA’S CAP STRATEGIC PLAN CAP Strategic Plan Croatia - Overview New programming period 2023-2027
The Agricultural Strategy	Post 2020	Sets visions for agriculture until 2030, focusing on competitiveness and sustainability. Includes support for innovation, digitalization, and climate adaptation. Aims to enhance food security and rural livelihoods.	Agricultural Strategy until 2030
National Aquaculture Development Plan for the period until 2027	2021	Develops sustainable aquaculture practices. Increases production and market access. Strengthens environmental monitoring.	National aquaculture development plan for the period until 2027 - Overview



			NPRA 2027
BIOEAST – Central and Eastern European Initiative for knowledge-based agriculture and forestry in the bioeconomy	2016	Croatia participates in a macro-regional initiative supporting sustainable agriculture, forestry, and aquaculture. Promotes knowledge-based bioeconomy strategies. Fosters cooperation among CEE countries.	BIOEAST Initiative BIOEAST CROATIA
Energy Development Strategy (2030 with an outlook to 2050)	2020	Provides a roadmap for a secure, sustainable, and low-carbon energy system. Supports diversification of energy sources and investments in renewables. Aligns with EU 2050 targets.	STRATEGY - ENERGY DEVELOPMENT OF THE REPUBLIC OF CROATIA UNTIL 2030 WITH A VIEW TO 2050
Integrated National Energy and Climate Plan for the Republic of Croatia (2020-2030)	2019	Aims to reduce GHG emissions, increase renewable energy, and improve energy efficiency. Aligns with EU energy and climate goals. Includes measures across all energy sectors.	Integrated National Energy and Climate Plan for the Republic of Croatia for the period 2021-2030
Low Carbon Development Strategy (2030 with an outlook to 2050)	2021	Guides decarbonization of the economy through energy, transport, and industry reforms. Promotes energy efficiency and low-emission technologies. Contributes to national climate goals.	STRATEGY - OF LOW-CARBON DEVELOPMENT OF THE REPUBLIC OF CROATIA UNTIL 2030 WITH A VIEW TO 2050
National Law on Forests	2018	Regulates sustainable forest management, biodiversity protection, and economic use of forest resources. Provides guidelines for forest ownership and public access. Ensures alignment with EU forestry policy.	NATIONAL LAW ON FORESTS
Nature Protection Strategy and Action Plan of the Republic of Croatia 2017-2025	2018	Protects ecosystems and endangered species through spatial planning and conservation. Implements EU directives on biodiversity. Encourages sustainable use of natural resources.	NATURE PROTECTION STRATEGY AND ACTION PLAN OF THE REPUBLIC OF



			CROATIA FOR THE PERIOD 2017-2025
Rural Development Program (2014-2020)	2014	Supported green farming, rural infrastructure, and sustainable land use. Created foundations for future CAP strategies. Some components remain influential in current planning. - Although this program is phasing out, it has set precedents that continue to influence current strategies. The program aimed at supporting rural infrastructure, ecological farming practices, and sustainable land management, aspects that are carried forward into current planning periods.	Rural Development Programme of the Republic of Croatia for the Period 2014-2020
Croatian National Development Strategy 2030		A comprehensive development framework covering economy, environment, and society. Encourages green growth, innovation, and sustainability. Includes cross-sectoral policy goals.	NATIONAL DEVELOPMENT STRATEGY
Smart Specialization Strategy and Action Plan (2016-2020)	2015	Promoted innovation in agriculture, food, energy, and environment sectors. Encouraged regional competitiveness. Focused on knowledge-based economic development.	STRATEGIJE PAMETNE SPECIJALIZACIJE REPUBLIKE HRVATSKE
Ordinance on Packaging and Packaging Waste (Official Gazette 88/2015, 78/2020, 137/2023)	2015 (last update 2023)	Regulates packaging standards, recycling quotas, and producer obligations. Aims to reduce the environmental impact of packaging waste. Aligns with EU waste directives.	Packaging and Packaging Waste - Overview and Links Packaging and Packaging Waste Fee - Overview and Links
Act on Waste Management (Official Gazette 84/2021 & 142/2023)	2021	Establishes legal obligations for waste reduction, recycling, and disposal. Implements extended producer responsibility. Supports transition to a circular economy.	WASTE MANAGEMENT ACT
National Plan for the Prevention and Reduction of Food	2022	Sets national objectives for reducing food waste in production, retail, and households. Encourages public awareness and sustainable	The Food Waste Prevention and Reduction Plan of



Waste (2023-2028)		consumption. Includes monitoring and evaluation mechanisms.	the Republic of Croatia
Waste Management Plan of the Republic of Croatia for the Period from 2023-2028	2022	Provides framework for integrated waste management. Emphasizes reuse, recycling, and improved infrastructure. Supports EU waste hierarchy and targets.	WASTE MANAGEMENT PLAN OF THE REPUBLIC OF CROATIA FOR THE PERIOD FROM 2023 TO 2028
Waste Management Strategy of the Republic of Croatia (2017-2022)	2017	Defines goals for waste prevention, reuse, and recycling. Encourages the circular economy. Provides a framework for sustainable waste treatment.	WASTE MANAGEMENT PLAN OF THE REPUBLIC OF CROATIA FOR THE PERIOD 2017-2022

4.4.2 Regional Strategies Supporting the Bioeconomy and Industrial Symbiosis

No specific region was highlighted in the project and, therefore, not analyzed in detail. In general, regional strategies for the bioeconomy and industrial symbiosis in Croatia are still in their early stages compared to those of other EU member states but show promising developments. Attempts are being made to align regional initiatives with national policies. Croatian regions are actively participating in EU projects, with the Osijek region being particularly notable. Increasingly, regional hubs for bioeconomy and industrial symbiosis are emerging in Croatian regions.

4.5. Spain

Spain has a national bioeconomy strategy in place, which also integrates regional dimensions. However, the overall number of bioeconomy-related policies remains limited compared to other SYMBIO pilot countries. While most thematic categories are represented in the national framework, coverage tends to be broad and general. Exceptions are “Forestry, Land Use and Nature” and “Chemicals and Textiles,” which are barely addressed at national level. When regional policies are included, Spain’s strongest focus areas become evident in waste management and packaging. Andalusia stands out with a dedicated circular bioeconomy strategy targeting innovative biomass use.

4.5.1 National Strategies Supporting the Bioeconomy and Industrial Symbiosis

Spain has adopted a national bioeconomy strategy, but its implementation remains broad and uneven across sectors. Strongest contributions come from agriculture, waste, and circular economy policies with recent legislation introducing eco-design obligations and extended producer responsibility., while areas



like forestry and chemicals are weakly addressed. **Table 20** shows the main national strategies and legal instruments relevant to bioeconomy and industrial symbiosis.

Table 20: National policies supporting the bioeconomy and industrial symbiosis in Spain.

Name	Publishing Year	Scope	Reference
CAP Strategic Plan Spain (2023-2027)	2021	Sets the national framework for implementing the EU's Common Agricultural Policy (CAP). Encourages sustainable agriculture, innovation, and rural development. Supports bioeconomy-related practices like biomass use and nutrient recycling.	At a glance: SPAIN'S CAP STRATEGIC PLAN Spain - CAP Strategic Plan - Overview
Spanish Bioeconomy Strategy (Estrategia Española de Bioeconomía)	2016	Defines the framework for bioeconomy development in Spain, focusing on innovation, sustainability, and sector integration. Aligns with EU initiatives like Horizon 2020 and Horizon Europe. Includes regional-level strategies to ensure cohesive national implementation.	ESTRATEGIA ESPAÑOLA DE BIOECONOMÍA Horizonte 2030 The Bioeconomy in Spain - Overview
Integrated National Energy and Climate Plan (2021-2030)	2020	Outlines Spain's strategy to reduce GHG emissions, improve energy efficiency, and boost renewable energy use. Supports EU energy and climate targets. Includes measures that intersect with the bioeconomy in adaptation and resilience.	INTEGRATED NATIONAL ENERGY AND CLIMATE PLAN 2021-2030
Spanish Strategy for Science, Technology and Innovation (2021-2027)	2021	Provides strategic priorities for research, development and innovation to enhance Spain's knowledge economy. Supports sectors including bioeconomy through funding and infrastructure. Emphasizes public-private collaboration and international alignment.	ECTI 2021-2027 Spanish Science, Technology and Innovation Strategy 2021-2027
Royal Decree 1055/2022 on Packaging and Packaging Waste	2022	Regulates packaging design, labeling, and waste treatment to improve recycling rates. Establishes extended producer responsibility and eco-design incentives. Aims to reduce	REAL DECRETO 1055/2022



		environmental impact through circular economy principles.	Royal Decree 1055/2022, of December 27, on packaging and packaging waste
Law on Waste and Contaminated Soils for a Circular Economy	2022	Introduces legal tools to reduce waste generation and promote circular practices in waste management. Targets sustainable resource use and the reduction of environmental impact. Encourages bio-waste valorization, relevant for bio-based value chains.	LAW 7/2022, of April 8, on waste and contaminated soil for a circular economy
Spanish Circular Economy Strategy and Action Plans 2030	2020	Establishes a roadmap to reduce Spain's material footprint and promote a sustainable production-consumption model. Integrates regulatory, economic, and social actions to drive circularity. Emphasizes synergies with bioeconomy and environmental sustainability goals.	Spanish Circular Economy Strategy and Action Plans - Overview and Links

4.5.2 Regional Strategies Supporting the Bioeconomy and Industrial Symbiosis

Andalusia stands out with a dedicated circular bioeconomy strategy that takes a cross-sectoral approach including key sectors like agriculture, fisheries, forestry, and waste valorization. It is complemented by regional policies supporting sustainable resource use in marine aquaculture and waste, aiming to foster innovation, sustainability, and rural development.

Table 21 summarizes Andalusia's most relevant regional policy frameworks that contribute to advancing circular and bio-based value chains.

Andalusia

Table 21: Regional policies supporting the bioeconomy and industrial symbiosis in Andalusia, Spain.

Name	Publishing Year	Scope	Reference
The Blue Economy in Andalusia	2019	Outlines the development potential of the blue economy in Andalusia, focusing on sustainable use of marine resources. It includes diagnostics of current sectors and proposes actions to strengthen marine-based industries. Emphasis is placed on innovation, sustainability, and public- private collaboration.	La Economía Azul en Andalucía



Andalusian Strategy for the Development of Marine Aquaculture	2014	Sets objectives for enhancing marine aquaculture in Andalusia through innovation, sustainability, and competitiveness. It provides an action plan spanning licensing, technology transfer, and environmental protection. The goal is to create a resilient and productive aquaculture sector.	ESTRATEGIA ANDALUZA PARA EL DESARROLLO DE LA ACUICULTURA MARINA
Andalusian Strategy for the Circular Bioeconomy	2018	Promotes the transition to a sustainable circular bioeconomy in Andalusia. It targets innovation in biomass use, bio-based products, and rural development. Key sectors include agriculture, fisheries, forestry, and waste valorization.	ESTRATEGIA ANDALUZA DE BIOECONOMÍA CIRCULAR Andalusian Circular Bioeconomy Strategy
Integrated Waste Plan for Andalusia. Towards a Circular Economy in the 2030 Horizon	2021	Lays out policies to improve waste management and support a circular economy by 2030. It addresses prevention, reuse, recycling, and recovery across all waste streams. The focus is on environmental protection and resource efficiency.	PLAN INTEGRAL DE RESIDUOS DE ANDALUCÍA

4.6. Belgium

In Belgium, nearly all relevant policies in the context of the bioeconomy and circular economy are developed, published, and implemented at the regional level. Only a few overarching frameworks remain under national responsibility, including the Sustainable Development Strategy and the Recovery and Resilience Plan. The Packaging Waste Agreement, while formally recognized at national level, is the result of coordinated cooperation between all three Belgian regions.

A dedicated regional bioeconomy strategy exists only in Flanders, which also stands out as the only SYMBIO pilot region to address the category “Chemicals and Textiles” in its policy framework. This, combined with a strong focus on circular economy, innovation, and industrial transformation, makes Flanders the most ambitious region in Belgium in terms of sustainability and circular bioeconomy policy development.

Wallonia shows a solid orientation as well, particularly in the areas of agriculture, industry, climate, digitalization, sustainable development, and circular economy. However, references to concrete bioeconomy practices or terminology remain limited. The region implements a number of relevant strategies, but with lower explicit mention of bio-based methods and value chains.



The Brussels-Capital Region focuses strongly on urban circular economy models and waste management, reflecting its metropolitan context. Across all regions, waste management and the circular economy are consistently prioritized and well represented.

4.6.1 National Policies Supporting the Bioeconomy and Industrial Symbiosis

In Belgium, only a few bioeconomy-relevant policies are managed at the national level. These include overarching frameworks on climate, sustainable development and a unified legal framework for the prevention and management of packaging waste, while most operational strategies are developed regionally.

Table 22 shows the main national-level instruments in Belgium contributing to a bioeconomy and industrial symbiosis.

Table 22: National policies supporting the bioeconomy and industrial symbiosis in Belgium.

Name	Publishing Year	Scope	Reference
Belgium's Integrated National Energy and Climate Plan 2021-2030	2019	Outlines Belgium's goals for climate neutrality through renewable energy, energy efficiency, and sustainable transport. Supports GHG reduction (35% by 2030), with emphasis on bioenergy and sectoral innovation)	PNEC 2023 National Energy and Climate Plan 2021-2030 - Overview
Belgian Recovery and Resilience Plan	2021	Supports sustainable growth, innovation, and circular use of bio-based materials. Encourages investment in renewable and bioeconomy sectors via regional initiatives and funding.	Belgium's Recovery and Resilience Plan - Overview National Recovery and Resilience Website
Federal Sustainable Development Strategy	2021	Includes circular economy as a central pillar, aiming for sustainable resource use, waste reduction, and eco-innovation. Provides a governance model and Key Performance Indicators (KPI's) to track circular performance.	FEDERAL PLAN FOR SUSTAINABLE DEVELOPMENT IN A NUTSHELL
Cooperation Agreement on the prevention and management of packaging waste	2008	Establishes a unified legal framework for the prevention and management of packaging waste (household, industrial, and commercial) across Belgium's three regions. It imposes three key obligations on companies placing packaged products on the Belgian market: a	BELGIAN OFFICIAL GAZETTE 29.12.2008



		reporting obligation, a take-back (recycling and recovery) obligation, and the submission of a prevention plan. The Agreement also defines the roles of accredited compliance and ensures consistent implementation nationwide.	The Cooperation Agreement - Overview
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4.6.2 Regional Policies Supporting the Bioeconomy and Industrial Symbiosis

In Belgium, regional governments play the central role in shaping policies related to the bioeconomy and circular economy. Flanders stands out with a dedicated bioeconomy strategy and targeted measures for sustainable biomass use, green chemistry, and industrial transformation. In contrast, Wallonia and Brussels focus more broadly on circular economy, innovation, and sustainable development, with only limited or indirect references to bio-based value chains.

Tables 23 to 25 show the most relevant regional policy instruments supporting the bioeconomy and industrial symbiosis in Belgium.

Brussels-Capital

Table 23: Regional policies supporting the bioeconomy and industrial symbiosis in Brussels Capital, Belgium.

Name	Publishing Year	Scope	Reference
Brussels Air Climate and Energy Plan (PACE)	2022 (last update 2023)	Integrates Brussels' strategies for air quality, climate mitigation, and energy transition. Focuses on reducing GHG emissions and enhancing resilience to climate impacts. Sets measurable targets for 2030 and 2050.	PLAN RÉGIONAL AIR-CLIMATENERGIE PACE - Overview
Regional Innovation Plan (RIS3) (2021-2027)	2021	Defines Brussels' research and innovation priorities for sustainable and inclusive growth. Aims to align investments with regional strengths and societal challenges. Encourages smart specialization and collaboration among stakeholders.	RIS3 – Overview Regional Plan for Innovation
BRUDALEX 2.0	2022	Updates Brussels' legal framework for sustainable waste management. Emphasizes circular economic principles and clearer responsibilities for waste producers. Provides detailed guidelines for reducing, reusing, and recycling materials.	Brudalex: waste management rules for the transition to a circular economy The Full Text of the Decree



Ordinance relating to waste	2012	Establishes the legal basis for waste prevention, collection, and treatment in Brussels. Aims to protect the environment and public health through proper waste regulation. Applies to all stakeholders involved in waste handling.	14 JUIN 2012. - Ordonnance relative aux déchets
Brussels Regional Program for a Circular Economy (BRPCE) (2016-2020)	2016	Promotes circular economy by supporting sustainable production, consumption, and resource use. Targets economic competitiveness while reducing environmental impacts. Engages public and private actors through collaborative initiatives.	BRPCE - Overview
Resource and Waste Management Plan (RWMP)	2018	Sets comprehensive guidelines for waste reduction and sustainable resource management in Brussels. Integrates circular economy goals to minimise the environmental footprint. Details actionable measures and sector-specific targets.	PLAN DE GESTION DES RESSOURCES ET DES DÉCHETS

Flanders

Table 24: Regional policies supporting the bioeconomy and industrial symbiosis in Flanders, Belgium.

Name	Publishing Year	Scope	Reference
CAP Strategic Plan Flanders (2023-2027)	2022	Aims to support Flemish farmers in adopting sustainable practices, ensuring income security, and enhancing resilience. It focuses on reducing GHG emissions, improving water quality, and promoting soil health. The strategy integrates direct payments, rural development, and sector-specific interventions to align with EU objectives.	At a glance: BELGIUM'S (FLANDERS) CAP STRATEGIC PLAN Belgium (Flanders) – CAP Strategic Plan
Flemish Bioeconomy Policy Plan	2020	Seeks to embed the bioeconomy within Flanders by promoting sustainable biomass production and utilization. It emphasizes innovation, circular economy principles, and the optimal use of resources. The strategy aims to strengthen the economic and ecological foundations of the bioeconomy sector.	Flanders' bioeconomy - An unfolding story of sustainable growth



			Bioeconomy Flanders - Overview
Bio-economy in Flanders (Vision and Strategy)	2013	Outlines Flanders' commitment to developing a sustainable and competitive bioeconomy. It highlights the importance of innovation and the efficient use of biomass for various applications. The strategy serves as a foundation for future bioeconomic initiatives in this region.	BIO-ECONOMIE IN VLAANDEREN Bio-economy in Flanders - Overview
Trilateral Strategy for the Chemical Industry	2017	A collaborative initiative between Flanders, the Netherlands, and North Rhine-Westphalia to enhance the chemical industry's sustainability and competitiveness. The strategy focuses on innovation, infrastructure development, and cross-border cooperation. It aims to position the region as a leading chemical cluster in Europe.	Trilateral strategy for the chemical industry - Overview and Link
Flemish Climate Strategy 2050	2019	This long-term strategy sets out Flanders' goals for reducing GHG emissions and transitioning to a low-carbon economy by 2050. It addresses various sectors, including energy, transport, industry, and agriculture. The plan emphasizes stakeholder engagement and the integration of existing initiatives.	VLAAMSE KLIMAATSTRATEGIE 2050 Flemish Climate Strategy 2050 - Overview
Decree for the Promotion of Sustainable Development	2008	Promotes coordinated and inclusive sustainable development in Flanders. It balances social, ecological, and economic goals for present and future needs. The Flemish Government must develop a strategy involving all governance levels and society.	Decree for the Promotion of Sustainable Development
Flemish Sustainable Development Strategy	2021	Outlines Flanders' approach to achieving sustainable development through the "Vizier 2030" and "Vision 2050" frameworks. It identifies seven transition priorities, such as circular economy and energy, to guide policy actions. The plan serves as a roadmap for integrating sustainability into all aspects of governance.	FLEMISH STRATEGY SUSTAINABLE DEVELOPMENT 4 Flemish Sustainable Development



			Strategy - Overview
Vision 2050 – A long-term strategy for Flanders	2016	Presents Flanders' aspiration for an innovative, sustainable, and inclusive society by mid-century. It emphasizes innovation, social cohesion, and international engagement. The strategy provides a framework for aligning policies with long-term objectives.	VISIE2050 Vision 2050. A long-term strategy for Flanders
Materials Decree – Decree on the sustainable management of material cycles and waste	2011	Establishes the legal framework for sustainable waste management and material use in Flanders. It promotes the circular economy by encouraging waste prevention, reuse, and recycling. The legislation aims to minimize environmental impacts and optimize resource efficiency.	MATERIALS DECREE
VLAREM II	1995	Sets out the environmental regulations and standards for various activities in Flanders. It provides detailed provisions on emissions, waste management, and environmental permits. The regulation ensures that industrial and other operations comply with environmental protection goals.	VLAREM II
Action Plan Food Loss and Biomass (residual) Flows Circular (2021-2025)	2021	Targets the reduction of food waste and the circular use of biomass residuals in Flanders. It outlines measures for prevention, valorization, and sustainable management of organic waste streams. The plan supports the transition to a circular bioeconomy by 2025.v	ACTIEPLAN VOEDSELVERLIES EN BIOMASSA(REST)STROMEN CIRCULAIR 2021-2025 Action plan food loss and biomass (residual) flows circular 2021-2025 - Overview



Sustainable use and creation of value from renewable raw materials for biobased industrial production	2013	Focuses on promoting the sustainable use of renewable raw materials in biobased industries. It encourages the development of biomaterials and green chemicals through innovation and value creation. The plan aims to strengthen Flanders' position in the biobased economy.	Sustainable use of and creation of value from renewable raw materials for biobased industrial production such as biomaterials and green chemicals in Flanders
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Wallonia

Table 25: Regional policies supporting the bioeconomy and industrial symbiosis in Wallonia, Belgium.

Name	Publishing Year	Scope	Reference
CAP Strategic Plan Wallonia (2023-2027)	2022	Defines Wallonia's agricultural priorities within the EU's Common Agricultural Policy (CAP), focusing on sustainable farming, innovation, and intergenerational renewal. Targets include improving farmers' income, enhancing environmental care, and revitalizing rural areas. Aligns with the EU Green Deal and Farm to Fork strategy.	At a glance: BELGIUM'S (WALLONIA) CAP STRATEGIC PLAN Belgium (Wallonia) - CAP Strategic Plan - Overview
Development Plan for Biological Production in Wallonia (Plan Bio 2030)	2021	Aims to triple organic agricultural surface by 2030 and develop local organic value chains. Focuses on consumer awareness, fair pricing, and innovation in organic farming. Promotes sustainable land use and food systems.	PLAN DE DÉVELOPPEMENT DE LA PRODUCTION BIOLOGIQUE EN WALLONIE À L'HORIZON 2030
"Eat tomorrow" Strategy	2018	Sets a long-term vision for sustainable food systems in Wallonia. Encourages local, healthy, and eco-responsible food choices. Brings together actors from agriculture, health, environment, and education.	Eat tomorrow - Overview



Energy Efficiency Directive 2012/27/EU - ART.14 Potential for efficiency in heating and cooling	2012	Assesses the efficiency potential in Wallonia's heating and cooling sectors. Proposes measures to exploit cost-effective energy savings. Supports transition to low-carbon heating systems.	DIRECTIVE D'EFFICACITE ENERGETIQUE 2012/27/EU - ART.14
Walloon Air Climate Energy Plan (PACE 2030)	2019	Lays out Wallonia's roadmap for achieving climate neutrality by 2050: Integrates air quality, climate change mitigation, and energy efficiency. Sets sectoral targets for transport, buildings, and industry.	PACE Plan - Overview
Digital Wallonia (Wallonia's Digital Strategy)	2018	Provides a strategic framework for Wallonia's digital transformation. Focuses on infrastructure, digital skills, smart regions, and innovation. It seeks to position Wallonia as a leading digital region.	DIGITAL WALLONIA V3 Digital Wallonia Strategy - Overview
Marshall Plan 4.0 for Wallonia	2017	Promotes economic development through innovation, industry modernization, and training. Aligns industrial policy with digital transformation and environmental goals. Supports SMEs and workforce adaptability.	Marshall Plan 4.0 for Wallonia - Overview
Regional Mobility Strategy (2019-2030)	2019	Aims for a sustainable, multimodal, and inclusive mobility system. Encourages public transport, cycling, and low-emission vehicles. Seeks to reduce congestion and environmental impacts.	SRM - Overview and Links SRM on Goods
Regional Smart Specialization Strategy (2021-2027)	2021	Defines priority sectors for research and innovation investments. Focuses on digital technologies, circular economy, and health. Enhances competitiveness and territorial cohesion.	S3 - Overview Official Website S3



Third Walloon Sustainable Development Strategy	2022	Integrates sustainable development across Walloon public policies. Aligns with the UN 2030 Agenda and Sustainable Development Goals (SDGs). Prioritizes inclusion, environmental protection, and economic resilience.	Third Walloon Sustainable Development Strategy Third Walloon Sustainable Development Strategy - Overview
Walloon Recovery Plan (PRW)	2022	Guides post-COVID economic recovery with a focus on sustainability and innovation. Funds infrastructure, digitalization, and green economy projects. Targets employment, productivity, and climate resilience.	Walloon Recovery Plan - Overview
Decree of 22 March 2007 (Tax decree promoting the prevention and recovery of waste in the Walloon Region)	2007	Regulates the environmental tax on waste disposal in the Walloon region. Aims to reduce landfill use and encourage recycling and recovery by applying financial penalties to less sustainable practices. Applies to entities operating waste treatment facilities or exporting waste outside the region.	22 MARS 2007. - Décret fiscal favorisant la prévention et la valorisation des déchets en Région wallonne Paying tax on waste in the Walloon region - Summary
Decree relating to waste, circularity of materials and public cleanliness	2023	Modernizes waste management and boosts circular economic practices. Introduces extended producer responsibility and more explicit sorting rules. Encourages cleaner public spaces and the reuse of materials.	9 MARS 2023. – Décret relatif aux déchets, à la circularité des matières et à la propreté publique - Official Document March 9, 2023 - Decree relating to waste, circularity of materials and public cleanliness



Order of the Walloon Government establishing an obligation to sort certain waste (MB 03.16.2015)	2015	Requires a separate collection of specified waste streams. Promotes recycling and reduces landfill use. Applies to households, businesses, and public bodies.	5 mars 2015 - Arrêté du Gouvernement wallon instaurant une obligation de tri de certains déchets (M.B. 16.03.2015)
Circular Wallonia	2021	Aims to decouple growth from resource use. Encourages design for durability, reuse, and closed-loop systems. Supports innovation and sustainable production-consumption patterns.	CIRCULAR WALLONIA Deployment Strategy of the Circular Economy in Wallonia At a glance: Circular Wallonia
Walloon Waste-Resource Plan (PWD-R)	2018	Provides a framework for integrated waste and resource management. Aims to reduce waste production and improve recycling rates. Coordinates actions across waste streams and sectors.	PLAN WALLON DES DÉCHETS-RESSOURCES The Challenges of the Walloon Waste Resources Plan (PWD-R)



4.7 Comparative Summary of Policy Landscape in SYMBIO Pilot Regions

From a comparative perspective, Italy emerges as the most ambitious pilot country in terms of policy activity and commitment to the bioeconomy. It has a comprehensive and regularly updated national bioeconomy strategy and covers nearly all relevant categories with dedicated national policies. Although regional implementation varies, the overall strategic alignment is strong.

Austria and Belgium show particular strengths in circular economy and waste management. Austria has an established but outdated bioeconomy strategy and is especially advanced in waste policy, whereas Belgium demonstrates a unique regionalized approach. In Belgium, Flanders stands out as the only region with a dedicated bioeconomy strategy and clear links to the chemicals and textiles sector. Wallonia, while not explicitly focusing on the bioeconomy, implements several strategies relevant to sustainability, particularly in agriculture, industry, digitalization, and climate.

Slovenia and Croatia are still in earlier stages of developing a national bioeconomy focus. Both countries have no formal bioeconomy strategy yet, although initial steps are visible. Their strongest policies lie in the areas of circular economy, waste management, and selected sectoral policies such as agriculture and forestry particularly in Croatia. Spain, despite having a national bioeconomy strategy that includes regional perspectives, shows relatively sparse policy coverage at national level. At the regional level, Andalusia is noteworthy with its dedicated circular bioeconomy strategy.

In summary, only three of the pilot countries - Italy, Austria, and Spain - currently have a national bioeconomy strategy, with Italy showing the most consistent and up-to-date implementation. At the regional level, bioeconomy strategies exist in Flanders (Belgium) and Andalusia (Spain), while other regions either embed bioeconomy-related aspects in broader frameworks or are still in exploratory phases. Across all pilot regions, waste management and the circular economy are the most consistently addressed policy domains in the context of sustainable economic development. This category serves as a frequent entry point for industrial symbiosis initiatives and provides a solid policy basis in most countries. However, in the absence of dedicated bioeconomy strategies, many policies remain sectoral in scope and do not address the full systemic potential of cross-sectoral biomass flows and symbiotic value chains.

One of the main challenges observed is the fragmentation of responsibilities and governance approaches, especially in countries with strong regional autonomy. This can lead to policy silos, where industrial symbiosis is supported in one sector or region but constrained in another. Additionally, temporal gaps e.g. outdated strategies or policies not aligned with current Green Deal objectives reduce the capacity of policy frameworks to effectively respond to evolving sustainability challenges. Another key barrier is the lack of harmonized terminology and monitoring mechanisms, which complicates comparative policy analysis and cross-border implementation. While some countries (e.g. Italy, Flanders) have developed relatively mature frameworks, others are still exploring the concept of a bioeconomy, resulting in significant asymmetries in regulatory maturity.



5. Discussion

The mapping and analysis of the EU, national, and regional policy frameworks reveal a comprehensive but fragmented regulatory landscape for the bioeconomy and industrial symbiosis. While the *European Green Deal* and the *Bioeconomy Strategy* provide a strong policy vision, their operationalization across Member States and sectors faces multiple challenges.

Our comprehensive analysis revealed four central dimensions:

1. policy coherence and sectoral integration,
2. biomass governance,
3. regional implementation gaps,
4. and funding-related barriers

5.1 Lack of Policy Coherence and Sectoral Integration

Despite numerous policy instruments addressing sustainability and circularity, there remains a lack of horizontal coherence between bioeconomy-relevant strategies. The mapping shows that many EU policies support aspects of industrial symbiosis such as waste valorization, cross-sectoral resource use, and decarbonization, but are rarely aligned in their objectives or implementation frameworks. The absence of a legally binding, overarching bioeconomy regulation reinforces fragmentation, as national policies often remain siloed within agriculture, climate, or other domains. This limits the systemic uptake of circular bioeconomy models and contributes to policy inefficiencies.

By clustering the policies thematically for analytical purposes, we observed clear progress in certain sectors, particularly agriculture and waste management, where relatively mature regulatory frameworks already support transitions toward bio-based solutions. However, in other sectors, particularly textiles, chemicals, and packaging, the integration of bioeconomy principles is still limited or inconsistently applied. For example, although the EU's *Sustainable Textiles Strategy* promotes material circularity, it lacks enforceable provisions for bio-based innovation. Similarly, while the *Chemical Strategy for Sustainability* highlights safe material use, it does not sufficiently differentiate between fossil-based and bio-based inputs. This imbalance impedes innovation in high-impact biobased value chains and highlights the need for targeted regulatory support that reflects the unique characteristics and benefits of bio-based materials.

5.2 Biomass Governance and Sustainability Risks

Biomass is central to achieving bioeconomy and climate goals, yet it remains a limited resource. Its growing demand across sectors (e.g. energy, packaging, construction) increases pressure on ecosystems and raises concerns about fair and sustainable allocation. While policies such as the *Renewable Energy Directive* and *LULUCF Regulation* address some trade-offs, gaps remain in lifecycle accounting, sustainability criteria, and end-of-waste definitions. Crucially, enabling industrial symbiosis requires greater transparency and monitoring of biomass flows across value chains. Currently, there is insufficient data on land use, material inputs and outputs, and sourcing conditions. Strengthening biomass governance through improved monitoring and cross-sectoral data sharing is key to unlocking circular resource use and supporting evidence-based policy decisions.



5.3 Regional Disparities and Implementation Challenges

Another key finding is the significant variation in national and regional policy maturity. While some Member States have developed comprehensive bioeconomy strategies, others focus only on individual sectors like agriculture or energy, without much coordination between them. This regional disparity is especially problematic for the replication of industrial symbiosis models, which depend on harmonized legal conditions, infrastructure, and institutional support. The analysis of pilot regions shows that local policies often lack alignment with EU-level ambitions or fail to address practical challenges such as permitting procedures, knowledge transfer, or SME financing. As a result, promising innovations may remain underutilized due to regulatory uncertainty or administrative barriers. Most importantly, bio-based products face strong market competition from cheaper fossil-based alternatives, which often benefit from financial advantages.

5.4 Funding Limitations and Access Barriers

While EU funding instruments such as Horizon Europe and LIFE provide valuable support, several limitations hinder their effectiveness. Long delays between programme development and project implementation reduce their impact, as illustrated by the timeline of Horizon Europe. Complex application procedures and regulatory burdens discourage companies from applying, and the absence of a central EU platform including all funding instruments makes it difficult to identify suitable programmes. Public and private funding remain misaligned: while public support targets long-term research, private investors seek short-term returns. In addition, early-stage and especially scale-up funding are lacking, making it difficult for start-ups to grow or for business models to be replicated across the EU. Accessing EU funding remains particularly challenging without prior experience or professional funding consultancy, as application processes are highly demanding and success rates are low. As a result, even though various funding opportunities exist, they are often not effective in advancing the bioeconomy in practice.

5.5 Overcoming Fragmentation: Towards Integrated Bioeconomy Governance

A key finding of this deliverable is that current policies often fail to reflect the inherently cross-sectoral nature of the bioeconomy. While numerous strategies and regulations support sustainability, they frequently follow a siloed “sector-by-sector” logic. Policies related to biomass use, for instance, are often developed independently within agricultural, energy, or waste frameworks, without ensuring coherence or mutual reinforcement. This fragmented governance approach significantly hampers the implementation of circular solutions such as industrial symbiosis, which rely on the seamless exchange of materials and by-products across sectors.

Moreover, while this deliverable provides a comprehensive mapping of relevant EU, national, and regional policy frameworks, a critical comparison reveals structural limitations that hinder the full integration of bioeconomy principles. In many SYMBIO pilot regions, policy environments lack operational instruments such as harmonized standards, or funding mechanisms necessary to support the replication of innovative business models. Particularly the absence of common end-of-waste criteria - that is, clear and consistent rules defining when a waste material ceases to be legally considered as waste and can be treated as a secondary resource - weakens the enabling environment for industrial symbiosis. Without such



harmonized standards across Member States, the reuse of biomass residues or industrial by-products remains administratively complex and legally uncertain. This, in turn, hampers cross-border resource flows and deters investment in circular bioeconomy solutions. Countries with dedicated bioeconomy strategies tend to offer more consistent support frameworks – yet even here, regulatory gaps persist at the regional level.

Ultimately, despite the availability of diverse and partially supportive policies, few frameworks currently create the enabling conditions for a systemic, cross-sectoral transformation. Fragmentation remains both horizontal – between policy domains such as agriculture, industry, energy, and waste – and vertical – between EU, national, and regional levels. The lack of binding governance instruments weakens accountability, while critical trade-offs, for example between biodiversity protection and biomass mobilisation, remain insufficiently addressed.

To address these challenges, future bioeconomy governance must:

- **Become more integrated** by aligning objectives and implementation mechanisms across key sectors;
- **Become more binding**, with enforceable sustainability criteria, harmonised definitions (e.g. for end-of-waste), and robust monitoring systems;
- **Become more adaptive**, by supporting regionally tailored policy approaches that reflect local resource conditions and capacities;
- **Become more equitable**, ensuring fair access to infrastructure, funding, and innovation opportunities across all EU regions and stakeholders.

Only by addressing these systemic barriers and adopting a holistic governance approach can the EU realize the full potential of a circular, regenerative, and inclusive bioeconomy.



6. Conclusions

This deliverable has provided a comprehensive mapping and comparative analysis of the regulatory landscape shaping the circular bioeconomy and industrial symbiosis in Europe. The findings confirm that while a wide array of policy instruments exists there is no unified legal framework dedicated to the bioeconomy. Instead, its development is shaped by multiple overlapping regulations, resulting in policy fragmentation, inconsistent implementation, and competing objectives. The bioeconomy is particularly affected by policies outside its immediate scope. Instruments such as subsidies, direct payments, environmental standards, and taxation, particularly those related to fossil fuels indirectly but significantly influence bio-based markets and resource allocation. For example, tax incentives for fossil fuel alternatives can create substitution effects in favour of bio-based products (7).

Considering the 6 SYMBIO pilot countries, only Italy, Austria, and Spain have developed dedicated national bioeconomy strategies. Among them, Italy stands out for the breadth and regular updates of its strategy. Regional strategies are even more limited, with only Flanders (Belgium) and Andalusia (Spain) having published dedicated bioeconomy strategies. Most other regions embed bioeconomy principles within broader sustainability or innovation frameworks but lack a focused policy approach. Interestingly, waste management and circular economy policies are generally more advanced and uniformly implemented across Member States and regions. These domains often serve as practical entry points for circular bioeconomy initiatives.

At the regional level, the bioeconomy is supported through several EU initiatives such as the European Bioeconomy Strategy, Cohesion Policy, and Smart Specialization Strategies (RIS3). These tools enable regions to shape tailored innovation trajectories and make strategic use of local assets. This is complemented by EU funding instruments, such as Horizon Europe and the European Regional Development Fund, which finance both research and implementation efforts (7). Despite differences in national approaches, most Member States align with a shared EU-level understanding of the bioeconomy. Eleven Member States have dedicated strategies, while others embed bioeconomy goals in related initiatives or have plans in development. This overall convergence provides a common foundation, but variation in implementation and priorities remains (14). In general, stronger coordination among Member States is essential for developing a coherent and harmonized EU policy framework. This would also foster knowledge exchange in a policy domain marked by rapid development and innovation. Fragmentation and insufficiently effective measures continue to undermine the implementation of bioeconomy policies, leading to frustration among stakeholders and missed opportunities (14,15).

Despite this diversity, a general alignment with EU-level priorities, such as the Green Deal and the EU Bioeconomy Strategy, can be observed. However, persistent structural challenges remain: vertical coordination between governance levels is often weak, monitoring systems for bio-based flows and impacts are underdeveloped, and funding instruments are not yet fully aligned with implementation needs. The potential of the bioeconomy to contribute to climate neutrality, innovation, and regional resilience is clear, but its realization requires more integrated, adaptive, and coherent governance frameworks. Particularly, the need for transparent monitoring of biomass flows and land-use changes is critical to support effective industrial symbiosis and sustainable resource allocation (7,15).



The aim of this study was not only to map the current policy landscape at EU level and in the SYMBIO pilot regions, but also to lay the foundation for a deeper investigation of circular value chains in the following stages of the project. These upcoming analyses will focus on selected business models and aim to identify concrete implementation barriers and opportunities, enabling practical policy recommendations tailored to real-world conditions.

To support the transition toward the next phase of the work in Deliverable 3.4, a synthesis of key enabling and hindering factors is provided below. These factors are derived from the cross-cutting policy analysis in this deliverable and reflect conditions that either foster or obstruct the implementation of circular, bio-based business models and industrial symbiosis across the EU.

Key enabling factors:

- Availability of dedicated EU and national funding programmes supporting research, innovation, and the deployment of bio-based and circular solutions.
- Existence of national or regional bioeconomy strategies in many Member States, often embedded in broader policy frameworks (e.g. agriculture, innovation, or climate policy), which offer entry points for cross-sectoral coordination.
- Increasing political and regulatory attention to industrial symbiosis, circularity, and resource efficiency, particularly through the European Green Deal and related initiatives.
- Strategic emphasis on regional development, which supports place-based bioeconomy initiatives and infrastructure investments aligned with local biomass availability and innovation capacity.

Key hindering factors:

- Fragmentation and inconsistency of policy instruments across governance levels and sectors, leading to limited integration of industrial symbiosis into mainstream economic or environmental policy.
- Lack of harmonized definitions, sustainability criteria, and end-of-waste standards (e.g. for biomass flows or secondary materials), which creates uncertainty and regulatory risk for bio-based business models.
- Insufficient monitoring systems and data availability to track biomass usage, environmental impacts, and circularity performance, limiting evidence-based policy design and investment decisions.
- Uneven access to funding, institutional capacity, and enabling infrastructure across EU regions, resulting in significant implementation gaps and limited scalability of innovative solutions.

7. Outlook

Deliverable 3.3 provides the conceptual and analytical groundwork for the next phase of *Task 3.2 - Mapping the regulatory framework of SYMBIO opportunities*, which will examine the business models developed in *Task 3.1 - MCDMA and MFA analysis of industrial symbiosis business models* in light of the



identified regulatory landscape. In T3.1, the 47 identified BioLinks will be narrowed down to approx. 10 most promising circular bio-based solutions with replication potential across Europe. The mapped policy landscape of D3.3 will be integrated with the prioritized 10 most promising BioLinks (D3.1 and D3.2) to analyze barriers and enablers for their concrete realization in the SYMBIO Pilot regions and to formulate targeted policy recommendations in D3.4. The recommendations to be developed in D3.4 will build on a comprehensive analysis of the legal, institutional, and financial frameworks, examining both enablers and constraints, with a focus on regulatory bottlenecks, funding gaps, and market entry challenges.

In this context, the next phase will concentrate on a detailed investigation of the most relevant policies linked to the 10 prioritized business models, considering their entire value chains. Particular attention will be given to the Waste Framework Directive, the updated Bioeconomy Strategy 2025, and related regulatory initiatives that shape hindering and enabling conditions for circular bio-based solutions. To generate insights into potential barriers on regional level and enable robust expert validation, multi-stakeholder focus group workshops and targeted policy surveys will be implemented.

The workshops, conducted in *Task 3.3 - Regional focus groups facilitating industrial symbiosis*, will build on the ecosystems of the SYMBIO pilot regions, previously engaged in WP1, and will be expanded to specifically include policy experts at both regional and EU levels. This approach is designed to systematically capture perspectives from value chain representatives and practitioners in the bioeconomy sectors, thereby providing nuanced insights into the barriers and enablers that influence the realization of circular business models. ANRI, together with CMU and regional partners in six SYMBIO pilot countries, will facilitate the regional focus group workshops. The first part of the workshop is envisaged to validate and refine ecosystem maps while identifying locally specific facilitating and hindering factors. The second part builds on this by examining the most promising business models in more detail, with particular focus on financing opportunities and legal frameworks. Taken together, these sessions aim to connect ecosystem-level insights with the validation and discussion of the circular business models, thereby informing integrated policy recommendations.

In addition, a targeted survey will adopt a systemic, cross-regional perspective, with particular emphasis on the EU level and its linkages to national and regional implementation. The survey will serve to validate initial results from desk research and workshops with policy experts and policymakers, thereby ensuring that recommendations are robust, policy-relevant, and aligned with decision-making needs across governance levels. To facilitate informed responses and meaningful validation, the survey will be accompanied by visually prepared materials (e.g. concise factsheets) that summarise the preliminary findings in an accessible format.

By linking model-specific regional stakeholder insights with system-level policy analysis and expert validation, this approach is intended to ensure that theoretical findings are translated into context-specific recommendations that support industrial symbiosis and the development of circular, bio-based business models across diverse European contexts.



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