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National Bioeconomy Action Plan - Slovenia

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DELIVERABLE TYPE	Report
DUE DATE	31/07/2026
DATE OF SUBMISSION	31/07/2026
WORK PACKAGE	WP7
BENEFICIARY	Circular Change, Ministry of Agriculture
DISSEMINATION LEVEL	Public/Sensitive
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PROGRAMME	HORIZON EUROPE
GRANT AGREEMENT NUMBER	101133398
NAME OF THE PROJECT	BOOST4BIOEAST
PROJECT START	1 January 2024
PROJECT DURATION	36 Months

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Revision History

VERSION	DATE	REVIEWER	MODIFICATIONS
1.0	17 06 2026	Dr. Leon Kaluža , National Institute of Chemistry, Center for Development, Demonstration and Training for Carbon-Free Technologies	Additions after Peer review 1: Lucija Marovt Circular Change Mario Plešej, Ministry of Agriculture
1.1	03 07 2026	Dr. Ilja Gasan Osojnik Črnivec , National Institute of Chemistry, Center for Development, Demonstration and Training for Carbon-Free Technologies	Additions after Peer review 2: Lucija Marovt Circular Change Mario Plešej, Ministry of Agriculture
1.2	17 07 2026	Dr. Luka Juvančič , University of Ljubljana, Biotechnical faculty	Additions after Peer review 3: Lucija Marovt Circular Change Mario Plešej, Ministry of Agriculture
1.3	20 07 2026	Imre Balasz Susi Susanti	Final version after task leader review:

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Disclaimer

BOOST4BIOEAST is funded by the European Union's Horizon Europe research and innovation programme under Grant Agreement no. 101133398. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or European Research Executive Agency (REA). Neither the European Union nor the granting authority can be held responsible for them.

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Abbreviations

B4B	BOOST4BIOEAST
CC	Circular Change
MKM	Ministry of Agriculture
GZS	Chamber of Commerce and Industry Slovenia
Si.Bio	Slovenian Bioeconomy Hub
AP	Action plan
KGZS	Chamber of Agriculture and Forestry of Slovenia
ZGS	Slovenia Forest Service
GIS	Slovenian Forestry Institute

Introduction to the project

BOOST4BIOEAST is a Coordination and Support Action funded by the European Commission developed to support the BIOEAST Initiative with the aim of empowering national stakeholders in the Central Eastern European and Baltic countries for the development of national bioeconomy action plans and to build long-lasting structures and spaces of dialogue for national and macro-regional cooperation. The project will enrich knowledge on the bioeconomy and stimulate related research and innovation across the macro-region.

Executive summary

The bioeconomy is becoming a necessary strategic component of Europe's transition towards climate neutrality, resource efficiency, industrial resilience and sustainable competitiveness. It supports the **shift from fossil-based and linear production models** towards circular value chains that make better use of biological resources, side streams and renewable carbon, while safeguarding biodiversity, soil and water resources.

This agenda is closely **linked to the evolving EU policy and legislative framework on the circular economy and bioeconomy**, including the Circular Economy Act, the EU Bioeconomy Strategy, and the emerging policy agenda on biotechnology and biomanufacturing, as well as related initiatives under the European Green Deal and the EU Industrial Strategy. Together, these frameworks aim to strengthen circular markets, increase the availability and uptake of high-quality secondary materials, and **support Europe's competitiveness and strategic autonomy**.

In this context, the bioeconomy can play a key and complementary role by expanding the circular economy beyond recycling and waste management towards the sustainable industrial processes, sustainable use of renewable biological resources, development of bio-based materials, cascading value chains, ecosystem services, and nature-based value creation.

Slovenia has strong foundations for this transition: extensive forest resources, diverse agricultural systems, relevant biomass side streams, a solid research and innovation base, and production and innovation industrial capacities in food, forestry, wood processing, chemicals, pharmaceuticals and advanced materials. However, these **assets are not yet sufficiently connected into a coherent and scalable bioeconomy system**.

The core challenge is not a lack of resources or knowledge, but a limited capacity to connect, valorise and scale them. Biomass and side streams remain underutilised or are exported with low added value, while research and innovation are not systematically translated into industrial deployment – there is a gap in pre-development. Value chains remain fragmented – there is a gap in industrial cooperation and clustering. Governance, investment pathways and scale-up mechanisms remain insufficiently coordinated.

The Action Plan addresses these gaps through five strategic priorities:

1. strengthening governance, coordination and policy integration;
2. increasing domestic valorisation of biomass through circular value chains;
3. accelerating innovation scaling and demonstration capacity;
4. ensuring sustainable and climate-resilient primary production;

5. strengthening skills, education and societal awareness.

These priorities are operationalised through five thematic pathways: agroecology and sustainable yields, food systems, forest value chains and wood industry, bio-based materials, and education and skills.

A key enabling structure for implementation is the Slovenian Bioeconomy Hub (Si.Bio), which connects stakeholders from research, industry, public administration, primary production and civil society. Building on Si.Bio and other national capacities, the Action Plan sets out a pathway for Slovenia to move from a fragmented, project-based landscape towards a coordinated, sustainable and scalable bioeconomy system aligned with Europe's circular, clean and resilient transition. A key success factor for implementation will be strong political ownership and prioritisation of the bioeconomy at the governmental level.

1 Introduction

1.1 Strategic context

Across Europe, the transition to a circular, climate-neutral and resource-efficient economy is becoming inseparable from the way biological resources are produced, used and regenerated. Food systems, forests, soils, water, renewable carbon, industrial innovation and rural development are no longer separate policy conversations. Together, they form the strategic field of the bioeconomy.

This shift is reflected in the evolving EU policy and legislative framework on the circular economy and bioeconomy, including the European Green Deal, the EU Bioeconomy Strategy, the Circular Economy Action Plan, the Farm to Fork Strategy, and the emerging Circular Economy Act, as well as the broader policy agenda on biotechnology and biomanufacturing. Their common direction is clear: reducing fossil dependency, using resources more intelligently, strengthening circular markets, and building value chains that are more resilient, competitive, and sustainable.

Within this wider transition, the bioeconomy adds a specific and increasingly important contribution. It expands the circular economy beyond recycling and waste management towards cascading biomass use, renewable biological resources, the development of bio-based materials, ecosystem services, nature-based value creation, and new industrial pathways.

For Slovenia, this creates both an opportunity and a responsibility: to turn existing natural, knowledge and industrial assets into higher value, lower-impact and more resilient development.

1.2 National context and need for action

Bioeconomy-related priorities are already present in several Slovenian policy frameworks, including the Slovenian Development Strategy 2030, the Smart Specialisation Strategy, the CAP Strategic Plan and sectoral policies in agriculture, forestry, energy, industry, research and regional development. Yet these elements remain dispersed across portfolios, instruments and institutions.

The main gap is therefore not strategic recognition, but implementation coherence. Responsibilities are spread across ministries and agencies, while mechanisms for joint priority-setting, investment planning, delivery and monitoring are still weak. This limits Slovenia's ability to turn existing capacities into coordinated value creation.

In practice, promising initiatives often remain project-based. Value chains develop unevenly. Research results do not consistently reach industrial deployment. Biomass, residues and side streams are not yet systematically directed towards higher-value uses. Public resources, private investment and stakeholder capacities are not sufficiently aligned around a shared national direction.

The timing is important. A new governmental term, evolving EU policy and funding frameworks – including the European Green Deal, the EU Bioeconomy Strategy, the Circular Economy Action Plan, the Farm to Fork Strategy, the emerging Circular Economy Act, and the broader policy agenda on biotechnology and biomanufacturing, as well as the Critical Raw Materials Act, Renewable Energy Directive and surrounding legislation on low-carbon fuels and carbon capture – together with the growing maturity of the Slovenian Bioeconomy Hub, create a window of opportunity to position the bioeconomy as a strategic national priority. The Action Plan provides the framework to move from scattered activities towards coordinated and systemic implementation.

1.3 Purpose of the Action plan

The purpose of this Action Plan is to provide a practical framework for the development of the Slovenian bioeconomy in the period 2026–2030, with a longer-term strategic perspective towards 2040. It is designed as an implementation bridge between strategic ambition and concrete action.

Its role is not to replace existing national strategies, but to connect them where bioeconomy-relevant priorities already exist. The Action Plan identifies implementation gaps, proposes priority areas for coordinated action and provides a shared basis for further policy discussion, investment planning and stakeholder alignment.

The Action Plan aims to:

- support coordinated policy development and inter-ministerial alignment;
- connect existing initiatives, projects and stakeholder platforms into a more coherent system;
- improve conditions for investment, innovation and industrial scale-up;
- strengthen circular and higher-value use of biomass, residues and side streams;
- support skills, knowledge transfer and stakeholder capacity for implementation.

The strategic orientation is clear: Slovenia should not pursue volume-based growth in biomass extraction. Its strongest opportunity lies in smarter use of existing resources, cascading value

chains, modular and selectively industrial-scale processing, stronger links between research and industry, and integration into European bio-based value chains.

1.4 Timeframe and strategic approach

The Action Plan distinguishes between an operational timeframe up to 2030 and a longer-term strategic perspective towards 2040.

The period 2026–2030 has been selected as the implementation horizon. It marks the shift from analysis, stakeholder mobilisation and project-based activity towards coordinated action. It is also aligned with current national and EU policy cycles, creating an opportunity to integrate proposed measures into existing funding instruments, strategic frameworks and the new governmental agenda.

The 2040 perspective sets the direction for deeper systemic change. By then, Slovenia should move towards a more integrated, circular, climate-resilient and innovation-driven bioeconomy that creates higher value from biological resources while respecting ecological limits.

The strategic approach is therefore focused on value creation, implementation capacity and long-term system change. The 2026–2030 period should create the conditions for better coordination, stronger investment pathways and more effective use of Slovenia's existing bioeconomy assets.

1.5 Methodological approach

The Action Plan is based on analytical work, stakeholder engagement and insights from national and EU-supported bioeconomy initiatives. Its evidence base brings together policy analysis, available data, project outputs and stakeholder knowledge.

Key inputs include:

- national stakeholder consultations conducted within the BOOST4BIOEAST project;
- thematic workshops covering key bioeconomy areas;
- contributions from ministries, research institutions, industry actors and stakeholder organisations;
- analysis of existing strategies, policy frameworks, projects and available data;
- insights from related EU initiatives and platforms.

1.5.1 The stakeholder process

The stakeholder process followed the methodology developed within the BOOST4BIOEAST project and was structured in several phases, including Diagnosis & Visioning, Visioning & Strategizing, and a final Future-proofing stage. It was based on a multi-stakeholder approach, involving actors from all relevant sectors, including public administration, research and innovation, industry, primary production and civil society.

The process was strengthened and expanded through the activities of the Slovenian Bioeconomy Hub (Si.Bio), which connects stakeholders across sectors and initiatives. In addition to the core B4B process, inputs were enriched through synergies with other bioeconomy-related projects and initiatives within the Si.Bio community.

The Slovenian Bioeconomy Hub (Si.Bio) played an important role in this process as a multi-stakeholder platform connecting research, industry, primary production, public administration and civil society. It supported consultation, knowledge exchange and the identification of implementation needs across sectors.

Within this Action Plan, Si.Bio is positioned as an enabling structure for dialogue, coordination and implementation support. It does not replace political ownership, inter-ministerial coordination or dedicated financing, but can help connect these elements into a more functional national bioeconomy framework.

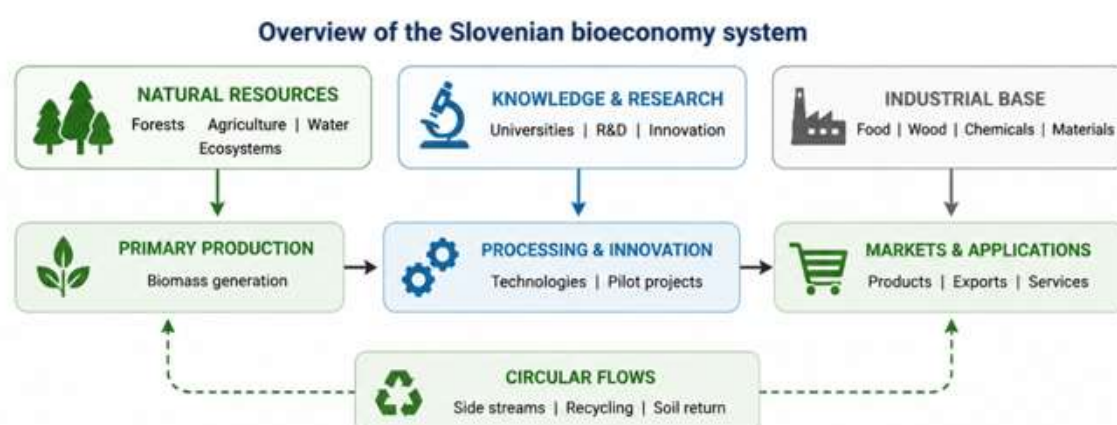
2 Slovenia's bioeconomy

2.1 Overview of the Slovenian bioeconomy system

Slovenia's bioeconomy is a system of resource flows, value chains, institutions and markets connecting forests, agriculture, food systems, water resources, research capacities, industrial know-how and regional development needs.

Figure 1 provides a simplified system-level overview of the Slovenian bioeconomy, illustrating how resources, knowledge, industry and value creation pathways interact.

Figure 1: Overview of the Slovenian bioeconomy system

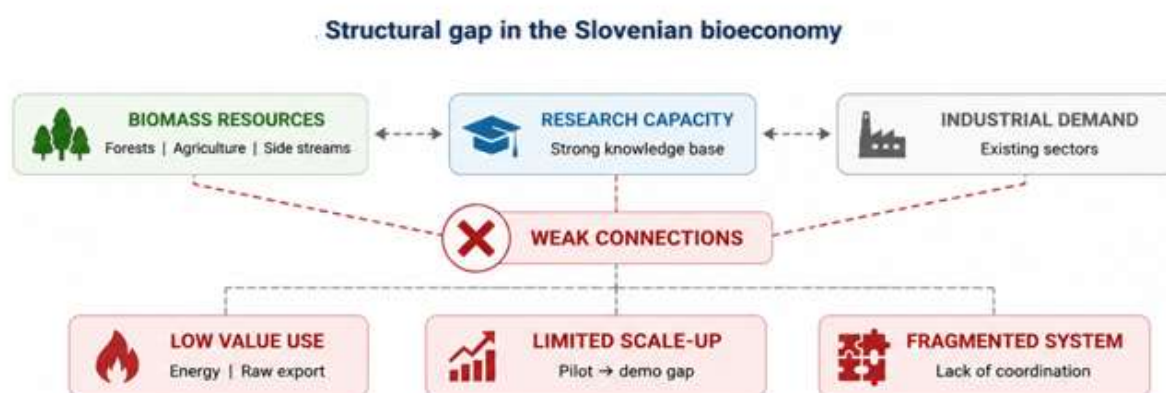


The country has a strong starting position within the BIOEAST macro-region: high forest coverage, diverse agricultural landscapes, relevant biomass side streams, a solid research base and industrial capacities in food, wood, chemicals, pharmaceuticals and advanced materials.

Its main weakness is connectivity. Resource flows, research capacities and industrial demand are insufficiently aligned. Biomass and side streams often remain in low-value uses or leave the country with limited processing, while pilot projects do not yet form a coordinated pipeline towards demonstration, investment and scale-up.

Figure 2 illustrates the key structural gap in the Slovenian bioeconomy system: strong assets exist, but remain insufficiently connected, limiting value creation and scale-up.

Figure 2: Structural gap in the Slovenian bioeconomy system



Together, Figures 1 and 2 frame the core logic of this chapter: Slovenia has a strong resource and knowledge base, but lacks the systemic connectivity required to translate these assets into higher-value and scalable bioeconomy pathways.

2.2 Regulatory and institutional framework

2.2.1 A framework without a dedicated bioeconomy law or strategy

Slovenia has no dedicated bioeconomy strategy and no single legal act that defines the bioeconomy as a regulated policy field. Bioeconomy content is instead distributed across sectoral strategies, programming documents and regulations in agriculture, forestry, environment, energy, waste, industry and research. This has been a consistent finding since the first systematic national assessment (Bridge2Bio, 2019) and it remains valid today: the individual components of the framework have evolved, but its underlying architecture has not.

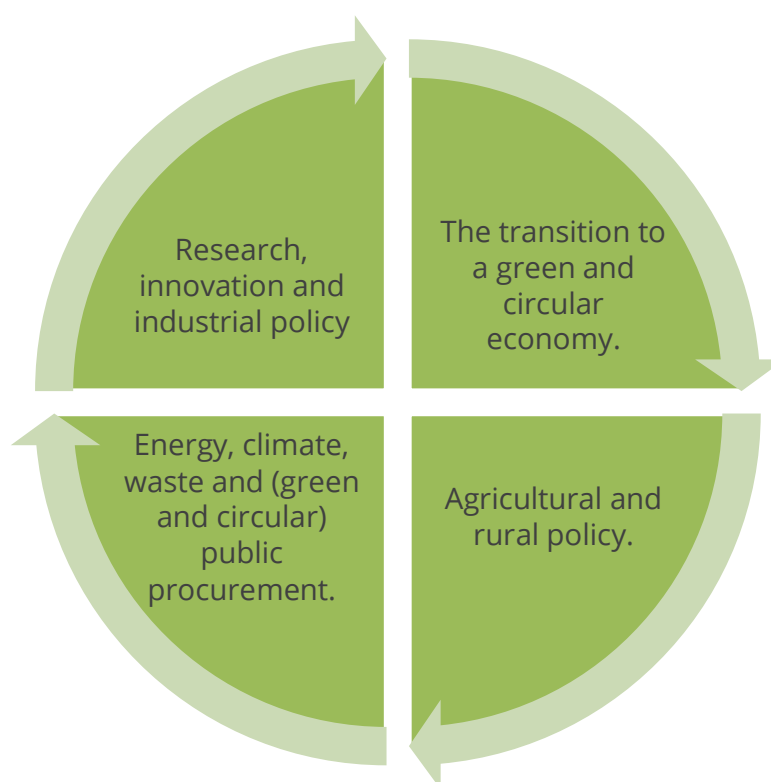
The practical consequence is that no instrument in Slovenia is formally designated as a “bioeconomy instrument”. Measures that support the bioeconomy do so indirectly, as a by-product of sectoral objectives — most often decarbonisation, energy efficiency, waste management or competitiveness. Relevance to the bioeconomy is therefore a matter of interpretation rather than of legal or programming definition. This also explains why the bioeconomy is difficult to budget, monitor or evaluate as a coherent policy area.

This is the regulatory expression of the governance gap identified in Chapter 3: the absence of an umbrella framework is not a gap in ambition, but a gap in coordination and attribution.

2.2.2 Strategic and programming documents

The diversity and fragmentation of the regulatory framework can be better understood through the main groups of strategic and programming documents presented below.

Figure 3: Groups of documents of the bioeconomy-relevant content in Slovenia



Research, innovation and industrial policy.

The Smart Specialisation Strategy — adopted in 2015 and continued as S5 (Slovenian Smart Specialisation Strategy) for 2021–2027 — remains the first and central national strategic document to incorporate bioeconomy content, and is cited as such in JRC sources. The bioeconomy is not named as a priority area in its own right; it is addressed implicitly through the priority areas Networks for the Transition to a Circular Economy, Sustainable Food Production, Smart Buildings and Home with a Wood Value Chain, and Development of Materials as Products. Under S4/S5, Strategic Research and Innovation Partnerships (SRIPs)

were established in each priority area as the main mechanism for aligning research, industry and public actors around joint investment planning.

The transition to a green and circular economy.

The Roadmap towards the Circular Economy in Slovenia (2018) treats the bioeconomy as an integral part of the circular economy and highlights two cross-cutting fields: green agricultural practices across the whole food chain, and the forest-wood value chain, where wood is identified as one of the most circular materials. The Roadmap also identified insufficiently active involvement of individual ministries and the absence of a circular agricultural policy as key public-policy shortcomings — a diagnosis that anticipates the structural gaps set out in Chapter 3 of this Action Plan.

Agricultural and rural policy.

The bioeconomy is addressed most explicitly in this domain. Under the 2014–2020 Rural Development Programme (RDP), bioeconomy content was concentrated in focus area 5C (facilitating the supply and use of renewable energy sources, by-products, wastes, residues and other non-food raw materials for the purposes of the bioeconomy), which had no stand-alone measures of its own; support was delivered through investment measures addressing mainly energy use, i.e. the final step of the biomass cascade. The CAP Strategic Plan 2023–2027 is now the operative framework and gives the bioeconomy a more systematic place, in line with the strengthened role of the bioeconomy in the CAP regulatory package. The resolution “Our Food, Countryside and Natural Resources after 2021” already positioned bioeconomy development as a specific objective, on the reasoning that bio-based value chains operate mostly at local and rural level and can therefore support economic convergence between urban and rural areas.

Energy, climate, waste and (green and circular) public procurement.

These fields provide much of the regulatory substance affecting biomass use in practice: sustainability criteria for biofuels and greenhouse gas emissions in the fuel life cycle, support schemes for renewable energy sources, the regulation on the management of biodegradable kitchen waste and green garden waste, and the regulation on green public procurement. National frameworks in these areas are largely transpositions or implementations of EU legislation.

The forest–wood value chain is addressed separately through the Action Plan for Increasing the Competitiveness of the Forest–Wood Value Chain, covering investment in wood-processing capacity, business–research cooperation, technological equipment, wood use in construction, and the collection, sorting and recycling of wood residues and post-consumer wood.

2.2.3 Instruments and support mechanisms

Support for the bioeconomy in Slovenia is delivered through instruments that were designed for other primary purposes:

- **Agricultural biomass:** investment support and cooperation measures under the CAP Strategic Plan (successor to RDP measures M4.1, M4.2, M6.4, M8.6 and M16).
- **Forest and wood biomass:** measures under the Action Plan for the Forest–Wood Value Chain, financed predominantly from European structural funds with linked national resources.
- **Energy:** Eco Fund loans and incentives (renewable energy installations, cogeneration, heating and cooling from renewable sources, energy efficiency in public and residential buildings).
- **Industry and entrepreneurship:** generic RDI and competitiveness instruments, under which bio-based technologies and products compete with all other sectors; no ring-fenced bio-based allocation exists.
- **Regulatory and market-based instruments:** green public procurement, sustainability criteria, standards and labelling.
- **Local level:** municipalities and their associations, active mainly in sustainable tourism, energy supply and waste management.

Two structural features follow from this. First, almost all instruments with a positive effect on the bioeconomy rest on EU policies and programmes that address the bioeconomy only indirectly; purely national schemes are, in practice, almost absent. Second, energy dominates among sectors, and investment support and regulatory requirements dominate among instrument types. Measured against international classifications of bioeconomy policy instruments, this places Slovenia in the average-to-better-developed group globally, but in the lower half at European level.

2.2.4 Institutional actors and stakeholders

Ministries. The Ministry of Agriculture (MKM) covers agriculture, forestry, food and rural development, and is the national lead in the BIOEAST Initiative; the Ministry of the Environment (MOP) covers environment, climate, waste, circular economy and green public procurement; the Ministry of Education, Science and Youth (MIZM) covers research, innovation and the S5

framework; economic development and industrial policy, energy, and finance and cohesion policy are further relevant portfolios. Competences for bioeconomy coordination are currently under review following the formation of the new government, and the lead ministry for bioeconomy coordination — including representation of Slovenia in the European Commission Expert Group on Bioeconomy — has not yet been determined.

Public bodies and agencies. The Slovenia Forest Service (ZGS), Slovenian Forestry Institute (GIS), Agricultural Institute of Slovenia (KIS), the Chamber of Agriculture and Forestry of Slovenia (KGZS) with its advisory service, the Eco Fund, SPIRIT Slovenia and the Slovenian Enterprise Fund, and the Slovenian Research and Innovation Agency (ARIS).

Research and knowledge institutions. University of Ljubljana (in particular the Biotechnical Faculty and its Department of Wood Science and Technology, and the Faculty of Social Sciences), University of Maribor, University of Primorska, University of Nova Gorica, the Jožef Stefan Institute, the National Institute of Chemistry, the Pulp and Paper Institute, the Slovenian Forestry Institute, the National Institute of Biology and the Slovenian National Building and Civil Engineering Institute (ZAG).

Business and intermediary organisations. The Chamber of Commerce and Industry of Slovenia (GZS) and its branch associations, the Chamber of Craft and Small Business, the Štajerska Chamber of Commerce (coordinator of the SRIP Circular Economy), regional development agencies, and cooperatives and producer organisations in agriculture and forestry.

Enterprises. Actors are present along the whole cascade: state-owned Slovenian State Forests (managing around 325,000 hectares) and Kočevski les in the forest-wood chain; the pulp, paper and packaging industry; chemicals and pharmaceuticals; producers of advanced bio-based materials; waste management and utility companies; and energy companies.

Coordination platforms. SRIP Circular Economy (coordinated by the Štajerska Chamber of Commerce) is the only SRIP whose action plan explicitly includes the bioeconomy, focusing on its technological component (bio-based economy), with six focus areas: sustainable energy, biomass and alternative raw materials, secondary raw materials, functional materials, processes and technology, and circular business models. Further relevant platforms are the SusChem technology platform for sustainable chemistry and biotechnology (hosted by the National Institute of Chemistry), the InnoRenew CoE centre of excellence for renewable materials and healthy living environments, the Cel.Krog strategic RDI programme coordinated by the Pulp and Paper Institute, and the Competence Centre for Human Resources in the Chemical Industry (KoCKE).

The Slovenian Bioeconomy Hub (Si.Bio) - a partnership of MKM, Circular Change, Anteja ECG and GZS, connecting more than 150 stakeholders — is currently the only structure that brings

these actors together across sectors. It has no formal mandate and no dedicated financing, which is precisely why the governance question addressed in Chapter 4 is central to implementation.

2.2.5 Implications for the Action Plan

1. **The problem is not the absence of regulation, but the absence of attribution and coordination.** Bioeconomy-relevant rules and instruments exist across at least six policy fields, but no actor holds a mandate to align them.
2. **The instrument mix is skewed towards the end of the cascade.** Support concentrates on energy use and on the substitution of fossil fuels, while higher-value cascading uses — the pathways with the strongest multiplier effects in added value and employment — remain the least supported. This has been the case since at least 2019 and has not fundamentally changed.
3. **The institutional landscape is rich but unconnected.** Slovenia does not lack actors; it lacks a mandated venue in which they set priorities jointly. This is the reasoning behind the governance scenarios (A/B/C) presented in Chapter 4.

2.3 Natural resources and biomass potential

Slovenia's natural resource base is one of the strongest foundations of its bioeconomy. Forests, agricultural land, food-system side streams, water resources and ecosystem services provide significant potential for circular and higher-value use. The main question is how to mobilise and valorise these resources without exceeding ecological limits.

2.3.1 Forest resources

Forests are the backbone of Slovenia's biomass potential, covering approximately 58% of the national territory. Annual production of forest wood assortments averages around 4.5 million m³, while 60–70% of the annual increment is currently harvested.

Behind this strong resource base lies a structural constraint: highly fragmented private ownership and challenging logistics for the secondary materials collection. More than 300,000 forest owners, with an average property size of approximately 2.9 hectares, make coordinated supply, logistics and industrial use difficult.

A significant share of unprocessed roundwood is still exported, estimated at 1.3–3 million m³ annually. Lower-quality wood, logging residues and bark also remain underused, although they offer potential for cascading use, biorefineries and advanced bio-based materials.

Climate change adds another layer of transition. As forest composition gradually shifts towards hardwoods, especially beech, Slovenia will need to adapt its processing capacities, product development and industrial pathways accordingly.

2.3.2 Agricultural and food-system biomass

Small-scale structure defines much of Slovenian agriculture. Around 58% of utilised agricultural land is grassland, and approximately three-quarters of farmland is located in areas with natural constraints.

The largest biomass stream comes from livestock production, which represents around 56% of agricultural output. Livestock manure is estimated at over 620,000 tonnes of dry matter annually, yet its biogas potential remains utilised at well below 10%.

Crop residues add further volume. Cereals and maize generate approximately 550,000 tonnes of dry matter annually, with additional streams from vegetables, oilseeds, root crops and horticulture. Food-processing side streams from dairy, meat processing, brewing and wine production are especially relevant because they are relatively homogeneous and potentially scalable.

Today, many agricultural and food-system side streams remain locked in low-value uses, mainly fertilisation or energy. Redirecting suitable flows towards bioactive compounds, bio-based packaging and materials, biostimulants, biochar and advanced biorefining would create higher value without increasing pressure on primary biomass.

2.3.3 Aquatic biomass, soils and ecosystem services

Aquatic biomass is modest in volume, but strategically relevant. Fisheries and aquaculture generate limited primary biomass, while fish-processing residues and emerging algae-based systems offer niche opportunities linked to the EU blue bioeconomy agenda.

Ecosystem services are a more central asset. Around 37% of Slovenia's territory is part of Natura 2000, much of it forested, and the country is among the more water-abundant EU Member States. Biodiversity, soil quality and water resources therefore function as both ecological safeguards and future value assets.

New mechanisms such as carbon farming, nature-based solutions, nature credits and ecosystem service payments could open additional income streams. They also sharpen the

need for careful trade-off management, particularly where biomass mobilisation, biogenic carbon trading, biodiversity protection, climate adaptation and land use meet.

2.3.4 Overall assessment

The resource base is strong; the system around it is weaker. Forests, agricultural biomass, food-system side streams, water availability and short internal transport distances give Slovenia a credible foundation for bioeconomy development.

The main constraints are structural:

- fragmented ownership in forestry and agriculture;
- weak aggregation and logistics systems;
- dispersed and insufficient processing capacity;
- lack of industrial-scale biorefineries and strained economics in existing ones;
- limited mobilisation of residues and side streams;
- weak integration into higher-value value chains.

The BOOST4BIOEAST integrated readiness assessment supports this diagnosis. Lower scores in biomass production capacity (33%), yields (33%) and reserves (31%) reflect constraints linked to geography, land use and farm structure. Environmental indicators, including carbon footprint (23%) and biodiversity intactness (37%), underline the need to balance biomass use with ecological resilience.

The strategic implication is clear: Slovenia's priority should be better use of existing biomass streams and side streams, not growth based on higher primary biomass extraction.

2.4 Scientific, research and innovation capacities

Slovenia has a strong research and innovation base relevant to the bioeconomy and ranks among the leading BIOEAST countries in several RDI indicators. R&D intensity is approximately 2% of GDP, above the BIOEAST average, while business expenditure represents around 74% of total R&D investment.

A high-performing network of institutions supports this capacity, including the University of Ljubljana, University of Maribor, University of Nova Gorica, Jožef Stefan Institute, National Institute of Chemistry, Agricultural Institute of Slovenia, Slovenian Forestry Institute and National Institute of Biology. Scientific output is strong in fields such as biotechnology, biomaterials, agriculture and sustainability, with active participation in EU research programmes.

The innovation ecosystem is also supported by the Smart Specialisation Strategy, Strategic Research and Innovation Partnerships and the Slovenian Bioeconomy Hub. These structures provide an important basis for connecting research, industry and public institutions.

Yet the bridge from knowledge to deployment remains fragile. Pharmaceuticals and chemicals show strong R&D intensity and global competitiveness, while food processing, wood industry and agriculture have lower R&D investment and weaker research-industry collaboration.

The main bottlenecks are:

- limited pilot and demonstration infrastructure at TRL 5–8;
- absence of operational biorefinery facilities;
- limited access to scale-up financing;
- weak industry-research collaboration in traditional sectors.

The BOOST4BIOEAST readiness assessment confirms this imbalance: circular bio-based industry maturity scores 75%, and pilot-to-demo scale-up 89%, while new value chains score only 4% and investment platform readiness 25%.

The task ahead is not to generate more isolated knowledge, but to turn research capacity into industrial pathways, market applications and investable bio-based solutions.

2.5 Industrial capacities and economic foundations

A diversified industrial base already exists, but its bioeconomy potential is unevenly distributed. Activities span approximately 16 economic sectors, with food and beverage processing, forestry and wood processing, pulp and paper, chemicals and pharmaceuticals, plastics and advanced materials forming the main backbone.

Employment remains strongly concentrated in primary and conventional sectors. Agriculture and forestry account for around 65% of the bioeconomy workforce, above the EU average of approximately 57%, while higher-value processing is concentrated in a smaller number of technology-intensive industries.

This imbalance is visible in productivity. Labour productivity in the bioeconomy is approximately €20,500 per employee, less than 60% of the EU average of around €35,000. Pharmaceuticals and chemicals are the main exception, with value added per employee exceeding €135,000 and stronger integration into global markets.

Export performance also varies. Wood processing enterprises export approximately 55% of production, while food processing exports around 34%, below the overall manufacturing

average. The paper industry already demonstrates circular potential, with more than half of raw material inputs derived from recycled fibre.

The strategic task is to connect two realities that still operate too far apart: traditional sectors that provide biomass, employment and regional anchoring, and advanced industries that offer higher value-added potential, stronger R&D intensity and global competitiveness. This connection is central to building circular, investable and higher-value bio-based value chains.

The following figures illustrate key structural characteristics of the Slovenian bioeconomy in terms of employment and value creation across sectors.

Figure 4: Employment by sector in Slovenia, 2023 (number of people employed)

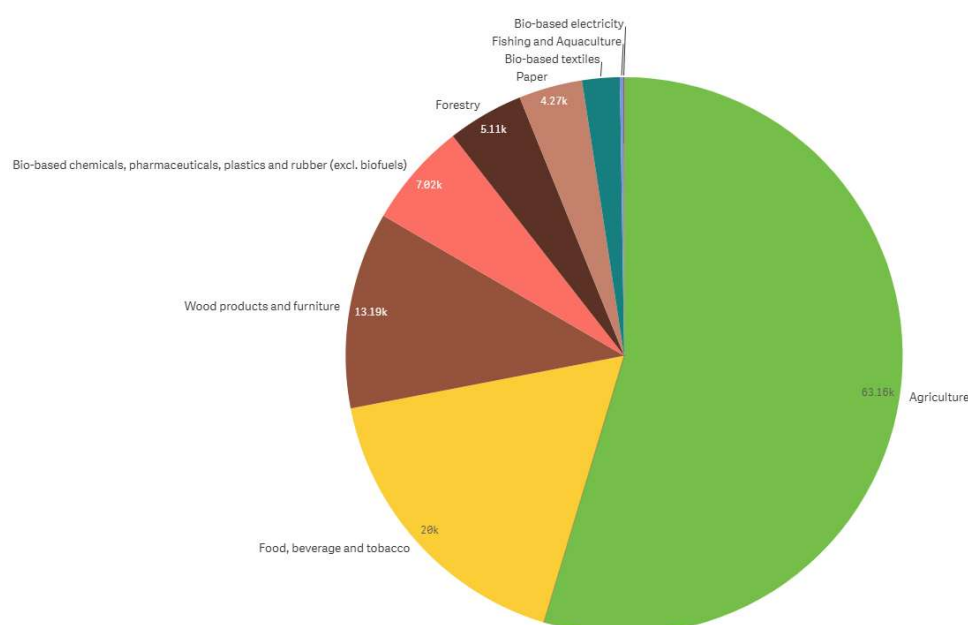


Figure 5: Value added by sector in Slovenia, 2023 (million EUR)

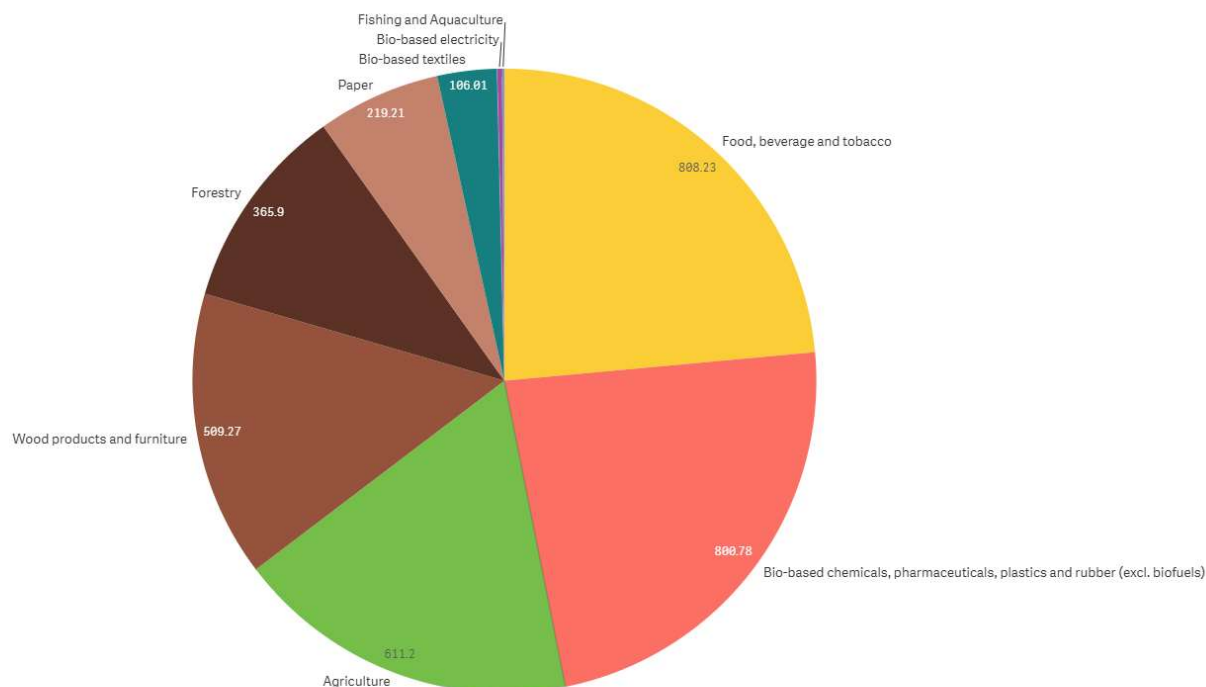


Figure 6: Development of the number of people employed in selected sectors, Slovenia (2008–2023)

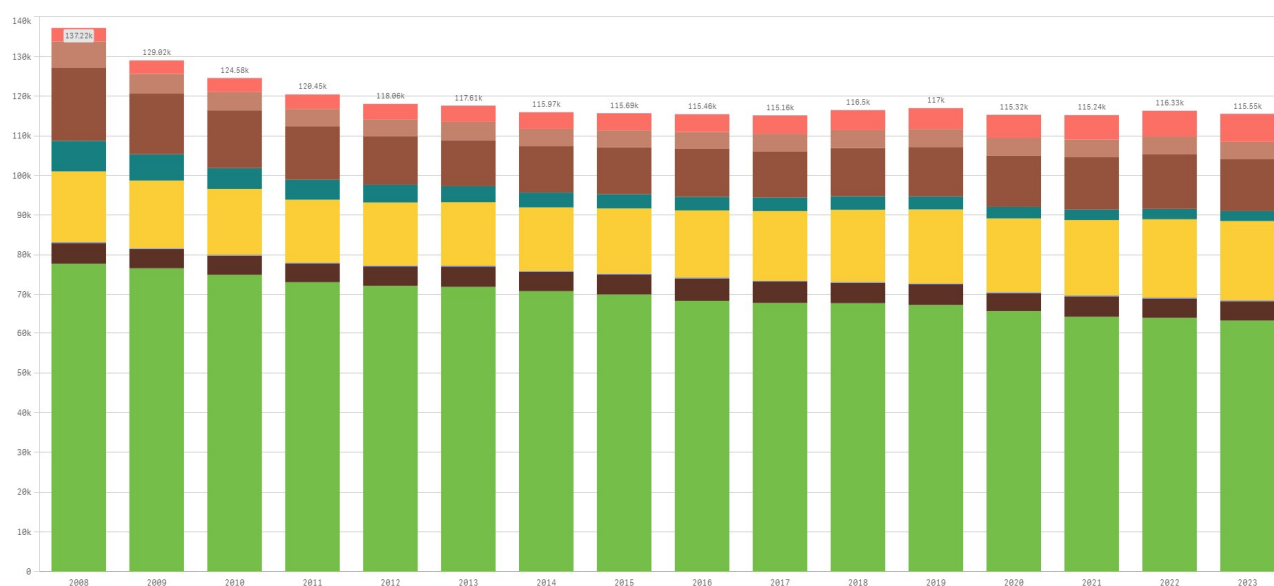
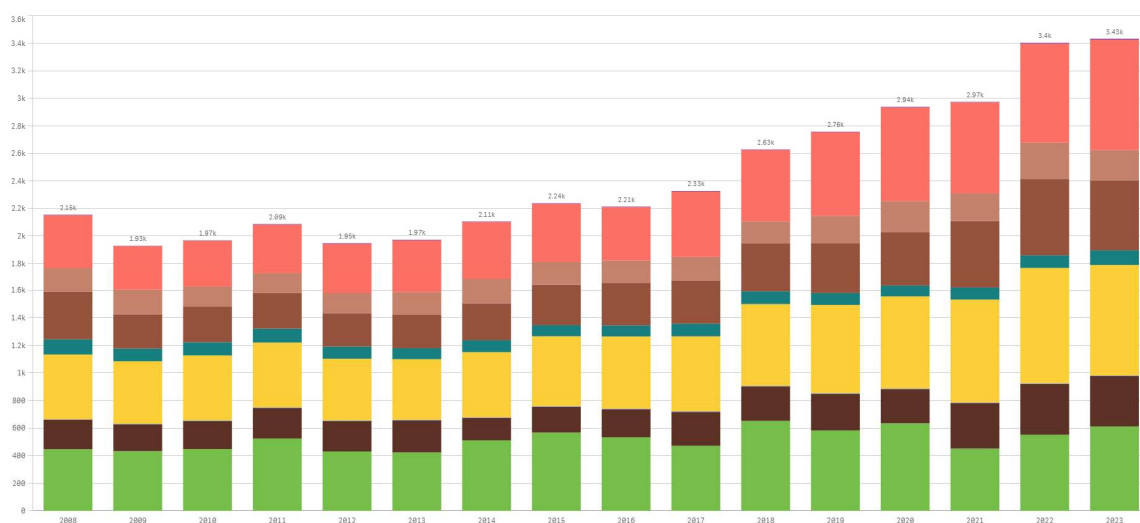


Figure 7: Development of value added in selected sector, Slovenia, 2008-2023



Taken together, these figures confirm a structural imbalance: employment remains concentrated in primary and lower-value sectors, while higher value added is generated in a limited number of technology-intensive industries. Bridging this gap is central to the development of a more competitive and resilient bioeconomy.

2.6 Pilot activities, circular innovation and EU projects

A growing project and pilot ecosystem is already shaping Slovenia's bioeconomy. EU-funded initiatives such as BIOLOC, BIOEASTsUP, Bridge2Bio, BioINSouth, BOOST4BIOEAST, CEE2ACT, CircAgro and BIOECO-UP have supported biomass mapping, value-chain analysis, stakeholder engagement and governance development.

One of the most important outcomes is the Slovenian Bioeconomy Hub (Si.Bio), which connects more than 150 stakeholders across research, industry, primary production, public administration and civil society. Its value lies in creating a shared space where fragmented knowledge, project results and implementation needs can be brought together.

Concrete innovation examples show that Slovenia is not starting from zero. They include the pilot-scale biorefinery development in Velenje, expansion of fermentation capacities by Acies Bio, bio-based chemical inputs in industrial coatings by Helios, regional biochar value chains through Alps4GreenC, predevelopment for advanced carbon-based materials, low-carbon fuels and feedstocks and carbon capture utilisation at the Centre for Development of Carbon Free

technologies in Kisovec, fermentation-based food innovation and insect-based bioconversion of agricultural by-products.

These examples confirm technological capacity, entrepreneurial initiative and industrial interest. What is still missing is a coordinated national pipeline that connects pilots with demonstration infrastructure, investment readiness, regulatory support and market uptake.

For the Action Plan, the implication is practical: Slovenia needs fewer isolated success stories and a stronger scale-up architecture. Platforms such as Si.Bio, SRIP Circular Economy and sectoral partnerships can help turn project outputs into investable pathways, industrial deployment and visible market solutions.

2.7 Emerging shift towards systemic bioeconomy thinking

Stakeholder consultations in 2025 show a clear shift in how the bioeconomy is understood in Slovenia. It is increasingly seen less as a set of sectoral activities and more as a cross-sector transition linking agriculture, forestry, food systems, industry, energy, research, municipalities and regional development.

This shift is visible across several processes, including BOOST4BIOEAST, CEE2ACT, CircAgro, BIOECO-UP and the Decarbonisation project. Stakeholders consistently emphasise circular value chains, cascading biomass use, industrial symbiosis, regional ecosystem approaches and stronger cooperation between public institutions, research organisations and industry.

The Slovenian Bioeconomy Hub has become an important expression of this new way of working. It provides a shared space for dialogue, coordination and stakeholder mobilisation, while helping to connect project-based knowledge with national implementation needs.

The BOOST4BIOEAST integrated readiness assessment confirms that Slovenia is well positioned in the BIOEAST region, with an overall readiness level of 52% and a 2030 target of 71%. This indicates both progress and ambition.

The next step is institutionalisation. Systemic awareness now needs to be translated into stable governance, predictable funding, shared monitoring and a stronger investment pipeline. Without these elements, the bioeconomy risks remaining a landscape of promising projects rather than a coherent national transition.

The analysis reveals a clear pattern: strong assets exist, but remain insufficiently connected to enable higher-value and scalable bioeconomy development. These structural challenges are further addressed in Chapter 3.

3 SWOC analysis of the bioeconomy system in Slovenia

Building on the structural analysis presented in Chapter 2, this chapter identifies the key gaps and barriers limiting the development of the Slovenian bioeconomy. The SWOC analysis translates the evidence from Chapter 2 into a strategic diagnosis. It identifies which strengths can be mobilised, which weaknesses block implementation, which external challenges require careful management, and which opportunities offer the strongest leverage for action.

Its purpose is not to repeat the system overview, but to provide a filter for decision-making. The analysis shows where Slovenia's bioeconomy has momentum, where the system is stuck, and where coordinated action can create the highest value.

3.1 System-level SWOC analysis

At system level, the picture is not one of absence, but of unfinished organisation. Capabilities exist across the bioeconomy system, yet they are not sufficiently aligned around shared priorities, investment decisions and implementation pathways.

This is why the same assets can appear both as strengths and as missed opportunities. Natural resources, research excellence, industrial capacities and stakeholder platforms create momentum, but without stronger coordination and scale-up mechanisms they do not yet add up to a mature bioeconomy system.

3.2 Key systemic bottlenecks and structural gaps

Five structural gaps cut across the Slovenian bioeconomy system.

First, governance remains fragmented. Bioeconomy-relevant responsibilities are spread across several ministries and institutions, while joint priority-setting, delivery and monitoring are still limited.

Second, investment and scale-up pathways are weak. Research results and pilot projects often do not move into demonstration, industrial deployment or market uptake.

Third, value chains remain underdeveloped. Biomass producers, processors, technology providers, researchers and end-users are not yet sufficiently connected into circular and higher-value pathways.

Fourth, aggregation, logistics and processing capacities are insufficient. Fragmented ownership and dispersed biomass streams make reliable supply and industrial use more difficult.

Fifth, skills and implementation capacity need to be strengthened. Bioeconomy development requires interdisciplinary knowledge, practical training, transition brokerage and stronger links between education, research, industry and public administration.

These gaps explain why Slovenia's bioeconomy remains high-potential but under-integrated. They also define the core intervention logic of this Action Plan.

3.3 SWOC matrix

The SWOC matrix below summarises the system-level diagnosis. It should be read as a decision-support tool: strengths indicate what can be mobilised, weaknesses show what must be corrected, challenges identify risks to manage, and opportunities point to where coordinated action can create the greatest leverage.

Table 1. SWOC analysis of the bioeconomy in Slovenia

Strengths	Weaknesses	Opportunities	Challenges
Strong biomass resource base: 58% forest coverage, diverse agricultural biomass streams, high water availability	Fragmented resource base: small-scale ownership in forestry and agriculture limits mobilisation and industrial use	Shift to higher value-added bioeconomy: moving from raw biomass export to advanced bio-based products	Need for cross-sectoral governance: lack of coordinated bioeconomy policy and institutional leadership
Diverse biomass streams: manure (>620,000 t DM), crop residues (~650,000 t DM), agro-food side streams, excess active sludge (~20.000 t DM)	Export of raw biomass: significant roundwood export with low domestic value added	Valorisation of side streams: bio-based materials, biochemicals, packaging, biochar, biostimulants, advanced materials	Scaling challenge: moving from pilot projects to industrial-scale implementation
Strong research and innovation base: high scientific output, strong EU participation, ~2% R&D intensity	Innovation gap: weak translation of research into market applications, especially in traditional sectors	Development of modular biorefineries suited to Slovenia's fragmented resource base	Financing gap: lack of investment platforms and scale-up funding

Strengths	Weaknesses	Opportunities	Challenges
Existing industrial capacities: food, wood, chemicals, pharmaceuticals, materials	Lack of biorefinery infrastructure and pilot facilities (TRL 5–8)	Industrial biotechnology and advanced materials as growth areas	Integration challenge: connecting fragmented value chains and stakeholders
International positioning: strong role in BIOEAST and EU projects	Fragmented value chains and weak industry–research linkages	Ecosystem services as economic assets: carbon farming, nature-based solutions	Balancing biomass use and sustainability (biodiversity, soil, water)
Emerging systemic awareness among stakeholders	Low productivity in traditional sectors and SME limitations	EU policy alignment and funding opportunities: Green Deal, CBE JU, and a growing focus on competitiveness, industrial capacity and innovation	Climate change impacts on forestry and agriculture

The matrix points to a limited number of recurring bottlenecks. The key implication is clear: **future progress will depend less on creating new isolated initiatives and more on connecting existing capacities, scaling what works and making implementation easier.**

While the system-level SWOC shows the main cross-cutting patterns, the thematic SWOC brings the diagnosis closer to implementation. It highlights how strengths, weaknesses, challenges and opportunities appear within the five priority areas identified through stakeholder consultations and the BOOST4BIOEAST process.

The table below provides a more detailed basis for defining targeted actions, responsibilities and implementation pathways in the Action Plan (Chapter 5).

Table 2. SWOC analysis of the bioeconomy priority areas in Slovenia

	Strengths	Weaknesses	Opportunities	Challenges
Agroecology and sustainable yields	• Diverse agro-ecological conditions and relatively high biodiversity. • Growing awareness and adoption of sustainable and agroecological practices. • Strong policy support through CAP and environmental measures. • Existing research and advisory institutions in sustainable agriculture. • Active participation in EU projects and networks.	• Fragmented farm structure and small-scale production. • Limited integration of agroecological practices into mainstream production. • Low productivity in certain sectors. • Weak knowledge transfer and advisory systems. • Limited use of digital and precision agriculture tools.	• Expansion of regenerative and climate-smart agriculture. • Digitalisation and precision farming. • EU funding for sustainable agriculture and climate adaptation. • Carbon farming and ecosystem services markets. • Development of local and resilient food systems.	• Increasing climate variability (droughts, floods, extreme events). • Need to balance productivity with sustainability. • Strengthening resilience of agricultural systems. • Improving farmer uptake of innovative practices. • Aligning policies across agriculture, environment, and climate.
Food systems	• Strong tradition of food production and processing. • High quality and diversity of local food products.	• Fragmented value chains and weak integration between actors.	• Development of circular food systems and waste valorisation. • Innovation in sustainable and functional foods.	• Ensuring food security under changing climate conditions. • Reducing environmental footprint of food systems.

	Strengths	Weaknesses	Opportunities	Challenges
	- Increasing consumer awareness of sustainability. - Existing short supply chains and local initiatives. - Well-developed food safety and quality standards.	- Limited scale and competitiveness of food processing sector. - High dependence on imports for certain products. - Food waste along the value chain. - Limited innovation uptake in SMEs.	- Strengthening local and regional supply chains. Digitalisation and traceability systems. - Integration of bio-based side streams into new products.	- Strengthening resilience of supply chains. - Balancing affordability and sustainability. - Reducing food loss and waste.
Forest value chain and wood industry	- High forest coverage (~60%) and strong biomass base. - Long tradition of sustainable forest management. - Strong public support for forest conservation. - Existing wood-processing industry. - Potential for multiple ecosystem services.	- Export of raw wood with low value added. - Limited production of high-value wood products. - Fragmented forest ownership. - Insufficient processing capacity. - Weak integration across the value chain.	- Development of high-value wood products and bio-based materials. - Investment in processing infrastructure. - Afforestation and sustainable forest management. - Integration into circular bioeconomy systems. - Digital forest management systems.	- Climate change impacts (pests, droughts, storms). - Need to increase value added in wood processing. - Balancing economic use with ecosystem protection. - Improving mobilisation of forest resources. Strengthening skills and workforce.

	Strengths	Weaknesses	Opportunities	Challenges
Bio-based materials	- Existing chemical, material, and industrial base. - Strong research capacity in materials science and biotechnology. - Participation in EU research and innovation projects. - Emerging bio-based product initiatives. - Growing demand for sustainable materials.	- Limited industrial-scale production of bio-based materials. - Lack of pilot and demonstration facilities. - Weak connection between research and industry. - High investment barriers and risks. - Limited market development for bio-based products.	- Development of new bio-based products (bioplastics, biochemicals, composites). - Investment in biorefineries and pilot plants. - EU funding and innovation support. - Growing demand for sustainable alternatives. - Integration into circular economy systems.	- Scaling up production from lab to market (TRL gap). - Competing with fossil-based materials. - Ensuring stable supply of biomass feedstock. - Regulatory uncertainty and standards. - Need for stronger industry collaboration.
Education and skills	- Well-developed education system and research institutions. - Existing expertise in bioeconomy-related fields. - Participation in international networks and programmes - Growing awareness of sustainability topics.	- Lack of interdisciplinary bioeconomy curricula. - Weak connection between education and industry needs. - Limited lifelong learning opportunities. - Skills gaps in emerging bioeconomy sectors.	- Development of new study programmes and training modules. - Strengthening collaboration between academia and industry. - Lifelong learning and reskilling programmes. - Integration of digital and green skills.	- Aligning education systems with labour market needs. - Developing interdisciplinary and system-level skills. - Attracting talent to bioeconomy sectors. - Strengthening knowledge transfer.

	Strengths	Weaknesses	Opportunities	Challenges
	Active initiatives (e.g. Eco-Schools, university programmes).	Insufficient practical training and hands-on experience.	International cooperation and exchange programmes.	Updating curricula to reflect new technologies and approaches.

3.6 Link to Action plan development

The SWOC analysis defines the practical logic of the Action Plan. It shows where the system has enough strength to move forward, where implementation gets stuck, and which levers can unlock progress.

The focus of the Action Plan is therefore on governance, investment, value-chain integration, sustainable resource use, skills and implementation capacity. These are the areas where coordinated action can turn scattered potential into visible results.

Chapter 4 translates this diagnosis into strategic objectives. Chapter 5 turns it into concrete actions, responsibilities and implementation pathways.

4 Vision 2040 and strategic objectives

A credible bioeconomy transition requires strategic choices: which resources to prioritise, which value chains to build, where to invest, how to manage trade-offs and which institutions can carry implementation over time.

For Slovenia, these choices point towards higher value creation, circular use of resources, targeted scale-up and stronger integration into European bio-based value chains. This chapter defines the long-term vision, strategic direction and core objectives guiding the transition.

A more detailed and comprehensive version of this chapter, including system characteristics, governance scenarios, indicators, trade-offs and implementation considerations, is provided in Annex 1. Implementation actions, priority areas and thematic pathways are further developed in Chapter 5.

4.1 Long-term vision towards 2040

By 2040, Slovenia will develop a bioeconomy based on circular use of resources, high value creation and integration into European bio-based value chains, while operating within ecological limits.

The bioeconomy will:

- maximise the value of domestic biological resources through cascading and circular use;
- strengthen integration of primary sectors, industry and research into resilient value chains;
- support sustainable economic growth while preserving biodiversity, soil and water;
- contribute to climate neutrality and resource efficiency;
- position Slovenia as a specialised, knowledge-driven partner in European and global bioeconomy networks.

This vision reflects Slovenia's specific structural conditions: a limited but diverse biomass base, fragmented ownership structures, strong research capacity, selected industrial strengths and a small domestic market. The transition therefore relies on quality, specialization, knowledge and strategic positioning rather than volume-based growth.

Priority areas of transformation include:

- higher value-added utilisation of biomass;
- efficient and circular use of existing resources;
- integration into European and global bio-based value chains;
- development of specialised and knowledge-intensive bio-based solutions.

A detailed description of system characteristics and sectoral dynamics is provided in Annex 1.

4.2 Strategic outlook

Limited biomass is not a weakness if it is treated as a design condition. For Slovenia, the bioeconomy cannot be built on volume, but on intelligent use of resources, stronger domestic value creation, circular design and targeted scale-up.

Residues and side streams from forestry, agriculture and food systems represent key opportunities, but require careful matching with the most appropriate and highest-value uses within sustainability limits. Scaling should therefore be deliberate and selective, focusing on value chains where resources, knowledge, industrial capacity and market demand align.

This implies a shift from fragmented initiatives towards coordinated value chains and stronger integration into European bio-based systems.

Further elaboration of strategic trade-offs, biomass use conflicts and system-level considerations is provided in Annex 1.

4.3 Strategic focus and transition priorities (2026–2030)

The period 2026–2030 represents the core implementation window. The strategic objectives therefore focus on key leverage points where coordinated action can enable structural change:

- governance and coordination;
- value creation and industrial development;
- innovation scaling and deployment;
- sustainability and resilience;
- human capital and skills.

These objectives are not intended to deliver full transformation within one policy cycle, but to establish the conditions for a more integrated, scalable and resilient bioeconomy system.

4.4 Strategic objectives

Five strategic objectives structure the transition:

- SO1 - Strengthen governance, coordination and policy integration across bioeconomy-relevant portfolios
- SO2 - Increase domestic valorisation of biomass through integrated circular value chains
- SO3 - Accelerate innovation scaling and demonstration capacity
- SO4 - Strengthen sustainable and resilient primary production while protecting ecosystem services
- SO5 - Build human capital, skills and societal awareness

These objectives are operationalised through three structural pillars described in Section 4.5 and further elaborated in Chapter 5.

4.5 Structural pillars of the bioeconomy transition

To ensure coherence between the vision, strategic objectives and implementation, the transition is structured around three interconnected pillars:

- **Pillar 1 – Governance and enabling framework**
Focuses on coordination, policy integration, institutional alignment and monitoring systems.
- **Pillar 2 – Bio-based value chains and industrial development**
Addresses domestic valorisation of biomass, circular value chains, industrial capacity, investment and market development.

- **Pillar 3 – Innovation, skills and sustainability**

Connects research, education, skills development, innovation uptake and environmental safeguards.

Together, these pillars provide the structural logic linking strategic objectives (Chapter 4) with implementation actions, priority areas and thematic pathways defined in Chapter 5.

Figure 1 shows how the pathways connect the 2040 vision, strategic objectives and implementation actions.

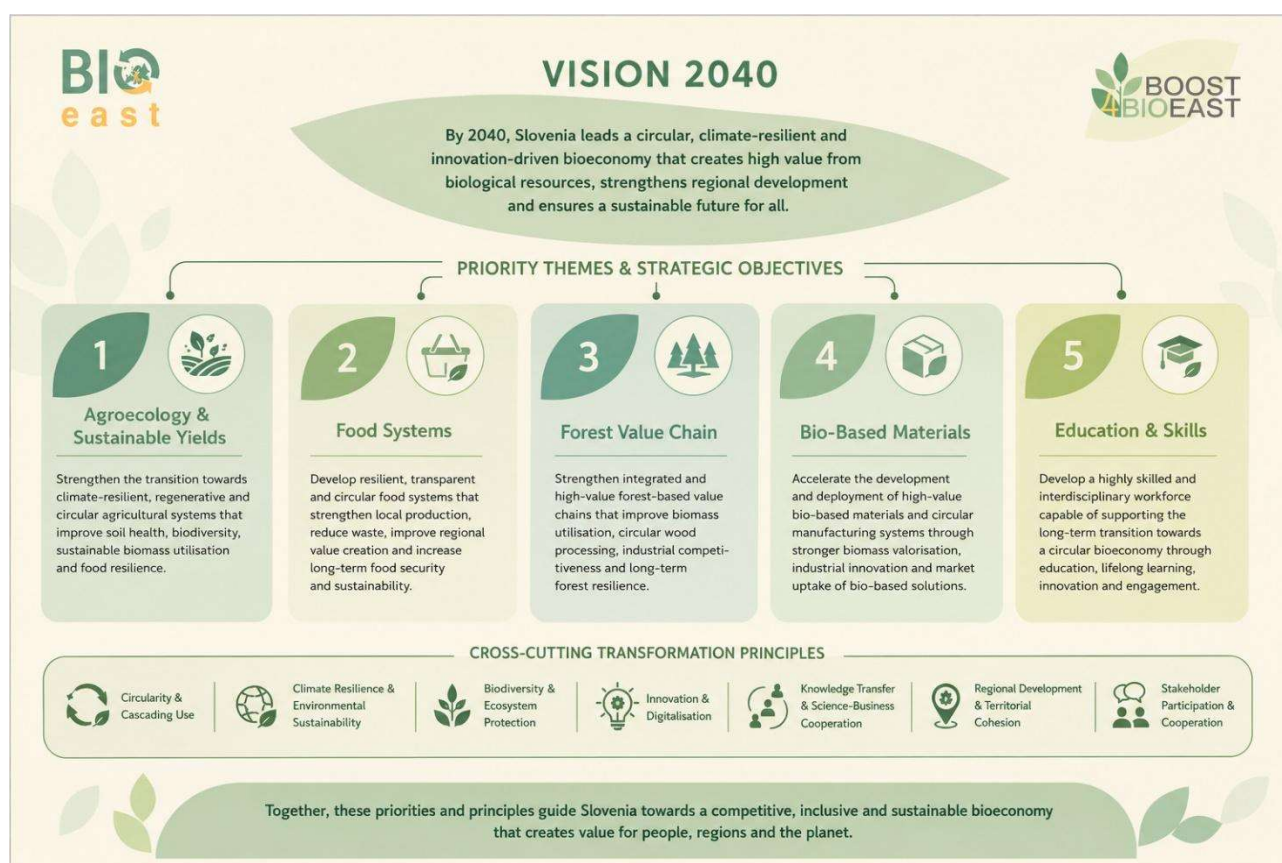


Figure 8. Vision 2040 and strategic transformation pathways of the Slovenian bioeconomy

A more detailed description of the pillars, including objectives, actions and target states, is provided in Chapter 5 and additionally in Annex 1.

5 Action Plan 2026 –2030

In the tables below, thematic strategic objectives define the direction of change within each priority area, while operational objectives specify the concrete implementation focus. These are aligned with the five overarching strategic objectives defined in Chapter 4.

5.1 THEME 1: Agroecology and Sustainable Yields

Sub-theme 1: Agroecological transition and knowledge transfer					
Strategic objective 1:	Strengthen adoption of agroecological, regenerative and climate-smart farming systems through improved knowledge transfer, demonstration activities, and regional implementation support.				
Timeframe	Key actions	Indicators	Milestones	Resources & funding	Responsible
2026 – 2030	Establish regional agroecology competence centres	Number of centres established	At least 3 regional centres operational	CAP, National Budget, Cohesion Funds	Ministry of Agriculture, Universities
2026 – 2030	Develop demonstration farms and field laboratories	Number of demonstration farms operating	National demonstration network established	CAP, Horizon Europe	Agricultural Institute of Slovenia (KIS), Chamber of Agriculture and Forestry of Slovenia (KGZS) and its regional institutes

Sub-theme 1: Agroecological transition and knowledge transfer					
Strategic objective 1:	Strengthen adoption of agroecological, regenerative and climate-smart farming systems through improved knowledge transfer, demonstration activities, and regional implementation support.				
Timeframe	Key actions	Indicators	Milestones	Resources & funding	Responsible
2026 – 2030	Strengthen advisory systems and farmer training programmes	National training programme implemented	Number of farmers trained annually	CAP, National Budget	KGZS - Agricultural Advisory Service and Regional institutes
2026 – 2030	Improve research-to-practice pathways	Applied innovation partnerships established	Number of research-practice projects; adoption rate of innovations	Horizon Europe, National R&I Funds	Research Institutions

Sub-theme 2: Soil health, biodiversity and carbon farming					
Strategic objective 1:	Improve soil health, biodiversity, ecosystem services, and carbon sequestration through regenerative land management and climate adaptation measures.				
Timeframe	Key Actions	Indicator	Milestones	Funding	Responsible
2026–2030	Launch and scale carbon farming pilot programmes	Number of farms participating in carbon farming schemes	National carbon farming framework established	CAP Strategic Plan, LIFE, National Budget	Ministry of Agriculture, Research Institutions
2026–2030	Establish national soil health monitoring system	Soil health monitoring indicators operational	National soil monitoring system implemented	National Budget, Horizon Europe	Research Institutions, KGZS - Agricultural

					Advisory Service and Regional institutes
2026–2030	Promote biodiversity-supporting agricultural practices	Area under biodiversity-supporting measures	Increase in biodiversity-friendly farming practices	CAP Eco-schemes, LIFE Programme	Farmers, Advisory services
2026–2030	Develop ecosystem service demonstration projects	Number of ecosystem service pilots	Regional demonstration projects operational	LIFE Programme, CAP	Research institutions, Municipalities

Sub-theme 3:	Digital and precision agriculture				
Strategic objective 3:	Accelerate deployment of digital technologies, precision agriculture, and AI-supported farm management systems to improve productivity, resource efficiency, and climate resilience.				
Timeframe	Key Actions	Indicator	Milestones	Resources & Funding	Responsible
2026–2030	Deploy precision farming technologies and smart monitoring systems	Number of farms using precision agriculture solutions	Precision agriculture adoption significantly increased	CAP, Digital Europe, National budget	Technology providers, Farmers, KGZS - Agricultural Advisory Service and Regional institutes
2026–2030	Develop AI-supported decision-support and advisory tools	Number of digital tools deployed	National digital advisory ecosystem operational	Horizon Europe, Digital Europe	Research Institutions, SMEs

Sub-theme 3:		Digital and precision agriculture			
Strategic objective 3:		Accelerate deployment of digital technologies, precision agriculture, and AI-supported farm management systems to improve productivity, resource efficiency, and climate resilience.			
Timeframe	Key Actions	Indicator	Milestones	Resources & Funding	Responsible
2026–2030	Introduce smart irrigation and water management systems	Number of smart irrigation systems installed	Demonstration regions established	CAP, Cohesion Funds	Water authorities, Farmers, Municipalities, Ministry for agriculture
2026–2030	Strengthen digital skills among farmers and advisors	Number of participants trained	National digital agriculture training programme implemented	CAP, National Budget	Advisory services, Universities

Sub-theme 4: Circular agricultural biomass systems					
Strategic objective 4:		Increase circular utilisation and valorisation of agricultural biomass, residues, nutrients, and side streams through integrated circular value chains.			
Timeframe	Key Actions	Indicator	Milestones	Funding	Responsible
2026–2030	Establish regional biomass coordination systems	Number of operational biomass platforms	Regional biomass coordination systems established	Cohesion Funds, CAP	Regional Development Agencies, Municipalities

Sub-theme 4: Circular agricultural biomass systems					
Strategic objective 4:	Increase circular utilisation and valorisation of agricultural biomass, residues, nutrients, and side streams through integrated circular value chains.				
Timeframe	Key Actions	Indicator	Milestones	Funding	Responsible
2026–2030	Support nutrient recovery and side-stream valorisation projects	Number of circular biomass projects implemented	Demonstration projects operational	Horizon Europe, National Budget	Research Institutions, Industry
2026–2030	Scale circular agricultural business models	Number of business models deployed	Commercial deployment achieved	CAP, Private Investment	Cooperatives, SMEs
2026–2030	Integrate agricultural residues into bio-based value chains	Biomass valorisation rate	Significant increase in agricultural side-stream utilisation	Public-Private Funding	Industry, Farmers, Cooperatives, Research institutes

5.1.1 Risks & Mitigation

Theme 1: Agroecology and sustainable yields

The main risk is slow uptake on farms. Agroecological practices require knowledge, trust, advisory support and financial space for experimentation. Without this, they remain good examples rather than mainstream practice. Climate pressures, fragmented support systems and weak links with circular biomass value chains could further slow progress.

Mitigation starts with the people who implement the transition: farmers, advisors, cooperatives and local actors. Stronger advisory services, practical demonstration sites, targeted CAP incentives, regional cooperation and better links between research and field practice are essential.

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5.1.1 RISKS & MITIGATION

Key risks that may affect the implementation of Theme 1: Agroecology and Sustainable Yields and corresponding mitigation measures.

RISK	POTENTIAL IMPACT	MITIGATION MEASURES
 Low adoption of agroecological practices by farmers	Slow implementation and limited impact of transition measures	 Strengthen advisory services, demonstration farms, peer-learning networks, and incentive schemes
 Insufficient coordination between research, advisory systems, and agricultural practice	Weak knowledge transfer and limited uptake of innovation	 Establish Regional Agroecology Competence Centres and strengthen technology transfer mechanisms
 Limited financial incentives for regenerative farming	Reduced participation in sustainable farming measures	 Align CAP measures, eco-schemes, carbon farming incentives, and national support programmes
 Climate change impacts (droughts, floods, pests)	Reduced productivity and increased implementation risks	 Promote climate-smart agriculture, resilient crop varieties, precision farming, and adaptive management systems
 Skills and capacity gaps among farmers and advisors	Slow adoption of new technologies and practices	 Develop targeted training programmes and lifelong learning initiatives
 Limited integration of agricultural biomass into circular value chains	Reduced biomass valorisation and circularity potential	 Strengthen regional biomass coordination systems and support circular business model development
 Fragmented implementation across regions	Uneven development and reduced system-wide impact	 Strengthen regional coordination mechanisms and stakeholder cooperation platforms

Overall, the identified risks can be effectively mitigated through stronger coordination, demonstration activities, targeted incentives, and continuous investment in knowledge transfer and implementation capacities.

Figure 9. Key implementation risks and mitigation measures for Agroecology and sustainable yields

5.1.2 Connection to the priorities of the BIOEAST Thematic SRIA on Agroecology

The Slovenian priority areas are closely aligned with the BIOEAST Thematic SRIA on agroecology, but their role is not only to reflect macro-regional priorities. They turn them into an implementation agenda shaped by Slovenia's specific conditions: fragmented resource ownership, strong forest and agricultural side streams, a solid research base, selected industrial capacities and the need for better scale-up mechanisms.

Theme 1: Agroecology and sustainable yields

Agroecology and Sustainable Yields connects to sustainable agriculture, soil health, biodiversity, climate resilience and circular biomass use. In Slovenia, this means stronger advisory systems, carbon farming, ecosystem services, digital agriculture and practical support for farmers.

5.2 THEME 2: Food systems

Sub-theme 1: Regional food systems and local value creation					
Strategic objective 1:	Develop resilient, transparent, and circular food systems capable of strengthening local production, reducing waste, improving regional value creation, and increasing long-term food security and sustainability.				
Timeframe	Key actions	Indicator	Milestones	Funding	Responsible
2026–2030	Establish Regional Circular Food Hubs connecting producers, processors, municipalities, retailers, and consumers	Number of food hubs established	Regional food hubs operational in all major regions	CAP Strategic Plan, Cohesion Funds, National and municipal public budget	Municipalities, Regional Development Agencies
2026–2030	Strengthen local food processing and distribution capacities	Processing capacity established or upgraded	Regional processing systems operational	CAP, Cohesion Policy, Private Investment	Food Industry, Cooperatives
2026–2030	Develop local supply-chain partnerships and proximity-based food systems	Number of partnerships established	Regional food coordination mechanisms operational	Public-Private Funding	Municipalities, Food Producers
2026–2030	Promote sustainable public procurement and local sourcing schemes	Share of sustainable procurement contracts	Procurement guidelines implemented nationally	National Budget	Public Institutions, Municipalities

Sub-theme 1: Regional food systems and local value creation					
Strategic objective 1:	Develop resilient, transparent, and circular food systems capable of strengthening local production, reducing waste, improving regional value creation, and increasing long-term food security and sustainability.				
Timeframe	Key actions	Indicator	Milestones	Funding	Responsible
2026–2030	Strengthen consumer awareness and sustainable consumption initiatives	Number of awareness campaigns and participants	National awareness programme operational	National Budget, LIFE Programme	Educational Institutions, NGOs, Ministry of Agriculture - "Selected Quality – Slovenia" quality scheme

Sub-theme 2: Circular food value chains and food waste valorisation					
Strategic objective 2:	Increase circularity within food systems through efficient utilisation of food resources, reduction of food waste, valorisation of side streams, and development of circular packaging solutions.				
Timeframe	Key actions	Indicator	Milestones	Funding	Responsible
2026–2030	Support cascading use of food-system side streams and by-products	Quantity of side streams valorised	Circular food valorisation pilots operational	Horizon Europe, National Budget	Food Industry, SMEs
2026–2030	Establish food waste collection and valorisation systems	Amount of food waste diverted from disposal	Regional food waste valorisation systems established	Cohesion Funds, LIFE Programme	Municipalities, Waste Management Operators

Sub-theme 2: Circular food value chains and food waste valorisation					
Strategic objective 2:	Increase circularity within food systems through efficient utilisation of food resources, reduction of food waste, valorisation of side streams, and development of circular packaging solutions.				
Timeframe	Key actions	Indicator	Milestones	Funding	Responsible
2026–2030	Develop circular packaging solutions based on bio-based materials	Number of new packaging solutions developed	Demonstration projects completed	Horizon Europe, Private Investment	Research Organisations, Industry
2026–2030	Promote industrial symbiosis between food producers and bioeconomy sectors	Number of cross-sector partnerships	Operational circular value chain partnerships established	Public-Private Funding	Industry, Regional Actors

Sub-theme 3: Food Traceability, Transparency and governance					
Strategic objective 3:	Strengthen transparency, traceability, and governance across food value chains to improve consumer trust, sustainability monitoring, and system coordination.				
Timeframe	Key actions	Indicator	Milestones	Funding	Responsible
2026–2030	Deploy digital food traceability systems	Number of operators connected to traceability systems	National traceability framework operational	Digital Europe, National Budget	Government (Ministry of Agriculture), Digital Providers
2026–2030	Establish sustainability monitoring mechanisms for food systems	Monitoring framework established	Sustainability indicators integrated into reporting systems	National Budget	Government (Ministry of Agriculture), Research Organisations
2026–2030	Improve transparency across food value chains	Number of participating stakeholders	Value-chain transparency tools operational	Public Funding	Food Sector Stakeholders
2026–2030	Strengthen coordination between producers, processors, retailers, and public institutions	Number of coordinated initiatives	Food system coordination platform operational	Public Funding	Government, Industry Associations

5.2.1 Risks & Mitigation

Theme 2: Food systems

Food systems will not change through isolated projects. The main risks are fragmented value chains, weak cooperation between producers, processors, retailers and public institutions, limited consumer demand and insufficient transparency. Without stronger market signals, circular and sustainable food-system models will remain marginal.

Public procurement, regional food hubs, traceability tools and food-waste prevention can create the first practical levers. The focus should be on building functioning regional ecosystems, not only promoting individual good practices.

 5.2.1 RISKS & MITIGATION Key risks that may affect the implementation of Theme 2: Food Systems and corresponding mitigation measures. 		
RISK	POTENTIAL IMPACT	MITIGATION MEASURES
 Market concentration and limited diversity of food value chains	Reduced resilience, weaker competition, and limited opportunities for local producers	 Support regional food ecosystems, short supply chains, and producer cooperatives; promote fair market access
 Limited stakeholder cooperation and fragmented governance	Inefficient implementation, duplication of efforts, and slow systemic change	 Strengthen multi-actor platforms, regional food councils, and cross-sector cooperation mechanisms
 Low consumer awareness and limited acceptance of sustainable options	Weak market demand for sustainable and circular food solutions	 Implement awareness campaigns, education programmes, and transparent communication on sustainability benefits
 Fragmented value chains and weak coordination across food system actors	Higher costs, inefficiencies, and limited ability to scale circular food solutions	 Develop integrated value-chain partnerships, digital coordination tools, and shared infrastructure
 High food waste and inefficient resource use	Environmental impacts, economic losses, and missed circularity opportunities	 Promote food waste reduction, surplus redistribution, circular processing, and resource-efficient technologies
 Regulatory and administrative barriers to innovation and new business models	Delays in innovation uptake and limited scaling of new food-system solutions	 Simplify regulations, provide innovation-friendly frameworks, and support pilot testing of new approaches
 Climate change impacts on food production and supply stability	Increased production risks, supply disruptions, and price volatility	 Promote climate-resilient production, diversified sourcing, and adaptive risk-management strategies
 Overall, the identified risks can be effectively mitigated through stronger cooperation, innovation, transparent governance, and a coordinated transition towards resilient and circular food systems. 		

Figure 10. Key implementation risks and mitigation measures for food systems

5.2.2 Connection to the priorities of the BIOEAST Thematic SRIA on Food systems

Theme 2: Food systems

Food Systems links to food security, sustainable production and consumption, circular food systems and value-chain integration. The national focus is on regional food ecosystems, public procurement, traceability, food-waste prevention and higher-value use of food-system side streams.

5.3 THEME 3: Forest value chains and wood industry

Sub-theme 1: Forest-based industrial clusters and value chains integration					
Strategic objective 1:	Strengthen integrated forest-based value chains through improved cooperation, regional coordination, industrial symbiosis, and increased domestic value creation from forest resources.				
Timeframe	Key actions	Indicator	Milestones	Funding	Responsible
2026–2030	Establish regional forest-based industrial clusters connecting forestry, processing industries, logistics providers, municipalities, and innovation actors	Number of clusters established	Regional forest-based clusters operational	Cohesion Funds, National Budget, Private Investment	Regional Development Agencies, Municipalities, Forestry Organisations, Industry Clusters
2026–2030	Develop cooperation platforms and value-chain partnerships	Number of partnerships established	Regional coordination mechanisms operational	Public-Private Funding	Regional Development Agencies
2026–2030	Strengthen industrial symbiosis and integrated supply-chain management	Number of cross-sector cooperation initiatives	Integrated supply systems established	National Budget, Private Investment	Industry Associations
2026–2030	Promote domestic processing and value creation from forest resources	Share of processed domestic biomass	Increased domestic processing capacity	Public-Private Funding	Industry, SMEs

Sub-theme 2: Biomass logistics and residue utilisation					
Strategic objective 2:	Improve collection, logistics, and valorisation of forest biomass, low-quality wood, and secondary biomass streams through integrated resource management systems.				
Timeframe	Key actions	Indicator	Milestones	Funding	Responsible
2026–2030	Map forest biomass flows and residual biomass resources	National biomass inventory completed	Biomass mapping system operational	National Budget, Horizon Europe	Forestry Institute, Research Organisations
2026–2030	Develop collection, storage, and logistics infrastructure	Number of logistics facilities established	Regional logistics systems operational	Cohesion Funds, Private Investment	Municipalities, Logistics Providers
2026–2030	Support utilisation of low-quality wood and forest residues	Quantity of secondary biomass utilised	Residue valorisation systems operational	Public-Private Funding	Forestry Sector, Industry
2026–2030	Strengthen regional biomass coordination systems	Number of biomass partnerships established	Biomass coordination platforms operational	National Budget	Regional Agencies

Sub-theme 3: Advanced wood processing and circular manufacturing					
Strategic objective 3:	Increase production of high-value wood products and strengthen circular wood-processing industries through innovation, industrial upgrading, and bio-based manufacturing.				
Timeframe	Key actions	Indicator	Milestones	Funding	Responsible
2026–2030	Support development of advanced timber products and engineered wood solutions	Number of new products developed	Advanced processing pilots operational	Horizon Europe, Private Investment	Industry, Innovation Centres
2026–2030	Scale circular wood-processing systems and manufacturing models	Number of circular manufacturing projects implemented	Circular manufacturing systems established	Cohesion Funds, National Budget	SMEs, Industry
2026–2030	Strengthen bio-based manufacturing and industrial innovation	Number of innovation projects supported	Industrial upgrading initiatives operational	Public-Private Funding	Industry Associations
2026–2030	Promote market uptake and export of high-value forest-based products	Export value of advanced wood products	Export growth achieved	Private Investment	Industry

Sub-theme 4: Digital forest management and forest resilience					
Strategic objective 4:	Strengthen sustainable forest management, climate resilience, and ecosystem monitoring through digital technologies, improved data systems, and adaptive management approaches.				
Timeframe	Key actions	Indicator	Milestones	Funding	Responsible
2026–2030	Deploy digital forest monitoring and management systems	Area covered by digital monitoring systems	National digital monitoring framework operational	Digital Europe, National Budget	Forestry Institutes – ZGS, GIS, Digital providers
2026–2030	Strengthen climate adaptation and forest resilience measures	Number of resilience measures implemented	Regional resilience plans adopted	LIFE Programme, National Budget	Government (Ministry of Agriculture), Forestry Organisations
2026–2030	Improve ecosystem monitoring and forest health assessment systems	Number of monitoring systems established	Integrated ecosystem monitoring framework operational	Horizon Europe, LIFE Programme	Research Institutions, ZGS
2026–2030	Develop forest data platforms supporting decision-making and resource planning	Operational forest information systems	National forest data platform operational	Digital Europe, National Budget	Government (Ministry of Agriculture), Forestry Institutes

5.3.1 Risks & Mitigation

Theme 3: Forest value chains and wood industry

The forest-based bioeconomy depends on coordination across thousands of small owners, processors, logistics providers and industrial users. Fragmented ownership, weak biomass mobilisation, limited logistics infrastructure and climate-related forest risks can all block higher-value use of wood and residues.

The response has to be practical: better owner cooperation, stronger regional logistics, digital forest management, stable demand for low-quality wood and residues, and investment in advanced wood processing. Climate adaptation must be built into forest value-chain planning from the start.



5.3.1 RISKS & MITIGATION

Key risks that may affect the implementation of Theme 3: Forest Value Chain and corresponding mitigation measures.



	RISK	POTENTIAL IMPACT	MITIGATION MEASURES
	Fragmented forest ownership and limited coordination	Reduced harvesting efficiency, higher transaction costs, and limited ability to implement sustainable management	Strengthen forest owner cooperation, establish forest management associations, and provide advisory and capacity-building support
	Limited mobilisation and supply of sustainable forest biomass	Underutilised resources, inconsistent supply, and limited value-chain development	Improve forest planning, promote sustainable harvesting, develop biomass supply agreements, and strengthen regional coordination
	Insufficient logistics and infrastructure	Higher costs, delays, and reduced competitiveness of forest-based products	Invest in forest roads, storage hubs, and digital logistics systems; support shared infrastructure solutions
	Low demand for low-quality wood and residues	Limited market opportunities and economic viability of value-added products	Promote advanced wood processing, biomass valorisation, and innovation in high-value applications
	Limited digitalisation and data availability	Inefficient operations, weak traceability, and limited decision-making capacity	Expand digital tools, data platforms, and remote sensing applications; support digital skills and uptake
	Workforce shortages and skills gaps	Labour shortages, operational bottlenecks, and reduced productivity	Develop training programmes, improve working conditions, and promote forestry careers and lifelong learning
	Climate change impacts and forest health threats	Increased risks of pests, fires, storms, and reduced productivity and resilience	Promote climate-resilient forest management, diversification of species, monitoring systems, and adaptive strategies



By strengthening cooperation, infrastructure, innovation, and sustainable management, the identified risks can be mitigated and the full potential of Slovenia's forest value chain can be realised.



Figure 11. Key implementation risks and mitigation measures for the forest value chain and wood industry

5.3.2 Connection to the priorities of the BIOEAST Thematic SRIA on Forestry

Theme 3: Forest value chains and wood industry

Forest value chains and wood industry bring together sustainable forest management, biomass mobilisation, circular wood use, forest-based industries and climate adaptation. The core task is to turn a strong forest resource base into more domestic processing, better logistics, higher-value wood products and more resilient forest ecosystems.

5.4 THEME 4: Bio-based materials

Sub-theme 1: Bio-based demonstration and biorefinery infrastructure					
Strategic objective 1:	Strengthen demonstration, pilot, and biorefinery infrastructure capable of accelerating the transition from research and innovation to industrial deployment and commercialisation of bio-based solutions.				
Timeframe	Key actions	Indicators	Milestones	Resources & funding	Responsible
2026–2030	Establish modular and regional biorefinery infrastructure	Number of biorefineries established	Regional biorefinery pilots operational	Horizon Europe, Cohesion Funds, National Budget, Private Investment	Government (Ministry of Economy, Labour and Sport; Ministry of Local Self-Government, Cohesion and Regional Development), Research Institutions, Industry
2026–2030	Develop industrial pilot and demonstration facilities	Number of pilot facilities established	National demonstration infrastructure network operational	Horizon Europe, EIB, Cohesion Funds	Research Institutions, Industry
2026–2030	Support industrial-scale testing and validation of bio-based technologies	Number of technologies tested	Industrial testbeds operational	Public-Private Funding	Industry, Innovation Centres

Sub-theme 1: Bio-based demonstration and biorefinery infrastructure					
Strategic objective 1:	Strengthen demonstration, pilot, and biorefinery infrastructure capable of accelerating the transition from research and innovation to industrial deployment and commercialisation of bio-based solutions.				
Timeframe	Key actions	Indicators	Milestones	Resources & funding	Responsible
2026–2030	Improve access to demonstration infrastructure for SMEs and start-ups	Number of SMEs supported	Shared infrastructure access mechanisms established	National Budget, Innovation Funds	Innovation Agencies, Si.Bio HUB

Sub-theme 2: Circular industrial value chains and biomass valorisation					
Strategic objective 2:	Develop integrated circular industrial value chains that maximise biomass valorisation, strengthen industrial symbiosis, and improve resource efficiency across sectors.				
Timeframe	Key actions	Indicator	Milestones	Funding	Responsible
2026–2030	Establish industrial symbiosis partnerships between sectors	Number of partnerships established	Operational industrial symbiosis networks created	Cohesion Funds, Private Investment	Industry Clusters, Municipalities, Regional Development Agencies

Sub-theme 2: Circular industrial value chains and biomass valorisation					
Strategic objective 2:	Develop integrated circular industrial value chains that maximise biomass valorisation, strengthen industrial symbiosis, and improve resource efficiency across sectors.				
Timeframe	Key actions	Indicator	Milestones	Funding	Responsible
2026–2030	Strengthen biomass coordination and logistics systems	Volume of biomass coordinated through organised systems	Regional biomass coordination platforms operational	Public-Private Funding	Municipalities, Regional Development Agencies, Industry
2026–2030	Promote cascading use of biomass resources	Biomass utilisation rate	Cascading use principles integrated into value chains	National Budget, Horizon Europe	Industry, Research Institutions
2026–2030	Support development of new bio-based industrial value chains	Number of value chains established	New cross-sector bioeconomy value chains operational	Cohesion Funds, Private Investment	SMEs, Industry

Sub-theme 3: Market deployment of bio-based products					
Strategic objective 3:	Increase market uptake, competitiveness, and commercial deployment of bio-based materials and products through enabling market conditions and demand-side measures.				
Timeframe	Key actions	Indicator	Milestones	Funding	Responsible
2026–2030	Introduce green public procurement mechanisms for bio-based products	Share of procurement incorporating bio-based criteria	National procurement guidelines adopted	National Budget	Government
2026–2030	Strengthen certification and quality assurance systems	Number of certified secondary materials and bio-based products	Certification framework operational	National Budget, Industry Funding	Government, Chambers
2026–2030	Improve market access for bio-based materials and products	Number of products entering the market	Market deployment support programmes operational	Public-Private Funding	Industry, Chambers
2026–2030	Promote awareness and acceptance of bio-based alternatives	Number of promotion and awareness initiatives	National awareness campaign implemented	National Budget	Government, Industry Associations

Sub-theme 4: Circular business models and innovation ecosystems					
Strategic objective 4:	Strengthen circular bioeconomy innovation ecosystems and support the development and scaling of circular business models, SMEs, and start-ups.				
Timeframe	Key actions	Indicator	Milestones	Funding	Responsible
2026–2030	Support development and scaling of circular bioeconomy SMEs and start-ups	Number of SMEs and start-ups supported	Dedicated support programmes established	Innovation Funds, Private Investment	Innovation Agencies
2026–2030	Strengthen bioeconomy innovation ecosystems and collaboration networks	Number of innovation partnerships established	Regional innovation ecosystems operational	Horizon Europe, Cohesion Funds	Si.Bio HUB, Innovation Agencies
2026–2030	Deploy circular business model pilots based on biomass valorisation	Number of pilots implemented	Demonstration business models operational	Horizon Europe, National Budget	SMEs, Research Institutions
2026–2030	Facilitate cooperation between research, industry, investors, and public institutions	Number of cross-sector collaborations	National bioeconomy innovation platform operational	Public-Private Funding	Si.Bio HUB, Industry, Research Organisations

5.4.1 Risks & Mitigation

Theme 4: Bio-based materials

This is the most investment-sensitive pathway. Promising technologies can get stuck between laboratory, pilot and market because demonstration infrastructure is missing, capital needs are high, biomass supply is fragmented and market demand is still uncertain.

Mitigation should focus on the scale-up gap. Priority is needed for demonstration facilities, modular biorefinery concepts, industrial symbiosis, clearer biomass coordination, market incentives and partnerships that connect technology providers, industry and investors.



5.4.1 RISKS & MITIGATION

Key risks that may affect the implementation of Theme 4: Bio-Based Materials and corresponding mitigation measures.



RISK	POTENTIAL IMPACT	MITIGATION MEASURES
 High investment needs and limited access to financing	Delays in infrastructure development and slow scaling of bio-based solutions	Mobilise public and private funding, blended finance, and European instruments; de-risk investments through guarantees and pilot support
 Limited industrial-scale infrastructure and technological maturity	Constraints on production capacity and limited commercial availability of solutions	Develop demonstration and biorefinery infrastructure; support R&D and pilot projects to accelerate technological maturity and scale-up
 Weak market demand and limited uptake of bio-based products	Reduced profitability and commercial viability of bio-based solutions	Create market incentives, green public procurement, standards and certification schemes; raise market awareness and build demand
 Fragmented biomass supply and competition for resources	Supply risks, higher costs, and limited availability of sustainable biomass	Strengthen biomass coordination, improve sustainability criteria, promote cascading use and efficient resource allocation
 Regulatory barriers and complex permitting procedures	Delays in project implementation and reduced innovation deployment	Streamline permitting, harmonise standards, and establish innovation-friendly regulatory frameworks
 Insufficient private sector engagement and weak innovation ecosystems	Limited innovation capacity and slow development of competitive solutions	Strengthen industry-research collaboration, innovation clusters and hubs, and business support programmes
 Environmental concerns and sustainability risks	Public opposition, reputational risks, and potential negative environmental impacts	Ensure sustainability assessments, LCA, monitoring systems, and transparent communication of environmental benefits

By strengthening investment conditions, innovation capacity, biomass coordination, and market development, the identified risks can be mitigated and the full potential of bio-based materials can be unlocked.





Figure 12. Key implementation risks and mitigation measures for bio-based materials

5.4.2 Connection to the priorities of the BIOEAST Thematic SRIA on Bio-Based Materials

Theme 4: Bio-based Materials

Bio-based Materials connects industrial bioeconomy, biomass valorisation, circular manufacturing, biorefineries and market deployment. This is where research, industrial biotechnology, materials innovation and circular processing can become specialised, higher-value applications.

5.5 THEME 5: Education and skills

Sub-theme 1: Formal education and interdisciplinary learning					
Strategic objective 1:	Integrate bioeconomy principles, circularity, sustainability, and systems thinking across all levels of formal education to build future bioeconomy competencies and interdisciplinary capacities.				
Timeframe	Key Actions	Indicator	Milestones	Funding	Responsible
2026–2030	Integrate bioeconomy concepts into primary, secondary, vocational, and higher education curricula	Number of curricula updated	Bioeconomy topics integrated across education levels	National Budget, Erasmus+, ESF+	Ministry of Education, Science and Youth, Schools, Universities
2026–2030	Develop interdisciplinary bioeconomy programmes and learning pathways	Number of programmes established	New interdisciplinary programmes operational	National Budget, Erasmus+	Universities
2026–2030	Strengthen sustainability, circular economy, process design and systems-thinking education	Number of students participating	Educational materials and teaching resources developed	Public Funding	Educational Institutions
2026–2030	Support development of (regional) specialised bioeconomy study programmes	Number of students enrolled	Expanded higher education offer established	National Budget	Universities

Sub-theme 2: Lifelong Learning, Upskilling and Micro-Credentials					
Strategic objective 2:	Develop flexible lifelong learning systems capable of supporting continuous upskilling, reskilling, and professional development for the bioeconomy transition.				
Timeframe	Key actions	Indicator	Milestones	Funding	Responsible
2026–2030	Establish national bioeconomy micro-credential framework	Number of micro-credentials developed	National framework operational	ESF+, National Budget	Ministry of Education, Science and Youth, Universities
2026–2030	Develop (regional) vocational and technical training programmes	Number of training programmes established	Sector-specific training pathways operational	ESF+, National Budget	Vocational Centres
2026–2030	Support workforce upskilling and reskilling programmes	Number of participants trained	National lifelong learning platform established	ESF+, Industry Funding	Education Institutions, Industry Associations
2026–2030	Strengthen professional development and practical secondments for public administration and decision-makers	Number of public officials trained	Bioeconomy training modules operational	National Budget	Public Institutions

Sub-theme 3: Industry–Research–Education cooperation					
Strategic objective 3:	Strengthen cooperation between education, research, industry, and innovation actors to accelerate knowledge transfer, applied learning, and practical implementation of bioeconomy solutions.				
Timeframe	Key actions	Indicator	Milestones	Funding	Responsible
2026–2030	Develop applied learning partnerships between academia and industry	Number of partnerships established	National cooperation programmes operational	Horizon Europe, National Budget	Universities, Industry
2026–2030	Support mobility schemes between research organisations and businesses	Number of exchanges implemented	Mobility programmes established	Erasmus+, Horizon Europe	Universities, Research Organisations
2026–2030	Integrate practical implementation projects into education programmes	Number of applied projects completed	Project-based learning embedded into programmes	Public Funding	Educational Institutions
2026–2030	Strengthen knowledge transfer and innovation support mechanisms	Number of collaborative innovation projects	Expanded science-business cooperation networks	Horizon Europe, Innovation Funds	Research Organisations, Industry

Sub-theme 4: Bioeconomy literacy, Stakeholder engagement and Knowledge					
Strategic objective 4:	Strengthen bioeconomy literacy, stakeholder engagement, and knowledge exchange across society to support informed decision-making, behavioural change, and long-term system transformation.				
Timeframe	Key actions	Indicator	Milestones	Funding	Responsible
2026–2030	Develop national bioeconomy awareness and communication programmes	Number of campaigns implemented	National awareness programme operational	National Budget, LIFE Programme	Public Institutions
2026–2030	Strengthen the role of Si.Bio HUB as a national learning and knowledge-exchange platform	Number of stakeholders engaged	Continuous stakeholder learning platform operational	Public Funding	Si.Bio HUB
2026–2030	Organise stakeholder workshops, forums, and cross-sector, national and international learning events	Number of events organised	Annual stakeholder engagement programme established	Public Funding	Si.Bio HUB
2026–2030	Develop communication tools targeting citizens, businesses, policymakers, and educators	Outreach and participation rates	National communication framework implemented	National budget	Public Institutions

5.5.1 Risks & Mitigation

Theme 5: Education and skills

Implementation will fail if skills remain behind ambition. The main risk is that bioeconomy knowledge stays fragmented across disciplines, projects and institutions, while public administration, industry, farmers, forest owners and educators lack the practical capacities needed for delivery.

The response should combine formal education with lifelong learning, micro-credentials, applied training and stronger science-business cooperation. Bioeconomy literacy also needs to reach beyond experts, so that citizens, municipalities and institutions understand what the transition means in practice.

 5.5.1 RISKS & MITIGATION 		
Key risks that may affect the implementation of Theme 5: Education and Skills and corresponding mitigation measures.		
RISK	POTENTIAL IMPACT	MITIGATION MEASURES
 Fragmented education systems and lack of coordination	Duplication of efforts, inefficient use of resources, and limited system-wide impact	 Strengthen coordination between education providers, research institutions, industry and public authorities; establish national and regional coordination mechanisms
 Insufficient interdisciplinary approaches and integration of bioeconomy topics	Limited development of cross-cutting competencies and innovation capacity	 Promote interdisciplinary curricula, cross-sector projects, and systems thinking approaches in formal education and lifelong learning
 Slow adaptation of curricula and limited relevance to labour market needs	Skills mismatch, reduced employability, and limited uptake of bioeconomy innovations	 Continuously update curricula with industry input; develop competency frameworks and align education with emerging bioeconomy needs
 Low participation in lifelong learning and upskilling opportunities	Limited workforce adaptability and slow transition towards new skills	 Expand accessible lifelong learning programmes, micro-credentials and online learning; promote awareness and incentives for participation
 Weak collaboration between education, research and industry	Limited knowledge transfer, innovation uptake and practical skills development	 Strengthen university–industry–research partnerships, innovation hubs and living labs; promote joint training and mobility schemes
 Limited stakeholder engagement and low bioeconomy literacy across society	Low public support, limited behavioural change and weak societal uptake	 Increase stakeholder engagement, awareness campaigns and knowledge exchange platforms; promote bioeconomy literacy among citizens, businesses and policymakers
 Insufficient funding and resources for education and skills initiatives	Limited scale and sustainability of education and capacity building programmes	 Diversify funding sources, leverage EU and national funds, and encourage private sector and philanthropic support
 By strengthening education systems, promoting lifelong learning, fostering collaboration, and increasing bioeconomy literacy, the identified risks can be mitigated and a skilled, informed and engaged society can drive long-term bioeconomy transformation. 		

Figure 13. Key implementation risks and mitigation measures for Education and skills

5.5.2 Connection to the priorities of the BIOEAST Thematic SRIA on Bioeconomy Education and skills

Theme 5: Education and skills

Education and skills provide the enabling capacity across all thematic areas. Formal education, vocational training, lifelong learning, micro-credentials and stronger science-business-policy cooperation are essential for moving bioeconomy priorities from projects into practice.

Together, the five priority areas position Slovenia as an active contributor to the BIOEAST vision of a sustainable, circular and knowledge-based bioeconomy. The Action Plan shows how macro-regional priorities can become concrete: rooted in national assets, organised through implementation pathways and connected to European value chains.

6 Monitoring, implementation and evaluation

6.1 Implementation arrangements

Implementation is where the credibility of this Action Plan will be tested. Slovenia already has knowledge, projects, stakeholder energy and relevant platforms. What is missing is not another coordination promise, but a clear decision on who leads, who supports delivery, how implementation is financed and how progress is monitored.

As outlined in Chapter 4.10, the new government should select a national governance model within the first 100 days. This decision should define the political lead, operational coordination structure, mandate, budget and reporting responsibilities. Without it, the Action Plan will not have the institutional force needed for delivery and risks remaining a well-structured document rather than becoming an implementation framework.

At national level, strategic oversight should be provided through the governance model selected by the new government. This may include a National Bioeconomy Coordination Council or another formal coordination structure with clear political mandate, institutional anchoring and operational capacity. As the governance framework evolves, coordination mechanisms may also be considered at regional level to ensure effective implementation and territorial alignment.

Thematic actions will be implemented by relevant sectoral actors, including ministries and agencies, research organisations, industry associations, SMEs, municipalities, regional development agencies, agricultural, forestry and food-system stakeholders, education institutions, civil society organisations and innovation networks.

Si.Bio Hub should play a central enabling role in stakeholder coordination, knowledge exchange and implementation follow-up. However, it cannot be expected to carry a national implementation role as an informal or project-dependent structure. If Si.Bio is to support delivery, its mandate must be institutionally recognised, connected to the selected governance model and supported by stable funding.

With such support, Si.Bio Hub can facilitate cross-sectoral dialogue, connect research, policy, business and society, support priority actions, promote knowledge transfer, link Slovenia with BIOEAST and European bioeconomy initiatives, and contribute to monitoring, reporting and stakeholder engagement.

6.2 Monitoring and evaluation framework

Monitoring and evaluation should keep implementation focused, transparent and adaptive. The system should combine implementation, output, outcome and impact indicators.

Monitoring should be organised through three steps:

- Annual implementation monitoring
 - review progress against planned actions;
 - identify implementation bottlenecks;
 - report on completed activities and outputs.
- Mid-term evaluation, 2028
 - assess progress towards 2030 objectives;
 - review implementation effectiveness;
 - identify emerging priorities and adjustment needs.
- Final evaluation, 2030
 - assess overall achievements and impacts;
 - evaluate governance effectiveness;
 - review lessons learned and future development needs.

Monitoring activities should be coordinated by the selected national bioeconomy governance structure, with technical support from Si.Bio Hub and relevant thematic stakeholders.

6.3 Financing and funding mechanisms

Implementation will require a mix of national, European, public and private financing. The key task is to connect funding sources with the Action Plan's priority areas, instead of relying on isolated project opportunities.

Key funding sources include:

National funding

- national and local budget allocations
- sectoral ministry programmes
- national research and innovation funding schemes
- environmental and climate-related funding instruments

European Union funding

- Common Agricultural Policy (CAP) Strategic Plan and its successor instrument in the next programming period
- Cohesion Policy Funds
- Horizon Europe
- LIFE Programme
- Digital Europe Programme
- Erasmus+
- European Regional Development Fund (ERDF)
- European Social Fund Plus (ESF+)
- Recovery and Resilience Facility (RRF)
- Future European Competitiveness Fund (ECF) and other successor EU funding instruments under the next Multiannual Financial Framework (2028–2034), where applicable.

Financial and investment instruments

- European Investment Bank (EIB)
- Circular Bio-based Europe Joint Undertaking
- InvestEU
- blended finance mechanisms
- venture capital and private equity funds
- public-private partnerships
- corporate investment and industrial financing

Particular emphasis should be placed on supporting:

- pilot and demonstration projects
- biorefinery and processing infrastructure
- industrial deployment and scale-up activities
- circular business models and innovation ecosystems
- skills development and lifelong learning programmes
- regional implementation initiatives

6.4 Reporting and adaptive governance

The Action Plan should operate as a living framework, not a static list of measures. Reporting should serve decision-making by showing what is moving, where implementation is blocked and where political or financial intervention is needed.

Annual implementation reports should be prepared by the selected governance structure, with input from Si.Bio Hub, responsible institutions and thematic stakeholders.

Findings from monitoring and evaluation should be used to improve implementation efficiency, adjust priorities, strengthen stakeholder cooperation, support evidence-based policy development, align with BIOEAST and European bioeconomy initiatives, and identify issues requiring decision-maker attention.

6.5 Action Plan Review and Renewal

The Action Plan should be formally reviewed after the final evaluation in 2030.

The review should test five things: whether strategic objectives are being met, whether governance works, whether environmental, economic and social impacts are visible, whether the Action Plan remains aligned with national and EU priorities, and where new technologies or markets require adjustment.

The 2030 review should not close the process; it should open the next investment and implementation cycle. Its findings should provide the basis for a renewed Slovenian Bioeconomy Action Plan beyond 2030, focused on scaling what works, correcting what does not and staying aligned with the 2040 vision.

7 Concluding remarks

The preparation of this Action Plan confirmed a simple but important message: Slovenia's bioeconomy potential is already present in its people, knowledge, resources, projects and emerging partnerships. The missing piece is the institutional decision to connect this potential into a coordinated implementation framework.

The process carried out through Si.Bio Hub has been particularly important. For many stakeholders, it provided the only structured space for guided multi-stakeholder dialogue, cross-sector cooperation and the development of concrete actions. Its value lies not only in consultation, but in a systemic approach: connecting sectors, translating different institutional languages and helping stakeholders move from individual projects towards shared value systems.

The response exceeded expectations. Participants began connecting projects, shaping new initiatives, exploring links with investors and opening pathways towards international markets. This is precisely where transition brokers make a difference: by turning fragmented interest into collaboration, and collaboration into implementation potential.

This momentum should not be lost. The trust created through the Si.Bio process now needs to be justified through continuity, mandate and support. If properly positioned and resourced, Si.Bio can help Slovenia move from scattered potential to coordinated delivery — connecting people, projects, investment and policy around a shared bioeconomy agenda.

The choice now is whether this momentum remains project-based, or whether Slovenia gives it the mandate, financing and institutional home needed to become a real implementation force for the bioeconomy transition.

8 Acknowledgement

8.1 Contributors and collaborators

The Slovenian Bioeconomy Action Plan is the result of a collaborative process involving a wide range of stakeholders who contributed their knowledge, time, and expertise.

The core team of authors would like to sincerely thank all participants who engaged through workshops, consultations, and shared inputs. Their constructive approach, and commitment were essential in shaping this Action Plan and building a shared direction for the development of the bioeconomy in Slovenia.

We would like to acknowledge the Si.Bio community and its core coordinators: Alenka Dovč (Chamber of Commerce and Industry Slovenia - Association of Chemical Industries of Slovenia) and Miha Škrokov (ANTEJA ECG d.o.o.), who have been closely involved throughout the process and, together with the core team, actively contributed to shaping both the Action Plan and the broader development of the bioeconomy within the BOOST4BIOEAST context, as well as Nina Meglič (ACT-SI), an engaged and valued member of the Si.Bio community, and Katarina Krek Hudoklin (Ministry of Agriculture), for her continued support to the process. All have played an important role in co-creating this Action Plan and strengthening the Si.Bio community.

We extend our sincere gratitude to dr. Luka Juvančič (Biotechnical Faculty, University of Ljubljana) for his expert guidance, strategic direction, and continuous support throughout the process, as well as for his contribution to the peer review.

We also thank dr. Leon Kaluža (Centre for Development, Demonstration and Training for Carbon-Free Technologies, National Institute of Chemistry) for his valuable contribution, particularly to the indicator assessment within the BOOST4BIOEAST project, as well as for his role in the peer review.

We would also like to acknowledge dr. Gasan Ilja Osojnik (Centre for Development, Demonstration and Training for Carbon-Free Technologies, National Institute of Chemistry) for his contribution to the peer review, which, together with the contributions of all peer reviewers, helped to further strengthen and improve the final document.

Finally, we thank all stakeholders and organisations who participated in the workshops and consultations and are listed below. This Action Plan reflects a shared effort and a collective commitment to advancing the bioeconomy in Slovenia.

8.2 Si.Bio stakeholder network

The following list includes stakeholders who contributed to the development of the Action Plan through workshops, consultations, individual discussions, interviews, and other forms of engagement. The process was built on the active involvement of the Si.Bio community, where workshops and events served as a space for exchange and co-creation. Many contributors are also actively engaged as partners, experts or innovators in bioeconomy-related projects connected to the Si.Bio community, reflecting the strength of collaboration across sectors. We sincerely thank all contributors for their valuable insights and engagement, and we look forward to continuing this collaboration in the implementation of the Action Plan and the next steps of the Si.Bio community. This list remains open and will continue to evolve as the community grows and new contributions emerge.

Organisation
ACT-SI
Aetheria
Agricultural Institute of Slovenia
Alchemia Nova
ANTEJA ECG d.o.o.
Avenia M – Non Tox Uni Kum
Bellona Europa
Bioeconomy Cluster
BISNet Transylvania ASIMCOV
BSC Kranj
Chamber of Agriculture and Forestry of Slovenia – Nova Gorica Regional Unit
Circular Change
Climate KIC
COGREEN
Consultant
Creatiger (HU)
DELFY
Deloitte
DMS
DOOR
Eco-Harmony
Ecolibrium d.o.o.
EKO LIKA GREENNOVATION
Emona Razvojni center za prehrano d.o.o.
Energy Agency of Savinjska, Šaleška and Koroška Region (KSENA)

Ecologists Without Borders (Slovenia)
Energy Institute Hrvoje Požar
EPEKA, SCE
ETRI Group
Faculty of Design
Falcon-Vision
Glasgow Chamber of Commerce
GoParity
Green Energy Association
Green Sustainable Solutions d.o.o.
GZS - Chamber of Commerce and Industry Slovenia
GZS - Chamber of Agricultural and Food Enterprises (ZKŽP)
GZS - Association of Chemical Industries of Slovenia (ZKI)
GZS - ZGIGM (Construction Industry and Materials Association)
HEDONI d.o.o.
HML EU
Independent Researcher
Infinite Pure Solutions
Institute for Sustainable Development TRS
Institute Kontekst
Istanbul Aydın Üniversitesi
JP VOKA SNAGA d.o.o.
Komunalno podjetje Logatec
KOTO d.o.o.
KOTO d.o.o.
Krožno R&R (Circular R&R)
Ljubljana Marsh Nature Park
MAE
Makabi Agritech
Mazowiecka Agencja Energetyczna
META Circularity
Ministry of Agriculture
Ministry for Environment and Spatial Planning
Ministry of the Economy, Tourism and Sport
Ministry of Higher Education, Science and Innovation
Ministry of Public Administration
MIRET d.o.o.
MKRR / S5
Moree
Mycopor
National Institute of Chemistry

National Institute of Chemistry
National Institute of Chemistry - Center DUBT
PDR/Cardiff Metropolitan University
Pivovarna Laško Brewery
Product Feed d.o.o.
Publicist
R1ng d.o.o.
Regional Development Agency of Ljubljana Urban Region (RRA LUR)
Research Design
Rutena d.o.o.
Sewergy (HU)
Slovenia Forest Service
ŠGZ - Regional Chamber of Commerce Štajerska
TECOS
Telekom Slovenije
Technology Park Ljubljana
TT Okroglica d.o.o.
TVG Institute
University of Eastern Finland
University of Ljubljana, Biotechnical Faculty
University of Ljubljana, School of Economics and Business
University of Montpellier
University of Pannonia
UTZO
Zenteh d.o.o.

9 References

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10 ANNEX 1:

Detailed Vision 2040, governance scenarios and implementation framework

A credible bioeconomy transition requires strategic choices: which resources to prioritise, which value chains to build, where to invest, how to manage trade-offs and which institutions can carry implementation over time.

For Slovenia, these choices point towards higher value creation, circular use of resources, targeted scale-up and stronger integration into European bio-based value chains. The following sections define the 2040 vision, 2030 strategic objectives and governance principles needed to move from diagnosis to implementation.

10.1 Long-term vision towards 2040

Slovenia's long-term bioeconomy vision is built around circularity, innovation and integration into European bio-based value chains. It is not based on higher biomass extraction, but on better use of existing biological resources, stronger value creation and careful management of ecological limits.

By 2040, Slovenia aims to develop a bioeconomy that:

- maximises the value of domestic biological resources through cascading and circular use;
- integrates primary sectors, industry, and research into functional and resilient value chains;
- supports sustainable economic growth while preserving biodiversity, soil, and water resources;
- contributes to climate neutrality and resource efficiency;
- is embedded within European and global bio-based value chains.

Key expected characteristics by 2040 include:

- modular and selectively industrial-scale biorefineries converting wood, agricultural and food-system side streams into bio-based chemicals, materials and selected food-grade products, with bioenergy used mainly for residual flows and hard-to-abate needs;

- stronger domestic processing of harvested wood into durable, high-value products such as construction materials, engineered timber and advanced bio-based materials;
- mainstream agroecological and locally adapted production systems, supported by soil health, biodiversity protection, CAP instruments, carbon farming and emerging nature-based markets;
- digital infrastructure for biomass exchange, precision agriculture, forest management, traceability and logistics;
- active participation in European and global bio-based value chains through high-value products, technologies and know-how, while maintaining sustainable domestic biomass use within planetary boundaries;
- diversified rural and regional income streams linked to ecosystem services, local processing, short supply chains and circular bioeconomy solutions.

This vision reflects Slovenia's specific conditions: a rich but limited biomass base, fragmented ownership structures, strong research capacities, selected advanced industries, high environmental sensitivity and a small domestic market. The opportunity lies in quality, specialisation, proximity, knowledge and the ability to connect smaller resource flows with higher-value applications.

10.2 Strategic outlook

Limited biomass is not a weakness if it is treated as a design condition. For Slovenia, the bioeconomy cannot be built on volume. It has to be built on intelligence: better use of existing flows, stronger domestic value creation, circular design, targeted scale-up and the ability to connect knowledge with industry.

The strategic direction is based on four priorities:

- higher value-added utilisation of biomass;
- efficient and circular use of existing resources;
- integration into European and global bio-based value chains;
- development of specialised and knowledge-intensive bio-based solutions.

Residues and side streams from forestry, agriculture and food systems are among the clearest opportunities. Some flows can support modular biorefineries; others are better suited for local processing, bio-based materials, soil improvement, ecosystem services or circular food systems. The task is to match each flow with the use that creates the highest value within sustainability limits.

Scaling should therefore be deliberate, not automatic. Priority should go to value chains where resources, knowledge, industrial partners, market demand and safeguards are strong enough to move from pilot activity to implementation.

Achieving this vision is not a linear extrapolation of current trends. It requires sustained political commitment across government cycles, predictable financing, continuous investment in skills and the ability to manage strategic trade-offs.

10.3 Strategic objectives for 2030

The 2026–2030 period is the implementation window. The strategic objectives therefore focus on the leverage points where coordinated action can make the biggest difference: governance, value creation, scale-up, sustainability and implementation capacity.

They do not promise full transformation within one policy cycle. Their role is to create the conditions for a more coordinated, integrated and scalable bioeconomy system on the way to the 2040 vision.

10.4 Strategic objectives and indicative 2030/2040 targets

Five strategic objectives translate the strategic outlook into measurable directions of change. They define what Slovenia needs to strengthen by 2030 in order to move credibly towards the 2040 vision. Each objective is operationalised in Chapter 5 through priority areas, actions, lead institutions and financing mechanisms.

- SO1 - Strengthen governance, coordination and policy integration across all bioeconomy-relevant portfolios.
- SO2 - Increase domestic valorisation of biomass through integrated circular value chains and a mature processing base.
- SO3 - Accelerate innovation scaling and demonstration capacity, with priority on TRL 5–8 stages and industrial deployment of bio-based solutions.
- SO4 - Make primary production, including agriculture, forestry and aquaculture, more climate-resilient, sustainable and integrated into circular value chains, while protecting ecosystem services and biodiversity.
- SO5 - Build human capital, skills and societal awareness for the bioeconomy transition, integrating bioeconomy content into formal education, lifelong learning and public communication.

Together, these objectives structure the core transformation priorities of the Action Plan and provide the basis for indicative 2030 and 2040 targets.

10.5 Strategic pillars of the bioeconomy transition

The five strategic objectives are organised around three pillars that define the main areas of transformation: governance, value creation and implementation capacity.

Pillar 1 - Governance and enabling framework

Creates the institutional conditions for coordination, policy integration, monitoring and stakeholder alignment.

Pillar 2 - Bio-based value chains and industrial development

Focuses on domestic valorisation of biomass, circular value chains, processing capacity, investment and industrial pathways.

Pillar 3 - Innovation, skills and sustainability

Connects knowledge, education, skills, innovation uptake and environmental safeguards into a resilient bioeconomy system.

Together, these pillars provide the action framework for moving from fragmented initiatives towards a coordinated and scalable bioeconomy transition.

10.6 Core strategic objectives within pillars

10.6.1 PILLAR 1: Governance and enabling framework

10.6.1.1 Objective 1: Strengthen governance, coordination and policy integration

Establish a coherent cross-sectoral governance framework for the bioeconomy, with clear political ownership, inter-ministerial coordination, stakeholder involvement and shared monitoring.

Action focus:

- establish an inter-ministerial coordination mechanism;
- clarify institutional roles and responsibilities;

- integrate bioeconomy priorities into national strategies and programming documents;
- strengthen coordination platforms such as Si.Bio Hub and SRIPs;
- develop a national bioeconomy monitoring dashboard aligned with the EU Bioeconomy Monitoring System.

10.6.1.2 Target state by 2030

A stable coordination mechanism is in place at decision-maker level. A permanent multi-stakeholder platform connects research, industry, primary producers, regions and civil society. Bioeconomy priorities are reflected in key national frameworks, including the CAP Strategic Plan and its successor instrument, the National Energy and Climate Plan, the Smart Specialisation Strategy, the Slovenian Development Strategy, the National Forest Programme, cohesion policy programmes and regional development strategies.

10.6.2 PILLAR 2: Bio-based value chains and industrial development

10.6.2.1 Objective 2: Enable investment and scale-up

Improve access to finance and support the transition from pilot activity to demonstration, industrial deployment and market uptake.

Action focus:

- establish dedicated bioeconomy investment instruments;
- strengthen pilot and demonstration infrastructure at TRL 5–8;
- support public-private partnerships for industrial deployment;
- improve access to scale-up financing;
- align research funding more closely with industrial innovation needs.

10.6.2.2 Target state by 2030

Functional mechanisms support the scaling of bioeconomy innovations from pilot to industrial level. Demonstration infrastructure is available in priority sectors, financing pathways are clearer, and more bio-based projects reach commercialisation, particularly in industrial biotechnology, advanced materials, circular processing and bio-based production systems.

10.6.2.3 Objective 3: Develop integrated bio-based value chains and industrial pathways

Connect biomass producers, processors, technology providers, researchers and markets into functional circular value chains.

Action focus:

- improve aggregation, logistics and traceability of biomass supply;
- increase domestic processing and reduce export of unprocessed biomass where value can be retained;
- develop higher value-added bio-based products;
- promote cascading use of biomass and circular material flows;
- support modular and regionally distributed biorefinery concepts adapted to Slovenia's fragmented resource base;
- connect forestry, agri-food, chemicals, materials and biotechnology into higher-value production systems.

10.6.2.4 Target state by 2030

Circular bio-based value chains are better connected, with stronger domestic processing, clearer industrial pathways and visible regional clusters. Progress is achieved in the use of residues and side streams from forestry, agriculture and food systems. Slovenia strengthens its position in European bioeconomy value chains through specialised, high-value applications rather than volume-based production.

10.6.3 PILLAR 3: Innovation, skills, and sustainability

10.6.3.1 Objective 4: Strengthen knowledge, skills, and innovation ecosystems

Improve knowledge transfer, skills development and innovation uptake across the bioeconomy system.

Action focus:

- develop interdisciplinary education and training programmes;
- align education and lifelong learning with industry and public-sector needs;
- strengthen applied research and innovation uptake;
- support knowledge exchange platforms and networks;
- develop transition brokerage capacities for cross-sector implementation.

10.6.3.2 Target state by 2030

Research, education and industry are better connected. Interdisciplinary training programmes are established, industry participation in applied research increases, and knowledge transfer mechanisms become more effective. A higher share of research results moves into practical applications, market solutions and public-sector implementation.

10.6.3.3 Objective 5: Ensure sustainability and resilience

Align bioeconomy development with climate objectives, biodiversity protection, soil and water resilience, and long-term ecosystem integrity.

Action focus:

- promote sustainable biomass management in forestry, agriculture and related sectors;
- integrate biodiversity, soil and water protection into bioeconomy value chains;
- develop carbon farming, nature-based solutions and ecosystem service models;
- monitor environmental impacts and trade-offs;
- apply sustainability safeguards to public support, investment and procurement.

10.6.3.4 Target state by 2030

Bioeconomy development is systematically aligned with environmental and climate objectives. Sustainable biomass management is strengthened, biodiversity, soil and water protection are integrated into value-chain development, and nature-based income streams begin to complement production-based models. Monitoring of environmental impacts and trade-offs supports better decision-making and helps maintain ecosystem services within planetary boundaries.

10.7 Thematic pathways

The thematic pathways show where the bioeconomy transition becomes concrete. They connect the strategic objectives with the sectors, value chains and capacities where action is needed.

Five pathways structure the implementation logic:

1. Agroecology and Sustainable Yields;
2. Food Systems;
3. Forest Value Chain and Wood Industry;
4. Bio-Based Materials;
5. Education and Skills.

Each pathway plays a different role. Agroecology and sustainable yields shape the resource base. Food systems, forest value chain and wood industry and bio-based materials are the main spaces for circular value creation. Education and skills make the transition possible in practice.

Figure 1 shows how the pathways connect the 2040 vision, strategic objectives and implementation actions.

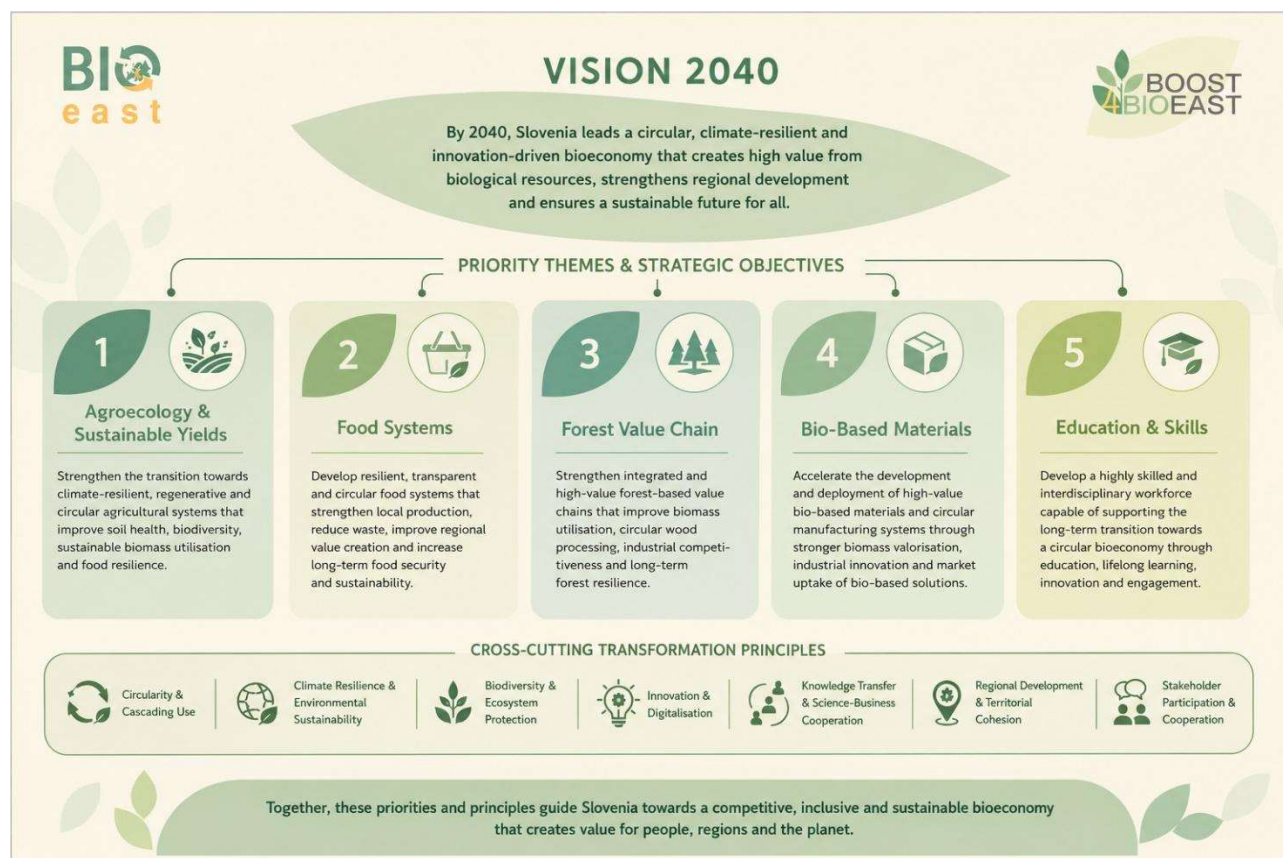


Figure 14. Vision 2040 and strategic transformation pathways of the Slovenian bioeconomy

Chapter 5 builds on this structure and defines the actions, actors and enabling conditions needed to move from strategy to delivery.

10.8 Indicators and monitoring

The following indicative targets are proposed for discussion. Baseline values should be updated with the most recent figures available; targets should be confirmed during stakeholder validation. The five rows highlighted in light green are drawn from the BOOST4BIOEAST

integrated readiness assessment, which provides Slovenia with an internationally peer-reviewed, multi-indicator readiness framework.¹

Table 3. Indicative targets for 2030 and 2040 for strategic transformation of the Slovenian bioeconomy

Indicator	Baseline (recent year)	Target 2030	Long-term 2040
Share of bioeconomy in national value added	≈ 20% (BIOEASTsUP analysis, 2018–2021)	≥ 25%	≥ 28%
Labour productivity in bioeconomy sectors (EUR/employee)	≈ 11,500 (2018-2021)	≥ 18,000	≥ 25,000
National bioeconomy readiness composite index	52% (2026, prioritised)	≥ 71%	≥ 85%
Detailed knowledge of biomass production and valorisation	50% (2026)	100%	maintained
Public-administration bioeconomy readiness	60% (2026)	≥ 85%	≥ 95%
Private-sector bioeconomy readiness	63% (2026)	≥ 88%	≥ 95%
National bioeconomy investment and investor platform readiness	25% (2026)	≥ 50%	≥ 75%
Share of harvested wood processed domestically	≈ 60–70%	≥ 80%	≥ 90%
Share of harvested wood used for material applications (vs energy)	≈ 50%	≥ 65%	≥ 80%

¹ The indicators in rows highlighted in light green provide an externally validated, internationally peer-reviewed monitoring framework. The framework consists of twenty-eight Level-4 sub-goals and sixty-eight Level-5 indicators organised in a four-level analytical hierarchy process, with documented minimum and maximum normalisation ranges and a transparent aggregation methodology. Slovenia has already submitted full input data and explicit 2030 desired levels in the process of preparing the BOOST4BIOEAST integrated readiness assessment.

Indicator	Baseline (recent year)	Target 2030	Long-term 2040
Number of operational TRL 5–8 bioeconomy demonstration/pilot facilities	Low / dispersed	≥ 3–5	≥ 10
Coverage of forest properties by aggregation/service cooperatives	Low	Doubling vs baseline	Predominant
Bio-based content in relevant green public procurement categories	Marginal	15–20%	≥ 35%
Adoption of agroecological / regenerative practices (share of UAA)	Limited (organic ≈ 11%)	≥ 25% (broader sustainable practices)	Mainstream
Operational national bioeconomy coordination structure	Absent	Operational from 2026	Embedded
Share of bioeconomy graduates with interdisciplinary curricula	Limited	Significant share (target to specify)	Mainstream

The baselines and targets provide a starting point for the national bioeconomy monitoring dashboard to be developed under the selected governance and monitoring framework.

10.9 Navigating strategic conflicts and trade-offs

Bio-based solutions are not automatically sustainable. Biomass is finite, land is contested, and different policy objectives can point in different directions.

The table below identifies the main strategic tensions and proposes compromise principles for further validation with relevant ministries, institutions and stakeholders. These principles should guide investment, public support, procurement and inter-ministerial coordination.

Table 4. Main strategic tensions and proposed compromise principles for further validation

Conflict area	Nature of the tension	Proposed compromise / guiding principle
Material vs energy use of biomass (cascading)	Large share of wood and other biomass currently used for low-value energy (firewood, biogas of variable quality); cascading principle requires materials first, energy from residues only.	Apply cascading hierarchy progressively: prioritise material use where feasible; reserve energy use for residues, by-products and lowest-quality biomass; maintain bioenergy role only in hard-to-abate sectors and for grid balancing; support rural energy transition (heat pumps, efficient district heating) to gradually reduce primary biomass demand for heating, while protecting household heating affordability during the transition.
Forest production vs forest protection, biodiversity and carbon sink	Around 37% of the country is in Natura 2000 (much in forests); LULUCF requires a resilient carbon sink; mobilisation of biomass pulls in the opposite direction.	Differentiated forest management zoning (production, multi-function, protection); focus mobilisation on lower-quality biomass and residues, prioritising high-quality timber for long-term carbon storage in construction; locally adapted sustainable management; integration of CRCF carbon farming; restoration as part of management; rejection of intensification beyond ecological carrying capacity.
Food and nutrition security vs biomass for materials and energy	Productive agricultural land cannot be allocated to non-food uses at the expense of food security.	Clear hierarchy in agricultural biomass: food and feed first, then high-value materials, then bioenergy from residues. Strong restrictions on dedicated energy crops on productive arable land. Focus on side streams, by-products and limited use of marginal/abandoned land for non-food uses.

Fragmented small-scale ownership vs industrial-scale biorefining	Average forest property 2.9 ha; fragmented agriculture. Biorefineries need consistent, large-scale, homogenous feedstock.	Combination of cooperative aggregation models, digital biomass exchange platforms, regional collection logistics, and modular/smaller-scale processing units calibrated to local feedstock structures. CAP support for cooperation and joint investments. A small number of selectively industrial-scale facilities for streams where critical mass is achievable.
Domestic processing vs export of unprocessed raw materials	Large share of wood (especially coniferous logs) exported unprocessed; building domestic capacity is capital-intensive and risky.	WTO-consistent demand-side measures (green public procurement, voluntary alliances under the EU Competitiveness Coordination Tool, certification schemes), combined with blended finance (EIB, ECF, Cohesion Policy) to de-risk first-of-a-kind domestic facilities. Avoid export restrictions; instead make domestic processing competitive.
Speed of innovation/authorisation vs precautionary principle	Industry needs faster authorisation pathways (EU Biotechnology Acts I and II); environmental and health protection requires thorough assessment.	Streamlined but evidence-based national authorisation processes aligned with EU simplification (chemicals omnibus, food and feed safety package). Voluntary standards and certifications. Strong, well-resourced national scientific advisory capacity to deliver fast and credible review. Maintain non-regression on core environmental and health safeguards.

Use of manure for soil fertilisation vs for biogas/biomethane	Both are circular, both useful; competing claims on the same flow.	Integrated systems: anaerobic digestion with full return of properly treated digestate to soils as bio-based fertilising product (RENURE-aligned). ² Avoid biogas plants that destroy soil amendment value. Apply the same logic to sewage sludge nutrients.
Industrial decarbonisation needs (biogenic carbon) vs limited biomass availability	Steel, cement, aviation and chemistry need bio-based carbon to decarbonise; biomass is a finite resource.	Prioritise biogenic carbon use for hard-to-abate sectors where no alternative decarbonisation route exists; back this with biomass-flow modelling, lifecycle assessment and Knowledge Centre for Bioeconomy data; avoid biomass-intensive options where electrification or other decarbonisation is available.
Renewable energy land use (solar, wind) vs agricultural/forest production	Spatial pressure on land in a small, densely organised country; competition for the same plots, especially marginal land.	Spatial planning priority to already-built surfaces (roofs, brownfields, infrastructure corridors); agrivoltaics on selected agricultural sites; avoidance of productive farmland and high-biodiversity forest. Energy projects integrated into bioeconomy-relevant rural development rather than competing with it.
Ministry of Agriculture as institutional owner vs cross-sectoral nature of bioeconomy	Bioeconomy spans at least 8 ministries; no single ministry can credibly own the full agenda; risk of one-sided framing.	Cross-sectoral coordination architecture, with a clearly identified lead and rotating sectoral chairs where appropriate. Strong, well-resourced technical secretariat. Joint financing and joint monitoring across portfolios.

² RENURE stands for recovered nitrogen from manure.

Open market and fair competition vs strategic autonomy and SME protection	EU and global single market vs need to build domestic capacity and protect small/local processors.	WTO/single market-compatible support: demand-side measures, blended finance, voluntary alliances, certification, simplified administrative procedures for SMEs and local processors. No protectionism; strategic autonomy through capability-building rather than trade barriers.
Use of biomass from invasive alien species (IAS)	IAS biomass can be valuable for fibre, pulp, biochar, energy; but commercial use could create incentives to maintain the invasion.	Use IAS biomass strictly within the EU Regulation 1143/2014 permit/authorisation regime; commercial valorisation only as part of certified eradication and management measures; close monitoring to avoid perverse incentives.

These compromise principles are not final solutions. They provide the operating logic for designing the priority areas, implementation actions and support mechanisms in Chapter 5.

10.10 Governance and coordination model: Scenarios for the new government

Governance is the main enabling condition for the implementation of this Action Plan. Slovenia already has relevant platforms, projects and stakeholder networks, but bioeconomy coordination remains too fragmented to support systemic delivery.

Comparative exchanges across EU Member States, including those facilitated by the European Commission and the Knowledge Centre for Bioeconomy, show a clear pattern: governance models led by the Prime Minister's Office tend to achieve the strongest political traction, while sectoral leadership models are easier to establish but more vulnerable to siloed implementation.

Experience from related national processes, including the Decarbonisation project, confirms the same lesson. An inter-ministerial group alone is not enough. Effective coordination requires political ownership, a clear lead, an operational secretariat, predictable financing and a mandate to work across portfolios.

The Action Plan therefore presents three governance scenarios for further political and institutional discussion. Each scenario builds on the existing Si.Bio Hub as a multi-stakeholder advisory platform. The difference lies in where political leadership and operational coordination are anchored.

Table 5. Governance scenarios for the adoption of the Slovenian bioeconomy governance framework

Scenario	Lead	Strengths	Risks / conditions
Scenario A: PMO-led coordination	Prime Minister's Office (PMO), supported by a strong technical secretariat and a governmental council on bioeconomy	Strongest political authority and ability to align across all relevant portfolios (agriculture, environment, climate, energy, industry, research, regional development, finance). Best protection against siloed implementation. Aligns with EU peer exchange indicating stronger political traction in PMO-led models.	Requires sustained personal attention from the Prime Minister and clear placement in PMO priorities. Risk of overload at PMO level. Conditional on adequate secretariat resources (staff, expertise, mandate).

Scenario B: Joint lead of Ministry of Agriculture–Ministry of Environment–Ministry of Research	Three-ministry co-leadership with rotating chair; broader inter-ministerial group (Ministry of Economy, Ministry of Cohesion and Regional Development, Ministry of Finance, Ministry of Infrastructure and Energy, Ministry of Interior and Public Administration, Ministry of Foreign and European Affairs)	Balances the three core perspectives of bioeconomy (primary production / environment & climate / research & innovation). Shared political ownership reduces risk of any single ministry losing interest. Continuity with existing Si.Bio hub partnership.	Co-leadership models can blur accountability and slow decisions. Requires very strong working-level coordination and an unambiguous secretariat lead (likely Ministry of Agriculture or Ministry of Environment). Depends on sustained political commitment and effective cooperation between three ministerial leaderships.
Scenario C: Ministry of Agriculture-led with strengthened structure	Ministry of Agriculture as institutional owner; reinforced inter-ministerial working group; technical support from Si.Bio hub	Strong continuity with current arrangements and primary-sector focus; clearest accountability; lowest set-up cost.	Bioeconomy may continue to be perceived as primarily an agricultural agenda, reducing buy-in from environment, energy, industry and research portfolios. Highest risk of recreating the implementation gap observed in the Decarbonisation project.

EU peer experience suggests that Scenario A offers the strongest political traction, Scenario C is the easiest to establish at low political cost, and Scenario B provides a middle path between political reach and institutional feasibility.

The Action Plan recommends that the new government takes an explicit decision between these scenarios within the first 100 days. Regardless of the model selected, three operational requirements should be secured:

1. a clearly identified lead with a dedicated mandate, staff and budget;
2. a permanent multi-stakeholder advisory platform, such as the Si.Bio Hub or its successor, institutionally connected to the coordination structure and supported by stable funding;
3. a shared monitoring, evaluation and learning framework linked to the EU Bioeconomy Monitoring System and to the national indicator set proposed in this Action Plan.

10.11 Cross-Cutting Principles for Implementation

Across all strategic objectives, priority areas and implementation actions, the Action Plan applies five cross-cutting principles. They should guide project selection, public funding, procurement, monitoring and coordination between institutions.

1. Subsidiarity and territorial sensitivity

Measures should be designed at the scale where they can work best: national, regional, municipal or value-chain level. They should reflect the diversity of Slovenian territories, from Alpine and forest-based regions to agricultural, urban, Karst and coastal areas.

2. Cascading and circularity by design

Biomass should be directed towards the highest-value sustainable use before lower-value applications are considered. Cascading use and circular design should be embedded in investment criteria, support schemes and project development.

3. Planetary boundaries and ecosystem integrity

Biomass mobilisation must remain within planetary boundaries. Food and nutrition security, biodiversity, soil and water quality, climate resilience and the LULUCF carbon sink should be treated as core conditions, not external constraints.

4. Evidence-based and adaptive management

Decisions should be based on transparent data, including biomass flows, lifecycle impacts, environmental monitoring and market development. Priorities should be reviewed regularly and adjusted through structured learning.

5. Just transition and inclusiveness

The bioeconomy transition should create opportunities for small-scale farmers, forest owners, SMEs, rural and remote regions, and local communities. It should also recognise and mitigate transition risks for vulnerable groups, including households dependent on traditional biomass use.

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