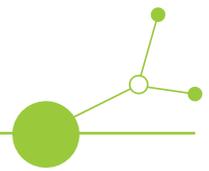


Strategy and Action Plan for Bioeconomy Measures

Deliverable D.3.2.1



Version 2

15.12.2025





Project title		Circular BioEconomy Market Uptake and Policy Support in Central Europe (BIOECO-UP)
Action (code, title)	A.3.2 Development of strategy and action plan for implementing bioeconomy measures	
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Prepared by	The document was prepared by the Institute of Soil Science and Plant Cultivation - State Research Institute (IUNG-PIB), drawing on comprehensive inputs from project partners – including desk research analyses, Delphi Group findings, and expert contributions – directly engaged in developing the Strategy and Action Plan. The report also incorporates valuable input from BAB (Austria), which led the related Activity A3.1 and conducted an in-depth analytical research of the CAP Vision 2040.	
Dissemination level	Confidential, only for members of the consortium, (including European Commission Services). A brief summary of A3.1 will be provided on the BIOECO-UP website (www.interreg-central.eu/projects/bioeco-up/).	
Abstract	<p>The Central European Bioeconomy Strategy and Action Plan (Deliverable D.3.2.1) developed within the Interreg Central Europe project BIOECO-UP provides an integrated transnational framework to embed circular bioeconomy principles into the Common Agricultural Policy (CAP) and national policy systems across six Central European countries: Croatia, the Czech Republic, Hungary, Poland, Slovakia, and Slovenia, supported by partners from Austria and Italy. Grounded in extensive desk research, Delphi consultations, and expert assessments, the Strategy synthesises evidence from national CAP Strategic Plans (2023-2027), bioeconomy strategies, and stakeholder insights to define shared priorities and policy pathways for a more sustainable and competitive regional bioeconomy.</p> <p>The research points towards ongoing East-West asymmetries in governance, innovation and investment capacities and concludes that bioeconomy imperatives are only partially reflected within existing CAP frameworks. It discusses four underlying obstacles such as fragmented governance, poor knowledge transfer, low market uptake, and technological gaps, while also pointing to enabling opportunities including the EU Green Deal, Horizon Europe, and BIOEAST cooperation structures.</p> <p>Six strategic pillars structure the Action Plan: (1) Governance and AKIS, (2) Research, Innovation, and Digitalisation, (3) Climate and Environmental Sustainability, (4) Sustainable Agriculture, Food and Forestry Value Chains, (5) Rural Communities and Regional Hubs, and (6) Knowledge and Skills. Each pillar includes concrete measures, indicators, and financing tools linking CAP instruments with EU programmes such as LIFE, ERDF, and Digital Europe.</p>	

The Strategy emphasises co-creation, policy coherence, and evidence-based implementation through policy labs, regulatory sandboxes, and transnational peer learning. It envisions Central Europe as a macro-region leading the transition toward regenerative, circular, and digitally enabled agri-food systems under the CAP 2028-2034 and the EU Agri-Food Vision 2040. By strengthening territorial cohesion, innovation ecosystems, and bio-based value chains, BIOECO-UP contributes to EU climate neutrality goals, rural revitalisation, and resilience. Expanding the CAP policy scope to circular bioeconomy practices—such as cascading biomass use, nutrient recycling, and green public procurement—creates new opportunities for tailored national interventions and adaptive governance, positioning Central Europe as a driving force of sustainable transformation within the European Green Deal.

D.3.2.1 is based on inputs from / materials prepared by national teams

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Abbreviations

AKIS	Agricultural Knowledge and Innovation Systems	HORIZON EUROPE	EU Framework Programme for Research and Innovation (2021-2027)
AOP	Annual Operational Programme	ICT	Information and Communication Technologies
BIOEAST	Central and Eastern European Initiative for Knowledge-based Agriculture, Aquaculture and Forestry in the Bioeconomy	IUNG-PIB	Institute of Soil Science and Plant Cultivation - State Research Institute (Poland)
BIOECO-UP	Circular BioEconomy Market Uptake and Policy Support in Central Europe	JRC	Joint Research Centre (European Commission)
CAP	Common Agricultural Policy	KETs	Key Enabling Technologies
CAP SP	CAP Strategic Plan	LAG	Local Action Group
CCS	Carbon Capture and Storage	LIFE	The LIFE programme is the EU's funding instrument for the environment and climate action
CEE	Central and Eastern Europe	LULUCF	Land Use, Land Use Change and Forestry
CE	Circular Economy	MoA	Ministry of Agriculture
CFP	Common Fisheries Policy	MoE	Ministry of the Environment
CLLD	Community-Led Local Development	MSP	Member State Partnership / Member State Platform
CO ₂	Carbon Dioxide	NCBR	National Centre for Research and Development (Poland)
DG AGRI	Directorate-General for Agriculture and Rural Development	NGO	Non-Governmental Organisation
DG RTD	Directorate-General for Research and Innovation	NUTS	Nomenclature of Territorial Units for Statistics
D.3.1.1 / D.3.2.1	Deliverables 3.1.1 and 3.2.1	OECD	Organisation for Economic Co-operation and Development
EAFRD	European Agricultural Fund for Rural Development	PESTEL	Political, Economic, Social, Technological, Environmental and Legal Analysis
EC	European Commission	PPP	Public-Private Partnership
EIP-AGRI	European Innovation Partnership for Agricultural Productivity and Sustainability	R&I	Research and Innovation
ENRD	European Network for Rural Development	RDP	Rural Development Programme
ERDF	European Regional Development Fund	RTO	Research and Technology Organisation
EU	European Union	SDG	Sustainable Development Goal

FAO	Food and Agriculture Organization of the United Nations	SME	Small and Medium-sized Enterprise
GHG	Greenhouse Gas	SWOT / TOWS	Strengths, Weaknesses, Opportunities, Threats / Threats, Opportunities, Weaknesses, Strengths
GDP	Gross Domestic Product	UN	United Nations
GIS	Geographic Information System	UN SDGs	United Nations Sustainable Development Goals
AKIS Hub	Agricultural Knowledge and Innovation Systems Hub	LRA	Local or Regional Authority
CAP Pillar I	Direct Payments and Market Measures under the Common Agricultural Policy	M&E	Monitoring and Evaluation
CAP Pillar II	Rural Development Measures under the Common Agricultural Policy	MoEIT	Ministry of Economy and Information Technology
CBI	Circular Bioeconomy Initiative	MoES	Ministry of Education and Science
CBE JU	Circular Bio-based Europe Joint Undertaking	MoER	Ministry of Environment and Resources
DG CLIMA	Directorate-General for Climate Action	MoI	Ministry of Innovation
DG ENV	Directorate-General for Environment	MoRD	Ministry of Regional Development
DG REGIO	Directorate-General for Regional and Urban Policy	MoSD	Ministry of Sustainable Development
DG SANTE	Directorate-General for Health and Food Safety	MS	Member State
EAGF	European Agricultural Guarantee Fund	MSP Platform	Member State Partnership Platform
EIP	European Innovation Partnership	NGP	National Governance Platform
EIT	European Institute of Innovation and Technology	NRN	National Rural Network
EUSAIR	EU Strategy for the Adriatic and Ionian Region	NSP	National Strategic Plan
EUSALP	EU Strategy for the Alpine Region	NWRM	Natural Water Retention Measures
EUSDR	EU Strategy for the Danube Region	OECD-FAO	Organisation for Economic Co-operation and Development - Food and Agriculture Organization Joint Reports
ESIF	European Structural and Investment Funds	P2P	Peer-to-Peer
EUROSTAT	Statistical Office of the European Union	PA	Priority Axis
FP7	Seventh Framework Programme for Research and Technological Development (EU, 2007-2013)	RAC	Regional Advisory Centre
GVA	Gross Value Added	RIS3	Research and Innovation Smart Specialisation Strategy



HEI	Higher Education Institution	RRF	Recovery and Resilience Facility
ICT-BE	Information and Communication Technologies for the Bioeconomy	RTD	Research and Technological Development
IFI	International Financial Institution	SD	Sustainable Development
IPCC	Intergovernmental Panel on Climate Change	SE	Social Economy
ISO	International Organization for Standardization	SIEA	Slovak Innovation and Energy Agency
IT	Information Technology	SRIA	Strategic Research and Innovation Agenda
JTF	Just Transition Fund	STEM	Science, Technology, Engineering and Mathematics
LCA	Life Cycle Assessment	TRL	Technology Readiness Level

MAIN PART

Executive Summary

Strategic Context and Rationale

The Central European Bioeconomy Strategy and Action Plan (D.3.2.1), developed under the Interreg Central Europe BIOECO-UP project, provides a joint transnational framework for integrating circular bioeconomy principles into the CAP and national policies across six Central European countries. Based on prior research and extensive expert consultations, the document combines long-term strategic directions with a concrete action plan.

The strategy addresses the specific challenges of Central and Eastern Europe, where fragmented policies, lower innovation capacity and limited investment slow down bioeconomy development compared to Western EU countries. BIOECO-UP responds by creating a coordinated, evidence-based approach that strengthens policy coherence, cross-sector collaboration and alignment with EU Green Deal priorities.

It supports the BIOEAST Initiative and is consistent with the EU Bioeconomy Strategy, Circular Economy Action Plan and the emerging CAP 2028-2034 vision.

Overall, the deliverable aims to position the circular bioeconomy as a key driver of sustainable growth, innovation and resilience in Central Europe – empowering rural communities, improving resource efficiency and accelerating the region's contribution to EU climate neutrality goals.

Methodology and Approach

The formulation of the Strategy and Action Plan followed a rigorous and participatory methodological process designed to ensure scientific validity, stakeholder ownership, and policy transferability. The approach combined three complementary components:

1. Desk Research – a harmonised evaluation of national CAP Strategic Plans (2023-2027), bioeconomy strategies, and policy instruments in the six target countries. Each partner applied a common analytical template developed by IUNG-PIB to map institutional frameworks, funding measures, governance models, and policy gaps related to circular bioeconomy integration.

2. Delphi Group Consultations – participatory expert workshops in each country engaging 10-20 representatives of policy, research, business, and civil society. These structured sessions identified converging opinions on bioeconomy priorities, drivers, barriers, and feasible policy actions within CAP implementation. Over 40 experts participated across the region.

3. Expert Assessments and Thematic Analyses – thirty in-depth reports were collected from national experts across key domains, applying PESTEL, SWOT/TOWS, and impact-effort matrices to assess Key Enabling Technologies (KETs) and bioeconomy pathways such as biogas and biomethane, regenerative agriculture, precision farming, and bio-based materials.

Together, these methods generated an evidence-driven, multi-layered knowledge base that integrates quantitative policy mapping with qualitative stakeholder insight. The resulting outputs lead to develop consolidated catalogue of 100 proposed policy measures useful for action plan, categorised under six strategic pillars, checked through transnational peer review.

The methodology also fostered a culture of co-creation and mutual learning – reflecting the quadruple-helix principle by bringing together government, academia, business, and civil society. This participatory

ethos ensured that the strategy not only responds to empirical findings but also embodies shared ownership among Central European partners.

Key Findings from the Strategy

1. Policy and Territorial Context

Across the BIOECO-UP partner countries, bioeconomy development remains uneven. Austria and Italy operate mature national bioeconomy strategies and coordination platforms, whereas most Eastern partners are still in the early phases of policy formulation or implementation. Differences in governance capacity, financing mechanisms, and institutional collaboration persist.

The Common Agricultural Policy (CAP) represents one of the most powerful instruments to mainstream bioeconomy objectives. However, exploration of national CAP Strategic Plans revealed that bioeconomy priorities are only partially integrated, often indirectly through agri-environmental, innovation, or circular economy measures rather than explicit bioeconomy schemes. Gaps also exist in indicator systems, monitoring mechanisms, and alignment between CAP and national research or industrial strategies.

Despite these disparities, several enabling factors were identified:

- The EU Green Deal, Farm to Fork and Competitiveness Compass initiatives create strong incentives for regenerative and circular farming.
- Horizon Europe, LIFE, and ERDF programmes support innovation and cross-sector cooperation.
- BIOEAST's strategic working groups and other initiatives supporting BIOEAST initiative (e.g. CEEZACT project) provide a macro-regional governance framework for knowledge exchange and capacity building.

2. Structural Challenges and Needs

The diagnosis phase identifies four major systemic challenges:

1. **Fragmented governance** – limited coordination among ministries and policy sectors, resulting in overlapping responsibilities and inconsistent implementation.
2. **Insufficient knowledge transfer** – not sufficiently developed Agricultural Knowledge and Innovation Systems (AKIS), underdeveloped advisory services, and limited skills in bio-based innovation.
3. **Low market uptake** – poor consumer awareness, insufficient demand for bio-based products, and lack of dedicated investment instruments.
4. **Technological and infrastructural gaps** – uneven availability of processing facilities, data systems, and R&D infrastructure across rural territories.

Addressing these challenges requires policy coherence, cross-sector integration, and targeted investment. The Strategy therefore defines a long-term vision for a resilient, circular, and innovation-driven agricultural economy that bridges the West-East policy divide and fosters inclusive regional growth.

3. Analytical Insights

The Delphi and expert analyses converged on several priority fields and transformation pathways:

- Bioenergy (biogas, biomethane, biofuels): Key to decarbonising rural energy systems, improving waste management, and promoting energy self-sufficiency.
- Regenerative and precision agriculture: Essential for enhancing soil health, biodiversity, and productivity through digital and data-driven practices.
- Bioprocessing and biomaterials: Strategic for diversifying rural economies and replacing fossil-based inputs in manufacturing, packaging, and construction.

- Each domain was analysed through SWOT/TOWS frameworks, revealing shared leverage points such as:
 - strong natural resource potential (S),
 - increasing EU support for innovation and sustainability (O),
 - fragmented markets and low investor confidence (W),
 - and regulatory uncertainty (T).

4. Drivers and Barriers

The PESTEL analysis identified key drivers – technological advancement, EU funding opportunities, social awareness of sustainability, and geopolitical demand for energy independence – contrasted with barriers such as unstable legislation, limited feedstock logistics, and skills shortages.

Experts identified six cross-cutting challenges, namely (1) Fragmented policy and institutional frameworks; (2) High investment risk and limited private financing; (3) Low market acceptance of bio-based products; (4) Technological gaps and lack of testing infrastructure; (5) Weak human capital and limited skills; (6) Insufficient monitoring and evaluation indicators.

The synthesis of expert findings emphasised the need for systemic measures: e.g. strengthening governance, promoting innovation ecosystems, enhancing farmer training, and connecting rural bioeconomy hubs through digitalisation and knowledge exchange.

Strategy specification

1. Governance & AKIS - Build integrated, adaptive knowledge and innovation systems that link research, policy, and practice.

Actions: national bioeconomy policy labs, digital AKIS platforms, and regional monitoring systems.

2. Research, Innovation & Digitalisation - Accelerate the twin green-digital transition through bio-based R&D, data-driven farming, and open innovation networks.

Actions: bioeconomy digital twins, living labs, and funding synergies between CAP and Horizon Europe.

3. Climate & Environmental Sustainability - Move from compliance-based to performance-based CAP measures.

Actions: carbon-farming pilots, result-based eco-schemes, soil health monitoring, and nutrient recycling incentives.

4. Sustainable Agriculture, Food & Forestry Value Chains - Close resource loops and promote bio-based processing.

Actions: biorefinery pilots, support for biomass valorisation, and incentives for low-emission value chains.

5. Rural Communities & Regional Bioeconomy Hubs - Strengthen local transformation through short supply chains and community participation.

Actions: regional bioeconomy hubs, agrotourism incentives, and LEADER-based innovation clusters.

6. Knowledge & Skills for Farmers and Advisors - Enhance human capital and lifelong learning in circular bioeconomy topics.

Actions: modular certification, training of advisors, and inclusion of bioeconomy curricula in agricultural education.

Action Plan Overview and Implementation Framework

The Action Plan (Part 2 of the report) transforms the Strategy's orientations into a structured operational framework built around six strategic pillars.

Each pillar corresponds to a domain of intervention that collectively ensures the integration of bioeconomy priorities into the CAP and national policies.

Pillar 1. Governance and AKIS - Building Adaptive and Integrated Knowledge Systems

This pillar addresses the institutional dimension of the bioeconomy transition. It proposes to:

- establish national bioeconomy coordination platforms;
- integrate bioeconomy objectives into AKIS structures;
- create bioeconomy policy labs and regulatory sandboxes to test innovative approaches; and
- develop harmonised monitoring and indicator frameworks for assessing bioeconomy performance.

These measures enhance evidence-based policymaking, strengthen horizontal cooperation across ministries, and ensure continuity between CAP periods.

Pillar 2. Research, Innovation, and Digitalisation - Accelerating the Twin Transition

Recognising innovation as the engine of the bioeconomy, this pillar promotes:

- investment in Key Enabling Technologies (e.g., biogas, biomaterials, precision agriculture);
- deployment of digital twins and data platforms for monitoring sustainability;
- support for pilot and demonstration projects; and
- improved access to EU R&I programmes for SMEs and rural actors.

The objective is to accelerate the uptake of digital and bio-based innovations and to strengthen Central Europe's participation in European research networks.

Pillar 3. Climate and Environmental Sustainability - From Compliance to Performance

This pillar aligns the bioeconomy with the EU's climate and environmental objectives by:

- expanding result-based agri-environment-climate measures;
- supporting carbon farming and soil-health initiatives;
- promoting nutrient recycling, biological pest management, and circular waste systems;
- and integrating biodiversity protection into bioeconomy value chains.

It shifts policy focus from compliance toward measurable environmental performance and outcome-based incentives.

Pillar 4. Sustainable Agriculture, Food, and Forestry Value Chains - Closing Loops Across Sectors

This pillar operationalises the circular principle in production and processing. It proposes:

- development of regional bio-based clusters for biogas, biomethane, and biorefineries;
- promotion of cascading biomass use and by-product valorisation;
- support for short supply chains, green public procurement, and eco-labeling of bio-based products;
- and encouragement of cross-sector cooperation among agriculture, forestry, food, and industrial actors.

These actions foster competitiveness, resource efficiency, and new market opportunities for rural SMEs.

Pillar 5. Rural Communities and Regional Bioeconomy Hubs - Empowering Local Transformation

The Strategy recognises rural areas as the engine of the bioeconomy. This pillar focuses on:

- creating regional bioeconomy hubs as multi-stakeholder innovation ecosystems;
- linking them with LEADER/CLLD structures to mobilise local action groups;
- supporting community-based entrepreneurship, circular tourism, and renewable energy initiatives; and
- promoting social innovation and participatory governance.

Such hubs serve as territorial anchors for place-based bioeconomy development and citizen engagement.

Pillar 6. Knowledge and Skills for Farmers and Advisors - Enabling Lifelong Learning and Innovation

Human capital development is central to successful implementation. Actions include:

- establishing training and certification programmes for bioeconomy competencies;
- integrating circular bioeconomy modules into agricultural curricula;
- strengthening advisory and extension services; and
- promoting peer-to-peer learning, demonstration farms, and digital learning tools.

This ensures that farmers, advisors, and rural entrepreneurs are equipped to adopt innovative and sustainable practices.

Guiding Principles

The Action Plan is grounded in ten overarching principles that guide all measures:

1. Sustainability and Climate Neutrality/Climate Change Adaptation
2. Food and Nutritional Security
3. Innovation, Digitalisation, and Evidence-Based Policy
4. Good Governance and Adaptive Cooperation
5. Cascading and Circular Resource Use
6. Local Empowerment and Regional Bioeconomy Hubs
7. Knowledge, Skills, and Human Capital
8. Inclusiveness, Transparency, and Social Innovation
9. Transnational Cooperation and Policy Learning
10. Policy Coherence Across Sectors and Scales

These principles ensure that actions are coherent with EU policy frameworks, socially inclusive, and adaptable to varying national contexts.



Expected Impacts and Benefits

Economic Impacts

- Strengthening of regional value chains and creation of new bio-based markets.
- Diversification of rural economies through new products, services, and SMEs.
- Enhanced investment attractiveness and mobilisation of public-private partnerships.

Environmental Impacts

- Reduction of GHG emissions through renewable energy and low-carbon practices.
- Improvement of soil fertility, biodiversity, and water management.
- Promotion of resource efficiency and waste valorisation across sectors.

Social Impacts

- Empowerment of rural communities through participatory governance.
- Creation of green jobs and lifelong learning opportunities.
- Increased consumer awareness and behaviour change toward sustainable consumption.

Policy and Governance Impacts

- Improved coordination between CAP and bioeconomy strategies preparation.
- Strengthened monitoring and evaluation systems using measurable indicators.
- Enhanced policy learning and transnational cooperation under the BIOEAST framework.

Collectively, these impacts will contribute to a more competitive, inclusive, and climate-resilient Central Europe, positioning the region as a key contributor to EU bioeconomy ambitions.

How the Action Plan's Policy Measures Operationalise the Vision for the Common Agricultural Policy for 2028-2034

The Action Plan turns the vision for the Common Agricultural Policy into concrete measures across six pillars. Each measure in the tables is linked to a specific implementation lever of the Common Agricultural Policy (for example: ecological schemes under direct payments, agri-environment-climate measures, knowledge-transfer and advisory services within Agricultural Knowledge and Innovation Systems, cooperation projects, investments financed by the European Agricultural Fund for Rural Development, sectoral programmes, and performance frameworks based on measurement, reporting and verification), a time horizon, responsible institutions, financing sources, and indicators.

- **Outcome-based delivery and measurement, reporting and verification.**

The measures define standard indicators for soil organic carbon, nutrient circularity, cascading use of biomass, and the uptake of certified bio-based products. Results feed into performance reviews of the Common Agricultural Policy and annual public reports, allowing ecological scheme rates and agri-environment-climate measures to be adjusted on the basis of evidence.

- **Capability building through Agricultural Knowledge and Innovation Systems.**

Training pathways, micro-credentials, strengthened advisory services, and Living Labs embed bioeconomy skills in national knowledge and innovation systems. Common Agricultural Policy instruments for knowledge transfer, cooperation, and technical assistance finance on-farm demonstrations and peer-to-peer learning so that countries move from awareness to practical capability.

- **Integrated portfolios and financing.**

Investment measures combine resources from the Common Agricultural Policy (both direct payments and rural development instruments) with Horizon Europe, the LIFE programme, the European Regional Development Fund, the Digital Europe Programme, and InvestEU. This de-risks pilots and scales proven solutions such as modular biorefineries, biogas hubs, and cooperative precision-farming infrastructure.

- **Demand creation and market pull.**

Certification and quality-assurance systems, digital product passports and traceability, and green public procurement create predictable demand for bio-based inputs and materials. Instruments of the Common Agricultural Policy for cooperation and rural development support buyer engagement and pre-commercial procurement pathways.

- **Adaptive regulation through policy laboratories and regulatory sandboxes.**

Time-bound pilots test designs for ecological schemes that pay for results (for example, verified increases in soil organic carbon), protocols for cascading biomass use, and standards for digestate. Proven designs are then written into national implementing rules.

- **Place-based hubs and territorial coordination.**

Regional bioeconomy hubs—linked to Leader and Community-Led Local Development—aggregate feedstocks, offer shared services, and coordinate cross-sector projects. Measures align with territorial instruments of the Common Agricultural Policy to strengthen rural value chains.

- **Data and digitalisation for performance.**

Interoperable data platforms, farm-level traceability, and digital twins support monitoring, certification, and payments based on results. These tools are aligned with indicators used by the Common Agricultural Policy and with interfaces of the European Union Soil Mission to ensure comparability across countries.

- **Transnational alignment and peer learning.**

Measures under the BIOEAST cooperation framework coordinate standards, indicators, and joint pilots across Central and Eastern Europe, speeding up the convergence of policy maturity and practice.

Sector snapshots – how the tables make this operational:

- **Bioenergy** (including biogas and biomethane): ecological schemes that reward verified use of digestate and documented cascading pathways; rural-development investments for clustered anaerobic digestion and biomethane upgrading; procurement guidelines for bio-fertilisers; and national biomass registries for planning and performance tracking.

- **Regenerative agriculture and precision agriculture:** multi-year ecological schemes linked to outcomes in soil organic carbon and biodiversity; cooperative access to precision technologies financed through rural development; national soil-health observatories and digital traceability integrated into monitoring of the Common Agricultural Policy.

- **Bioprocessing and biomaterials:** investment windows for modular biorefineries and logistics hubs; ecological schemes that prioritise higher-value cascading before energy use; national certification and quality-assurance systems; and green public-procurement targets for bio-based construction and packaging.

In short, the Action Plan's measures are the delivery mechanics of the vision for the Common Agricultural Policy: they embed outcomes, capability, financing, market demand, adaptive rules, territorial hubs, and data into a single pathway that tests, learns, and scales.

Conclusions and Recommendations

The Central European Bioeconomy Strategy and Action Plan proposed in the report represents a milestone in regional policy cooperation. It provides both a strategic vision and an operational toolbox for embedding circular bioeconomy measures into CAP implementation and broader national frameworks.

Key Recommendations

1. Institutionalise bioeconomy coordination within national CAP governance structures through cross-ministerial committees and AKIS networks.
2. Adopt measurable indicators for monitoring bioeconomy contributions to CAP objectives, linked to EU-wide sustainability frameworks.
3. Leverage EU funding synergies between CAP, Horizon Europe, LIFE, ERDF, and national programmes to finance bio-based innovation.
4. Strengthen education and skills development through dedicated bioeconomy curricula and certification systems.
5. Promote cross-border cooperation via regional bioeconomy hubs, BIOEAST working groups, and shared pilot projects.
6. Support market creation through public procurement, certification schemes, and consumer awareness campaigns.
7. Encourage adaptive policy learning, using policy labs and regulatory sandboxes to test and scale innovative measures.

Policy implications and next steps

Looking ahead to the CAP 2028-2034 and the EU Agri-Food Vision 2040, the Strategy envisions Central Europe as a leader in circular, regenerative, and digitally enabled agriculture. It calls for stronger macro-regional coordination to close the East-West gap, accelerate the twin transition, and harness the full potential of bio-based innovation.

Through BIOECO-UP, the region has demonstrated that transnational cooperation is not only possible but essential to achieving sustainable transformation. The deliverable thus contributes directly to EU cohesion, resilience, and green growth, laying the foundations for a new generation of integrated bioeconomy policies that balance economic competitiveness, environmental responsibility, and social inclusiveness.

Expanding the policy scope to the circular bioeconomy widens the toolbox for Member States – linking cascading biomass use, soil-health outcomes, nature-based solutions, and green public procurement – thereby increasing room for tailored interventions. It also strengthens climate-change adaptation by diversifying crops and inputs, improving water and nutrient cycles, spreading risk across value chains, and creating credible alternatives to fossil- and input-intensive models. Despite real challenges – regulatory fragmentation, capacity gaps in advisory and administration, financing constraints for scale-up, and uneven digital infrastructure—the Strategy outlines practical safeguards: phased pilots and policy laboratories, measurable indicators and verification, portfolio financing that blends EU and national sources, and transnational peer learning to reduce implementation risk. Taken together, these measures make the transition both actionable and resilient, even under uncertainty.

STRATEGY - STRATEGIC ORIENTATION FOR ACTION PLAN

Summary

The Central European Bioeconomy Strategy (BIOECO-UP Deliverable D.3.2.1) provides a coordinated framework for how circular bioeconomy measures can be incorporated into the Common Agricultural Policy (CAP) and its associated policies for the six BIOEAST countries (CZ, HR, HU, PL, SI, SK). It is built on established evidence-based observations from Deliverable D.3.1.1 and develops a frame of reference for advancing a sustainable, circular and innovation-driven bioeconomy in Central Europe.

Context and Rationale

Central Europe is struggling with lagging development of bio-based value chains, insufficient cross-sector-focused integration and different levels of policy maturity in the West and East. The BIOECO-UP project, executed by 12 partners from 8 countries, addresses these deficiencies through transnational learning, sharing of knowledge and co-production of policy. It reinforces the BIOEAST Initiative and aligns with the EU Green Deal, Circular Economy Action Plan, and EU Bioeconomy Strategy.

Objectives

The strategy aims to:

1. Strengthen transnational bioeconomy value networks and cooperation.
2. Foster citizen participation and awareness, turning consumers into *bioeconomy prosumers*.
3. Enhance policy learning and coherence to embed bioeconomy objectives into CAP and national frameworks.

Methodology

A coherent multi-step approach combined:

- Desk research on CAP Strategic Plans and national policies;
- Delphi Group consultations with over 100 experts from policy, academia, business, and civil society across six countries;
- Expert assessments using PESTEL and SWOT/TOWS tools to identify drivers, barriers, and strategic pathways;
- Integration and synthesis of over 30 national expert reports and 100 proposed policy measures.

This evidence-based, participatory methodology guaranteed that the strategy was grounded in the context and consensus among stakeholders.

Main Findings

1. Policy fragmentation persists across the region, with uneven integration of bioeconomy priorities into CAP instruments.
2. There are many potential applications in regenerative agriculture, precision farming, bioprocessing, bioenergy, and biomaterials.
3. Key enabling technologies (KETs) - for example, biogas and biomethane production, precision agriculture tools, and bio-based processing innovations - are essential transition accelerators.
4. Drivers are Long-term Vision for Sustainable Agriculture and Bioeconomy (CAP 2040 context) policy related documents targets, consumer awareness and technological innovation, barriers weak coordination; limited funding and regulatory instability.

5. Transnational cooperation and policy learning are essential to bridge the East-West policy gap and ensure coherent CAP implementation.

Strategic Recommendations

- Integrate circular bioeconomy objectives systematically into CAP eco-schemes, AKIS, and rural development measures.
- Promote adaptive governance through bioeconomy policy labs and national coordination platforms.
- Strengthen monitoring, indicators, and result-based frameworks for bioeconomy performance.
- Encourage innovation, digitalisation, and capacity building across bio-based sectors.
- Empower rural communities and SMEs as key agents of bio-based transformation.

Strategic Outlook

The Strategy sets the long-term vision for a circular, resource-efficient agricultural system in Central Europe, aligning CAP reform (2028-2034) with the EU's climate neutrality/adaptation and sustainable growth objectives. It establishes the conceptual foundation for the Action Plan, which operationalises the vision through concrete measures and implementation frameworks.

Condensed Abstract:

The strategic orientation provides a transnational framework for integrating circular bioeconomy priorities into the CAP and national policies across six BIOEAST countries. It describes strategic approaches, supporting technologies, and policy suggestions after detailed research and experts' consultation, for the promotion of innovation, sustainability, and regional cooperation. It also envisions an integrated, inclusive bioeconomy transition in line with the EU Green Deal and CAP targets post-2027.

1. BIOECO-UP: Introduction

The BIOECO-UP project (“Circular bioeconomy market uptake and policy support in Central Europe”) brings together twelve organisations from eight countries to accelerate the development of a sustainable, circular bioeconomy in the Central European region. The initiative responds to a set of structural challenges that have constrained bioeconomy progress in this part of Europe: fragmented and poorly developed value chains, a strong consumer preference for fossil-based products, limited innovation ecosystems, and insufficient exchange of policy experience among national administrations.

Central Europe faces specific socio-economic and environmental pressures that make the transition towards a circular bioeconomy both urgent and complex. While the circular economy focuses mainly on recycling and reusing materials, the circular bioeconomy goes further by replacing fossil resources with renewable, bio-based materials and creating new value chains in agriculture, forestry, food systems, biotechnology, and bio-based industries. However, progress across the region remains uneven. Countries such as Austria and Italy have advanced strategies and stakeholder platforms, whereas many Central and Eastern European countries still lack integrated policy frameworks, strong institutional coordination, and mature innovation networks. This East-West divide limits the region’s ability to fully contribute to EU climate neutrality goals and to the ambitions of the Green Deal.

BIOECO-UP seeks to overcome these barriers by advancing three intertwined transformations: strengthening regional value chains, building citizen awareness and participation, and enhancing policy coherence. The project supports economic actors by helping them identify bio-based innovation opportunities and by fostering the development of transnational and cross-sector value chains. At the same time, it recognises that consumers play a central role in market uptake. Public awareness of the benefits of bio-based products remains low, and fossil-based goods dominate everyday consumption. For this reason, the project invests significantly in education, behavioural change, and citizen engagement, aiming to create a new generation of “bioeconomy prosumers” who make informed choices and actively support green innovation.

A critical dimension of BIOECO-UP is its contribution to policy learning. The region’s decision-makers need access to shared knowledge, tested governance models, and proven policy instruments if they are to integrate circular bioeconomy measures effectively into national strategies and into the Common Agricultural Policy. Early findings confirmed that although CAP Strategic Plans acknowledge the relevance of the bioeconomy, its integration is still indirect and fragmented. Key barriers include low awareness among policymakers, insufficient expertise in bioeconomy-related fields, and a lack of measurable indicators for assessing bioeconomy outcomes.

To address these gaps, the project has developed the Central European Bioeconomy Strategy and Action Plan, which provides a harmonised set of strategic directions and practical measures for mainstreaming bioeconomy objectives in the region. The strategy is built on extensive analytical work, transnational consultations, and thirty expert reports exploring key enabling technologies such as biomethane, precision agriculture, biorefining, bio-based materials, and nutrient recycling. The resulting policy toolbox includes one hundred measures covering governance, research and innovation, environmental sustainability, market development, rural transformation, and skills development. The recommendations are aligned with the European Commission’s vision for the future of the CAP for 2028-2034, ensuring strategic relevance and forward-looking coherence.

The project also strengthens macro-regional cooperation through close alignment with the BIOEAST Initiative, which unites eleven Central and Eastern European countries around a shared vision for the bioeconomy. By transferring knowledge, tools, and lessons learned to BIOEAST working groups and national ministries, BIOECO-UP helps build a common evidence base and fosters long-term collaboration. Ongoing foresight activities further enrich this process, feeding into a joint Central European Bioeconomy Future Vision that outlines priorities for the period leading up to 2030 and beyond.

Although political transitions and administrative changes in some countries temporarily limited participation of policymakers, the project continues to engage national authorities through targeted consultations planned for the closing phase. Additional communication materials, infographics, and visual summaries will support the uptake and dissemination of policy recommendations.

Overall, BIOECO-UP provides a comprehensive, transnational response to the challenges facing the circular bioeconomy in Central Europe. By connecting evidence, innovation, citizens, and policymakers, the project lays the groundwork for a more resilient, competitive, and sustainable region capable of driving Europe's wider transition to a climate-neutral future.

2. BIOECO-UP: Concepts considered

Various concepts and policies are related to (circular) bioeconomy matters. BIOECO-UP WP3 particularly considers the Common Agricultural Policy (CAP) and the concepts of bioeconomy, circular economy, circular bioeconomy.

- **Common Agricultural Policy (CAP):** The European Commission (EC) describes the CAP as “a partnership between society and agriculture that ensures a stable supply of food, safeguards farmers’ income, protects the environment and keeps rural areas vibrant” [EC, 2024a]. The EU countries implement the CAP 2023-2027 by means of their national CAP strategic plans [EC, 2023], which were developed based on 10 key policy objectives of the CAP period 2023-2027 [EC, 2024b].
- **Bioeconomy, circular economy and circular bioeconomy:** There is no common understanding or globally acknowledged definition of the terms “bioeconomy”, “circular economy”, and “circular bioeconomy”, and definitions may change over time. In principle: The bioeconomy seeks to replace fossil resources by renewable ones in as many sectors and applications as possible. The circular economy aims to reduce the use of resources; materials and products should be kept in the circle for as long as possible; and economic growth is decoupled from resource use. In a circular bioeconomy, the principles of bioeconomy and circular economy are combined.

3. Methodology

Overview of context, goals, and methodology

The Central European Bioeconomy Strategy and Action Plan was developed using a combined analytical and participatory methodology. It integrated three core elements: harmonised desk research mapping national policy frameworks, Delphi Group consultations gathering expert perspectives from policy, science, business, and civil society, and a strategic design phase translating findings into actionable proposals. Desk research provided the factual basis for comparing CAP-related bioeconomy measures across countries, while Delphi workshops validated results and added practical, experience-based insights. The final stage used tools such as SWOT/TOWS, PESTEL, and impact-effort analyses to define key technologies, barriers, opportunities, and transformation pathways. Optional Social Network Analysis was explored by some partners but remained outside the main comparative scope. Altogether, the methodology ensured that the strategy is evidence-based, co-created with stakeholders, and tailored to diverse national contexts.

Desk Research

In parallel with the Delphi Group workshops, a comprehensive desk research exercise was carried out in all participating countries to provide a solid analytical foundation for the strategy and action plan on bioeconomy measures. This stage aimed to map the existing policy frameworks, instruments, and practical

experiences related to the integration of circular bioeconomy into the Common Agricultural Policy (CAP) across Central European countries [1].

The research process followed a harmonised methodological template developed by the Institute of Soil Science and Plant Cultivation - State Research Institute (IUNG-PIB), which acted as the lead coordinator of this activity. The template served as both a structure and a set of analytical guidelines, ensuring consistency and comparability among national reports prepared by project partners [2].

Each national team conducted a detailed review of relevant policy documents, legislative acts, CAP Strategic Plans (2023-2027), national bioeconomy and circular economy strategies, as well as research publications and official statistics [3].

The template guided partners through a step-by-step review covering:

- the national policy and institutional context of the bioeconomy,
- the structure and implementation of the CAP,
- the main instruments supporting bio-based and circular measures under both CAP pillars,
- the identification of challenges, opportunities, and gaps between CAP and national bioeconomy policies,
- and the collection of best practices and transferable solutions [4].

The desk research also included a synthesis of findings from Activity A3.1, allowing each country to build on previous analytical work and to connect policy evidence with expert insights gathered in subsequent stages of the project.

To ensure quality and methodological coherence, IUNG-PIB provided detailed instructions, examples, and formatting guidance accompanying the template (see Annex 1).

The outputs of the desk research formed the empirical and conceptual basis for the formulation of the Central European Bioeconomy Strategy and Action Plan. They provided a valuable overview of how the CAP instruments currently contribute to circular bioeconomy objectives and revealed areas where further policy integration, capacity building, and stakeholder involvement are required [5].

Delphi Group

The Delphi Group methodology was applied in all participating countries as a structured, expert-based process to gather and compare informed views on the development of the circular bioeconomy. Each country organised a workshop involving representatives of policy, research, business, and civil society, ensuring a quadruple-helix perspective. Experts were selected to reflect a wide range of fields, including bioenergy, agroecology, sustainable food chains, biomaterials, precision agriculture, carbon farming, biodiversity, and climate policy.

Workshops combined individual scoring with collective reflection. After an introduction to the method and questionnaire, experts rated their agreement with specific statements on a numerical scale. The aggregated scores were then presented in plenary, where moderators highlighted areas of convergence and divergence. This facilitated structured discussion, allowing participants to explain their reasoning, share evidence, and deepen collective understanding of complex issues. In some countries, experts refined their assessments in a follow-up round; in others, emphasis was placed on qualitative interpretation and key messages.

All workshops followed a harmonised methodological framework, with minor adjustments to national conditions. Facilitators ensured balanced participation and transparent moderation, enabling constructive dialogue and preventing dominance of individual voices. The process produced both quantitative results and rich qualitative insights, which each national team documented in detailed reports.

These national outputs were synthesised into a transnational analysis forming the empirical basis for subsequent strategic recommendations and for shaping a shared Central European view on bioeconomy

policy development. Beyond data collection, the Delphi process served as a platform for mutual learning, reflection, and policy dialogue across the BIOEAST region.

Final stage - developing the strategic orientation of actions

The last step included specifying biobased pathways and key enabling technologies for transition to the bioeconomy, then examining networks and actors involved, and further implementing planning methods to develop strategies.

Table of contents

1. Key enabling technologies (KET) selection: list of relevant alternatives related to agriculture.
2. Input KET to evaluate suggested pathways using action priority (impact/effort) and sustainability (policy/profit) matrices => outcome: pathways appropriate to the country.
3. Social network analysis to determine actors and assess power and farmers' position.
4. PESTEL-I input: country appropriate pathways - enablers/barriers based on criteria from (9).
5. SWOT > TOWS > strategic actions.
6. Initial evaluation of measures translating strategic actions.

Step 1. Key enabling technology fields with potential to foster the transition toward a bio-based economy

Addressing to hub participants and focus group + experts (when necessary) as suggested by Devaney [7] and Henchion (2018) they are asked to suggest technologies that drive to the development of bioeconomy.

KETs are “knowledge-intensive and associated with high R&D intensity, rapid innovation cycles, high capital expenditure and highly skilled employment. [...] They are multidisciplinary, cutting across many technology areas with a trend towards convergence and integration.” [8] (European Commission, 2012). They are distinguished with regard to ‘emerging technologies’ and ‘general purpose technologies’ in terms of growth (fast growth), novelty (novel combination of technological classes), originality (combining former distinct pre-existing technology fields), complementarity (include different technology fields) and applicability (building blocks for further technological improvement in a broad range of fields [9]).

Select technology fields for sustainable bioeconomy [10]: Which criteria have to be fulfilled by technologies to become KETs and foster the transition toward a sustainable bio-based economy according to bioeconomy experts? (RQ 1);

Which technologies are perceived by bioeconomy experts to be key enabling technologies to pursue the bioeconomy transformation? (RQ 2);

a) Characterization of technologies for a sustainable bioeconomy: Technologies drive transformation in the bioeconomy. List up to five characteristics of these technologies you think are important to make sustainable bio-based transformation possible (e.g., create new functionalities, increase productivity in bio-based primary sectors, etc.).

b) Promising technology fields for a sustainable bioeconomy: List up to five promising technology fields that could enable bio-based transformation (e.g., enzyme technologies, bioinformatics, algae technologies, etc.)

Transformation pathways :

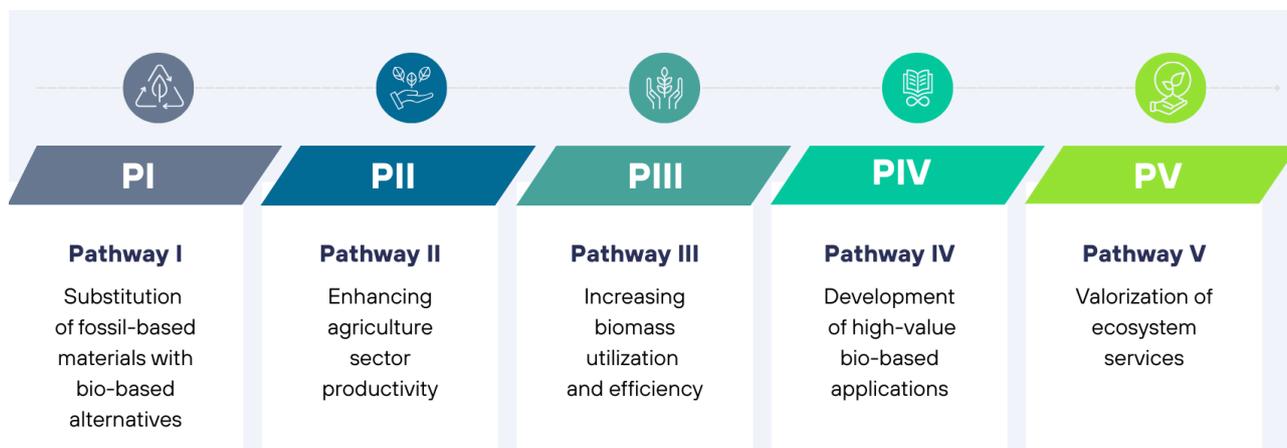


Figure 1. Transformation Pathways

Proceed as follows: Most relevant items derived from expert interview and the literature.

Table 1. Key Enabling Technologies (example)

Transformation Pathway (more than one)	Selected KETs	Brief Justification
PI (Fossil Substitution)	Example: Enzyme technologies	Supports bio-based plastics and chemical production.
PII (Agricultural Productivity)	Example: Precision farming & digitalization	Enhances efficiency and resource use.
PIII (Biomass Utilization)	Example: Biorefinery technologies	Enables high-value processing of biomass.
PIV (High-Value Applications)	Example: Bioinformatics & synthetic biology	Supports advanced bio-based innovations.

- Identify and **select relevant KETs** from the provided categories.
- Provide justification for each technology based on **its potential to drive bioeconomy transformation**.

Transformation pathway	PI Fossil Substitution				PII Agriculture				PIII Biomass Use/Processing				PIV High Value			
	Substitution of fossil by bio-based resources				Increases in primary sector productivity				Increases in biomass use efficiency and new biomass uses				Bio-based value added in low-volume/high value industries			
		x/345	% of 345			x/345	% of 345		x/345	% of 345		x/345	% of 345		x/345	% of 345
Deductive Codes (total: 12)	• Fermentation	18	5.2%	• Digitalization/ICT	39	11.3%	• Biomass processing	40	11.6%	• Synthetic biology	22	6.4%				
	• C1 technologies	21	6.1%	• Breeding advances	38	11.0%	• New biomass uses	2	0.6%	• Special/fine chemicals	2	0.6%				
	• Bio-ethanol/bio-chemicals	5	1.4%	• Genome editing	28	8.1%	• Alternative biomass	15	4.3%	• Enzyme technologies*	117	33.9%				
Inductive Codes (total: 42)	1) Biofuels/bioenergy	15	4.3%	1) Genomics/genetic engineering	34	9.9%	1) Organosolv/biomass pretreatments	8	2.3%	1) Biotechnology/metabolic engineering	44	12.8%				
	2) Functional biopolymers / bioplastics (PLA/PEF)	30	8.7%	2) Renewable energy not bio-based	12	3.5%	2) Cascading/circular biosystems	11	3.2%	2) Bio-electrochemistry/artificial photosynthesis	7	2.0%				
				3) Bioinformatics*	64	18.6%	3) Utilization of lignocellulose	10	2.9%	3) Medicinal applications	7					
	(total: 42)			4) Robotics/AI	21	6.1%	4) Aquatic biomass (general, fish etc.)	13	3.8%	4) Bionics/biomimicry	3	2.0%				
				5) Water management	6	1.7%	5) Algae (incl. Cyanob.)*	86	24.9%	5) Advanced technologies (Space science; extreme Os)	3	0.9%				
				6) Satellite/LIFI technologies	4	1.2%	6) Insects	9	2.6%	6) Advanced materials (packaging, construction etc.)	14	4.1%				
				7) City/urban/vertical/alternative farming methods	13	3.8%	7) Animal protein/meat alternatives	12	3.5%	7) Biochemistry/cell biology	9					
				8) Bio-fertilizer/biocontrol	10	2.9%	8) Bioremediation	3	0.9%	8) Nanotechnology	20	2.6%				
				9) Organic agriculture	8	2.3%	9) Waste reuse/processing	32	9.3%	9) Pharmaceuticals/biopharming	10	5.8%				
				10) Ecology/plant physiology	6	1.7%	10) Utilization of wood	7	2.0%	10) Functional food/nutraceuticals	13	2.9%				
				11) Biological nutrient supply	25	7.2%	11) Bio-refineries/bio-ccs/biogas plants	6	1.7%	11) Chemistry advance/green chemistry	19	3.8%				
				12) Warning systems/biosensors			12) Transport technologies/logistics	34	9.9%	12) Metabol-; Prote-; Gen)	11	5.5%				
				13) Precision farming/agricultural systems			13) Social/organizational innovations			13) Omics/systems biology	13	3.2%				
							14) Utilization of enzymes/MOs for biomass processing			13) Big Data	13	3.8%				
Total				89	11%		261	33%		245	31%		197	25%		

Figure 2. Frequency of mentioned technology field categories assigned to a transformation pathway [10]

Step 2. Suggested pathways by Delphi method over action priority and sustainability:

In this exercise we opted to evaluate the importance of KET's by means of action priority and sustainability matrices that allow for ranking in four quadrants the technologies at the same time to measure the frequency of experts suggestions for each one of them. The most promising technologies in the field of biogas production according to Kulisic et al. [11] comprise the following:

- Biogas done right
- Small scale AD for biomethane
- Leased small scale AD for biomethane
- Business models for decarbonization of dairy and meat sector
- Business models of CHPs towards small scale biorefineries
- Cascading use of biomass for biobased products and bioenergy
- Post-harvest management systems to bio-hubs
- Aquaculture with biogas
- Business models for AD grid balancing (flexible biogas)

Action priority matrix > Impact-effort axes

High impact - low effort: short term, fast results pathways (priority projects)

High impact - high effort: long term pathways (strategic projects)

Low impact - low effort: short term, fast results pathways (projects in synergy)

Low impact - high effort: long term pathways (synergy-other policy domains)

Sustainability matrix > Policy support - profit potential

High support - low profit (subsidy): recognized pathways requiring public funds

Low support - subsidy: not recognized pathways requiring public funding

High support - profit: recognized pathways but competitive (1st priority)

Low support - profit: not recognized pathways but competitive (2d priority)

Assessment of KETs

- Analyze each selected KET's impact and sustainability using the matrices below.

Technology				
Example KET	✓	Effort (input) →	low	high
		Impact (outcome)		
		low	Synergistic	Future Potential
		high	Short Term Priority	Long Term Strategic

Figure 3. Action Priority Matrix: Impact vs. Effort

Technology				
Example KET	✓	Policy support (input) →	low	high
		Profit (outcome)		
		Low	Niche	Public Funding Needed
		high	Emerging	Market Ready

Figure 4. Sustainability Matrix: Policy Support vs. Profit Potential

The combination of the two matrices above (action versus sustainability) can give an overall ranking of the KET based on preference for low support or effort with high impact or profit respectively, see for example:



Table 2. Matrices analysis of selected KET (example)

Support/profit (input) / Effort/impact (outcome)	Low - high	High - high	Low-low	High-low
Low - high	Composting ²	Fermentation ¹		
High - high	Artificial intelligence and Machine Learning	Hydrogenation ¹	Pyrolysis ⁴	
Low - low	Composting ⁴		Agricultural production residues ²	
High - low				Pyrolysis ¹ Renewable energy-organic waste

Social Network Analysis (optional method to qualify experts from their position in the technology network): Biogas is a process for producing renewable energy, which has recently gained interest in contributing to a territorial strategy for the deployment of the circular economy. The projects, which are collective in nature, bring together multiple actors or local stakeholders from a wide variety of backgrounds. The article proposes to analyse the territorial governance of this type of project by studying the relations of synergy and cooperation between stakeholders [12].

Table 3. Social Network Analysis (example)

Actors	#	Qualitative participation
Local authorities (members)	14 disposal sites	Waste collection
Local authorities (non-members)		Waste input convention Public procurement
Decision making bodies		Administrative-financial-risk management
Waste treatment plants	1 biogas unit	Transport, sorting, treatment of waste
Co-product customers	1 company 1 company	Electricity distribution Compost distribution

Farmers (customers)	many	compost use
Governmental agencies		Regulatory monitoring
Local residents (assoc.)		Concertation and risk management

Analysis of the networks of stakeholders in the Cavigny biogas project, first in terms of material and energy exchanges and then in terms of communication relations, led us to identify dense relational structures conducive to stakeholder cooperation and coordination.

A limited number of subgroups means the circulation of information and knowledge that strengthen social ties and facilitate collaboration. This logic of belonging, linked to the geographical proximity of the actors, enables the construction and consolidation of relational networks and the cohesion of the network as a whole.

Intermediary actors' critical presence guarantees the efficient mobilization of material resources to make the anaerobic digestion plant profitable, preventing any conflicts or oppositions that may emerge. Furthermore, trust relationships, often considered a decisive condition for the success of territorial renewable energy projects.

Step 3. Social Network Analysis: fill tables below to build relevant networks

Table 4. Actors in the agricultural extension network (example)

Information exchange flows: describe	ranking	daily	weekly	monthly	3-monthly	occasionally	never
Farmers groups *							
Farmers' cooperatives *							
Advisors agronomists *							
Ministry agronomists (department)							
Providers agronomists *							
Bank - financial system *							
Internet							
Suppliers *							
Retailers*							
Intermediaries*							
Final clients*							
Exhibitions							
Seminars - training							
Peers - colleagues*							
Family & neighbours *							

*(name and/or location ?)

Table 5. Actors in the agricultural network (example)

Financial-material exchange flows: describe	ranking	daily	weekly	monthly	3-monthly	occasionally	never
Farmers groups							
Farmers' cooperatives							
Advisors agronomists							
Ministry agronomists							
Providers agronomists							
Bank - financial system							
Internet							
Suppliers							
Retailers							
Intermediaries							
Final clients							
Exhibitions							
Seminars - training							
Peers - colleagues							
Family & neighbours							

Similarly to interactions in terms of information in the extension network, interactions regarding material and financial transactions are to be detailed in subsequent tables, all of them are taken into account to illustrate the sector/activity/technology network.

SNA/ Leader - Local Action Groups in governance [13]



Figure 5. Types of interaction

Voice to marginal actors: Irish dairy - power and knowledge dynamics in multiactor Operational Group

Official bioeconomy strategies include farmers as mere recipients of scientific knowledge, rather than providers of their own knowledge [14]:

- top-down development model whereby members of the bioeconomy’s ‘triple helix’ (academia, large industries, and policy) have had an eminent role,
- two key areas of improvement for bioeconomy development: increasing the payments farmers receive for the production of biomass; and greater recognition of their importance within bioeconomy value chainscreation of a robust governance system in the bioeconomy, ensuring that future developments are ‘more sustainable, inclusive, and evenly distributed’.

The inclusion of local and tacit knowledge has been identified as important for securing the sustainable and innovative development of the bioeconomy:

- higher levels of connectivity with farmers ensure that researchers have the opportunity to gain ‘on the ground’ expertise within the OG, for example in terms of the requirements for grass supply,
- unlikely that dairy farmers in general would be willing to reduce the level of grassland available for their stock to be used for a biorefinery,
- planning of the OG in terms of the timing of work.

Step 4. Enumerate drivers and barriers for each KET/ bioeconomy pathway

Table 6. Drivers/barriers classified according to PESTEL, TIS and/or foresight dimensions

TIS Functions		Foresight dimensions	Driving factors and barriers	
<i>Bergek et al., 2008 [15]</i>		<i>Ladu & Quitzow, 2017 [16]</i>	<i>Brunnhofer et al., 2020 [17]</i>	
Resource mobilization	Human, financial, networking capital	Biomass availability and trends		Raw material
Market formation	Nursing, bridging and mass markets	Market acceptance	Supply chain	Customer/market
Influence on the direction of search	incentives and/or pressures for the organizations to enter it	Regulatory and policy framework	Stakeholders	Financing (public - private)
Legitimation	social acceptance and compliance with relevant institutions			Legislation and policies
Entrepreneurial experimentation	To tackle uncertainty in technologies, applications and markets	Development and horizon scanning of the emerging technology	Requirements	Collaboration
Knowledge development and diffusion	Types and sources of knowledge (R&D, DUI)			Innovation management
Development of positive externalities	Generation of positive external economies > new entrants			Sustainability

Expanding PESTEL with infrastructural aspects to improve strategic concepts

Ideally this outcomes from workshops [18] to gather information on macro-environmental factors (stakeholders include : upstream (feedstock providers), conversion (technology companies, producer companies, research) and downstream users (refineries, transport sector)).

Schematic description of the methodology to follow:

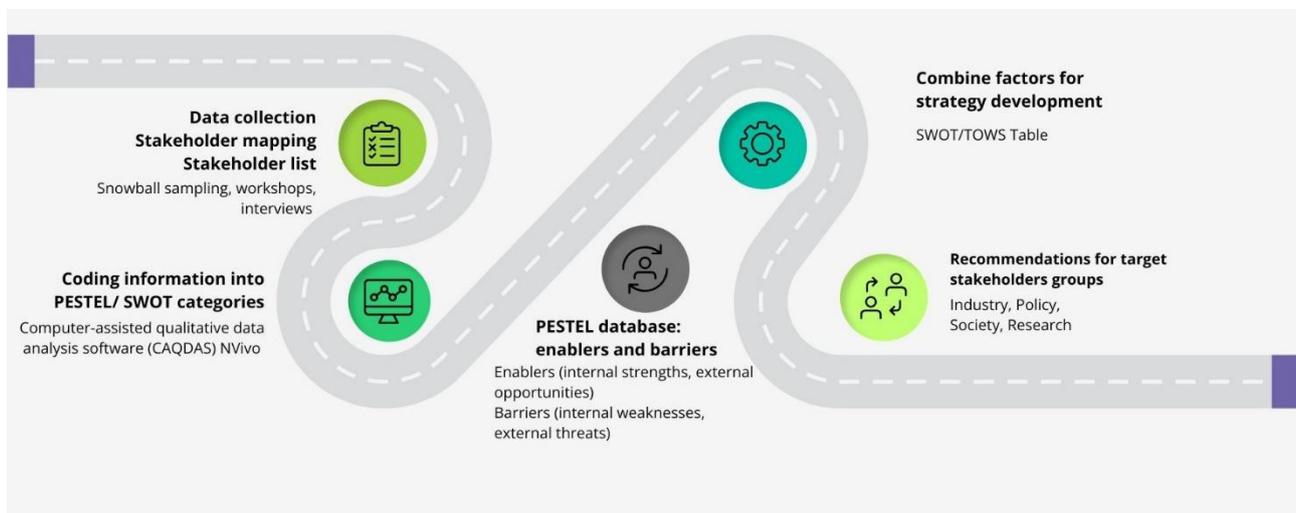


Figure 6. Methodology of PESTEL analysis

Put drivers/barriers in the SWOT format

Table 7. External factors derived from the drivers/barriers list

Factor	Key Elements	Impact on Bioeconomy Development This is example / Expert add his view
Political	CAP policies, national bioeconomy strategy, regulatory framework	Defines investment and funding priorities.
Economic	Market demand, investment climate, subsidy schemes	Determines financial feasibility of bio-based industries.
Social	Consumer acceptance, workforce skills, rural engagement	Influences adoption of bio-based innovations.
Technological	Infrastructure, digitalization, R&D capacity	Determines feasibility of advanced bio-based processes.
Environmental	Climate policies, sustainability goals, resource availability	Influences policy-driven incentives for green innovation.
Legal-Institutional	Regulations, intellectual property laws, funding mechanisms	Affects ease of implementation and commercial scaling.

Table 8. Internal factors derived from the drivers/barriers list (example)

Code	Strengths	Description
S1	Capabilities for a spectrum of waste substrate	1.1 local accessibility of waste from various sources 1.2 application potential of various waste types
S2	Income generation from various outflows	2.1 wide range of products in el/heat 2.2 satisfying demand for base/peak electricity
S3	Capacity for positive externalities	3.1 potential of local energy use 3.2 creation of new workplaces 3.3 air quality improvement by reducing odors from direct use of waste (tamburini 3-5) 3.4 regulation of soil nutrients by reducing spreading of organic load and digestate 3.5 global climate regulation by saving GHG emissions
S4	Technological advantages	4.1 mature technology available 4.2 networking R&D centers active throughout the country 4.3 fermenting chambers tightly sealed preventing odor
	Weaknesses	Description
W1	Technology state-of-the-art	1.1 problems with access to power supply 1.2 technical constraints to handle heterogeneity of biological waste 1.3 breakdowns and high repair costs
W2	Plant establishment issues	2.1 significant costs for grid connection 2.2. demand of considerable capital for investment 2.3 lack of expertise to deal with the administration
W3	Inherent issues to technology	3.1 heat unused directly become waste 3.2 bulky raw material increasing transport costs
W4	Lack of consensus	4.1 Local community protests



Table 9. External factors derived from the drivers/barriers list (example)

Code	Opportunities	Description
O1	Resource availability	1.1: unexploited potential (numerous farms circa or above 100 LSU) 1.2: financial support/funding from domestic and EU sources 1.3. great potential for generating biodegradable waste from industry
O2	Technology progress	2.1 fast development of the technology 2.2 experience/knowledge transfer from neighbor countries 2.3 emerging innovative technologies for biogas production
O3	Defossilization momentum & Climate policy	3.1: feed-in price for 15 years by current legislation 3.2: iLUC restriction clause in EU energy/climate policies
O4	Agricultural policy synergy	4.1: compatible with Polish CAP national strategic plan 4.2: compatible with regional/rural development
O5	Societal imperatives	5.1: raising environmental awareness/deficit of organic fertilizers 5.2: growing demand by dairy industry for low GHG milk production
O6	Energy independence geopolitical concerns	6.1: energy self-sufficiency objective 6.2: fossil fuel prices fluctuation
O7	Waste policy synergy	7.1: stricter regulations for manure/slurry 7.2: increasing cost of disposing food waste 7.3: financial stability of food industry/free of charge or willing to pay
Threats		Description
T1	Input availability	T1.1: no guarantee of stable feedstock supplies T1.2: geographically scattered input supplies
T2	Resource issues	T2.1: decrease of agricultural land for food _ prices volatility T2.2: loan high cost by banking sector or investment funds
T3	Legislative issues	T3.1: unstable policy (i.e. installation subsidy, feed-in tariffs for electricity) T3.2: constantly changing legal regulations T3.3: long process for issuing permits / bureaucratic formalities
T4	Market issues	T4.1: lack of experienced professionals in the country T4.2: small, difficult, unstable market T4.3: development of biogas competitors
T5	Policy conflicts	T5.1: incentives/programs to reduce waste in the agricultural & food sectors T5.2: legal restrictions on fertilizers

Combine factors for strategy development: SWOT / TOWS table		
INTERNAL FACTORS	S (Internal Strengths) - 'Enablers':	W (Internal Weaknesses) - 'Barriers':
EXTERNAL FACTORS	O (External Opportunities) - 'Enablers':	T (External Threats) - 'Barriers':
	SxO Strategies	WxO Strategies
	Maximising internal strengths by using external opportunities	Minimalising internal weaknesses by using external opportunities
	SxT Strategies	WxT Strategies
	Avoiding external threats by using internal strengths	Minimalising internal weaknesses and avoiding external threats

Figure 7: Methodology for SWOT/TOWS analysis

Table 10. TOWS matrix Interaction grid Strengths - Opportunities: illustrative example

Opportunity	Strength	S1	S2	S3	S4
O1		0	+	+	+
O2		+	+	+	0
O3		+	0	+	0
O4		0	0	+	0

Table 10 detects the interactions of one or more combinations that support actions/measures toward the development of the KET/activity under consideration. Using Table 11 next, we can illustrate the SWOT coverage for each proposed action as well as the evaluation matrix that assess the impacts of them against selected objectives/criteria, this way one proceeds to the prioritization of actions.

Table 11. Strategic propositions suggested in the TOWS grid (Table A1) grouped for different aspects and classifications (example)

Factor								
S#	Domain	Classification	Strategies	S	W	O	T	Description
1	Knowledge development and diffusion	R&D funding schemes	S ₁ O ₁ S ₃ O ₂ S ₃ O ₇ S ₄ O ₇ W ₁ O ₂ W ₁ O ₇ W ₂ O ₂ W ₃ O ₂ W ₃ O ₂	3	3	5	2	R&D Develop certified labs for efficient anaerobic digestion from various sources - to cope with substrate heterogeneity - diversify raw material to minimize distance of feedstock transport - Prevent odor technology improvement - Enhance biorefinery R&D for cascading use of waste - Fund R&D for max biogas production efficiency for various plant capacities - Develop mass produced standard technology equipment flexible - Development of reliable equipment - exploit unused heat to increase the electricity efficiency - Surcharge or subsidy for biogas producers EDU Promote training for operation/maintenance technician jobs in the periphery - Support for professional associations to organize courses of lifelong education - Promote technical education in circular economy technologies - Adjustment of legislation on technology transfer offices in higher education and state research institutes- Training for business model expertise - Promotion of the role and importance of biogas plants in a zero-emission energy system Info DSS for the strategic performance evaluation of state-of-the-art tech - Undertake studies for evaluating savings in houses from biogas heat - Creation of an IT tool for information exchange and partnerships on bio-waste production and collection
		Educational policies	S ₄ O ₅ W ₂ O ₅ S ₁ T ₄ S ₄ T ₃ S ₁ O ₂ S ₃ O ₃ S ₄ O ₆					
		Informational instruments	W ₃ O ₅ S ₁ O ₁					
2	Influence on the direction of search	Overarching visions : energy security, sustainable bioeconomy	S ₁ O ₆ S ₂ O ₆ S ₃ O ₆ W ₂ O ₆ W ₃ O ₃ W ₄ O ₅ S ₄ T ₂	4	4	3	3	Security Explicit self-sufficiency targets critical raw materials (i.e. phosphates) - Campaign for independence from imported natural gas - establish energy independence fund for base load energy generation from domestic sources - Support heat use for substitution of imported gas Expectations Promote citizen participation and co-creation of biogas location decisions - Build capacity for fund-raising through submission of high TRL demo projects Generate demand Support for state-of-the-art storage to increase peak electricity capacity - promote consumer awareness for low GHG food products
	Incentives to enter	Expectations	S ₂ O ₁ S ₂ O ₅ S ₁ T ₂					
		Generate demand	W ₂ T ₁ S ₃ T ₅ W ₂ T ₅ W ₃ T ₁					

Incentives for vertical integration of energy module in food industry - Locate next to important heat/cooling demand sites to compensate for input transport expenses -Fast track investment subsidies for laggard regions - Prioritize small size on-farm biogas -Distributed production linked to livestock activity



Bundles of action - formulation of strategies

Beyond the assessment of individual measures, the strategic bundling examination showcased opportunities for cross-sectoral bundling, especially for measures that perform well in some areas but are penalized for underperformance in others. Several bundles are recommended to be proposed, each oriented to meet a strategic objective while mitigating the weaknesses of its core measure. Thus, measures/actions can be grouped into thematic bundles, each corresponding to a major challenge. In both cases, the analysis highlights the value of bundling as a strategy to overcome individual measure limitations and enhance cross-sectoral benefits and systemic impact [19].

4. Results of strategic orientation

Desk research

Summary: CAP Structure and National Implementation in Partner Countries

Across the six partner countries, the Common Agricultural Policy (CAP) functions as a performance-based framework built on two stable pillars: Pillar I (income support and market measures) and Pillar II (rural development and innovation). While the architecture is common, the effectiveness of implementation depends largely on national governance structures, paying agencies, monitoring systems, and their capacity to integrate climate, biodiversity, and bioeconomy priorities.

Each country has a central ministry and an accredited paying agency, supported by multi-stakeholder Monitoring Committees and national CAP networks.

- Croatia stands out for transparency and inclusiveness, involving diverse actors from environmental authorities to civil society.
- Czechia combines strategic direction under the Ministry of Agriculture with financial oversight by the Ministry of Finance and strong environmental mainstreaming.
- Hungary demonstrates integration of innovation and digitalisation through its CAP Network and Green Support Unit.
- Poland coordinates policy through MRiRW and ARiMR, with broad participation (research institutes, advisory centres, farmers' organisations).
- Slovakia adopts a cross-ministerial model linking agriculture with climate, energy, and innovation.
- Slovenia ensures alignment with its National Energy and Climate Plan and 2030 Development Strategy.

All six CAP Strategic Plans (2023-2027) translate EU objectives into national sustainability priorities: climate action, biodiversity, soil and water protection, farm viability, and rural diversification. Pillar I rewards environmentally responsible practices through eco-schemes (e.g., cover crops, reduced tillage, pollinator habitats), while Pillar II finances modernisation, cooperation, and knowledge transfer.

Budgets and emphasis vary: Poland's plan (€25.2 bn) is the largest, Hungary shows strong national co-financing, and Croatia and Czechia excel in quantifiable environmental targets. Slovakia and Slovenia lead in carbon farming, biomass valorisation, and circular bioeconomy pilots.

Rural resilience is strengthened via LEADER and CAP networks, empowering local communities to implement short supply chains, eco-tourism, and local markets.

Monitoring Committees in all countries ensure accountability, while Croatia and Slovenia provide the most transparent reporting systems.

Two systemic challenges persist:

- I Cross-sectoral coordination, as CAP's agricultural focus limits vertical (bioeconomy) integration (energy, forestry waste)
- II Administrative complexity, especially for smaller farms

Figure 8. Systemic challenges

Emerging solutions include AKIS reinforcement, digitalisation, simplified eco-schemes (challenge 2), and stronger LEADER facilitation to lower transaction costs (challenge 1).

Key lessons: Pillar I drives behavioural change, while Pillar II delivers structural transformation. Countries with strong cross-ministerial cooperation, transparent monitoring, and active local networks progress fastest toward climate-smart and circular bioeconomy goals.

Future priorities should focus on:

- I Mainstreaming bioeconomy in CAP governance
- II Scaling results-based monitoring (soil carbon, nutrients, biodiversity)
- III Promoting AKIS-driven adoption for low-friction uptake of circular, bio-based practices

Figure 9. Future priorities

Summary: CAP Instruments Supporting the Circular Bioeconomy

Across all partner countries, the CAP's instrument mix – eco-schemes (Pillar I), investment and cooperation measures (Pillar II), and knowledge systems (AKIS, EIP-AGRI, CAP networks) – is increasingly translating circular bioeconomy concepts into practical farm and rural actions. Although few measures are explicitly labelled as “bioeconomy,” their functional impacts converge: closing biomass and nutrient loops, reducing fossil and chemical inputs, and generating higher local value.

Eco-schemes have become the main entry point for circular and climate-smart practices.

- Czechia dedicates 30% of its Pillar I budget to eco-schemes supporting permanent grasslands, reduced tillage, soil cover, and non-productive areas.
- Hungary's AÖP promotes cover crops, biological fertilisation, extensive grazing, and water retention, embedding circularity in daily farm routines.
- Poland targets carbon farming and nutrient management, combining precision fertilisation, catch crops, and organic amendments.
- Slovakia applies a Whole-Farm Eco-Scheme compensating crop rotation, extensive grasslands, and organic farming.
- Croatia focuses on carbon-positive livestock and legume-rich rotations, while Slovenia generalises precision nutrient management and conservation tillage.

Across the region, eco-schemes now act as the mainstreaming lever for climate and circular outcomes – carbon storage, biodiversity, nutrient recycling, and reduced input dependency.

Precision and digital technologies complement these efforts.

Czechia, Hungary, Poland, and Slovakia link eco-schemes to precision fertilisation, irrigation, and data-based nutrient management, co-financing hardware and advisory support. These tools enhance efficiency and environmental performance.

Agroforestry and forestry measures further bridge agriculture and the bioeconomy. Croatia and Hungary lead with comprehensive forestry packages that modernise wood processing, promote afforestation, and integrate trees into farms—boosting carbon storage, erosion control, and renewable feedstocks for bio-based industries.

Pillar II investments serve as the structural engine for circular value chains.

Czechia has modernised thousands of farms and supported sustainable processing and packaging. Poland and Slovakia invest in renewable energy, bio-based processing, and afforestation. Croatia and Hungary channel substantial funding to green technologies, biogas, and rural cooperation. Slovenia focuses on biorefineries, biomass logistics, and circular clusters – creating the enabling infrastructure for rural circularity.

Knowledge systems (AKIS, EIP, CAP networks) ensure that innovation translates into practice.

All six countries reinforce advisory services, demonstration farms, and multi-actor groups.

Croatia's AKIS Coordination Body, Hungary's Innovation & Digitalisation Unit, and Poland's KSOW+ and EIP networks illustrate structured approaches to link science, policy, and practice.

Overall, the CAP toolbox already provides the levers for circular transformation:

- Eco-schemes scale sustainable management across millions of hectares.
- Pillar II builds processing, logistics, and renewable systems.
- AKIS and cooperation ensure knowledge transfer and adoption.

The main gap remains coordination and visibility – many actions support the bioeconomy but are not labelled or monitored as such. The next step could be to systematically tag and track bioeconomy outcomes (carbon retained, nutrients recycled, residues valorised, local value added) and use LEADER, EIP, and

cooperation mechanisms to connect agriculture, forestry, energy, and waste actors into integrated circular territories.

In short, the CAP already contains the tools – partner countries are learning to use them in synergy to make climate, biodiversity, and bio-based competitiveness mutually reinforcing.

Summary: Challenges and Opportunities in CAP Implementation

Across the partner countries, the Common Agricultural Policy (CAP) remains the key instrument for greening primary production and building circular bioeconomy value chains. Yet, its implementation is uneven – constrained by administrative burden, fragmented governance, and limited capacity among small farms and SMEs.

Three structural challenges recur:

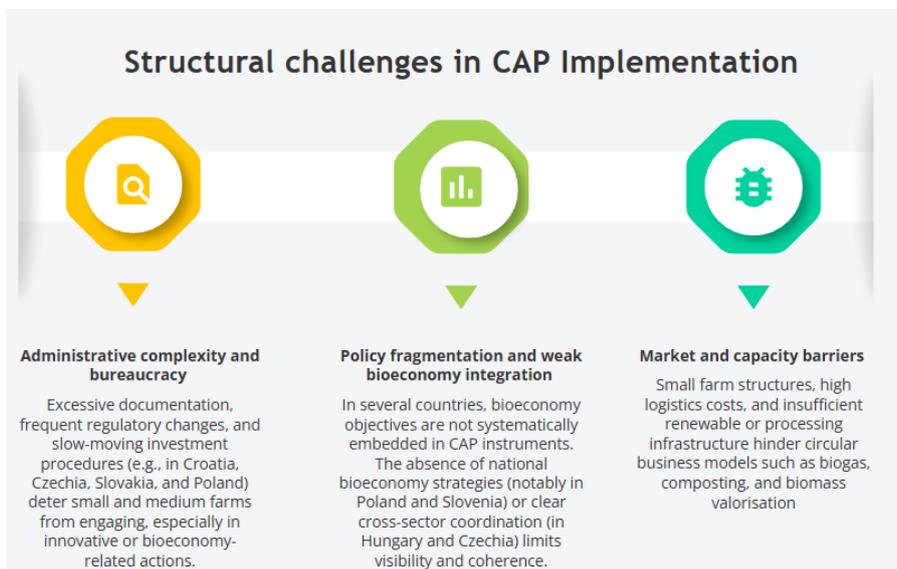


Figure 10. Structural challenges in CAP Implementation

At the operational level, awareness and advisory capacity lag behind. AKIS systems are still adapting to circular concepts – carbon farming, digestate use, agroforestry, or precision fertilisation – while eco-schemes are sometimes misunderstood or underused. Environmental pressures, from droughts to soil degradation, further limit adoption.

Despite these obstacles, the current CAP toolbox already provides strong opportunities to accelerate circular outcomes:

- Eco-schemes effectively mainstream sustainable practices when linked to clear guidance and advisory support. Examples include Poland’s carbon-and-nutrient farming schemes, Slovakia’s whole-farm eco-scheme, Croatia’s grassland and legume measures, Hungary’s AÖP programme, and Slovenia’s precision-agriculture incentives.
- Pillar II investments (EAFRD) could possibly scale circular value chains by financing renewable energy, bio-based processing, small biorefineries, biomass logistics, and forest valorisation. Croatia, Slovakia, Slovenia, and Hungary already provide replicable models with high support intensity for environmental objectives.
- Cooperation and AKIS systems are emerging as critical accelerators. Croatia’s AKIS Coordination Body, Hungary’s Innovation & Digitalisation Unit, and Poland’s KSOW+/EIP structure illustrate how

multi-actor engagement speeds up adoption. EIP-AGRI projects—such as bio-ash soil amendments in Croatia or nutrient recycling pilots in Czechia—show tangible circular benefits.

Five strategic directions could maximise impact:

1. Simplify administration and ensure SME-friendly access.
2. Improve targeting and fairness by reserving funds for small, organic, and HNV farms.
3. Make cooperation (LEADER, EIP, COOPERATION) the default to create circular territories.
4. Use precision and digital tools as enablers of eco-scheme performance.
5. Introduce clear bioeconomy indicators (carbon retained, nutrients recycled, local value added) for visibility and policy alignment.

Country examples show diverse growth niches: cooperative biogas and digestate markets (Czechia, Hungary), forest-based value chains (Croatia), agroforestry and organic farming (Slovakia), bio-based packaging (Slovenia), and carbon-nutrient farming (Poland).

If the next CAP cycle explicitly recognises these as bioeconomy pathways and aligns eco-schemes, investments, and AKIS under a common narrative, partner countries can transform today's fragmented initiatives into coherent, profitable, and climate-resilient circular systems.

Summary: Key Policy Documents and Existing Bioeconomy Measures

Across Central and Eastern Europe, the circular bioeconomy is increasingly recognised as a key tool for implementing the EU Green Deal, Farm-to-Fork strategy, and CAP reform. While all partner countries are aligning policies in this direction, progress remains uneven. Generally, CAP provides the operational backbone, while national circular economy, energy, and innovation strategies define thematic priorities. Where these layers align – supported by active advisory and innovation systems – bio-based value chains develop fastest.

National strategies and frameworks:

- Croatia is finalising a Bioeconomy Strategy 2035, coordinated cross-ministerially and linked to its Agriculture Strategy 2030; it establishes a national coordination body and skills pipeline.
- Czechia operates a portfolio approach—Bioeconomy Concept 2019-2024, Circular Czechia 2040, and Strategic Framework 2030—focusing on biomass use, water retention, and climate neutrality.
- Hungary integrates bioeconomy within a Sustainable Development Framework Strategy, complemented by a Circular Economy Action Plan, NECP, and forestry/energy programmes.
- Poland lacks a dedicated bioeconomy strategy but prepares within CEE2ACT project proposition of Circular Bioeconomy Roadmap; its policy ecosystem (Circular Economy Roadmap, Energy Policy 2040, Hydrogen Strategy, Biodiversity 2030) supports CAP implementation.
- Slovakia embeds bioeconomy directly in its CAP Strategic Plan (SO8), Circular Economy Action Plan, Low-Carbon Strategy, and Bioeconomy Roadmap.
- Slovenia mainstreams bioeconomy through Smart Specialisation (S4), Development Strategy 2030, and NECP 2030, focusing on forestry and agriculture-based resources.

Circular economy and energy policies across all countries reinforce CAP objectives by stimulating biomass, biogas, and nutrient recycling markets. Croatia, Czechia, Hungary, and Slovenia prioritise biogas/biomethane, while Poland and Slovakia link renewables and circular resource efficiency to CAP eco-schemes and rural development measures.

Funding mechanisms are abundant, yet coordination and visibility remain the main bottlenecks.



- Croatia combines CAP, NRRP, Cohesion, and Modernisation Funds for renewable energy, forestry, processing, and LEADER projects.
- Czechia, Hungary, and Slovakia mobilise EAFRD and ERDF for green processing, bio-based packaging, and biogas cooperatives.
- Poland develops strong public-private partnerships (PPP) and EIP-AGRI innovation pilots.
- Slovenia supports biorefineries, biomass logistics, and packaging innovations aligned with CAP and NECP goals.

Alignment with CAP reform is improving: CAP eco-schemes, AECMs, and Pillar II investments now operationalise climate, energy, and circular economy targets. Examples include:

- Croatia's strategy linkage to CAP and AKIS;
- Czech eco-schemes advancing nutrient recycling;
- Hungary's regenerative AÖP;
- Poland's carbon and nutrient farming eco-schemes;
- Slovakia and Slovenia's explicit bioeconomy focus in CAP SPs.

Persistent gaps hinder full potential:

1. Governance silos between agriculture, energy, and environment ministries—Croatia's planned coordination body is a best-practice model.
2. Insufficient funding focus on emerging bio-based industries (biorefineries, advanced materials, cascading biomass).
3. Administrative complexity limiting SME and farm access.
4. Weak advisory and knowledge systems – AKIS and EIP-AGRI need scaling.
5. Lack of monitoring and market pull – countries need soil carbon baselines, MRV tools, and green public procurement for bio-based products.

In summary, CEE countries possess the policy ingredients and financial instruments to expand their bioeconomies. The next step is to ensure policy coherence, measurable outcomes, and stronger coordination between CAP and national strategies – turning fragmented initiatives into systemic circular bioeconomy frameworks.

Summary: Opportunities the Region Can Seize Now

Central and Eastern Europe has the policy frameworks, funding instruments, and stakeholder momentum to accelerate the circular bioeconomy – provided it strengthens integration and focus.



Mainstream bioeconomy in the next CAP (post-2027)

- Treat bioeconomy as a horizontal priority linking agriculture, energy, and industry and other activities. Align CAP with National Energy and Climate Plans (NECPs), Smart Specialisation Strategies (S3), and chemicals sustainability policies to create a coherent investment and innovation space.

Broaden eco-schemes and strengthen AKIS

- Expand eligible practices to include agroforestry, manure-to-biomethane systems, precision nutrient management, and biodiversity-enhancing habitats, supported by advisory and training services that reduce adoption barriers.

Build regional circular value chains under Pillar II

- Use LEADER and cooperation measures to connect farms, foresters, municipalities, and SMEs into place-based loops—e.g. bio-waste and manure to biogas and fertiliser, forestry residues to engineered wood and heat, aquaculture by-products to feed and bio-materials.

Scale risk-tolerant and blended finance

- Mobilise Modernisation Fund, Innovation Fund, Horizon Europe, and national green finance windows to help move pilots to commercial scale through public-private partnerships.

Strengthen multi-level governance and monitoring

- Establish national bioeconomy coordination bodies, joint CAP-NECP working groups, and shared MRV dashboards to turn policies and funding into measurable, lasting results.



In short, the region can turn ambition into impact by coupling CAP implementation with systemic coordination, innovation, and finance.

Summary: Insights from Activity A3.1 - Country-Level Situation

Across the six partner countries—Croatia, Czechia, Hungary, Poland, Slovakia, and Slovenia—the bioeconomy is increasingly visible in practice, yet remains only partially integrated or explicitly named in CAP Strategic Plans. Most national actions support soil health, nutrient recycling, and biomass use, but policy coherence and measurable indicators are still limited.

Key findings:

- **Policy integration is incomplete.** Agricultural, energy, circular economy, and innovation policies often run in parallel rather than in coordination.
- **Existing CAP instruments already deliver circular outcomes:** grassland management, cover crops, manure recycling, short supply chains, and farm modernisation.
- **Institutional learning is advancing,** with CAP networks and regional hubs facilitating knowledge exchange. However, advisory services lack bioeconomy toolkits and simple metrics.
- **Monitoring gaps persist,** especially for soil carbon, nutrient cycling, employment, and value added in bio-based sectors.

Best practices and transferable solutions:

- **Whole-farm eco-schemes** (Hungary) demonstrate how transparent scoring can mainstream sustainable practices across farm types.
- **Biogas and biomethane models** (Czechia, Poland, Slovakia) show how cooperative and public-private approaches can close nutrient loops and diversify rural income.
- **Community-led pilots** (Croatia, Czechia)—such as composting, biomass district heating, and reuse of recycled materials—illustrate quick, low-cost learning.
- **Bio-based materials platforms** (Czechia, Slovenia) and nature-based innovations (Slovakia) demonstrate cascading biomass use, carbon capture, and high-value bioproducts.
- **Market tools like the Czech “green bonus” for biomass heat** show how fiscal incentives can drive municipal decarbonisation.

Main challenges:

- Fragmented governance and regulation—multiple ministries lead overlapping agendas with limited coordination.
- Funding gaps—few targeted instruments for emerging bio-based industries; administrative complexity reduces absorption, particularly among SMEs.
- Limited private-sector engagement—low awareness, weak partnership pipelines, and scarce advisory support for circular business models.
- Country-specific barriers, such as low competitiveness, small farm size, tax disincentives for cooperatives, and lack of national bioeconomy strategies (Croatia, Poland, Slovenia).

Implementation levers and recommendations:

1. **Name and measure the bioeconomy** – include a clear label in funding calls and adopt concise indicators (carbon sequestered, nutrients recycled, bioenergy capacity, bio-based jobs).
2. **Simplify access for small entities**—offer feasibility and LCA vouchers, one-stop calls for mini-biorefineries, and bonus points for nutrient circularity.
3. **Scale biomethane sustainably** – modernise plants, ensure digestate management plans, and monitor soil/water impacts.

4. **Strengthen AKIS and EIP-AGR I** – train advisers, expand demonstration farms, and foster operational groups on carbon farming, agroforestry, and bio-based products.
5. **Improve horizontal coordination** – create a standing platform linking agriculture, energy, environment, and industry to align eligibility rules, funding, and monitoring systems.

In short, bioeconomy development in the region is progressing, but coherence, visibility, and support systems must be strengthened to turn scattered initiatives into a systemic, measurable, and market-ready circular transformation.

Delphi Group

Questions and topics considered and discussed during the Delphi Group meetings

Question 1: To what extent do you agree that the current Common Agricultural Policy (CAP) effectively supports the implementation of the circular bioeconomy?

Consensus:

In general, consensus was moderate. In Poland, agreement emerged after two Delphi rounds, implying a somewhat moderate view of the effectiveness of CAP. Croatia and Slovakia showed moderate agreement and admitted limited implementation capacity while there was some progress. For Slovenia the perceptions were divided from cautious optimism to heavy critique arising from the different experiences with organizational cooperation and political commitment.

Summary of Experts' Insights:

According to all expert analysis in various countries, CAP can be seen as one of the possible approaches for fostering circular bioeconomy but the system is not useful in practice. Key shared insights include:

- The CAP instruments related to circularity (eco-schemes, cooperation, rural development) exist only on paper (however, such can only be translated into practice, implementation and access, bureaucracy, finance and the institutional impediments that obstruct their coverage).
- Most ministries of agriculture do not see bioeconomy as a strategic priority at all – so they take fragmented or symbolic measures instead of broad-based systemic integration.
- Administrative complexity and the absence of incentives reduce investment in bio-infrastructure (biogas, nutrient recycling).
- Experts noted that they had a need for greater coordination among ministries (agriculture, environment, industry) to set objectives and ways of funding.

Result Achieved:

Delphi review of CAP revealed that CAP offers a strong foundation structure, however, its operationalization lacks a clear direction to offer actual support by means of circular bioeconomy development. The methodology led them to arrive at a shared diagnosis, that enhanced coordination, clearer prioritization and targeted incentive structure are key to ensuring that CAP becomes a real driver of circular transformation.

Question 2: To what extent do you agree that specific areas of the Common Agricultural Policy (CAP) require reforms or changes to more effectively support the development of the bioeconomy?

2a. Pillar I - Direct Payments (GAEC Standards)

Consensus:

Consensus was reached in Poland (score 7.75) and partial agreement observed in Croatia (6.6) and Slovenia (7.1), while Slovakia expressed low confidence (2.0).

Summary of Experts' Insights:

Experts acknowledged that GAEC standards effectively protect soil and ecosystems, yet their link to the bioeconomy is indirect. The standards are perceived as environmental safeguards rather than circular enablers. Experts suggested that to strengthen their role, GAEC rules should integrate resource efficiency, carbon retention, and nutrient recycling criteria, supported by better farmer communication and more predictable incentives.

Result Achieved:

The discussion clarified that GAEC reform should not only reinforce environmental compliance but also embed circular bioeconomy logic, aligning basic standards with bio-based resource management and measurable sustainability outcomes.

2b. Market Intervention Measures

Consensus:

Moderate to strong consensus was reached in most countries—Croatia and Slovakia (6.0), Slovenia (6.9), and Poland (7.0)—that market measures need reform to better serve bioeconomy goals.

Summary of Experts' Insights:

Experts agreed that market interventions are still short-term and reactive, designed primarily as crisis tools. They should instead stimulate bio-based value chains, improve market stability, and support sectors such as fruit production, viticulture, and beekeeping, where waste reduction and residue valorisation are possible. The current system lacks strategic alignment with circular goals and does not adequately channel liquidity or investment support into sustainable practices.

Result Achieved:

The analysis highlighted the need to transform crisis mechanisms into proactive instruments that build market resilience and incentivise low-waste, bio-based production systems.

2c. LEADER and Producer Organisations (LAGs)

Consensus:

High consensus across all countries: Croatia (7.6), Slovenia (8.5), Poland (8.06), and Slovakia (9-10).

Summary of Experts' Insights:

LEADER and LAGs were identified as the most effective CAP mechanisms for promoting the circular bioeconomy at local level. They successfully mobilise community-driven innovation, though constrained by limited budgets and low awareness of bioeconomy potential. Experts emphasised the need to refocus LEADER toward agriculture, renewable energy, and bio-based industries, paired with knowledge transfer and targeted guidance.

Result Achieved:

Experts reached strong consensus that LEADER is a proven tool for piloting local circular models, provided that funding and expertise are scaled up to embed bioeconomy thinking in rural development strategies.

2d. Cooperation Measure (EIP Operational Groups)

Consensus:

Mixed results—moderate agreement in Croatia, Poland, and Slovakia (=6.0); strong consensus in Slovenia (8.8).

Summary of Experts' Insights:

Operational Groups are viewed as a promising but underused innovation mechanism. While they foster collaboration among farmers, researchers, and SMEs, their fragmented structure, limited funding, and bureaucracy reduce impact. Experts in Poland and Slovakia expressed concern about low systemic influence, whereas Slovenian participants demonstrated high confidence in the model's scalability if adequately supported and simplified.

Result Achieved:

The Delphi process confirmed that EIP-AGRI remains a valuable instrument for innovation in the circular bioeconomy, but requires simplification, stable financing, and long-term continuity to move from isolated pilots to transformative networks.

Question 3: To what extent do you agree that the current Common Agricultural Policy (CAP) contributes to supporting regional initiatives and developing local value chains?

Consensus:

Overall agreement was moderate to high from the experts of the countries in question that the CAP supports both regional programmes and localized value chains. But the consensus also reflected a shared understanding of serious challenges in scale, targeting and efficiency.

Summary of Experts' Attitude:

Experts emphasised that the CAP forms a great benchmark of bioeconomy development at the local and regional level, using mechanisms such as LEADER, EIP-AGRI, support for small farms, diversification, and short supply chains. These instruments have enabled innovation in entrepreneurship, community initiatives and innovation in rural areas. At the same time, several cross-cutting challenges were identified:

- Fragmented and insufficient funding, often scattered among duplicative schemes and lacking concentration on the most impactful projects.
- Administrative complexity (with unequal access) reduces the participation of small actors and innovators in rural areas.
- Weak coordination and poor strategic focus (especially in trying to strike a balance between small community projects and competitive investment).
- Good momentum in knowledge transfer and digitalisation, which have gained widespread acceptance as good sources of local capability building and innovation.
- Local value chains were broadly accepted as a viable gateway for circular bioeconomy that would provide tangible opportunities to conserve value in rural regions and bolster community resilience.

Result Achieved:

Delphi deliberations concluded that the CAP has a constructive but an under-utilised role to play in developing regional initiatives and local value chains which are relevant to the circular bioeconomy. Experts agreed that in the future, better strategic coordination, greater simplification of procedure and targeted financing schemes prioritising innovation, collaboration, and territorial integration were needed.

Question 4: Which aspects related to the creation of short supply chains require the greatest financial support under CAP funding?

Consensus:

Consensus among experts indicated moderate to high agreement that the development of sales systems and channels to communicate with consumers should receive the most CAP support, which would generally be in the order of one-quarter to one-third of the resources available. However, agreement to compare

operational, promotional, and participation-related expenses was mixed (although very well-established, a key group discussed their positions on the relative importance of each area).

Summary of Experts' Insights:

The Delphi conversations all emphasised the importance of market access and consumer engagement as the cornerstones of effective short supply chains. Key insights include:

- Systems of sales and communication (e.g., online, apps, direct marketing) were the leading investment focuses essential for generating consumer trust in the organisation, transparency, and consistent demand.
- It was noted that support for organic producers has been appreciated, but not prioritised universally; funding is best when tied to local processing, marketing or brand differentiation, experts added.
- Promotion and labelling were perceived as complements to sales systems, but not particularly influential for consumer choice, as brand exposure and storytelling often matter more than formal certification.
- Product passporting and traceability scored lower on this dimension, given that in short supply chains trust-based relationships often are more significant than formal traceability processes.
- Operational costs and growth of participation was acknowledged as essential for scaling and sustaining producer groups, although financial support should be targeted as it can lead to inefficiencies and dependence on subsidies.

Result Achieved:

The Delphi process clearly delineated multiple priorities for assistance to short supply chains in the CAP. The first need is to fund digital and direct sales systems that connect producers to consumers. These must be accompanied by targeted promotion and local branding and education while support in operations and participation must be tailored and measured based on outcomes. Taken together, the experts concurred that effective short supply chains rely mostly on the credibility, visibility and continuous consumer engagement of suppliers instead of certification or administrative controls.

Question 5: To what extent do you agree that the Common Agricultural Policy (CAP) creates space for the development and expansion of markets for bioeconomy products such as biomaterials, biogas, biofuels, and other bioproducts?

Consensus:

Consensus across the Delphi discussions: across all opinions shared, though not enthusiastically, experts agreed that the CAP only limitedly contributes to enabling bioeconomy markets. Whilst there were those who acknowledged that CAP instruments offer indirect prospects, most experts said that the current effect was inadequate, fragmented, and not adequately adapted for the particularities of new bio-based industries.

Summary of Experts' Insights:

Experts generally concurred of partial and uneven contribution of CAP to bioeconomy market development. The policy gives an organizational framework for sustainable agriculture, rural technology, rural innovation and renewable energy activities, however, fails to support the real market growth for bio-based products in practice.

Key insights included:

- Several bioeconomy markets - most notably in biogas, biofuels, and biomaterials - are characterized by energy, climate and industrial policies rather than CAP instruments. This separation weakens coherence and investment continuity.

- Current CAP funding mechanisms are often at the infrastructure/installation level but do not apply to commercialisation, integration into the value chain or demand creation.
- Financial support for new crops and technologies (e.g. perennial biomass species, residue valorisation) is insufficient or unconnected to induce wide adoption.
- Implementation gaps leave open the realization of theoretically supportive (but not widely used) instruments as administrative infrastructure blocks up the necessary tools thus allowing many opportunities to lie dormant.
- Forestry and industrial bio-based industries continue to be outside the operational purview of CAP despite their critical importance for circular and low carbon transitions.

Result Achieved:

The Delphi process led to a common view that despite the CAP's structural significance, which is significant for sustainability goals, it is not a driver of bioeconomy market growth. Experts said it is still underused, due to fragmented governance and lack of financial drivers. The conversation set a collaborative expectation that stronger alignment of CAP and energy, industrial and innovation policies is required to unleash bio-based industry and also to guarantee that agricultural policy provides support for both agricultural production and market development, value-added processing and demand for bio-based products.

Question 6: To what extent do you agree that the level of investment under the second pillar of the Common Agricultural Policy (CAP) is sufficient to support the use of innovative technologies in the bioeconomy?

Consensus:

The experts shared a relatively clear-cut and consistent agreement that investment into CAP Pillar II is simply not up to the job of pushing forward innovation in the bioeconomy. Although the consensus was different from country to country, the general regional outlook was that of widespread doubt, and acknowledgment that there is too little money available for the size and cost of requisite technologies.

Summary of Experts' Insights:

Delphi participants unanimously agreed Pillar II financing fails to cover capital requirements of cutting-edge technologies, including biomanufacturing, advanced biomass processes, or bioenergy. Key insights included:

- Investment levels are too low for large-scale or capital-intensive technologies, and inflation also drives down their real value.
- Funding is biased toward administrative authority instead of true innovation, in a way that detracts from impact and inclusiveness.
- Support is frequently restricted to basic modernisation and not advanced or high-risk technologies critical to bioeconomy development.
- Experts emphasized that CAP alone will not satisfy technological needs and there are multiple EU and national instruments (like Horizon Europe, CBE JU, RIS3 strategies) to support, complement CAP.

Result Achieved:

Delphi process resulted in the consensus that CAP Pillar II has only a marginal role in facilitating the technology transformation at present. Stronger coordination with innovation-focused programmes and broader, more targeted investment envelopes are needed to make CAP a more effective driver of bioeconomy innovation by 2030, experts agreed.

Question 7: Which intervention areas related to the agricultural sector should be a key investment priority for the bioeconomy by 2030?

Consensus:

Experts agreed, broadly and consistently, all four intervention areas are necessary and contribute to each other, with slightly higher priority given to biotechnologies and biological waste management. The pattern overall was complementary and not competing between areas, as a collective awareness that the bioeconomy transition would require an integrated technology mix, not an individually directed solution in any of the sectors.

Summary of Experts' Insights:

The Delphi conversations repeatedly featured that the future investment in CAP would need to be spread across technological, environmental, and digital frontiers, to finance areas that bring both short-term efficiency gains as well as potential long-term transformation.

Key themes are:

- Biotechnologies were considered to be strategic for climate adaptation, sustainable breeding as well as alternative protein development, supporting resilience and innovation of agricultural systems.
- The effective management of biological waste was regarded as one of the most important operational goals, crucial for closing resource loops, producing renewable energy, and supplying feedstocks for biobased industries.
- Precision and digital agriculture was acknowledged to be a scalable, cost-efficient enabler of resource efficiency with tangible improvements in productivity, soil health monitoring, and emissions reduction.
- Highlighting the transformative potential of biorefineries and biomass conversion, which are considered capital-intensive and underfunded and need to be scaled through public-private partnerships and long-term financing mechanisms.
- In ongoing discussions, experts emphasized synergies across these sectors, including connecting precision data with waste valorisation or bridging biotechnologies to biorefinery feedstocks, would support maximising impact.

Result achieved:

The Delphi process created a common investment hierarchy for agricultural bioeconomy priorities by the year 2030:

- Biotechnologies and biological waste management as the key drivers of systemic change;
- Precision and digital agriculture as a cross-cutting enabler improving efficiency and data-driven decision-making;
- Biorefineries as a longer-term strategic objective requiring coordinated financial and industrial support.

In general, consensus emerged between academic experts (including me) that there is a need for integrated, complementary investment strategies to tie together innovation, circular resource management, and digital transformation within a coherent bioeconomy framework.

Question 8: To what extent do you agree that the development of alternative biomass sources—such as algae, insects, or microorganisms—can realistically contribute to supplementing or partially replacing traditional raw materials used in the bioeconomy?

Consensus:

Moderate yet cautious agreement by the experts that potential for diversification of raw materials is great in the long-run in the alternative biomass sources but their contribution now is limited because of economic, technological and market barriers.

Summary of Experts' Insights:

Participants in Delphi largely thought of alternative biomass as a long-term opportunity, not a short-term scalable one. Key insights included:

- Algae and insect biomass technologies are not that much used, and production costs are high.
- Microorganisms find little practical application (e.g. biofertilizers, substrates), but have yet widespread use.
- In insect-based applications, market development is hindered due to weak consumer acceptance and unproven business models.
- The benefits of climate adaptation and CO₂ sequestration justify continuing R&D and pilot investments, which experts agreed.
- Future advancement will require improved collaboration among research teams, enterprise, and primary producers to accelerate technology transfer and decrease costs.

Result Achieved:

The Delphi process validated a common cautious optimism: in the longer term alternative biomass can supplement traditional feedstocks, but to play a role in the short-term they will be limited unless investment, innovation support is coordinated and market development occurs.

Question 9: To what extent do you agree that the current Cooperation Intervention supports research and development (R&D) and the implementation of innovations in the bioeconomy sector?

Consensus:

The responses from experts showed some agreement but are mostly negative opinions. They agree that while the CAP Cooperation Intervention provides a framework for innovation, it does not sufficiently stimulate or scale up R&D in the bioeconomy. The views differed, but the general impression was one of fragmented impact, modest funding, and weak translation of research into practice.

Summary of Experts' Insights:

Conversations uncovered a systemic divide between research and application. Key insights included:

- The R&D support is well established, but not robust enough for the innovation-intensive sectors. Knowledge transfer is poor, as farmers, researchers and corporations are rarely getting together.
- Many projects are more concerned with research institutions, not the end users, in producing outputs that have little applicability to farmers or small businesses. Fragmented, scattered low-scale funding lacks genuine and sustained innovation impact.
- Experts urged greater coordination between ministries, academia, consultancies and the private sector to foster a cohesive bioeconomy innovation ecosystem.

Results Achieved:

The Delphi discussions led to a mutual understanding that the current Cooperation Intervention is structurally valuable but operationally insufficient. Future frameworks should aim to scale multi-actor projects, move R&D towards real-world applications and ensure that CAP measures are aligned with

innovation-oriented programmes (like Horizon Europe) and national smart specialisation strategies, experts recommended.

Question 10: To what extent do you agree that cooperation between the public and private sectors, the scientific community, and society meets the needs of developing and implementing a bioeconomy roadmap, strategy, or CAP Strategic Plan?

Consensus:

Experts provided mixed but ultimately cautious views on the degree to which stakeholder cooperation can progress the bioeconomy. Collaboration has been widely recognized as one of the most important processes; however, most participants shared that the current form of collaboration is fragmented and, at times, surface-level, with few examples of fully functional cross-sectoral coordination.

Summary of Experts' Insights:

The Delphi discussions showed that cooperation frameworks exist in most situations, yet there is a significant difference in the depth, inclusiveness of cooperation frameworks, and their effectiveness. Key insights included:

- Cooperation is a must - but failing to deliver - there are formal arrangements, but they are not well established, and true collaboration - and ownership - is too often lacking.
- Ministry and government agencies were repeatedly identified as the weakest link with low level of coordination and engagement with the major sectors, which include agriculture, climate, and environment.
- There's still a large shortfall of grassroots actors and locals, farmers, SMEs and local groups— who are at the heart of solving the bioeconomy problems.
- Institutional silos and innovation resistance among traditional industries have prevented systemic change.
- Positive examples where collaboration can be inclusive and strategically geared prove that effective multi-actor engagement greatly speeds up bioeconomy strategy generation.

Result Achieved:

The Delphi process demonstrated that although a unity of public, private, scientific, and societal actors is widely accepted as imperative, it is insufficient for a coherent bioeconomy strategy (or the CAP-linked roadmap) to be developed at this time. Experts concurred that to make meaningful progress, more intense interministerial coordination is needed, that national platforms or hubs are empowered, and that grassroots stakeholders are systematically involved if strategies are to be shaped to truly address needs and to achieve implementation in practice.

Question 11: To what extent do you agree that the current system of indicators monitoring the CAP Strategic Plan enables a reliable and comprehensive assessment of its real impact on the economy, environment, and society?

Consensus:

Moderate to low consensus was found amongst experts and a generally critical view was reported on the monitoring system for CAP. And though acknowledging its role as a mechanism for accountability, most users agreed that the current indicators of success, particularly when it comes to policy impact, are not fully or accurately informative.

Summary of Experts' Insights:

During Delphi workshops, there were also points of contention regarding systemic gaps in the monitoring and measurement of CAP outcomes. Key insights included:

- The indicator framework is concentrating too much on contextual and result indicators, whereas impact indicators are limited, underutilized, or poorly integrated.
- Quality of data and consistency remain critical challenges, and monitoring is motivated largely by the administrative and EU compliance needs, rather than by analytical usefulness.
- Experts found attribution is further complicated by external influences like climate change or market volatility that undermine the credibility of impact assessments.
- More verifiable, quantitative and long-term indicators will be required, with strong data collection and harmonised methods across Member States.
- Participation of stakeholders - farmers, researchers, civil society - was perceived as a mechanism that enhanced the relevance and credibility of monitoring procedures.

Result Achieved:

The Delphi talks formed a consensus that although the CAP indicator system offers a necessary format, it currently does not contribute to a meaningful evaluation of reality. Experts collectively decided that future reforms must focus on measurable impact indicators, integrate science-based measurement tools (e.g., monitoring soil, water, and biodiversity), and embed participatory evaluation processes so that data reflect policy performance as well as ground realities.

Question 12: What aspects of monitoring should be key in assessing the effectiveness of CAP measures supporting the bioeconomy?

Consensus:

Experts also agreed that monitoring CAP of the bioeconomy should comprise not only production statistics, but also environmental, economic, and systemic impacts. Biomass use efficiency emerged as the best and most significant priority in all discussions, followed by integration with the food system, job creation, and emission reduction as a second, indirect value.

Summary of Experts' Insights:

The Delphi discussions emphasized that effective monitoring should connect resource efficiency with social and environmental results rather than stick to narrow, quantitative indicators.

Key insights included:

- Efficiency of biomass use is considered the main indicator for circularity (waste reduction, energy recovery, side streams value creation).
- Bioeconomy measures need to be integrated with the food system to assure their sustainability, reduce losses, and produce co-benefits, such as improved food quality and resilience.
- Job creation in bio-based sectors (BBSs) can be a tangible indicator of benefits to society, exemplifying the economic diversification and contribution of CAP investments towards rural development.
- Emission reduction is essential yet viewed more as a result of effective biomass and food management than a direct monitoring focus.
- Experts concurred that EU indicator frameworks are too focused on outputs and requested qualitative, long-term, and systemic indicators that better highlight transformative impacts and sustainability trade-offs.

Result Achieved:

Delphi generated a hierarchical ordering of monitoring priorities for assessing CAP bioeconomy measures:

1. Efficiency of biomass use as the most reliable indicator of circular performance;
2. Integration of food systems to seize sustainability co-benefits;
3. Job creation to demonstrate social value;
4. Emission reduction as an indirect, complementary measure.

Experts agreed: a new generation of monitoring frameworks – integrating quantitative data with systemic assessment – was needed to more completely assess how CAP investments promote the circular and sustainable bioeconomy.

Question 13: To what extent do you agree that the current financial instruments under the Common Agricultural Policy (CAP) effectively encourage farmers to adopt practices aligned with the principles of the bioeconomy (e.g., regenerative agriculture)?

Consensus:

The consensus amongst experts for all discussions remained low to moderate, ultimately concluding that CAP financial instruments provide limited incentives for farmers to engage in bioeconomy-compatible or regenerative practices. These elements might be potentially supportive, but were considered insufficient to induce systemic behavioural change: the design, the scale, the implementation.

Summary of Experts' Insights:

Within the Delphi discussions, existing CAP instruments encouraged compliance rather than transformation. Key insights included:

- Farmers view CAP measures mostly as subsidies, as opposed to being innovation or transition mechanisms, so there is little incentive to change practices.
- Payment policies that reduce per-farmer support when participation increases were perceived as discouraging.
- Regenerative and circular practices are poorly known and understood, and there remains little guidance to support farmers towards effective implementation.
- A plethora of tools still promote traditional input-based systems, which has resulted in misalignment with bioeconomy and sustainability imperatives.
- Eco-schemes and carbon farming initiatives are acknowledged as promising, but optional, underfunded and poorly communicated, which weakens their impact.

Result Achieved:

The Delphi process validated our shared critical view: existing CAP financial instruments have not yet generated compelling or robust drivers of farmers' transition towards bioeconomy-aligned practices. Experts said that reforms in the future should strengthen results-based and performance-oriented payments, connect financial support to tangible environmental and circular outcomes, and improve access while expanding advisory and awareness programmes to make regenerative agriculture economically and operationally viable.

Question 14: To what extent do you agree that the current support system for regenerative agriculture under the Common Agricultural Policy (CAP) is sufficient?

Consensus:

Experts in all the discussions reported clear and consistent sentiments that the current CAP support for regenerative agriculture is not sufficient. Even where some examples of regenerative measures are developed, they are disjointed, largely underfunded, and lack defined criteria and visibility within CAP frameworks.

An overview of Experts' findings:

Delphi participants concurred that regenerative agriculture lacks appropriate integration into CAP policies and instruments.

Key insights included:

- Lack of a clear definition of regenerative agriculture prevents the creation of targeted measures and coherent support strategies.
- Farmers are under-informed and unaware, leading to low uptake and lack of utility of eco-schemes or agri-environmental applications.
- Current support is indirect and fragmented, regenerative practices seem only to play a peripheral role as subcomponents within wider sustainability measures.
- Financial incentives are inadequate to cushion the transition risks and investment costs, lacking the necessary incentive for widespread adoption.
- Experts suggested mechanisms like certification systems, price premiums, and pilot programmes to test scalable solutions and instill confidence in farmers.

Result Achieved:

The Delphi process created a very strong consensus that CAP's current framework offers little, if any, direct commitment to regenerative agriculture. Experts concurred that much progress will ultimately require tailored instruments, robust policy definitions, and improved financial and advisory mechanisms to ensure the feasibility and appeal of regenerative practices to farmers.

Question 15: Which areas should be prioritized for funding to further support the development of the bioeconomy within the CAP framework?

Consensus:

Experts from the Delphi workshops concurred that investments in bioeconomy must be systemic rather than sectoral, and must take in all of the components – soil, water, nutrients, and by-products. The priorities varied somewhat, but regenerative agriculture and modern water management consistently emerged as the most critical areas for future CAP funding, followed by valorisation of agri-food by-products and nutrient cycling. Biofuels and energy recovery received the lowest relative importance.

Summary of Experts’ Insights:

The discussions demonstrated that all aspects intersect and should complement one another within a circular framework. Main insights included:

- Regenerative agriculture is understood as the foundation of the bioeconomy, with positive co-benefits to soil health, carbon sequestration, and nutrient as well as water efficiency.
- Management of water was repeatedly identified as a strategic priority under climate stress, with smart irrigation systems, retention systems, and adaptive water use considered essential for agricultural resilience.
- Agri-food by-products for bioproducts were valued for generating high-value, low-emission materials and for strengthening circular value chains, which provided greater long-term economic potential than energy conversion.
- Nutrient cycling was acknowledged as critical, yet often discussed together with regenerative systems, as an integrated process, rather than as a standalone area of interest.
- Biofuels continue to be part of that bioeconomy transition but were seen as generally lower-impact investments than bioproduct innovation or soil-water regeneration.

Result Achieved:

The Delphi process produced a clear regional hierarchy of priorities for future CAP funding:

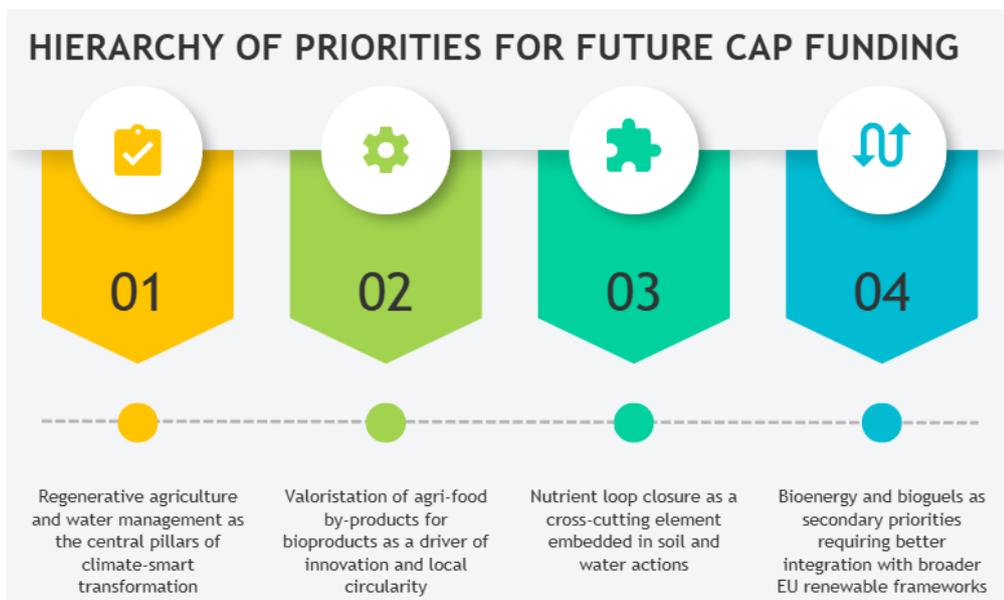


Figure 11. Regional hierarchy of priorities for future CAP funding

They decided that CAP investments are going to need to shift from piecemeal approaches to integrated system approaches, ensuring that soil, water, nutrient, and biomass cycles are managed together within a coherent circular bioeconomy strategy.

Question 16: To what extent do you agree that farmers are aware of the benefits of implementing bioeconomy practices (e.g., organic farming, agroforestry, regenerative agriculture, precision farming, closed nutrient cycles, insect protein, aquaponics)?

Consensus:

Experts at the Delphi round table concurred that awareness among farmers of bioeconomy principles and their benefits is low, at best incomplete among larger or more innovative producers. Although isolated instances of awareness and experimentation exist, the idea of bioeconomy is hardly articulated or adopted at farm level.

Summary of Experts’ Insights:

The message across the discussions was that farmers currently do not see themselves as part of the bioeconomy and that knowledge is fragmented and inconsistent between sectors and farm types.

Key points included:



Figure 12. Key points regarding Summary of Experts’ Insight: Question 16

Result Achieved:

The Delphi exercise further validated a fundamental farmer illiteracy, which was determined to be one of the major barriers to uptake of bioeconomy-aligned practices. The experts agreed that awareness-raising will require targeted knowledge transfer, advisory reform, and clear policy messaging that will place farmers not only as producers but as key actors in circular and regenerative value chains.

Question 17: Which factors most significantly limit farmers from implementing innovations in plant and animal production?

(Barriers considered: (1) Cost of implementing new technologies, (2) Lack of adequate financial instruments, (3) Insufficient knowledge and training, (4) Resistance to change and traditional preferences, (5) Insufficient advisory and expert support)

Consensus:

During the Delphi workshops, experts shared a common regional understanding that several, interrelated barriers limit farmers’ adoption of innovation. The most important were high costs of technology, limited financial instruments, and insufficient knowledge and training, while resistance to change and weak advisory systems were also significant but more specific to the context.

Summary of Experts’ Insights:

Experts concurred that financial and knowledge-based challenges predominate, but the relative contributions vary with context.

Key points included:



Figure 13. Key point regarding to Summary of Experts’ Insights: Question 17

Result Achieved:

The Delphi process found a commonality in the findings: to foster innovation in agriculture and livestock production, CAP measures must provide a combination of financial incentives, risk-sharing tools, and robust advisory and education support. Experts urged a systemic approach that combined investment aid with training, demonstration farms and easy-access credit structures to address economic and behavioural barriers to innovation.

Question 18: To what extent do you agree that the current support system under the Common Agricultural Policy (CAP) for livestock and crop production effectively integrates the sustainable use of natural resources?

Consensus:

Experts present in the Delphi discussions expressed an overall harsh or sceptical attitude on the degree to which CAP support systems mainstream sustainability principles within plant and animal production. Although the policy architecture formally encourages sustainable use of resources, the implementation of it is uneven, underfunded, and too often poorly aligned with the needs of farmers.

Summary of Experts' Insights:

A common perception recognized from the workshops was that sustainability priorities are presented on paper but are only marginally translated in practice.

Main points included:

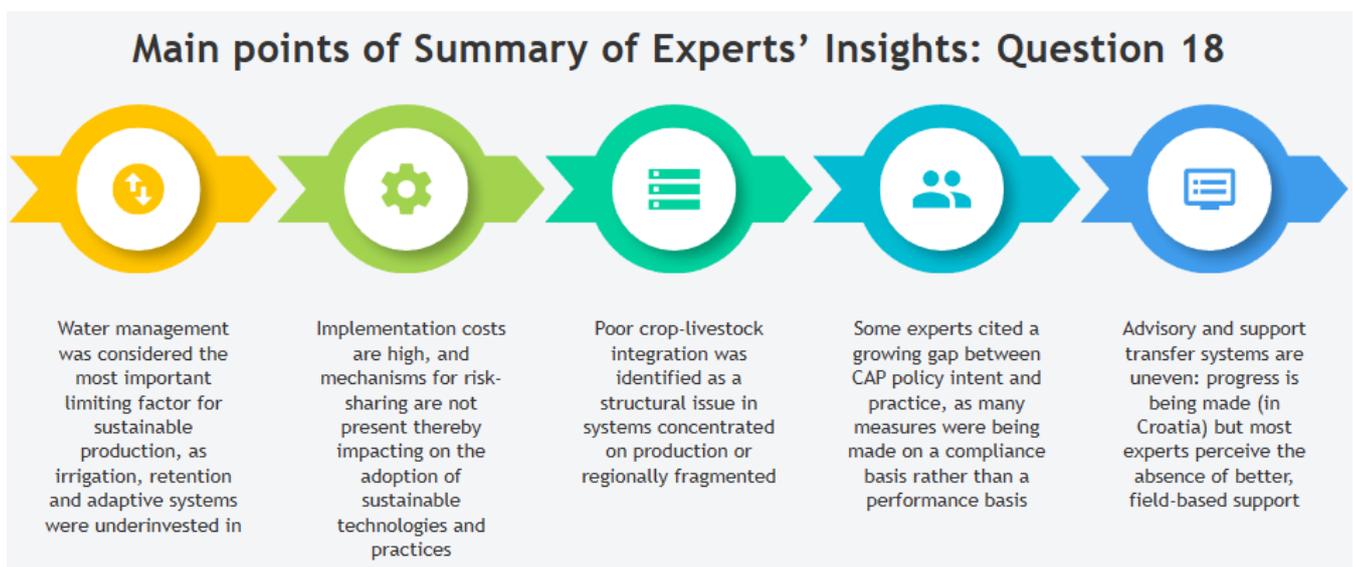


Figure 14. Main points of Summary of Experts' Insights: Question 18

Result Achieved:

The Delphi process validated a moderate to low level of confidence in CAP's capability towards the sustainable use of resources across livestock and crop production. Experts agreed that meaningful progress will require stronger financial incentives for resource-efficient practices, better crop-livestock integration, and systemic water management investments, supported by knowledge transfer and simplified advisory frameworks to ensure sustainability moves from principle to practice.

Question 19: To what extent do you agree that the current investment support mechanisms under the Common Agricultural Policy (CAP) effectively support the development of the bioeconomy?

(Examples: biogas/biomethane linked to agriculture, local biomass processing, regenerative agriculture, closed-loop systems, direct sales of bioproducts, digital tools for resource optimisation)

Consensus:

Experts at Delphi have largely shared a critical perspective but noted that CAP investment-support mechanisms are in place, yet their impact on bioeconomy development is limited. Low effectiveness was consensus reached in Poland and Slovakia, but Croatia expressed cautious optimism and Slovenia saw divergent viewpoints.

Summary of Experts' Insights:

Experts stressed that the only real impediments are around governance and implementation, and not the presence of investment instruments as required by law. Key insights included:

- Implementation gap – investment instruments officially support bioeconomy activities, yet few target circular (or regenerative) results.
- Inadequate targeting and prioritisation: funding still puts competitiveness and productivity over sustainability or innovation – especially in processing and infrastructure.
- No systemic integration: There is no alignment between crop and livestock systems and between value-chain actors so that investments cannot really impact on circularity.
- Funding and legislative obstacles: administrative restrictions, lack of funding, and a strict legal environment retard the adoption of novel or cross-sectoral bioeconomy endeavours.
- Stakeholders are underrepresented: policy design processes do not often capture farmers' or local stakeholders' needs, with low engagement and misaligned priorities.

Result Achieved:

The Delphi process reaffirmed region-level consensus that CAP investment measures are as yet not effective catalysts for a bioeconomy transition. Experts urged the shift of funding to circular, regenerative, and innovation-focused projects, tighter links between production systems, and streamlined, more focused implementation frameworks with meaningful stakeholder consultation.

Question 20: To what extent do you agree that the current eco-schemes within the Common Agricultural Policy (CAP) effectively support the development of the bioeconomy and the transformation of agriculture towards sustainability?

(Examples: carbon farming, sustainable agriculture, integrated crop production, biological protection, water retention)

Consensus:

Experts across the Delphi workshops reached generally mixed but cautious conclusions: eco-schemes are conceptually in alignment with sustainability and bioeconomy ambitions but have limited impact in practice. In Poland (low effectiveness) and Slovakia (moderate effectiveness), there was consensus; Croatia and Slovenia were diverging or cautious.

Summary of Experts' Insights:

Experts agreed that eco-schemes are promising but are poorly designed and implemented. Key points included:

- Short-term design and annual cycles discourage the development of transformational practices in a long-term perspective.
- The motives driving farmer participation are financial rather than real commitment to sustainability or innovation.
- There is administrative complexity and rigid eligibility rules with lower flexibility, which disincentivizes more ambitious participation.
- Gaps in implementation—from policy development to field implementation, and from policy implementation to monitoring—undermine credibility and efficacy.
- Economic sustainability is absent: eco-schemes are conceived of as subsidies rather than as instruments that reward sustainable environmental and economic performance.
- National differences are also evident here: Slovakia views eco-schemes as important tools, and Poland and Slovenia see them as underachieving and bureaucratic.

Result Achieved:

The Delphi process produced a regional consensus confirming that eco-schemes, while being core to the green architecture of the CAP, are not acting as effective levers of bioeconomy transformation at this point in time. Experts underscored the importance of multi-year design frameworks, better economic incentives, and simplified implementation, making sure eco-schemes motivate measurable environmental impact and align with meaningful transitions toward circular, regenerative agriculture.

Question 21: What actions within eco-schemes should be prioritised for development and financing to more effectively support the bioeconomy and sustainable development of rural areas?

(Please allocate 100% of support across five areas: regenerative agriculture, biodiversity, water retention, circularity/emission reduction, monitoring/advisory support.)

Consensus:

Experts from all four countries had a high degree of consensus on the priority aspects of the eco-scheme process in advance. In Poland there was a consensus, and in Croatia, Slovakia and Slovenia there were internally consistent preferences. Overall, regional trends identified regenerative agriculture, circularity and emission reduction, and water management as primary eco-scheme priorities, biodiversity and monitoring/advisory efforts as supportive and secondary actions.

Conclusions from Experts:

Across all the workshops experts concurred that eco-scheme funding ought to specifically concentrate on interventions that have practical, environmental and resource-efficiency effects, particularly as they pertain to the development of soil, water and carbon management systems.

Main conclusions included:

- Regenerative farming (i.e. no-till, catch crops, SOM increase) could be identified as the most strategic investment field with many co-benefits for soil health, water retention, and carbon sequestration.
- Circularity and emission mitigation measures (organic fertilisers, crop residue management) are acknowledged as the key for the alignment of bioeconomy and climate goals.
- Water retention and conservation are two common priorities, highlighting how agriculture is becoming more climate adaptive to shortages and droughts as its practices become better prepared for.
- While the impact of biodiversity actions are valued for ecosystem services as well as for improving landscape resilience, they are seen as supplementing, instead of central or primary to bioeconomy transformation.
- Systems for monitoring and advisory, although having low funding allocation rank, were widely recognized as vehicles for enhancing uptake, compliance, and impact of schemes when adequately resourced.

Result Achieved:

The Delphi process yielded regional consensus on the clear three strategic pillars of future eco-scheme investments: regenerative soil practices; circular nutrient and carbon management; and adaptive water use. These measures are mutually reinforcing, and establish the foundation for a sustainable, resource-efficient agricultural bioeconomy, experts said. They added that advisory systems and digital monitoring should be reinforced to lock in long-term behavioural change among farmers, and to make sure that eco-schemes transition from a compliance to a performance-based model.

Question 22: What bioeconomy activities should receive priority funding to effectively reduce greenhouse gas emissions and improve carbon sequestration?

(Please allocate 100% across: biofuels, carbon farming, livestock emission reduction, organic waste use, and sustainable forest management.)

Consensus:

Experts exhibited a clear consensus of opinions across the Delphi sessions: carbon farming and the efficient management of organic waste were repeatedly stated to be the most critical funding needs, with forest management and biofuels listed as second. Consensus was reached in Poland for both rounds, while Slovenian results showed that internal consistency was stable in regard to where CAP support would have a large climate impact.

Summary of Experts' Insights:

The workshops revealed experts had a preference for integrated, cost-effective solutions that provide both emission reduction and soil carbon gains.

Key insights included:

- Organic waste valorisation (for energy and fertiliser) is regarded as the most convenient and easily scalable option, to close nutrient loops and replace fossil fuels.
- Carbon farming strategies like cover cropping, minimising tillage and better management of manure are well-accepted to help sequester CO₂ long term, but experts emphasised the necessity of precise definition and solid MRV systems and effective incentives.
- Reducing livestock emissions (especially methane) is a continued opportunity area, though adoption is held back by costs, behavioural barriers, and lack of financial support.
- Biofuels are considered valuable but less effective in achieving overall carbon savings than waste recycling and soil sequestration.
- Sustainable forest management in particular received the lowest overall evaluations because of long storage time frames, minimal short-term ability of farmers to determine effects, and the fact that it wasn't directly aligned with the CAP funding cycle.
- Experts mentioned policy blind spots, including the omission of perennial crops and agroforestry that could provide the combined benefits of sequestration, biodiversity and resilience.

Result Achieved:

The Delphi process achieved a strong, cross-border consensus on prioritising carbon farming and organic waste valorisation as the strongest CAP-linked levers for emission reduction and sequestration. Consultants suggested future funding models would include rigorous carbon-accounting approaches and long-term incentives for long-term carbon reduction and closer harmonisation with environmental goals, establishing connections between CAP eco-schemes, carbon farming programmes as well as the broader goals of the Green Deal on climate.

Question 23 (question asked only in Poland): To what extent do you agree that further development of the bioeconomy in agriculture in Poland can contribute to achieving climate goals—particularly by reducing greenhouse gas emissions and promoting carbon sequestration practices?

Consensus:

At the second round of the Delphi, an excellent degree of consensus was achieved by Polish experts, as evidenced by an average score of 8.31, confirming the widespread consensus that the development of a bioeconomy can greatly contribute to national- and EU-level climate targets. Circular and regenerative bioeconomy practices were accepted to be transformative approaches to reduce emissions and enhance carbon sinks, with their impact conditional on scale, integration, and coherent policy, experts said.

Summary of Experts' Insights:

The bioeconomy was advocated by the experts as a way to tie agricultural production alongside mitigation of climate change. Key takeaways included:

- Efficient, circular resource use -- via nutrient recycling, waste valorisation, and precision management -- can yield immediate benefits in reducing emissions and improving soil and water quality.
- Carbon sequestration in soils and forests is considered a cornerstone of climate-smart agriculture, however it will require dedicated CAP incentives and a robust monitoring system to be effective.
- The urgency of the climate crisis was repeatedly mentioned: “Global warming has already exceeded 1.5°C, allowing very little time to act,” emphasizing the need to move swiftly in policy responses.
- Policy coherence continues to be tough: although the bioeconomy could help, experts said its contribution would be limited by broader EU and global economic pressures driving emissions upward.

Result Achieved:

The Delphi process also validated that the agricultural bioeconomy is now regarded as a major driver of climate neutrality, in particular for carbon farming, regenerative agriculture, and low-emission livestock systems. All experts agreed that circular bioeconomy actions must therefore be given priority and integrated more effectively into CAP frameworks so that emission reduction, carbon sequestration, and sustainable resource use contribute to the same objective nationally in a cohesive national climate strategy.

Policy incentives based on Delphi Group Workshop

The Delphi results from four countries reveal broad consensus that while the Common Agricultural Policy (CAP) provides a potentially powerful framework for advancing the circular and sustainable bioeconomy, its current implementation remains fragmented, overly bureaucratic, and insufficiently systemic. Strengthening the CAP's role in this transition requires structural, procedural, and cultural reforms across governance, markets, financing, and knowledge systems.

1. Governance and Strategic Alignment

- Strengthen interministerial coordination between agriculture, environment, innovation, and industry ministries to align strategies, budgets, and implementation.
- Establish national bioeconomy hubs or platforms to institutionalize cooperation, foster cross-sectoral dialogue, and connect policy with practice.
- Ensure consistent participation of key ministries, regions, and grassroots actors (farmers, SMEs, NGOs) in national and regional bioeconomy processes.
- Develop clear, shared definitions and objectives for the bioeconomy to guide programming, avoid duplication, and promote coherence across Member States.
- Position the bioeconomy as a central pillar of climate policy, integrating it into broader EU frameworks for decarbonization, circularity, and sustainable food systems.

2. CAP Reform and Policy Integration

- Revise GAEC and eco-scheme standards to explicitly incorporate circular bioeconomy, regenerative agriculture, and carbon farming principles.
- Integrate bioeconomy priorities into all CAP instruments, including investment support, cooperation measures, and agri-environmental schemes.
- Improve coordination between CAP and other EU instruments (Horizon Europe, CBE JU, LIFE, I3, RIS3) to ensure complementary funding and innovation pathways.
- Align CAP with energy, climate, forestry, and industrial policies, reducing fragmentation and creating coherent incentives for bio-based transitions.
- Simplify and streamline implementation and bureaucracy, ensuring equal access for small and medium-sized farms and local actors.

3. Financing and Market Development

- Expand and better target financial support, moving from isolated projects to value-chain-wide interventions and regional clusters.
- Prioritize long-term, outcome-oriented funding, rewarding innovation, cooperation, and systemic impact rather than formal compliance.
- Create synergies across funding sources and explore innovative instruments such as risk-sharing, blended finance, or revolving funds for biorefineries and circular infrastructure.
- Develop bioeconomy markets through targeted incentives for bioproducts, sustainable proteins, CO₂ sequestration, and waste valorisation.
- Strengthen support for short supply chains, local markets, and digital platforms that increase consumer trust, transparency, and demand for sustainable products.

4. Innovation, Knowledge, and Capacity Building

- Reorient cooperation measures (EIP-AGRI, LEADER, LAGs) toward farmer-driven innovation and local bioeconomy solutions.
- Simplify procedures for Operational Groups and scale up funding to ensure measurable, long-term impacts.
- Support cross-sectoral R&D frameworks that connect farmers, SMEs, and research institutions to accelerate applied innovation.

- Strengthen AKIS and advisory systems to raise awareness, provide hands-on guidance, and translate abstract bioeconomy concepts into farm-level benefits.
- Promote demonstration farms, pilot projects, and peer-to-peer learning to increase trust and adoption of innovative practices.
- Build capacity for SMEs and farmers to participate in international innovation projects and access EU-level funding.

5. Monitoring, Evaluation, and Data Systems

- Redesign indicator systems to balance contextual, result, and impact measures that reflect real sustainability and circularity outcomes.
- Prioritize indicators on biomass use efficiency, resource circularity, nutrient cycling, and job creation, alongside emissions metrics.
- Ensure harmonized methodologies and high-quality data across Member States to enable comparability and learning.
- Involve stakeholders in co-designing monitoring frameworks, keeping them practical, cost-effective, and oriented toward long-term goals.
- Extend evaluation timelines to capture systemic and multi-year impacts of bioeconomy and regenerative practices.

6. Regenerative Agriculture and Carbon Farming

- Develop clear definitions and dedicated CAP interventions for regenerative agriculture to ensure consistency and credibility.
- Expand financial incentives that cover transition costs and reward ecosystem services, soil health, and carbon sequestration.
- Integrate nutrient cycling and water management into regenerative practices, linking soil fertility, climate adaptation, and resource efficiency.
- Support carbon farming mechanisms with robust monitoring and certification frameworks.
- Embed livestock emission reduction and agroforestry systems in eco-schemes and investment support to foster long-term sequestration.

7. Education, Awareness, and Cultural Change

- Enhance communication and education programs that explain bioeconomy benefits to farmers, advisors, and consumers.
- Integrate bioeconomy training into eco-schemes, AECM, and advisory services.
- Address cultural and behavioural barriers through storytelling, peer examples, and recognition programs that valorise innovation.
- Encourage farmer-researcher collaboration and multi-actor knowledge exchange to bridge science and practice.
- Tailor outreach and support tools to different farm types and sizes, ensuring inclusivity and equitable access to innovation

Contributions from sectoral experts on the implementation of the CAP and the development of the circular bioeconomy

Consolidated Expert Results and Thematic Overview of Bioeconomy Transformation Pathways

Table 12. Expert results (key findings)

	Expert description	Expert specialization	Transformation pathways	Assessment of development pathways	PESTEL Analysis	SWOT / TOWS	Recommendations & Strategic Actions
1	1 CR	Bioenergy-biofuels-biogas	PII - PIII - PV	✓	✓	✓	✓
2	2 CR	Biomanufacturing	PI-PII-PIII-PIV-PV	✓	✓	✓	✓
3	1 PL	Biofuels	PI	✓	✓	✓	✓
4	2 PL	Horticulture	PII, PIII	✓	✓	✓	✓
5	3 PL	Regenerative Agriculture	PII, PIII	✓	✓	✓	✓
6	4 PL	Alternative agriculture	PIII	✓	✓	✓	✓
7	5 PL	Precision Agriculture	PII	✓	✓	✓	✓
8	6 PL	Biomass production and processing	PII>PIV>PIII> PI & PV	✓	✓	✓	✓
9	7 PL	Bioeconomy theory and assessment	PIII - PIV - PV	✓	✓	✓	✓
10	8 PL	Biomaterials from waste	PIII - PIV	✓	✓	✓	✓
11	9 PL	Biogas-Biomethane	PI - PIII	✓	✓	✓	✓
12	10 PL	Advisor-Broker Farm management	PII - PV	✓	✓	✓	✓
13	11 PL	Regenerative agriculture - bioproducts development	PII	✓	✓	✓	✓
14	12 PL	Innovation management	-	-	-	-	-
15	13 PL	Agriculture-Food - Digital Innovation	-	-	✓	-	-

16	14 PL	Policy making - Biotechnology - bio-based products	PIII - PIV	✓	✓	✓	✓
17	15 PL	Regenerative agri - logistics biomass	PI	✓	✓	✓	✓
18	16 PL	Biomanufacturing - biofuels					
19	1 SK	Biochar	PIII - PIV	✓	✓	✓	✓
20	2 SK	Bioleaching - biostimulants	PII - PV	✓	✓	✓	✓
21	3 SK	Biopolymers					
22	4 SK	Hemp-construction bioproducts					
23	5 SK	Regenerative agri					
24	1 SL	Algae to bioproducts	PI - PII - PIV	✓	✓	✓	✓
25	2 SL	Regenerative/precision agri	PIII	✓	✓	✓	✓
26	3 SL	Wood based value chains	PI - PIII	✓	✓	✓	✓
27	4 SL	Biogas	PI - PIII	✓	✓	✓	✓
28	5 SL	Precision agri - high tech gh	PII - PIII - PVI - PV	✓	✓	✓	✓

Table 13. Key Enabling Technologies according to Experts from Croatia

Key Enabling Technology	Biomass input Category	Technology Category	Destination sector of the economy	Transformation Pathway				
				PI	PII	PII -	PI >	PV
CR1 Genetic engineering Enzyme technology	Microbial biomass	Aerobic conversion	Food products, beverages	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
		Anaerobic digestion	Chemicals and chemical products					
		Fermentation						

Biotechnology/metabolic engineering		Blending/mixing	Pharmaceutical products						
Fermentation		Extraction and separation processes							
Bio-chemicals									
Functional biopolymers									
Genetic engineering	Residues from agriculture production	Aerobic conversion	Food products, beverages	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
Enzyme technology		Anaerobic digestion							
Biotechnology/metabolic engineering		Fermentation	Chemicals and chemical products						
Fermentation		Blending/mixing	Pharmaceutical products						
Biomass processing		Extraction and separation processes							
Biomass processing	Residues from forestry and forest-based industry	Aerobic conversion	Food products, beverages	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
New biomass uses		Anaerobic digestion							
Alternative biomass		Fermentation	Chemicals and chemical products						
Utilization of lignocellulose		Blending/mixing	Pharmaceutical products						
		Extraction and separation processes							
CR2 Renewable energy not bio-based	N/A	Combustion, Gasification	Energy	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
CR2 Biomass processing	Residues from natural and landscape resources management	Extraction & separation processes, Combustion, Pyrolysis	Energy, Industry, Forestry	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Utilization of wood	Residues from forestry and forest-based industry	Extraction & separation processes, Combustion, Pyrolysis	Energy, Forestry	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Renewable energy not bio-based	N/A	Combustion, Gasification	Energy	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

Table 14. Key Enabling Technologies according to Experts from Poland

Key Enabling Technology	Biomass input Category	Technology Category	Destination sector of the economy	Transformation Pathway				
				PI	PII	PII -	PI >	PV
PL2 Bio-fertiliser / Biocontrol				<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
	Agricultural production residues			<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		Aerobic conversion (composting)		<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
			Renewable energy, Organic waste management	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
PL4 C1 Technologies	Residues from forestry and the forest industry	Pyrolysis	Forestry and hunting	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
C1 Technologies	Remnants of environmental resource and landscape management	Pyrolysis	Green care, nature tourism and recreation	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Fermentation	Other organic residues	Aerobic conversion	Organic waste management; Green care, nature tourism and recreation	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
PL6 Functional Biopolymers	Residues from forestry and the forest industry	Valorization and cascading use of biomass	Bioproducts	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Fermentation	Residues from agricultural production	Fermentation	Renewable energy	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Functional Biopolymers	Residues from agricultural production	Valorization and cascading use of biomass	Bioproducts	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Insect Breeding	Residues from agricultural production	Valorization and cascading use of biomass	Insect bioproducts	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

PL7 Functional biopolymers/bioplastics (PLA/PEF)	Residues from agricultural production	Biomass valorization	Textiles, clothing, and leather	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
	Residues from forestry and the forest-based industry	Extraction and separation processes	Construction					
	Residues from environmental and landscape management	Development of biomaterials	Organic waste management					
	Residues from processed biological products							
PL8 Fermentation / Biotechnology / Bioengineering	Residues from processed biological products	Fermentation	Chemicals and chemical products	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Enzymatic technologies and the use of microorganisms	Agricultural and animal production residues	Bioprocesses / Biorefineries	Rubber and plastic products / Pharmaceutical products / Agriculture	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
PL14 Functional biopolymers/bioplastics (PLA/PEF)	Agricultural residues	Biomaterial development	Chemicals and Chemical Products Rubber and Plastic Products	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
New Biomass Applications	Animal Production Residues Agricultural Residues	<ul style="list-style-type: none"> • - Mushroom Cultivation • - Algae Cultivation 	- Food, Beverages, and Tobacco - Textiles, Clothing, and Leather	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Alternative Biomass Biotechnology/Metabolic Engineering	Microbial Biomass	BIOPROCESSES	- Pharmaceuticals - Chemicals and chemical products	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Advanced materials (packaging, construction, etc.)	Residues from forestry and the forest industry	Biomass Valorization	- Wood and Wood Products - Construction - Food, Beverages, and Tobacco	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Bio-fertilizer/biocontrol	Animal Production Residues Agricultural Production Residues	Fermentation	Agriculture	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Table 15. Key Enabling Technologies according to Experts from Slovakia

Key Enabling Technology	Biomass input Category	Technology Category	Destination sector of the economy	Transformation Pathway				
				PI	PII	PII -	PI >	PV
SK1 Low-emission pyrolysis of biowaste	Household/green waste	Thermal conversion - pyrolysis, gasification	Agriculture, landscaping, gardening, household use	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Modular biochar production units	Local residual biomass (wood, compost)	Small-scale decentralised conversion infrastructure	Rural innovation, energy-efficient waste management	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
Application of biochar in compost & soil systems	Composted organics / digestate	Soil enhancement + organic input blending	Agriculture, horticulture, organic waste valorization	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Exportable climate adaptation solution (e.g. Saudi desert greening)	Context-adapted biomass	Biochar for land regeneration / water retention	Environmental recovery, climate resilience	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
SK2 Microbial bioleaching / bio-stimulant production	Industrial residues / mineral waste	Biological transformation & microbial processes	Agriculture, forestry, soil remediation	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Circular nutrient cycling from bio-waste	Organic waste / compostable biomass	Extraction and formulation of soil conditioners	Agriculture, environmental technologies	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Precision biofertilizer application (AI-guided)	Digital integration (non-biomass)	Decision support systems / AI + remote sensing	Agriculture / smart farming	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
SK3 Functional biopolymers / bioplastics	Other organic residues/ starch-rich biomass	Bioprocessing → Extraction, polymerisation, compounding	Agriculture, horticulture, packaging, medical, forestry	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Compostable plastic input for agriculture	Plant-derived biopolymers	Biodegradable input materials for farming	Agriculture (mulch films, trays, clips, seed carriers)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Product design for dual-use biodegradability	Compostable household/industrial plastics	Ecodesign + industrial & home compost certification	Waste reduction, circular packaging, on-farm material use	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
SK4 Hemp-wool insulation material processing	Hemp stalks and raw sheep wool	Mechanical processing, fiber blending, felting	Construction / eco-building sector	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Modular panel development for natural insulation	Agricultural biomass	Composite panel forming, thermal/acoustic optimization	Building materials / rural housing	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Circular product design for soil compostability	Bio-based waste / degraded wool	Biodegradable material prototyping and soil return testing	Agriculture (e.g. organic fertilizer), end-of-life use	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Decentralized low-tech production technologies	Regional hemp/wool by-products	Mobile and small-scale equipment for fiber conversion	Local SMEs / rural micro-enterprises	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Table 16. Key Enabling Technologies according to Experts from Slovenia

Key Enabling Technology	Biomass input Category	Technology Category	Destination sector of the economy	Transformation Pathway					
				P	I	P =	P =	P -	P >
SL1 Microbial biomass (microalgae & macroalgae)	Cultivation in waste substrates	Bio-fertilizer/biocontrol Biotechnology	Agriculture	<input type="checkbox"/>					
			Fisheries, Aquaculture & Algae		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
			Renewable energy						
Microalgae & macroalgae	Extraction of bioactive substances	Biotechnology	Agriculture	<input type="checkbox"/>	<input type="checkbox"/>		<input checked="" type="checkbox"/>		
			Fisheries, Aquaculture & Algae			<input type="checkbox"/>		<input type="checkbox"/>	
Microalgae	Anaerobic digestion - improving feedstock	Biotechnology	Renewable energy	<input checked="" type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
SL3 Residues from forestry and forest-based industry (branches, bark, sawdust), Low-quality wood, Residues from wood processing industry	THERMOCHEMICAL (Pyrolysis, Torrefaction)	Biofuels / Bioenergy, Biochar production,	Energy,	<input checked="" type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>	
			Agriculture, soil improvement,			<input checked="" type="checkbox"/>		<input type="checkbox"/>	

Low-quality wood, Underutilized deciduous species and secondary wood assortments, Residues from wood processing industry	MECHANICAL & THERMOCHEMICAL	Extraction, separation (extractives e.g., tannins, phenolics), Mechanical pulping / upgrading biomass Biorefining (fibres, cellulose, lignin, ethanol), Advanced wood modification (e.g., acetylation, thermal treatment)	Biobased chemicals, Fibers, Textiles, Paper and paper products, Biobased adhesives, coatings, packaging Wood and wood products Construction	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Wood waste, end-of-life wood, by-products, low quality wood	Recycling and upcycling	Circular product design, composite manufacturing	Furniture, construction, panel production, Organic waste management	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Forest inventory and wood traceability data	Digitalization, data analytics, modeling	Wood flow modeling, value chain optimization	Forestry management, value chain integration	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
SL4 animal excreta, slurry, biogas digestate	Improvement of slurry or biogas digestate	Low-energy air-plasma treatment; RENURE - pyrolysis		<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Incorporation of suitably processed lignocellulosic residues (e.g. biochar) into the material stream of livestock fertilisers			<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Production of biostimulants based on microalgae			<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Biomethane production			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
By-products of arable production - fibrous waste	New packaging materials - Extraction of bioactive compounds			<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Residues from dairy products	Enzymatic processing and fermentation			<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Residues from food processing	Biogas			<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Isolation of biologically active compounds			<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Residues from potato processing	The production of microbial enzymes from residues -	production of antibiotics, biological pesticides, enzymes,	In Slovenia, there is rather little of this material	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

	processing into products with high added value	biodegradable polymers, bioadsorbents						
Bakery waste	Production of yeast		In recent years, bakeries have significantly reduced waste through parbaking technology	<input type="checkbox"/>				
SL5 Residues from plant (fruit and vegetable) production	Waste reuse / processing	Biomass processing	Organic waste management	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Residues from plant (fruit and vegetable) production	Biogas production	Biomass processing	Renewable energy	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Residues from plant (fruit and vegetable) production	Extraction & separation processes	Advanced materials	Fruit leather for textiles and accessories	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Residues from plant (fruit and vegetable) production	Ligno-cellulose	Functional biopolymers/bioplastics, Advanced materials	Biomaterials (e.g. bioplastics, composites, paper and paper products)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Residues from plant (fruit and vegetable) production	Biorefining	The extraction of oligosaccharides (emulsifiers) from fruit pomace, Medicinal applications	Chemicals and chemical products for cosmetics or food supplement industry (prebiotics) or food industry (natural emulsifiers, thickeners)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Residues from natural and landscape resource management	Composting	Waste reuse/processing	Organic waste management	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Strategic Orientation Results for the Bioenergy Sector (Biofuels, Biogas, Biomethane): Expert-Based

Table 17. Results of strategic orientation (biofuels/biogas/biomethane) based on experts responses (PL#-SL#). Action Priority Matrix: Impact vs. Effort

Effort (input)	Impact (outcome)	
	Low	High
Low	Biofuels/ Bioenergy Fermentation_P6 Micro-biogas_P9	Fermentation_P6 Methane fermentation_P9
High	Fermentation_P1 Transesterification_P1 Anaerobic digestion_P4 Biofuels/ Bioenergy_P7 Biogas_RENURE_SL4	Anaerobic fermentation_P1 Methane fermentation - final production of biomethane_P9 Biomethane_SL4

Table 18. Results of strategic orientation (biofuels/biogas/biomethane) based on experts responses (PL#-SL#). Ranking of technologies combining Support/ Profit and Effort/ Impact matrices

Policy support (input)	Profit (outcome)	
	Low	High
Low	Biofuels/ Bioenergy Fermentation_P6 Micro-biogas_P9 Micro-biogas_SL4	Fermentation_P6 Methane fermentation_P9 Biogas_RENURE_SL4
High	Biofuels/Bioenergy_P7	Anaerobic fermentation_P1 Fermentation_P1 Transesterification_P1 Anaerobic digestion_P4 Methane fermentation - final production of biomethane_P9 Biomethane_SL4

Table 19. Results of strategic orientation (biofuels/biogas/biomethane) based on experts responses (PL#-SL#). Ranking of technologies combining Support/ Profit and Effort/ Impact matrices

Support/profit (input)	Low - high	High - high	Low-low	High-low
Effort/impact (outcome)				
Low - high	Biofuels/Bioenergy_P7	Fermentation_P1 Transesterification_P1 Anaerobic digestion_P4		Biogas_RENURE_SL4
High - high		Hydrogenation_P1 Anaerobic fermentation_P1 Methane fermentation - biomethane_P9 Biomethane_SL4		
Low - low			Biofuels/Bioenergy Fermentation_P6 Micro-biogas_P9	
High - low				Fermentation_P6 Methane fermentation_P9

Final ranking effort/ impact versus support/ profit

Low effort - high impact / Low policy support - high profit: Biofuels/ Bioenergy_P7

Low effort - high impact / High policy support - high profit: Fermentation_P1 - Transesterification_P1 - Anaerobic digestion_P4

High effort - high impact / High policy support - high profit: Hydrogenation_P1 - Anaerobic fermentation_P1 - Methane fermentation - final production of biomethane_P9 - biomethane_SL4

Low effort - low impact / Low policy support - low profit Biofuels/ Bioenergy Fermentation_P6 - Micro-biogas_P9

High effort - low impact / High policy support - low profit Fermentation_P6 - Methane fermentation_P9

Table 20. SWOT combination to TOWS Analysis (biofuels - biogas/biomethane) (Threats-Opportunities-Weaknesses-Strengths)

TOWS Matrix	Strategic Actions examples
<p>SO (Strength-Opportunity) Strategies</p>	<p>PL1_Use the large raw material potential to build a sustainable strategy for fuel supply security with a high share of Polish biofuels.</p> <p>PL4_The use of available fermentation, pyrolysis, and composting technologies would harness Poland's virtually limitless biomass resources to generate additional energy. The use of fertilizer products rich in organic carbon would improve soil quality and reduce the use of conventional agricultural inputs.</p> <p>PL6_Use of post-production residues unsuitable for food and feed purposes in insect breeding to popularize a new direction of activity in the country</p> <p>PL7_S - The potential of domestic biomass and biowaste production for use in bio-agriculture systems. > O - Availability of EU funds for investments in precision agriculture, digitalization, and bio-based solutions.</p> <p>PL7_S - Increased knowledge and competence in the field of bio-agriculture and precision agriculture technologies among some farmers and advisors. > O - The Common Agricultural Policy promoting environmental initiatives, such as Eco-schemes.</p> <p>PL9_Leverage a strong R&D position to develop bio-based alternatives.</p> <p>PL9_Educating people who deal with the topic of biogas.</p> <p>SL4_Leverage the vibrant startup ecosystem (S-BVC2) and strong manufacturing interest (S-BVC1) to develop and scale innovative biogas and digestate valorization technologies that support energy security and rural development (O-IPF5, O-CBP1).</p> <p>SL4_Utilize abundant agrifood waste and strong organic waste logistics (S-BS3) to meet rising consumer demand for bio-based products (O-CBP2) and reduce fossil dependence (O-IPF5).</p> <p>SL4_Channel R&D spin-offs and infrastructure (S-BVC2) to capitalize on positive consumer perception and price competitiveness of biogas alternatives (O-CBP1).</p>
<p>WO (Weakness-Opportunity) Strategies</p>	<p>PL1_The unreliability and cost-intensiveness of new renewable transport fuel technologies and advanced biofuels should be a reason to take action aimed at revising the EU-wide limit for 1st generation biofuels.</p> <p>Increasing the number of installations in the country thanks to available financing mechanisms.</p> <p>PL4_The unprofitability of transporting biomass over long distances can be addressed by using only locally available biomass or by growing additional crops for energy purposes.</p> <p>The choice of location may also depend on the local availability of biomass. The electricity grid is not adapted to distributed energy sources, therefore, installations should be installed near facilities that can directly consume this energy, such as large farms with processing plants.</p> <p>PL9_Investments in training programmes to address labour shortages in bioeconomy sectors.</p> <p>PL9_Training people after professional education</p> <p>SL4_Strengthen systemic monitoring of biomass (W-BS3) and improve side-stream data infrastructure to unlock higher-value valorization and support biogas-linked rural job creation (O-IPF5, O-CBP2).</p> <p>SL4_Foster integration of niche operations (W-BVC3) to form regional hubs that support scaling of biomethane production and digestate upcycling (O-CBP2).</p> <p>SL4_Invest in TRL 3-6 scale-up support (W-RDI3) to capitalize on increasing market demand and favorable economic trends for bio-based energy (O-CBP1).</p>

<p>ST (Strength-Threat) Strategies</p>	<p>PL1_The huge fuel market and the resulting unrealistic volumes of new types of renewable transport fuels and advanced biofuels from the perspective of the goals should create an opportunity for EU countries to persuade the European Commission to verify their approach to biofuels produced from agricultural raw materials.</p> <p>PL4_High energy efficiency could encourage energy suppliers to invest in such installations. Interest from farmers and businesses could lead to the allocation of some agricultural land to energy crops, which would increase the profitability of agriculture.</p> <p>PL7_<u>S</u> - Development of national and regional R&D initiatives supporting the production of bioproducts and innovations in agriculture. > <u>I</u> - Price competition from cheap, mass-produced chemical products.</p> <p>PL7_<u>S</u> - Synergy between precision agriculture and biotechnology - the ability to precisely apply bioproducts, which increases their effectiveness. > <u>I</u> - Skepticism among some farmers regarding innovative solutions and the long-term effects of biotechnology.</p> <p>PL9_Using financing mechanisms to mitigate market risk for biotech startups.</p> <p>PL9_Connecting startups with capital</p> <p>SL4_Use strong R&D pipelines and business interest (S-BVC2, S-BVC1) to develop scalable, cost-efficient solutions that attract SME participation and overcome investment barriers (T-BVC2, T-RDI2).</p> <p>SL4_Promote transparency and performance of biogas projects using strong logistics and feedstock availability (S-BS3) to counteract negative public opinion and greenwashing concerns (T-CBP1, T-CBP3).</p>
<p>WT (Weakness-Threat) Strategies</p>	<p>PL1_Increased possibilities for increasing the consumption of biofuels in so-called standard fuels within blending by establishing new quality standards applicable from 2030.</p> <p>PL4_The need to engage large entities in investing in such technologies as tenants and investors.</p> <p>The need to limit the possibility of such investments being blocked by unjustified social resistance.</p> <p>The need to subsidize less profitable technologies such as pyrolysis and composting.</p> <p>PL6_Improvement of transparency and interpretation of regulations for entrepreneurs to support a smoother transition to solutions promoting cascading and multidirectional use of biomass</p> <p>PL7_<u>W</u> - Fragmentation of regulations regarding the use of bioproducts in agriculture. > <u>I</u> - Risk of greenwashing - the appearance of ineffective or untested bioproducts on the market.</p> <p>PL9_Improving regulatory transparency to support a smoother transition of biomass or bioprocess solutions</p> <p>PL9_Improving regulations and shortening administrative procedures</p> <p>SL4_Develop public awareness campaigns and stakeholder engagement strategies to rebuild trust (addressing W-IPF5, T-CBP3), showing the economic and environmental benefits of integrated biogas systems.</p> <p>SL4_Streamline regulatory procedures and provide innovation funding to de-risk projects (W-IPF5) and facilitate the commercialization of advanced biorefinery tech (W-RDI3) to avoid stagnation and "valley of death" risks (T-RDI2).</p> <p>SL4_Encourage cooperation between fragmented SMEs (W-BVC3) to improve resilience and jointly overcome high investment barriers (T-BVC2).</p>



Immediate Actions (Short-Term Priorities)

- **P1_Establishing** instruments aimed at reducing the carbon footprint from agriculture, including crops used in the production of biofuels (rapeseed, corn);
- **P1_Investment** support for agricultural biogas plants;
- **P1_Expanding** the "agricultural fuel" program to include biofuels, e.g. B30;
- **P1_Establishing** permanent monitoring of agricultural emissions and collection of statistical data for their calculation, including field emissions;
- **PL4_Creation** of CAP-supported measures (eco-schemes, interventions, or investments) that contribute to the increased use of digestate, biochar, and compost for carbon farming purposes.
- **PL4_Subsidies** for the purchase of digestate, biochar, and compost
- **PL4_Payments** based on the amount of organic carbon incorporated into the soil per hectare will promote such solutions, as only they deliver measurable results.
- **PL9_increase** the emphasis on reliable information about biogas plants
- **SL4_**
 1. Establish Biomass Monitoring and Valorization Systems
 2. Foster Integration Among Niche Actors
 3. Streamline Regulatory Processes
 4. Build Public Trust and Stakeholder Engagement
 5. Provide Bridge Funding for Technology Scale-Up



Long-Term Strategic Actions

- **PL1**_Establishing a strategy for bioeconomy that fits into the Polish Energy Policy until 2040;
- **PL1**_Establishing a national centre for agricultural emissions
- Simplification and liberalization of regulations regarding the management of agricultural biomass, biodegradable waste, and energy production.
- **PL4**_Reducing the monopoly of major energy suppliers, improving transmission network capacity, and developing energy storage technologies.
- **PL4**_Subsidizing the construction of installations that process biomass in unconventional ways, such as through pyrolysis or heat recovery from compost.
- **PL6**_Creation of local/municipal bioeconomy centers that operate practically and fulfill production and educational functions for local communities from the youngest to the oldest generation.
- **PL6**_Introduction of bioeconomy elements in educational programs at every level of education.
- **PL7**_Development of a national accreditation and standardization system for bioproducts, including indicators of their effectiveness and environmental impact
- **PL7**_Establishment of a national investment fund for the bioeconomy
- **PL7**_Introduction of a mandatory bioeconomy component in secondary and higher education curricula
- **PL7**_Implementation of long-term incentive systems (e.g. taxes, credit schemes) for farms and businesses adopting biological and precision technologies
- **PL7**_Engagement of the third sector to identify needs, connect them with innovations, and support implementation
- **PL9**_Assess the potential of the country, each voivodeship, county, commune in terms of biomass resources, the nature of this biomass and its potential development.
- **SL4**
 1. Develop and Institutionalize Circular Bioeconomy Clusters
 2. Incentivize High-Value Valorization Before Energy Use
 3. Strengthen Market Demand for Bio-Based Products
 4. Institutional Support for Public Education and Awareness
 5. Create Tailored Financial Instruments for SME

Strategic Assessment Results for Regenerative and Precision Agriculture: Expert-Based SWOT-TOWS Analysis and Recommended Actions

Results based on expert SWOT - TOWS analyses regarding regenerative and precision agriculture

SWOT Analysis (regenerative agriculture - precision agriculture)

Experts PL 2-5, 10, 13 **sustainable intensification agriculture (regenerative - precision - organic)**

Table 21. SWOT Analysis based on the example of Poland applicable to other BIOEAST countries

Strengths (S)	Weaknesses (W)
High research and development potential - innovation potential of Polish companies; development of national and regional R&D initiatives for bioproducts and innovations in agriculture.	Limited availability of local biomass resources
Horticulture is a leader in adopting biological solutions	Competition from global suppliers of new biological solutions
Expertise of industry leaders - strong human capital	Limited number of technologies suitable for use in small farms
Infrastructure for testing and disseminating new technologies	High entry and maintenance costs of technology for smaller farms
High potential for land management with forest-pasture systems	Consolidation in the agri-food market
High potential for waste management for feed purposes	"Brain drain"
Significant area of organic soils for grazing purposes	Land ownership restrictions, definitions of permanent grassland areas eligible for CAP payments subject to agro-environmental measures
Increased awareness of soil and water protection as a result of implementing the principles of conditionality and available instruments in eco-schemes	Sanitary restrictions
Growing awareness of farmers in the area of the role of trees, wastelands, field margins and buffer strips	Conversion of permanent grassland areas on organic soils to maize cultivation (irreversible degradation of rotten soils)
Production of fertilizer products rich in organic carbon	Rigid adherence to the rules (EU, MinAgri) is associated with decline in intuitively applied practices according to farmer observations
Interest from farmers and entrepreneurs	
Rapid technology adoption at the level of large farms	Low level of digital skills among some farmers
High alignment with the objectives of European Commission strategies	Fragmentation of solutions - lack of interoperability between devices and platforms

Easily measurable effects (savings in fertilizers, pesticides, fuel)	Weak advisory support combining technical and agronomic aspects
Integration with agricultural machinery	Poor integration with current CAP tools (e.g., eco-schemes)
High scalability of solutions	Lack of specialized staff in the young generation
Increased synergies and competence in agricultural biotechnology and precision farming technologies among farmers and advisors.	Insufficient cooperation between science and agricultural practice (low knowledge transfer).
The potential of domestic biomass and biowaste production for use in biotechnology systems.	High investment costs in precision farming equipment.

Table 22. SWOT Analysis based on the example of Poland applicable to other BIOEAST countries

Opportunities (O)	Threats (T)
New categories of biological products, such as nitrogen-fixing bacteria and soil activators - development of the bioproduct market.	Lack of trust in some new solutions on the market
Sustainable horticulture will be well perceived by consumers	Low profitability of production will limit the purchasing power of farms
Close collaboration between science and leaders in horticultural production	Instability of national and EU regulations
The large efficiency gap in Polish agriculture creates space for innovation	Dispersed institutional responsibility and lack of unified sectoral strategies
Development of low-emission agriculture and low-energy technologies in the EU	Illusory and contradictory climate, environmental and economic goals in the EU.
Expectations of strong competitiveness and development in pursuit of the EU's green transformation	Draghi report is a dead end for EU development. The model of common interests does not work.
Consumers expect healthy and safe food - increased consumers interest for organic food	"There is a farmer, there is food" - business as usual, without a strategy for transformation
Growing need to adapt to market requirements in the area of innovation in livestock buildings (management of animal manures, separation processes, fermentation) and in the field (applications reducing losses)	Technology costs
Mixed-profile farms use manure and their own feed (savings)	High costs of simplified cultivation, construction of biogas plants. Discouragement of extensive cultivation or organic production (high emission/product)
Opportunity to develop animal production	Labor intensity, significant costs of supporting their development (high transaction costs for a large number of beneficiaries)
Supply of devices and software for precision farming in plant and animal production	Restrictions on methane emissions, N and P water pollution, social conflict in the case of large farms
Very large biomass resources available for these technologies	Costs, licensing restrictions, poor cooperation of farmers in sharing innovation

Reduced use of conventional agricultural inputs	The use of biomass contaminated with plastic and heavy metals
Numerous financing mechanisms	Excessive allocation of agricultural land to energy crops
Increasing EU and national financial support for agricultural digitization - Availability of EU funds for investments in precision agriculture, digitalization, and bio-based solutions.	Widening technological gap between large and small farms
Growing importance of sustainable/regenerative farming	Resistance from traditional sectors
Projected growth of the satellite and AI-based services market in agriculture	Difficulties in verifying environmental outcomes
Ongoing generational shift in agriculture	Scepticism among some farmers regarding innovative solutions and the long-term effects of biologicalization.
Increase in public-private R&D partnerships	Price competition from cheap, mass-produced chemical products.
The Common Agricultural Policy promotes environmental initiatives, such as Eco-Schemes.	Risk of greenwashing - the appearance of ineffective or untested bioproducts on the market.



TOWS Analysis (Threats-Opportunities-Weaknesses-Strengths)

The TOWS analysis facilitates the development of action strategies based on the strengths and weaknesses, opportunities, and threats identified in the SWOT analysis. It encourages the integration of internal factors (strengths and weaknesses) with external factors (opportunities and threats) in order to generate strategic options. Four strategic approaches are defined:

- Utilize your strengths to capitalize on opportunities (SO)
- Overcome weaknesses by leveraging opportunities (WO)
- Use your strengths to avoid threats (ST)
- Minimize weaknesses and avoid threats (WT)

Based on the SWOT analysis conducted by you and the identified internal and external factors, we kindly request you to indicate potential strategic actions that may be undertaken within the framework of each approach.

Table 23. SWOT Analysis based on the example of Slovakia applicable to other BIOEAST countries

TOWS Matrix	Strategic Actions examples
SO (Strength-Opportunity) Strategies	SK5 Scale demo farms to access CAP eco-scheme funding and Horizon Europe Living Lab support SK5_Use strong field-level data from pioneers to shape CAP and policy dialogue on soil-focused schemes
WO (Weakness-Opportunity) Strategies	SK5 Build a national advisory system and training network to support regenerative transition and access new funding tools Integrate regenerative agriculture practices into national climate and soil action plans to strengthen legitimacy
ST (Strength-Threat) Strategies	SK5 Promote measurable ecosystem outcomes from pilot farms (carbon sequestration, water retention) to counteract policy inertia Use demonstration impact to influence certification system development and ensure future subsidy alignment
WT (Weakness-Threat) Strategies	SK5 Advocate for national recognition of regenerative agriculture in CAP Programming and policy documents Develop and promote standard soil health monitoring tools to bridge gaps in metrics and support reward mechanisms

Table 24. SWOT Analysis based on the example of Slovenia applicable to other BIOEAST countries

TOWS Matrix	Strategic Actions examples
SO (Strength-Opportunity) Strategies	SL2_Strategic allocation of CAP funds for green transition and sustainable development for enhancing soil health making farming systems more resilient to climate shocks, pests, and diseases, thus reducing production risks. SL2_Implementing innovative technologies from international partnerships for better utilization of livestock manure, arable production residues and cover crops in biogas production.
WO (Weakness-Opportunity) Strategies	SL2_Investing in digital infrastructure and precision farming can mitigate difficulties in farming practices in areas with natural constrains. SL2_Cooperation of farmers for joint purchase of equipment can overcome financial obstacles. SL2_Digital infrastructure and new technologies for traceability can enhance collection of agricultural residues at small landholdings. Larger quantities can than be used at biorefineries like biogas plants.



ST (Strength-Threat) Strategies	<p>SL2_Leveraging European funds for the generational renewal of Slovenian agriculture - young farmers will more quickly adopt sustainable agricultural practices such as regenerative agriculture and smart farming.</p> <p>SL2_Improve public perception of the importance of biogas plants. Better public support means a higher likelihood of the state providing funds for the development of biogas plants. Improved operation of biogas plants increases the utilization of agricultural by-products.</p>
WT (Weakness-Threat) Strategies	<p>SL2_We need clear national priorities for transition from conventional farming methods to regenerative agriculture and the establishment of supportive infrastructure (e.g., supply chains for inputs, markets for regenerative products) for sustainable (ESG framework) agricultural practices.</p> <p>SL2_Support mechanisms for adopting precision farming methods that are suitable for the specific Slovenian agricultural environment (aging farming population, small farm sizes, and high initial investment costs).</p>

Recommendations and Strategic Actions

Immediate Actions (Short-Term Priorities) [SWOT Analysis based on the example of chosen countries applicable to other BIOEAST countries]

- Expanding instruments to include incentives for biotechnology-based agriculture, e.g. increasing the budget for eco-schemes.
- Creation of **CAP-supported measures** (eco-schemes, interventions, or investments) that contribute to the increased use of digestate, biochar, and compost for carbon farming purposes.
- Subsidies for the purchase of digestate, biochar, and compost.
- Payments based on the amount of organic carbon incorporated into the soil per hectare will promote such solutions, as only they deliver measurable results.
- Expansion of instruments to include incentives for agriculture based on new digital technologies.
- Recognition of precision agriculture as a tool for achieving the environmental goals of the Common Agricultural Policy.
- Creation of a catalogue of precision agriculture tools available on the market and aligned with the circular bioeconomy.
- Establishment of an open, national standard and repository for agricultural data.
- Development of **digital tools** facilitating origin communication (QR, storytelling, video, smart labels).
- **Digitalization** for biomass management, optimizing its use, reliably assessing environmental impacts based on **high-quality data**.
- Development of a national bioeconomy development strategy.
- Promotion of **local partnership** models (farmers - processors - logistics - consumers) based on trust and data.
- Creation of local centers for integration and innovation in agriculture within local government and advisory structures.
- **Education** and awareness building.
- Implementation of **training and advisory** programs on biologization and biomaterial management at the local level.
- Expansion of training and technological advisory systems.
- Establishment of **demonstration** farms showcasing biologization and precision farming in practice.
- Supporting pilot and demonstration projects for the implementation of bio-based solutions in horticulture.
- Training for agricultural advisors and local leaders in traceability, blockchain technology, and product promotion. Supporting local solutions, supporting agrophotovoltaics, wind farms, the biogas sector, technologies for the production and use of lignocellulosic biomass,



including in forest-pasture systems, supporting the modernisation of livestock buildings that increase animal welfare and production efficiency, introducing incentives for animal production (beef cattle, dairy and beef cattle, sheep) on a small and medium scale in compliance with environmental protection and welfare standards.

- Development of a **certification** and evaluation program for bioproducts.
- Launch of pilot food passporting programs in bioeconomy regions, with farmers, processors, and SMEs.
- Information campaigns targeted at consumers and producers on the benefits of chain transparency and bio-products.
- Include regenerative agriculture practices explicitly within CAP eco-schemes by recognizing no-till, cover cropping, intercropping, and adaptive grazing as qualifying measures.
- Launch national training and advisory programs to build capacity for farmers and advisors on regenerative practices, linked to real-life demo farms and peer-learning events.
- Fund demonstration and Living Lab activities that monitor and showcase regenerative systems' impacts on soil health, biodiversity, and water retention.
- Develop practical soil monitoring tools and protocols (e.g., for soil organic carbon, water infiltration, biodiversity) that can be used by farmers and advisors to track outcomes.
- Promote field-level evidence through public awareness and policy workshops to bridge the science-policy-practice gap and accelerate recognition of successful models.
- Targeted Allocation of CAP Funds: Implement a strategic allocation of Common Agricultural Policy (CAP) funds to specifically support green transition and sustainable development. This should prioritize initiatives that enhance soil health, a cornerstone of regenerative agriculture, making farming systems more resilient to climate shocks, pests, and diseases, thereby reducing production risks
- Pilot Projects for Regenerative Agriculture: Launch pilot projects and demonstration farms across diverse Slovenian agricultural regions to showcase successful regenerative agriculture practices. These initiatives will serve as living laboratories and educational hubs, demonstrating the practical benefits and feasibility of these methods
- Digital Literacy and Training Programs: Develop and implement targeted digital literacy and training programs for farmers, especially the aging population, to enhance their understanding and adoption of precision farming technologies. These programs should be practical, accessible, and tailored to the specific needs and challenges of small farm sizes
- Establishment of Farmer Cooperatives for Equipment: Facilitate and incentivize the formation of farmer cooperatives for the joint purchase and shared use of high-cost precision farming equipment. This mechanism will directly address financial obstacles and make advanced technologies more accessible to smaller holdings.

Long-Term Strategic Actions [SWOT Analysis based on the example of chosen countries applicable to other BIOEAST countries]

- Establishing a national bioeconomy HUB to facilitate cooperation between research, industry, institutions, and farmers.
- Creating knowledge transfer centers that take into account market needs defined at the farm level.
- Including the bioeconomy as a key pillar in the development of sectoral strategies, e.g. for horticulture.
- Establishment of a national intersectoral bioeconomy center, commercialization of research institutes, establishment of a strategic center for government analyses (use of American solutions, JRC, etc.), financing of renewable energy sources, bioeconomy and protection of resources for food production as priorities of Polish national security.
- Evaluation and update of the agricultural digitalization strategy, incorporating bioeconomy and EU climate goals.
- Adaptation of agricultural education systems to new competencies (data, AI, agronomic modeling, bioeconomy).



- **Establishment of an institutional partnership: Bioeconomy-Digitalization-Agriculture.**
- **Development of a national accreditation and standardization system for bioproducts, including indicators of their effectiveness and environmental impact.**
- **Establishment of a national investment fund for the bioeconomy.**
- **Introduction of a mandatory bioeconomy component in secondary and higher education curricula.**
- **Building thematic consortia for the development of "Living Labs" focused on the digitization and promotion of bioproducts.**
- **Implementation of long-term incentive systems (e.g. taxes, credit schemes) for farms and businesses adopting biological and precision technologies.**
- **Engagement of the third sector to identify needs, connect them with innovations, and support implementation.**
- **Harmonizing digital passport standards with quality systems (BIO, PDO, PGI, etc.) and integrating them with European interoperability platforms.**
- **Supporting the development of digital infrastructure for traceability and blockchain at the regional level (including data infrastructure, sectoral clouds, and open APIs).**
- **Incorporating passporting and digital promotion technologies into national bioeconomy strategies and CAP strategic plans.**
- **Creating mechanisms to encourage SMEs to implement digital solutions (e.g., innovation vouchers, purchasing preferences in public procurement).**
- **Collaborating with the education sector to incorporate content on passporting, communication, and traceability into agricultural and food education curricula.**
- **Establish a national framework for the recognition and certification of regenerative agriculture, aligned with EU Soil Mission, carbon farming mechanisms, and ecosystem service markets.**
- **Create a permanent Living Lab for healthy soils in cooperation with research institutions, farmers, and policy makers, serving as a testing and policy-feedback platform.**
- **Integrate regenerative agriculture indicators into CAP monitoring and evaluation systems, including soil health metrics, biodiversity, and carbon storage.**
- **Develop long-term financing instruments for system-level transition (e.g., multi-year contracts, carbon credit mechanisms, ecosystem service payments).**
- **Promote regional cooperation and knowledge transfer through EU missions and projects (e.g., Best4Soil, Soil Mission, Soil-X-Change) to align Slovak efforts with European best practices.**
- **Clear National Priorities for Regenerative Agriculture: Establish clear national priorities and a defined roadmap for the transition from conventional farming methods to regenerative agriculture. This includes setting specific goals, developing supportive infrastructure (e.g., supply chains for regenerative inputs, markets for regenerative products), and integrating an ESG (Environmental, Social, Governance) framework into agricultural practices.**
- **Investment in Robust Digital Infrastructure: Make significant investments in robust digital infrastructure across rural areas, including high-speed internet connectivity. This is fundamental for the widespread adoption of precision farming technologies, especially in areas with natural constraints, enabling data-driven decision-making and efficient resource management.**
- **International Partnerships for Innovative Technologies: Foster and leverage international partnerships to implement innovative technologies for better utilization of agricultural by-products. This includes exploring advanced methods for processing livestock manure, arable production residues, and cover crops into biogas, thereby increasing the circularity of agricultural systems.**
- **Traceability and Residue Collection Systems: Develop and implement digital infrastructure and new technologies for enhanced traceability in the agricultural supply chain. This will facilitate the efficient collection of agricultural residues from small landholdings, enabling larger quantities to be aggregated and utilized in biorefineries like biogas plants.**
- **Support Mechanisms for Precision Farming Adaptation: Design and implement support mechanisms for adopting precision farming methods that are specifically suitable for the Slovenian agricultural environment. This includes addressing challenges posed by an aging**

farming population, small farm sizes, and high initial investment costs through tailored financial incentives, accessible technology solutions, and continuous technical support.

Strategic Assessment Results for Bioprocessing and Biomaterials: Expert-Based SWOT-TOWS Analysis and Action Priorities

Table 25. Results from Polish Experts bioprocessing biomaterials - SWOT Analysis

Strengths (S)	Weaknesses (W)
Strong expertise in academic community, especially in the STEM academic disciplines	Small number of researchers
Flexible academic community connected with experts in the field of bioeconomy worldwide	Highly-educated and skilled experts going abroad for better research environments and life quality
Study programmes devoted to prepare highly skilled and employable experts in the bioeconomy, IPT and TT	Rigid and long-term legal frameworks for adapting and improving study programs, as well as introducing new study programs
Start-ups and SMEs in the field of ICT and biotechnology/bioeconomy strongly engaged in so-called big EU projects	Education programs for starting and running successful businesses need significant improvements, the state apparatus should provide more support to (potential) entrepreneurs.
High research and development potential	Limited availability of local biomass resources
Horticulture is a leader in adopting biological solutions	Competition from global suppliers of new biological solutions
Expertise of industry leaders	Limited number of technologies suitable for use in small farms
Infrastructure for testing and disseminating new technologies	
Well-developed biomass energy processing technology	A small number of installations in the country.
High energy efficiency	Transporting biomass over long distances is unprofitable.
Production of fertilizer products rich in organic carbon	Not all locations are suitable for installing such units.
Interest from farmers and entrepreneurs	The electricity grid is not adapted to distributed energy sources.
Well-developed biomass energy processing technology	A small number of installations in the country.
High potential of biomass of agricultural and forest origin	Lack of specialized staff among the young generation of scientists
High research and development potential	Lack of domestic technologies for conversion and cascading use of biomass
High potential of post-production residues unsuitable for food and feed purposes	Lack of technological solutions and staff for insect breeding
High potential of biomass of agricultural and forest origin	Lack of specialized staff among the young generation of scientists
Strong R&D Potential	Lack of specialized staff in the young generation

Increased knowledge and competence in agricultural biotechnology and precision farming technologies among some farmers and advisors.	Insufficient cooperation between science and agricultural practice (low knowledge transfer).
The potential of domestic biomass and biowaste production for use in biotechnology systems.	High investment costs in precision farming equipment.
Development of national and regional R&D initiatives supporting the production of bioproducts and innovations in agriculture.	Lack of standardization and certification of many bioproducts - a problem with confidence in their effectiveness.
Synergy between precision farming and biotechnology - the possibility of precise application of biopreparations, which increases their effectiveness.	Fragmented regulations regarding the use of bioproducts in agriculture.

Opportunities (O)	Threats (T)
Exploitation of biomass from land, coastal areas and the sea, and support of such new business models Forming new and sustainable value chains	Inflexibility in business thinking/making, lack of support of the state apparatus, lack of investments Poor recognition and low acceptance of bio-based products and services by the end consumer
Better cooperation between academia, start-ups, SMEs, brand owners, decision makers, NGOs, and all other stakeholders in society	Misalignment of business transparency, IPR, TT, and other legal frameworks with the support and functioning of new value chains
Preserving biodiversity in the Republic of Croatia and increasing the quality of life in all its segments	Acceptance and use of biodiversity and natural resources as a source of income, but not as a basic prerequisite for survival and maintaining the quality of human life
New categories of biological products, such as nitrogen-fixing bacteria and soil activators	Lack of trust in some new solutions on the market
Sustainable horticulture will be well perceived by consumers	Low profitability of production will limit the purchasing power of farms
Close collaboration between science and leaders in horticultural production	
Biomass availability all year round	High cost of adapting infrastructure
Possibility of storing it in various forms	Social resistance in the case of biogas plants
Use of post-production residues unsuitable for food and feed purposes in insect breeding	Society's reluctance to insect products
Biomass availability all year round	High cost of adapting infrastructure
Possibility of storing it in various forms	Social resistance in the case of biogas plants
Use of post-production residues unsuitable for food and feed purposes in insect breeding	Society's reluctance to insect products
Biomass availability all year round	High cost of adapting infrastructure
The Common Agricultural Policy promotes environmental initiatives, such as Eco-Schemes.	Scepticism among some farmers regarding innovative solutions and the long-term effects of biologicalization.
Increased consumer interest in organic food.	Price competition from cheap, mass-produced chemical products.
Availability of EU funds for investments in precision agriculture, digitalization, and bio-based solutions.	Risk of greenwashing - the appearance of ineffective or untested bioproducts on the market.
Development of the bioproduct market.	

Table 26. TOWS matrix

TOWS Matrix	Strategic Actions examples
<p>SO (Strength-Opportunity) Strategies</p>	<p>Croatia Deploy CAP-funded biomass hubs Launch carbon farming initiatives</p> <p>Poland Leveraging a strong research and development position in collaboration with horticultural production leaders to develop needed in horticulture The use of available fermentation, pyrolysis, and composting technologies would harness Poland's virtually limitless biomass resources to generate additional energy. The use of fertilizer products rich in organic carbon would improve soil quality and reduce the use of conventional agricultural inputs. Use of post-production residues unsuitable for food and feed purposes in insect breeding to popularize a new direction of activity in the country <u>PL7</u> <u>S</u> - The potential of domestic biomass and biowaste production for use in bio-agriculture systems. > <u>Q</u> - Availability of EU funds for investments in precision agriculture, digitalization, and bio-based solutions. <u>S</u> - Increased knowledge and competence in the field of bio-agriculture and precision agriculture technologies among some farmers and advisors. > <u>Q</u> - The Common Agricultural Policy promoting environmental initiatives, such as Eco-schemes. <u>PL8</u> • Leveraging our extensive research and development infrastructure and fermentation expertise to rapidly develop and implement products such as PHAs and biosurfactants, meeting growing market and regulatory demands. • Creating research and industrial consortia that will leverage existing technical resources to apply for national and EU funding to support the development of bioproducts from agricultural waste.</p> <p><u>PL14</u> Bottom-up strategy definition + CAP integration = Creating local bioeconomy strategies aligned with CAP instruments, strengthening regional initiatives. Growing awareness of the circular economy + Development of bioproduct markets = Promoting high-value bioproducts among informed consumers and decision-makers. Bottom-up approach + EU support for bioinnovation = Initiating innovative projects with the participation of local stakeholders, supported by EU funds.</p> <p>Slovakia <u>SK1</u> Bottom-up strategy definition + CAP integration = Creating local bioeconomy strategies aligned with CAP instruments, strengthening regional initiatives. Growing awareness of the circular economy + Development of bioproduct markets = Promoting high-value bioproducts among informed consumers and decision-makers. Bottom-up approach + EU support for bioinnovation = Initiating innovative projects with the participation of local stakeholders, supported by EU funds.</p> <p>Slovenia</p>



SL1

- Use participation in EU platforms (S-RDI3) and green public procurement (S-IPF4) to support integration of biobased products into key export sectors (O-CBP2).
- Leverage sustainably managed resources (S-BS1) and forest/aquatic productivity to support circular bioeconomy principles in national strategies (O-IPF3, O-IPF1).
- Promote innovation among early adopters and firms active internationally (S-CBP1) to drive uptake of bio-based materials in response to social and market demand (O-CBP2, O-IPF1).

SL3

- Leverage the strong bioeconomy presence in manufacturing (S-BS4) and forest resource potential (S-BS2) to boost export-oriented sectors (O-CBP2).
- Use sustainable biomass base (S-BS1) and green public procurement (S-IPF4) to support wider economic shifts towards circular and low-carbon economy (O-IPF1, O-IPF3).
- Connect existing manufacturing capabilities and biomass availability (S-BS4, S-BS1) with R&D knowledge from the wood and paper industries (O-RDI1) to stimulate higher-value processing.
- Promote green procurement policies (S-IPF4) to support the adoption of biobased products in public construction and procurement markets (O-CBP2).

SL4

- Leverage the vibrant startup ecosystem (S-BVC2) and strong manufacturing interest (S-BVC1) to develop and scale innovative biogas and digestate valorization technologies that support energy security and rural development (O-IPF5, O-CBP1).
- Utilize abundant agrifood waste and strong organic waste logistics (S-BS3) to meet rising consumer demand for bio-based products (O-CBP2) and reduce fossil dependence (O-IPF5).
- Channel R&D spin-offs and infrastructure (S-BVC2) to capitalize on positive consumer perception and price competitiveness of biogas alternatives (O-CBP1).

SL5

- Leverage public R&D participation (S-RDI3) and strategic partnerships (S-RDI2) to support national commitments for knowledge-based bioeconomy development (O-BVC2).
- Use strong R&D and innovation environment (S-BVC2, S-RDI2) to establish networks of modular biorefineries (O-BVC4), promoting local circular models.
- Utilize organized organic waste systems (S-BS3) to create regional loops (O-BVC4) and integrate local2local supply chains.
- Promote spin-offs from research institutions (S-BVC2) aligned with increasing demand for sustainable solutions (O-CBP1).

**WO (Weakness-
Opportunity)
Strategies**

Croatia

Invest in training programs for farmers
R&D commercialization

Poland

Utilizing and enhancing biomass sources from other economic sectors
Increasing the number of installations in the country due to available financing mechanisms.
The unprofitability of transporting biomass over long distances can be addressed by using only locally available biomass or by growing additional crops for energy purposes.



The choice of location may also depend on the local availability of biomass.

The electricity grid is not adapted to distributed energy sources, therefore, installations should be installed near facilities that can directly consume this energy, such as large farms with processing plants.

Investment in training programs aimed at solving the problem of staff shortages in bioeconomy sectors, including insect breeding
PL7 W - Lack of standardization and certification for many organic products - a problem with confidence in their effectiveness > O - Increased consumer interest in organic food

W - Lack of standardization and certification for many organic products - a problem with confidence in their effectiveness > O - Availability of EU funds for investments in precision agriculture, digitalization, and bio-based solutions.

PL8 • Implementing training programs and workshops for farmers and local biorefinery operators to increase awareness and acceptance of bioproducts and enhance technical competence.

• Use of public funds (e.g., FENG, WPR, KPO) to co-finance the construction of processing infrastructure and technology demonstrators (DES, biorefineries), reducing barriers to market entry.

PL14 Lack of an integrated strategy + Integration with the CAP

= Development of a coherent national strategy based on new CAP instruments and EU funds.

Dispersion of competences + EU support for transformation

= Creation of a platform for inter-ministerial and institutional cooperation, supported by the EU.

Low farmer awareness + Development of bioproduct markets

= Educational and demonstration campaigns demonstrating the benefits of the bioeconomy for farmers.

Limited access to infrastructure + EU support

= Application for EU funds for infrastructure development (e.g., biorefineries, laboratories).

Slovakia

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Slovenia

SL1 Align public RDI funding priorities (W-IPF1, W-IPF3) with bioeconomy content already present in strategic documents (O-IPF3) to strengthen policy support.

• Use wider bioeconomy and circular economy context (O-IPF1) to address poor integration of business into biorefinery and cluster development (W-BVC2).

• Respond to international demand in export sectors (O-CBP2) by improving feedback between RDI and industry (W-RDI3) and building stronger innovation pipelines.

SL2

• Improve wood processing and value-addition (W-BS2) by mobilizing know-how from traditional industries (O-RDI1) and aligning with Smart Specialisation priorities (O-IPF3).



- Use wider circular economy goals (O-IPF1) and international market demand (O-CBP2) to strengthen the strategic role of bioeconomy in RDI funding (addressing W-IPF3).
- Promote better economic feedback loops into RDI (W-RDI2) by aligning innovation calls with industrial cluster needs and new export opportunities (O-CBP2).

SK4

1. Strengthen systemic monitoring of biomass (W-BS3) and improve side-stream data infrastructure to unlock higher-value valorization and support biogas-linked rural job creation (O-IPF5, O-CBP2).
2. Foster integration of niche operations (W-BVC3) to form regional hubs that support scaling of biomethane production and digestate upcycling (O-CBP2).
3. Invest in TRL 3-6 scale-up support (W-RDI3) to capitalize on increasing market demand and favorable economic trends for bio-based energy (O-CBP1).

SL5

- Support fragmented value chains (W-BVC1) through macro-regional cooperation platforms (O-BVC3) for knowledge and resource pooling.
- Use national strategic commitments (O-BVC2) to enhance financial leverage (W-BVC4) via targeted incentives and funding schemes.
- Promote modular biorefineries (O-BVC4) as a response to small-scale processing issues (W-BVC1), improving processing infrastructure.
- Leverage rising demand for biobased products (O-CBP1) to justify investment in closing the productivity gap in agriculture (W-BS1).

ST (Strength-Threat) Strategies

Croatia

Policy-resilient bioenergy - avoiding food-fuel competition

Apply sustainability criteria create price-stable alternatives for fossil fuels.

Poland

Utilizing financing mechanisms to reduce market risk for entities testing and implementing biological solutions in field conditions

High energy efficiency could encourage energy suppliers to invest in such installations. Interest from farmers and businesses could lead to the allocation of some agricultural land to energy crops, which would increase the profitability of agriculture.

Using the research and development potential to create new domestic technologies for conversion and cascading use of biomass, including insect breeding

PL7 S - Development of national and regional R&D initiatives supporting the production of bioproducts and innovations in agriculture. >

T - Price competition from cheap, mass-produced chemical products.

S - Synergy between precision agriculture and biotechnology - the ability to precisely apply bioproducts, which increases their effectiveness. > T - Skepticism among some farmers regarding innovative solutions and the long-term effects of biotechnology.

PL8 • Active participation in legislative processes and consultations (e.g., regarding biobased certification), drawing on a strong scientific and expert base to promote transparent regulations for bioproducts (which we are beginning to do at the HUB).

- Creating regional biorefinery models based on distributed biomass sources that leverage fermentation and extraction know-how to minimize raw material and logistical risks.

PL14 Growing awareness of circular economy + Risk of marginalization of the bioeconomy

= Building social and political support for the bioeconomy as a key element of the transformation.

Defining strategies from the bottom up + Regulatory instability

= Creating local strategic documents as stable reference points in a changing legal environment.

Slovakia

SK1 Growing awareness of circular economy + Risk of marginalization of the bioeconomy



= Building social and political support for the bioeconomy as a key element of the transformation.

Defining strategies from the bottom up + Regulatory instability

= Creating local strategic documents as stable reference points in a changing legal environment.

Slovenia

SL1

- Use green procurement (S-IPF4) to stabilize demand and reduce exposure to unfavourable price-cost ratios (T-CBP2).
- Leverage EU project participation (S-RD13) to address technological dependence and intellectual property limitations (T-RD13).
- Mobilize sustainably managed biomass resources (S-BS1) to reduce vulnerability to external competition and climate-related resource uncertainty (T-BVC3, T-IPF1).

SL3

- Use Slovenia's forest abundance and bioeconomy integration (S-BS2, S-IPF4) to increase resilience to supply disruptions caused by climate change (T-BS1).
- Strengthen domestic biomass markets through demand-pull mechanisms (S-IPF4) to counter competition from better-capitalized regional players (T-BVC1).
- Position green procurement (S-IPF4) as a long-term national policy tool to keep bioeconomy relevant in the face of shifting political agendas (T-IPF1).

SL4

Use strong R&D pipelines and business interest (S-BVC2, S-BVC1) to develop scalable, cost-efficient solutions that attract SME participation and overcome investment barriers (T-BVC2, T-RD12).

2. Promote transparency and performance of biogas projects using strong logistics and feedstock availability (S-BS3) to counteract negative public opinion and greenwashing concerns (T-CBP1, T-CBP3).

SL5

- Apply knowledge from EU projects (S-RD13) to shape better coordinated policies and reduce legislative fragmentation (T-IPF1).
- Use organized waste systems and R&D-business links (S-BS3, S-RD12) to minimize risk from poorly sited plants (T-BVC4).
- Strengthen start-up ecosystem (S-BVC2) to attract capital and reduce the negative effect of high investment costs (T-BVC2).
- Promote successful EU practices to counteract sporadic national progress (T-IPF1).

WT (Weakness-Threat) Strategies

Croatia

Improve regulatory clarity to reduce policy-delay impacts

Create environment and climate-resilient biomass corridors to secure supply chains

Poland

Improving regulatory transparency and deregulation to support smoother adoption of solutions using waste biomass

The need to engage large entities in investing in such technologies as tenants and investors.

The need to limit the possibility of such investments being blocked by unjustified social resistance.

The need to subsidize less profitable technologies such as pyrolysis and composting.

Improvement of transparency and interpretation of regulations for entrepreneurs to support a smoother transition to solutions promoting cascading and multidirectional use of biomass

PL7 W - Fragmentation of regulations regarding the use of bioproducts in agriculture. > T - Risk of greenwashing - the appearance of ineffective or untested bioproducts on the market.

PL8 • Building a platform for cross-sectoral collaboration (agriculture, industry, and science) to jointly address regulatory, infrastructure, and financial challenges related to bioproducts.



- Implementing pilot and testing strategies (living labs) in rural settings to reduce uncertainty and avoid costly implementation errors while building trust with local stakeholders.
- PL14 Lack of strategy + Risk of marginalization
= Urgent development of a national bioeconomy strategy with the participation of key stakeholders.
Dispersion of competencies + Regulatory instability
= Consolidation of competencies within the inter-ministerial working group on bioeconomy.
Legal barriers + High infrastructure costs
= Proposals for legislative simplification and joint investments in infrastructure (e.g., clusters, PPPs).
- Slovakia**
- SK1 Lack of strategy + Risk of marginalization
= Urgent development of a national bioeconomy strategy with the participation of key stakeholders.
Dispersion of competencies + Regulatory instability
= Consolidation of competencies within the inter-ministerial working group on bioeconomy.
Legal barriers + High infrastructure costs
= Proposals for legislative simplification and joint investments in infrastructure (e.g., clusters, PPPs).
- Slovenia**
- SL1
- Strengthen national strategies and RDI investment frameworks (W-IPF1, W-IPF3) to counter neglect of bioeconomy in public policy (T-IPF1).
 - Address high price-cost barriers (T-CBP2) by improving business integration and resource organization (W-BVC2, W-BS1).
 - Improve tech transfer mechanisms and demonstration-level infrastructure (W-RDI3) to respond to competitive threats and reduce dependence on foreign IP (T-BVC3, T-RDI3).
- SL3
- Support local biomass organization models to counter fragmented supply issues (W-BS1) and climate-induced risks (T-BS1).
 - Advocate for long-term policy consistency to secure sustained RDI funding and sectoral visibility (W-IPF3) despite post-crisis shifts (T-IPF1).
 - Improve cost-efficiency in wood processing (W-BS2) to buffer against unfavorable cost ratios of bio-based alternatives (T-CBP2).
 - Bridge the gap between RDI and market by supporting scale-up and demonstration initiatives to face advanced competitors (T-BVC1).
- SL4
- Develop public awareness campaigns and stakeholder engagement strategies to rebuild trust (addressing W-IPF5, T-CBP3), showing the economic and environmental benefits of integrated biogas systems.
 - Streamline regulatory procedures and provide innovation funding to de-risk projects (W-IPF5) and facilitate the commercialization of advanced biorefinery tech (W-RDI3) to avoid stagnation and "valley of death" risks (T-RDI2).
 - Encourage cooperation between fragmented SMEs (W-BVC3) to improve resilience and jointly overcome high investment barriers (T-BVC2).
- SL5
- Develop risk-sharing financing tools to address low financial leverage (W-BVC4) and counteract high capital costs (T-BVC2).
 - Establish clearer land use and biomass coordination mechanisms to prevent market disruption (T-BVC4) caused by fragmented structures (W-BS1).
 - Advocate for a coherent policy framework (mitigating T-IPF1) that supports scalable, coordinated investment in bioeconomy



infrastructure (addressing W-BVC1 and W-BVC4). • Promote cost-efficient, locally adapted technologies to reduce exposure to poor price-cost ratios (T-CBP2) and limited industrial biomass availability (W-BS1).

Recommendations and Strategic Actions

Immediate Actions (Short-Term Priorities) [examples from countries]

Croatia

- Develop farmer-friendly digital templates for sustainability compliance;
- Launch Modular Biogas/Biomethane Grant Scheme;
- Establish Spatial-Driven Biomass Collection Clusters;
- Engage (strongly) decision makers (primarily the government, and all ministries) in the working groups engaged in formulation of legal documents, policies, strategies;
- Establish fully operative „governmental body” entitled to support and implement bioeconomy and circular economy, and coordinate all activities, documents, projects, initiatives in the field in the RH in close collaboration with EU bodies;
- Expand the existing working groups with strongly engaged decision makers, more experts from academia, more experts from GO and NGO, more stakeholders from all segments of value chains, especially primary producers;
- In strategies, policies, legal and other documents specify financial instruments and investments to be devoted to networking (kind of CSA projects), research, IPR, TT and implementation of novel and sustainable value chains;
- Develop data bases as a dynamic structure (with constant updating) consisted of mapped: (1) biomass resources (mainland, coast, islands and sea), (2) methods of transporting and storing biomass, (3) HEIs involved in the bioeconomy and circular economy; (3) start-ups, SMEs, brand owners in the field; (4) GOs and NGOs involved in promotion of bioeconomy, biobased products and services; (5) other stakeholders - representatives of end consumers and patients;
- Develop less rigid frame for introduction of new study programmes and topics in the HEIs in close collaboration with the academic community worldwide;
- Invest considerable amount of finances to promote bioeconomy in the society by using only scientific results and confirmed/proven data in order to bust the bioeconomy sector and preserve biodiversity.

Poland

- Expanding instruments to include incentives for biotechnology-based agriculture, e.g. increasing the budget for eco-schemes;
- Supporting pilot and demonstration projects for the implementation of bio-based solutions in horticulture;
- Creation of CAP-supported measures (eco-schemes, interventions, or investments) that contribute to the increased use of digestate, biochar, and compost for carbon farming purposes;
- Subsidies for the purchase of digestate, biochar, and compost;
- Payments based on the amount of organic carbon incorporated into the soil per hectare will promote such solutions, as only they deliver measurable results;
- Support for perennial plantations of industrial and energy plants due to the lack of ploughing for up to 20-30 years, soil carbon sequestration, reduced use of fertilizers and plant protection products;
- Support for perennial fruit crops (trees and shrubs) due to the lack of ploughing and soil carbon sequestration



- Support for projects related to the cascading and multidirectional use of lignocellulosic biomass towards the production of bioproducts with higher added value;
- Support for projects related to the breeding and multidirectional use of insect products;
- Development of a national bioeconomy development strategy;
- Implementation of training and advisory programs on biologization and biomaterial management at the local level;
- Establishment of demonstration farms showcasing biologization and precision farming in practice;
- Implementation of training and advisory programs;
- Development of a certification and evaluation program for bioproducts;
- Support for pilot projects for fermentation and local biorefineries using agricultural waste;
- Expanding CAP interventions to include technologies such as biopolymers (PHA, PLA), green solvents (DES), and enzymatic bioprocesses;
- Incorporating the bioeconomy into CAP interventions for farm modernization, for example, as a rewarding criterion in investment competitions.;
- Increasing the competences of agricultural advisors in the bioeconomy, for example, through training, educational materials, and expert support;
- Establishing a national contact point for the bioeconomy in agriculture as a center for knowledge and coordination of activities between ministries.

Slovakia

- Launch a national pilot initiative to demonstrate the environmental and agronomic benefits of biochar produced from household biowaste, including compost enrichment and soil application;
- Include biochar in circular economy programs and composting strategies, enabling its co-application with digestate, green waste, or organic fertilizers;
- Create public awareness campaigns and farmer training modules in cooperation with gardening associations, municipalities, and agro-advisory networks to boost demand and proper use;
- Initiate expert dialogue with the Ministry of Agriculture to integrate biochar into Slovakia's CAP Strategic Plan under eco-schemes or soil-improving practices;
- Support development of national guidelines for safe and efficient biochar application, drawing from EU Regulation 2019/1009 and international best practices;
- Include certified bio-fertilizers and soil biostimulants in CAP eco-schemes and agri-environmental support by recognizing their role in reducing chemical inputs and restoring soil health;
- Launch demonstration programs and Living Labs to support real-farm validation of microbial bioleaching products and foster peer-to-peer learning among farmers;
- Facilitate fast-track approval and certification procedures for bio-based products by creating advisory hubs and pilot testing protocols aligned with EU Regulation 2019/1009;
- Develop training and advisory services to transfer scientific findings to practical use, focusing on precision application methods and soil monitoring;



- Use public funding to support initial infrastructure development for precision application and bio-fertilizer deployment in rural areas;
- Expand CAP eco-schemes and agri-environmental measures to recognize the use of certified compostable bioplastics (e.g., mulch films, seedling trays) as environmentally beneficial inputs in agriculture;
- Support regional pilot projects involving municipalities, farms, and bioeconomy companies to demonstrate the viability of local collection and composting systems for bio-based agricultural inputs;
- Launch awareness and education campaigns targeting farmers, consumers, and public authorities to explain the benefits and handling of compostable, bio-based materials (e.g., EN 13432 certified vs. oxo-degradable products);
- Introduce small-scale innovation vouchers or grants to enable farms and rural SMEs to trial and validate bio-based agricultural solutions based on compostable polymers;
- Develop pilot demonstration buildings (e.g., rural housing, eco-tourism lodges, community centers) using hemp-wool insulation to showcase performance and circularity;
- Include bio-based insulation materials in national bioeconomy pilot programs, particularly within bioeconomy hubs focused on rural innovation and local material use;
- Support awareness-raising campaigns targeting architects, construction engineers, and local governments to promote healthy, compostable, and soil-returnable insulation options;
- Initiate collaboration with testing and certification institutions to begin material characterization (thermal, acoustic, compostability, biodegradability);
- Integrate sheep wool and hemp insulation into local green procurement schemes and advocate for inclusion in municipal renovation or public housing calls.

Slovenia

- Support implementation of algae systems into farm;
- Support research & development based on national need;
- Explore potential of algae systems advantages and circularity at the national level;
- Actions suggested to **integrate bioeconomy measures into the CAP and national bioeconomy regulations:**
 - Enlarge algae production and biomass utilisation for all purposes: food, feed
 - Include algae bioremediation and nutrient recycling where possible
 - Nutrient recovery from anaerobic digestate at biogas plants and farms
 - Production of algae biofuels (including biomethane) from biomass grown on wastewater
 - Establish Clear End-of-Waste Criteria for products from algae cultivated in wastewater
 - Harmonize Quality and Safety Standards
 - Provide Targeted R&D and Pilot Project Fundin
 - Integrate with Broader EU Initiatives
 - Use wider bioeconomy and circular economy context



- Strengthen cross-sector coordination mechanisms between forestry, wood processing, and related ministries to improve coherence and implementation of bioeconomy-related policies and funding (e.g. CAP, cohesion policy);
- Establish a national database and traceability system for wood flows to improve transparency and support data-driven policy;
- Support SME networks and clustering to facilitate technology transfer, collaborative R&D, and better access to high-value markets;
- Implement green public procurement rules that prioritize certified, locally sourced wood products with circular design features (eco-design, recyclability, etc.);
- Establish biomass monitoring and valorization systems - a recurring weakness identified is the absence of systemic monitoring of biomass flows, which undermines cascading utilization. A national biomass registry and digital tracking platform should be developed to quantify and classify agrifood side streams. This would enable policymakers and businesses to identify high-value valorization opportunities before biogas production and align practices with circular economy principles;
- Foster integration among niche actors - fragmentation in the sector leads to inefficiencies and missed opportunities. Immediate support should be directed toward forming local or regional “biohubs” where small-scale producers can aggregate feedstock and co-invest in shared pre-processing, biogas, or bio-refining infrastructure. Pilot projects should be launched in regions with high biomass density and existing organic waste logistics, serving as proof-of-concept for larger-scale replication;
- Streamline Regulatory Processes - lengthy and uncertain permitting significantly discourages investment in bioeconomy ventures. In the short term, a task force should be created to review and propose amendments to the regulatory framework for biogas and bio-based projects. Fast-track procedures for circular economy projects and clearer guidance for investors would help mitigate the threat posed by administrative inertia;
- Build public trust and stakeholder engagement - the success of biogas projects depends on public and political support. Public skepticism must be addressed through proactive communication strategies. This includes transparent reporting of project outcomes, environmental performance, and economic benefits. Government agencies, municipalities, and private actors should engage local communities early in project development to minimize resistance and avoid “Not-In-My-Backyard” (NIMBY) opposition;
- Provide bridge funding for technology scale-up - to avoid the “valley of death” between lab and market dedicated funding instruments should be established to support TRL 3-6 projects. Innovation grants and public-private partnerships can enable the demonstration of advanced biogas and digestate processing technologies, thus accelerating their commercialization;
- Expand eco-schemes to include incentives for bio-based agriculture - within CAP National Strategic Plan it is crucial to expand current eco-schemes and include financial incentives for bio-based agriculture. Eco-schemes are a relatively new, mandatory but flexible element of CAP Pillar I (direct payments). They are designed to incentivize farmers to adopt more environmentally friendly practices. This existing framework allows for relatively quick expansion or modification to include new eligible bio-based activities without requiring entirely new legislation. Expanding eco-schemes with bio-based incentives provides direct financial support to farmers, helping to offset the initial costs or perceived risks of adopting new, bioeconomy-aligned practices. This improves the financial viability of individual farms and encourages farmers participation. Expanding eco-schemes aligns with the CAP's principle of rewarding farmers for contributing to public goods, which directly includes environmental benefits derived from bio-based agriculture;

- Support pilot projects for biorefinery infrastructure and circular economy and bio-based solutions in agriculture - this immediate action directly addresses the crucial gap between research and commercialization, and de-risks future larger-scale investments. Pilot projects are essential because they allow promising lab-scale innovations (e.g., new methods to extract high-value compounds from fruit pomace, novel fermentation processes for vegetable waste) to be tested and validated at a larger, pre-commercial scale. A successful pilot project provides tangible proof of concept, demonstrating technical feasibility, economic viability, and environmental benefits. This significantly increases investor confidence and willingness to commit capital for commercial-scale facilities. Pilot projects can generate real-world data on operating costs, yields, and product quality, allowing for more accurate financial projections. This helps to overcome the "unfavourable price-cost ratios" often faced by novel bio-based products by showing how the technology can lead to competitive cost structures at scale. The EU (e.g., through the Innovation Fund, Just Transition Fund, and parts of the Recovery and Resilience Facility) explicitly supports pilot and demonstration projects for the bioeconomy and circular economy. Slovenia can tap into these funds to co-finance such initiatives, reducing the national financial burden. Slovenia's National Recovery and Resilience Plan (NRRP) already emphasizes green transition, circular economy, and R&D. For fruit and vegetable production, which is often dispersed and generates diverse residues, pilot projects can test integrated circular economy solutions - from innovative collection logistics (addressed by data mapping) to multi-feedstock biorefinery concepts. This helps to solve the "Limited Economies of Scale and Logistical Costs" by finding efficient ways to aggregate and process distributed biomass. The experience and data gained from pilot projects provide valuable insights for refining existing regulations and designing new, more effective policies. For example, understanding real-world challenges in biomass supply chains or new product safety requirements can inform future CAP interventions, waste management regulations, or permitting processes. Operating pilot facilities provides invaluable practical experience and skills development for engineers, technicians, and managers in the bio-based sector, building Slovenia's human capital in this emerging field. Successful pilot projects serve as inspiring examples for aspiring entrepreneurs and established companies, demonstrating what's possible and encouraging them to pursue bio-based business opportunities.

Long-Term Strategic Actions

Croatia

- National Bioeconomy Spatial Plan;
- Macro-Regional Biomass Corridors;
- CAP Digital Transformation Hub;
- Circular Bioeconomy Act;
- Invest considerable amount of money in lifelong learning, especially for the primary producers, but also for all stakeholders;
- Encourage the entrepreneurial spirit of young educated people and provide them with financial, administrative and other support;
- Constantly work on changing values in society.



Poland

- Establishing a national bioeconomy HUB to facilitate cooperation between research, industry, institutions, and farmers;
- Creating knowledge transfer centers that take into account market needs defined at the farm level;
- Including the bioeconomy as a key pillar in the development of sectoral strategies, e.g. for horticulture;
- Simplification and liberalization of regulations regarding the management of agricultural biomass, biodegradable waste, and energy production;
- Reducing the monopoly of major energy suppliers, improving transmission network capacity, and developing energy storage technologies. Subsidizing the construction of installations that process biomass in unconventional ways, such as through pyrolysis or heat recovery from compost;
- Creation of local/municipal bioeconomy centers that operate practically and fulfil production and educational functions for local communities from the youngest to the oldest generation;
- Introduction of bioeconomy elements in educational programs at every level of education;
- Development of a national accreditation and standardization system for bioproducts, including indicators of their effectiveness and environmental impact;
- Establishment of a national investment fund for the bioeconomy;
- Introduction of a mandatory bioeconomy component in secondary and higher education curricula;
- Implementation of long-term incentive systems (e.g. taxes, credit schemes) for farms and businesses adopting biological and precision technologies;
- Engagement of the third sector to identify needs, connect them with innovations, and support implementation;
- Establishing a national support program for bioproducts (certification, bio-based label, long-term subsidies);
- Building a network of regional biorefineries utilizing cascaded biomass processing;
- Integrating bioeconomy indicators into the CAP and climate policy monitoring system (e.g., the share of biomaterials in the local market);
- Development and implementation of a national bioeconomy strategy integrated with the CAP, taking into account agriculture, forestry, the food and chemical industries;
- Building regional bioeconomy hubs that support local value chains, innovation, and cross-sectoral cooperation;
- Development of certification and labeling systems for bio-based products → increasing consumer confidence and the market value of agricultural products;
- Integrating the bioeconomy with agricultural and vocational education.

Slovakia

- Establish a legal and certification framework for biochar in Slovakia, including its use in agriculture, compost, and carbon sequestration;
- Support the commercialization of modular pyrolysis units for decentralized deployment in rural areas, helping reduce organic waste and generate carbon-storing products;



- Integrate biochar into carbon farming schemes and soil health credit systems, enabling farmers and local governments to monetize climate and environmental services;
- Position Slovakia as a regional leader in sustainable biochar use, including participation in international demonstration projects (e.g., arid zone revitalization, degraded land restoration);
- Ensure long-term inclusion of biochar in national bioeconomy, soil, and waste management strategies, enabling funding alignment with Horizon Europe, LIFE, and cohesion funds;
- Create a national/regional registry of certified and field-tested bio-inputs to enhance trust, support public procurement, and align with carbon farming schemes;
- Establish funding mechanisms tailored to KET-driven bioeconomy SMEs, particularly those engaging in circular resource valorization and ecosystem service restoration;
- Promote regulatory harmonization and mutual recognition of standards across EU markets to ease market access for bio-fertilizers derived from waste and mining residues;
- Integrate soil health indicators into CAP monitoring systems, recognizing contributions of microbial and biostimulant inputs to long-term fertility, carbon content, and biodiversity;
- Support the development of carbon and ecosystem service markets where bio-fertilizer use can be monetized through credits for detoxification, carbon sequestration, and biodiversity gains;
- Establish a national support framework for industrial-scale biopolymer production and biobased material applications in agriculture and packaging, aligned with RIS3 and CAP strategic goals;
- Integrate bioeconomy materials like Nonoil® into the monitoring and evaluation systems of national CAP implementation (e.g., through sustainability indicators on plastic use reduction or soil health impacts);
- Co-finance composting and separation infrastructure in rural and semi-urban regions, including digital tracking of bioplastic flows, to ensure end-of-life processing of compostable agricultural materials;
- Strengthen Slovakia's representation in EU-level harmonization processes to secure legal clarity and unified certification standards (e.g., compostability, labeling) for bio-based and compostable materials.

Slovenia

- Policy and regulative development;
- Imply algae solutions in various sectors;
- Integrate with Broader EU Initiatives;
- Use wider bioeconomy and circular economy context;
- Create a supportive regulatory and institutional environment for circular bioeconomy innovations – including pilot projects in biorefining, engineered wood construction, and high-value wood products – by streamlining permitting procedures, ensuring policy coherence across sectors, improving market transparency, and fostering collaboration between R&D institutions and industry. Rather than relying solely on subsidies, efforts should focus on removing systemic barriers and strengthening demand through green public procurement, recognition schemes, and infrastructure planning;



- Invest in industrial-scale lignocellulosic biorefineries and modular wood-processing facilities, with a focus on integrating primary wood processing with high-value product streams (e.g. ethanol, bio-based chemicals, engineered wood). These investments should be guided and supported by a regulatory and institutional framework that prioritizes system-wide coordination, demand stimulation (e.g., green procurement), and innovation-driven industrial transformation;
- Promote integration into international value chains, especially in sectors with strong multiplier effects (e.g. pulp & paper, green chemistry, timber construction);
- Encourage the adoption of advanced digital tools (e.g. AI, modeling, optimization) for improved efficiency across the value chain, from forest management to processing and logistics;
- Enhance consumer awareness and acceptance through communication campaigns and education on the role of wood-based bio-products in achieving climate and sustainability goals;
- Develop and institutionalize Circular Bioeconomy Clusters - to ensure long-term resilience and competitiveness, Slovenia should foster the formation of integrated bioeconomy clusters. These should involve stakeholders across the value chain—from waste producers and technology developers to end-users and investors. Clusters can promote cooperation, support skills development, and anchor innovation ecosystems that drive the biogas and broader bio-based industry forward;
- Incentivize high-value valorization before energy use - to align with cascading use principles, policy instruments should shift from solely promoting energy production to encouraging the extraction of high-value compounds prior to biogas generation. Incentives such as feed-in premiums or tax credits for cascading use (e.g., protein extraction followed by biogas conversion) can help reposition biogas within more complex and higher-value value chains;
- Strengthen market demand for bio-based products - consumer perception and cost-effectiveness of bio-based alternatives offer a strategic opportunity to increase demand. Public procurement policies should be adjusted to favor certified bio-based products, including those derived from digestate (e.g., biofertilizers). This can create predictable demand and further de-risk private sector investment in biogas-linked industries;
- Institutional support for public education and awareness - over the long term, a robust communication and education framework is needed to maintain public trust and political will. Bioeconomy literacy should be integrated into school curricula, vocational training, and public campaigns. Highlighting success stories and environmental benefits of biogas projects can shift public opinion and reduce resistance rooted in past policy missteps;
- Create tailored financial instruments for SMEs - given the SME-dominated nature of the agrifood sector, long-term financing must be tailored to their scale and risk profiles. Blended finance models, revolving green funds, and credit guarantees can make circular investments more accessible. These instruments should be co-designed with financial institutions to ensure alignment with market needs and biogas-specific challenges.

5. Discussion

Discussion on Strategic Actions to support bioenergy (biofuels and biogas)

Biogas production represents a pivotal element of the bioeconomy transition in Central Europe. Both Poland and Slovenia possess significant agricultural biomass resources and industrial byproducts suitable for anaerobic digestion and biomethane production. Yet, despite favorable EU climate and CAP frameworks, sectoral development remains constrained by regulatory uncertainty, limited integration of biomass flows, and fragmented stakeholder cooperation.

Drawing on expert TOWS analyses and strategic action plans, this brief outlines priority policy directions for unlocking the potential of biogas within national and regional bioeconomy strategies.

Key Leverage Points building on SO

- Large domestic biomass potential and developed agricultural sector (PL, SL).
- Existing R&D and industrial capacity for anaerobic digestion and biomethane upgrading.
- Increasing EU and CAP support for renewable energy and carbon farming.
- Emerging consumer interest in bio-based products and circular economy practices.

Policy Implications

- Strategic energy integration: Incorporate biogas into long-term energy policies (e.g., Poland's Energy Policy 2040) as a pillar for distributed, low-carbon power and heat generation.
- Biosecurity through localization: Promote local biomass use to reduce dependence on imported fossil fuels and strengthen rural economies.
- Circular value chains: Encourage valorization of side streams (compost, biochar, digestate) through CAP-supported eco-schemes and soil carbon incentives.

Identified Challenges from WT

- Complex and fragmented regulations, lengthy permitting processes.
- Public resistance linked to odor and environmental concerns.
- Limited skilled workforce and low bioeconomy literacy.
- Financial risk for SMEs and lack of scale-up funding (TRL 3-6).

Policy Implications

- Regulatory simplification: Create fast-track procedures for biogas projects and clear legal recognition of secondary bio-based products (digestate, biofertilizers).
- Transparency and monitoring: Develop national biomass registries and emissions monitoring centers to support traceability and policy evaluation.
- Public trust building: Implement education campaigns and local engagement processes to mitigate NIMBY opposition and highlight biogas benefits.
- Financial de-risking: Introduce revolving green funds, credit guarantees, and blended finance tools tailored to SMEs investing in bioeconomy technologies.

Short-Term Priorities (2025-2030)

Poland

- Introduce support instruments to reduce agricultural carbon footprints and expand agricultural biogas programs.



- Establish permanent agricultural emission monitoring systems.
- Extend biofuel blending schemes (e.g., B30) and subsidies for digestate and biochar utilization.
- Launch regional biohubs aggregating feedstock and co-financing shared biogas infrastructure.

Slovenia

- Create a national biomass monitoring platform and valorization system.
- Pilot integration among niche actors (farmers, SMEs, R&D institutions) via cooperative biogas hubs.
- Streamline permitting and licensing for biogas installations.
- Provide bridge funding for innovation scale-up and demonstration projects.

Long-Term Strategies (2030-2040)

Poland

- Establish a National Bioeconomy Strategy integrated into energy policy.
- Liberalize biomass management regulations and foster energy decentralization.
- Create educational pathways and national investment funds for bioeconomy skill development.
- Encourage third-sector engagement to connect local needs with technological innovations.

Slovenia

- Institutionalize circular bioeconomy clusters linking waste producers, technology firms, and investors.
- Incentivize cascading biomass use—supporting high-value material recovery before energy conversion.
- Stimulate market demand for certified bio-based products via public procurement policies.
- Embed bioeconomy education at all levels to maintain public trust and support.
- Tailor financial instruments for SMEs (e.g., tax credits, revolving green funds) to foster sustainable investments.

Both countries can mutually reinforce their biogas policy frameworks through EU-level cooperation—particularly in research standardization, technology transfer, and green finance design. Regional collaboration could foster a Central European Biogas Knowledge Hub, harmonizing data, certifications, and investment pipelines.

Biogas technologies in Poland and Slovenia stand at the intersection of energy transition, rural revitalization, and circular economy development. Effective policies must bridge technological maturity with societal trust, ensuring regulatory clarity, financial accessibility, and educational support. By aligning national actions with EU Green Deal objectives and fostering cross-border cooperation, both countries can transform biogas from a niche energy source into a cornerstone of sustainable regional development.

Discussion on Strategic Actions to support regenerative agriculture and precision farming

Central and Eastern Europe (CEE) sits at the crossroads of two major EU transitions:

1. The **Green Deal's Farm to Fork and Biodiversity strategies**, which call for sustainable intensification and circular use of resources.
2. The **digital and data-driven transformation** of agriculture through precision tools, AI, and smart farming.

Countries like **Poland, Slovenia, and Slovakia** already show strong innovation potential in regenerative and precision agriculture but face persistent barriers – small farm structures, weak digital infrastructure, fragmented advisory systems, and uneven CAP implementation.

Regenerative and precision farming together offer a coherent pathway to **enhance soil health, water retention, biodiversity, and carbon storage** while increasing productivity and resilience.



The TOWS analyses by national experts emphasize that these systems are not only complementary but mutually reinforcing: precision tools enable regenerative outcomes to be measured and rewarded, while regenerative systems create the ecological foundation for high-quality data-driven farming.

Strength-Opportunity Synergies (SO)

- **Poland:** Build on a strong R&D base and emerging digitalization strategy to integrate precision agriculture into CAP eco-schemes and national bioeconomy strategies.
- **Slovenia:** Use targeted CAP funds and pilot farms to demonstrate soil health improvements and resource efficiency.
- **Slovakia:** Leverage data from demo farms and Living Labs to shape eco-schemes and Soil Mission-aligned funding.

Strength-Threat Responses (ST)

- **Slovakia:** Promote measurable soil, water, and carbon outcomes from pilots to influence CAP certification systems.
- **Slovenia:** Use successful biogas-integrated regenerative systems to improve public perception of circular farming.
- **Poland:** Connect advanced R&D capabilities with transparent certification of bioproducts and soil-carbon verification.

Weakness-Opportunity Strategies (WO)

- **Expand advisory and training systems** to build farmer competence in soil health management and digital literacy.
- **Create cooperatives or equipment-sharing models** to make precision tools affordable for smallholders.
- **Invest in rural connectivity and open data platforms** to integrate precision technologies with carbon farming markets.

Weakness-Threat Strategies (WT)

- **Institutionalize regenerative agriculture** in national CAP Strategic Plans and climate strategies.
- **Develop standard soil health metrics and digital benchmarks** for CAP eco-schemes.
- **Support small farms through blended finance and simplified administrative tools** (mobile apps, cooperative access to sensors and data).

Regional implications: To counter policy inertia and regulatory fragmentation, CEE governments should **develop regional soil health observatories and digital traceability platforms** that feed directly into CAP performance monitoring.

CEE can position itself as a **testbed for regenerative digitalization** using field-level data, soil health indicators, and digital traceability to justify CAP payments and carbon farming incentives.

The CEE region must **shift from fragmented pilot initiatives to systemic frameworks** – e.g., CAP-recognized soil monitoring protocols, regionally aligned certification standards, and interoperable farm data systems.

Discussion on Strategic Actions to support bioprocessing and biomaterials



The experts from the Central and Eastern European (CEE) countries participating in the BIOEAST initiative have identified the development of bioprocessing and biomaterials as a strategic priority for strengthening regional bioeconomy capacity. Their insight provides a comprehensive understanding of the internal and external factors shaping the sector, which, when linked to the evolving Common Agricultural Policy (CAP) beyond 2027, offers a structured approach to policy design and implementation.

SWOT Analysis Overview

The experts' collective SWOT analysis highlights that the CEE region possesses **significant strengths** in scientific competence, technical research infrastructure, and growing innovation ecosystems related to key enabling technologies (KETs) such as fermentation, pyrolysis, and polymer bioprocessing. Academic institutions and emerging start-ups are increasingly active in applied bioeconomy research, particularly in biodegradable materials, biomass valorisation, and advanced processing.

However, **weaknesses** persist. The region faces fragmented value chains, a limited number of scale-up facilities, and insufficient domestic conversion technologies. There is also a lack of harmonised certification and standardisation systems for bioproducts, and farmers remain generally unaware of the economic and environmental potential of bio-based inputs. These structural gaps constrain both the upscaling of technologies and the creation of stable markets for bioproducts.

Opportunities lie in the growing European and global demand for sustainable materials, new funding windows under the European Green Deal, and the potential integration of bioeconomy objectives within the CAP and related EU frameworks. Modular biorefineries, biochar valorisation, and bioproduct certification systems were recognised as practical pathways to mobilise regional biomass resources while creating high-value markets.

Threats include regulatory uncertainty, social resistance to some technologies (such as biogas or insect-based processing), and competition from established fossil-based industries. The experts therefore emphasised the need for transparent regulation, consumer trust-building, and a clear policy framework that rewards sustainability and innovation.

Strategic Actions and CAP-Relevant Measures

Based on the SWOT findings and the subsequent strategic assessment, the experts propose a series of actions that can be directly linked to existing and future CAP instruments. These are summarised below according to their time horizon.

Short-term measures (within the current 2023-2027 CAP framework):

1. Eco-schemes for soil carbon and bio-input integration: Introduce targeted eco-schemes rewarding farmers for the application of certified biochar, compost, or digestate that demonstrably increases soil organic carbon. Payments should be performance-based (per tonne of carbon sequestered or per hectare treated).
2. Investment support for modular biorefineries and pre-processing hubs: Use rural development and innovation grants to fund small-scale, decentralised bioprocessing units that can handle diverse regional biomass streams and strengthen local value chains.
3. Knowledge transfer and advisory programmes: Under the Agricultural Knowledge and Innovation Systems (AKIS), develop training, demonstration farms, and advisory services focused on bio-based production, residue management, and cascading valorisation.
4. Certification and quality assurance: Establish or co-fund national certification and testing systems for bio-based inputs, compostable materials, and biofertilisers to enhance trust, ensure safety, and reduce the risk of greenwashing.



Medium-term measures (to be embedded in post-2027 CAP Strategic Plans):

5. Integration of bioeconomy indicators in CAP monitoring: Include metrics such as tonnes of residues valorised, hectares under soil carbon-enhancing practices, and number of operational bioprocessing facilities to ensure accountability and evidence-based policymaking.
6. Eco-schemes supporting cascading use: Design payment tiers that reward value-adding steps before energy conversion, thereby promoting higher-value uses of biomass.
7. Rural infrastructure and logistics support: Facilitate the establishment of biomass collection and aggregation hubs to improve feedstock logistics and reduce transportation costs.
8. Green public procurement (GPP) for biomaterials: Introduce mandatory GPP targets for certified bio-based construction, packaging, and textile materials to stimulate market demand and provide stability for emerging producers.

Long-term structural measures (post-2027 CAP architecture):

9. Mainstream bioeconomy within the CAP delivery model: Ensure that bioeconomy development becomes an explicit CAP objective, integrated into future strategic plans alongside climate, environmental, and rural resilience goals.
10. Establish a dedicated “bioeconomy investment window”: Create revolving funds or blended finance mechanisms for SMEs and regional bioeconomy hubs, coupled with fiscal incentives to attract private capital into sustainable bioprocessing.

The BIOEAST experts’ recommendations present a clear roadmap for strengthening bioprocessing and biomaterials in CEE countries through the CAP framework. Their vision aligns with the ongoing reform discussions on the post-2027 CAP, which aims to integrate bioeconomy, circularity, and climate objectives more explicitly into agricultural and rural policies. By operationalising the proposed measures—eco-schemes for carbon sequestration, investment support for modular biorefineries, advisory systems, certification mechanisms, and procurement incentives—Member States can accelerate the transition toward a sustainable bioeconomy. These actions will not only enhance rural competitiveness and resource efficiency but also contribute directly to the EU’s Green Deal and circular economy objectives.



Synthesis Discussion: Advancing the Bio-Based Economy Across CEE

The CEE region's comparative advantage lies in its abundant biomass resources, strong agricultural base, and expanding scientific and technical infrastructure. However, these assets are offset by persistent governance and market fragmentation. Current policy frameworks often address bioenergy, agriculture, and materials valorization as separate domains, limiting synergies and hindering cross-sector investments. Consequently, a cohesive regional strategy that connects these sectors through coordinated governance and harmonized regulatory standards is increasingly recognized as essential for unlocking the bioeconomy's full potential.

Drawing from national and expert analyses across Poland, Slovenia, Slovakia, and other BIOEAST countries, a clear regional trend emerges: the shift from sector-specific bio-based development (biogas, biomaterials, regenerative agriculture) toward a **systemically integrated regional bioeconomy**.

While each sector demonstrates distinctive trajectories—biogas as a driver of decentralized energy, regenerative agriculture as a soil- and climate-restorative system, and bioprocessing as an industrial value-addition platform—they are united by common enablers and constraints. Fragmented regulations, limited coordination between agriculture and industry, and inconsistent CAP implementation remain the most critical bottlenecks. Conversely, the region's **large biomass base, scientific competence, and increasing policy alignment with EU sustainability frameworks** constitute strong leverage points for transformation.

A cross-sector synthesis underscores that CEE's bioeconomy transition must move beyond technological demonstration to institutional and infrastructural consolidation. The creation of regional "bioeconomy clusters" or "biohubs"—integrating feedstock aggregation, innovation services, and financial instruments—can serve as the backbone for scaling sustainable bio-based value chains across national borders.

Shared Leverage Points Across Sectors

Across all three bio-based domains, the overview reveals several recurring leverage points that underpin the CEE's bioeconomic transition. First, **resource abundance and circular potential** remain foundational. The region's agricultural residues, forestry by-products, and organic waste streams provide a robust feedstock base for both energy and materials applications. Yet, the absence of coordinated biomass registries and cascading use frameworks limits the efficient mobilization of these resources.

Second, **technological and research capacity** has advanced considerably. CEE countries have developed competitive expertise in anaerobic digestion, precision agriculture, and bio-based materials processing. Universities and emerging start-ups contribute increasingly to applied research and innovation ecosystems. Nevertheless, the lack of dedicated demonstration infrastructures and scale-up facilities continues to impede technology commercialization.

Third, **alignment with European policy frameworks**—particularly the Common Agricultural Policy (CAP), the Green Deal, and the Circular Economy Action Plan—offers an enabling policy environment. Through eco-schemes, Agricultural Knowledge and Innovation Systems (AKIS), and upcoming post-2027 CAP reforms, Member States can integrate bioeconomy priorities into national strategic plans. Lastly, growing public awareness and consumer demand for renewable energy, sustainable food systems, and biodegradable materials create positive market pull, reinforcing the bioeconomy's societal legitimacy.

Structural Weaknesses and Convergent Challenges



Despite favorable conditions, the region faces a series of interlinked structural challenges. **Regulatory fragmentation** remains a central impediment: national frameworks often separate waste, energy, and agricultural regulation, creating ambiguity for cross-sector operations such as digestate use, biomass trade, or residue valorization. Similarly, **financial risk and limited de-risking mechanisms** constrain small and medium enterprises (SMEs) from investing in early-stage or pilot bio-based projects.

In addition, **digital and human capacity deficits** undermine the uptake of precision and regenerative technologies, particularly in rural areas with low broadband coverage and limited advisory support. **Public trust and social acceptance** represent further barriers, as local opposition to bioenergy installations and skepticism toward novel bio-based products often delay project implementation. These challenges reflect deeper institutional inertia, highlighting the need for governance innovation, stakeholder engagement, and education to ensure the bioeconomy's social and environmental credibility.

A regional approach can mitigate these challenges by fostering **policy harmonization, pooled financing, and shared capacity-building systems** through existing platforms such as BIOEAST or a future “CEE Bioeconomy Alliance.”

Strategic actions and policy coherence

Integrating bioeconomy objectives within the CAP provides a practical pathway for addressing these systemic weaknesses. The sectoral analyses collectively demonstrate that bioenergy, regenerative agriculture, and biomaterials are not isolated silos but **mutually reinforcing domains** along a continuum of resource efficiency and value creation. For instance, biogas systems supply renewable energy and nutrient-rich digestate that can enhance regenerative farming, while regenerative practices provide sustainable biomass feedstocks for bioprocessing industries. Bioprocessing and biomaterials, in turn, create downstream markets that strengthen the economic viability of both upstream agricultural and energy systems.

This interdependence suggests that national and regional policies should transition from sectoral support schemes toward **integrated bioeconomy governance models**. Embedding bioeconomy-specific indicators—such as residue valorization rates, soil carbon enhancement, or certified bio-based product uptake—within CAP monitoring frameworks could improve transparency and policy coherence. Furthermore, regional coordination platforms, such as the BIOEAST initiative, can serve as catalysts for harmonizing data systems, aligning certification standards, and pooling investment resources across Member States.

Strategic Priorities in perspective

Short-Term (2025-2030):

- Deploy CAP eco-schemes incentivizing carbon sequestration, renewable energy use, and circular resource flows.
- Create regional pilot networks (biogas hubs, regenerative Living Labs, modular biorefineries) to demonstrate integrated bio-based systems.
- Establish national certification and biomass monitoring systems to ensure traceability and build public trust.

Medium-Long Term :

- Institutionalize bioeconomy governance structures (e.g., national bioeconomy councils, CEE coordination clusters).
- Mainstream bioeconomy education, digital literacy, and vocational training.
- Introduce fiscal incentives, revolving funds, and blended finance tools dedicated to bio-based SMEs.



- Embed the bioeconomy within a *CEE regional green growth strategy*, fully integrated with EU carbon neutrality objectives.
- Achieve a regionally distributed, cascade-oriented bioeconomy where rural territories function as innovation and production hubs within global circular markets.

The synthesis of expert analyses underscores that the technological readiness of CEE bio-based sectors increasingly outpaces institutional and financial capacities. Without coherent governance and market coordination, promising innovations risk remaining isolated pilot projects. The transition therefore demands a move from **fragmented national initiatives** to **cohesive regional frameworks** that align regulatory, financial, and informational infrastructures.

By leveraging existing cooperation structures such as BIOEAST and aligning future CAP strategic plans, the CEE region can transform from a resource supplier to a **knowledge-based, value-adding bioeconomy hub**. This transformation would simultaneously advance energy security, rural livelihoods, and environmental resilience, positioning the region as a pivotal contributor to Europe's sustainable and competitive bioeconomy.



6. Policy assessment and recommendations

The post-2027 CAP must evolve beyond the current compliance-driven model to embrace measurable sustainability and circularity criteria. A key conclusion from the A3.1 evaluation assessment was that, while CAP 2023-2027 offers many entry points for bioeconomy, the actual uptake remains fragmented and indirect across Member States. Therefore, the next programming period (2028-2034) should explicitly embed bioeconomy objectives within its intervention logic, performance frameworks, and funding priorities.

The CAP's long-term direction will need to reflect systemic transitions in agricultural production, resource management, and consumer behaviour. Building upon A3.1 findings, three key transformations are essential:

1. **From sectoral to systemic policy design:** The bioeconomy must be recognised as a cross-sectoral field linking agriculture, forestry, food, and energy systems, requiring joint governance between ministries and agencies.
2. **From awareness to capability:** Member States need sustained investments in knowledge and skills, primarily through AKIS, to translate circular bioeconomy concepts into operational programmes.
3. **From pilot to mainstream:** Successful bio-based innovation pilots and eco-schemes must transition into standard CAP instruments supported by measurable indicators and transparent impact assessment.

The future CAP must integrate circular bioeconomy principles across its three layers – income support, sectoral programmes, and rural development – ensuring coherence between production incentives and sustainability targets. Policy coherence should be reinforced through stronger coordination mechanisms between the CAP, Horizon Europe, LIFE, and cohesion policy instruments. Findings from A3.1 underline the need for transnational policy learning and exchange among BIOEAST and Central European Member States, facilitated through networks of ministries, research institutions, and advisory services.

Drawing upon both the European Commission's "Vision for the Future of the CAP 2028-2034" and A3.1 findings, the following orientations are proposed:

- Mainstream circular bioeconomy as a guiding principle across all CAP objectives.
- Establish measurable indicators for bioeconomy contribution, including renewable resource use, carbon storage, and waste valorisation.
- Enhance inter-ministerial coordination to align CAP implementation with bioeconomy, energy, and industrial strategies.
- Strengthen AKIS systems to integrate bioeconomy training and advisory support for farmers, processors, and local authorities.
- Increase transnational cooperation between BIOEAST countries to harmonise policy maturity and ensure inclusive uptake of circular bioeconomy practices.
- Promote consumer awareness and market uptake of bio-based products through CAP-supported education and communication actions.



Relevance for bioeconomy-related action

Incorporating bioeconomy into the CAP 2028-2034 will accelerate the transition toward climate neutrality, resource efficiency, and rural innovation. Based on A3.1 recommendations, CAP should:

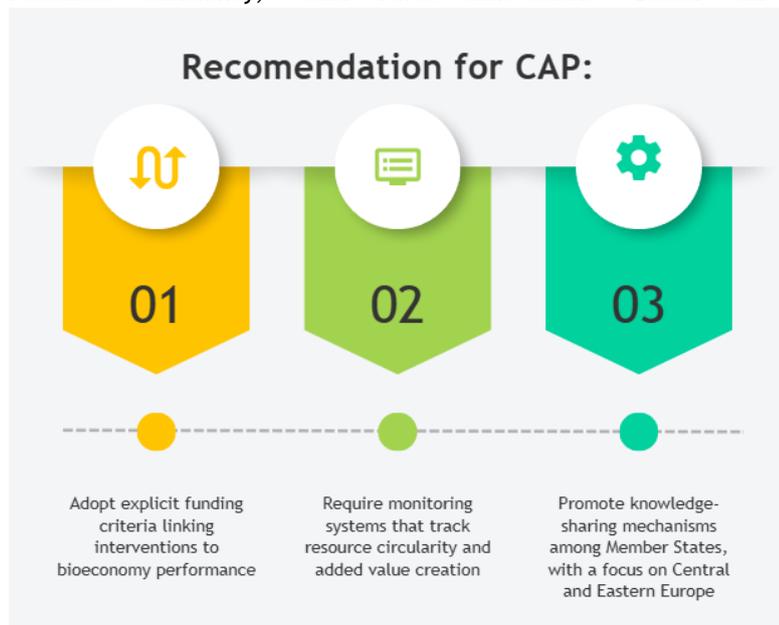


Figure 15. Recommendation from A3.1 for CAP

Bioprocessing, biomaterials, bioproducts - Policy Integration to the CAP and Implementation Logic

The proposed actions align with existing CAP instruments:

- **Eco-schemes** (Pillar I) can immediately reward farmers for environmental and climate benefits derived from bio-based practices.
- **Rural development measures** (Pillar II) can support infrastructure and innovation investments.
- **Knowledge transfer and cooperation actions** under AKIS can ensure continuous learning and skills development.
- **Public procurement and certification** create the market pull essential for scaling up the bio-based industry.

In the **post-2027 CAP**, the European Commission intends to simplify delivery mechanisms while maintaining strategic national flexibility. This opens the door for Member States to introduce integrated bioeconomy measures in their CAP Strategic Plans. CEE countries, through the BIOEAST platform, are particularly well positioned to leverage this flexibility to embed bioeconomy objectives in line with regional strengths and resource endowments.

Monitoring and Indicators

To ensure effective implementation, the following indicators could be incorporated into CAP monitoring frameworks:



- Tonnes of agricultural and forestry residues valorised annually into bioproducts.
- Hectares with verified soil organic carbon increase.
- Number and scale of operational modular biorefineries.
- Share of public procurement budget allocated to certified bio-based materials.
- Percentage of farms participating in bioeconomy-related eco-schemes.

Addressing Identified Risks

The experts stress that effective safeguards must accompany financial incentives. Certification and testing systems should precede large-scale payments to ensure the environmental integrity of bio-based products. Eco-schemes should prioritise cascading valorisation to avoid locking biomass into low-value or unsustainable uses. Transparent reporting, community engagement, and communication campaigns will be crucial for public acceptance.

Conclusion and Policy Outlook

The BIOEAST experts' recommendations present a clear roadmap for strengthening bioprocessing and biomaterials in CEE countries through the CAP framework. Their vision aligns with the ongoing reform discussions on the post-2027 CAP, which aims to integrate bioeconomy, circularity, and climate objectives more explicitly into agricultural and rural policies.

By operationalising the proposed measures—eco-schemes for carbon sequestration, investment support for modular biorefineries, advisory systems, certification mechanisms, and procurement incentives—Member States can accelerate the transition toward a sustainable bioeconomy. These actions will not only enhance rural competitiveness and resource efficiency but also contribute directly to the EU's Green Deal and circular economy objectives.

In essence, the experts advocate for a **CAP that rewards innovation, cascading biomass use, and ecosystem services**, thereby positioning the bioeconomy as a central pillar of agricultural policy in Central and Eastern Europe beyond 2027.

Biofuels and Biogas - Policy assessment and recommendations

How CAP instruments map to the priorities

Policy discussion to **specific Common Agricultural Policy (CAP) instruments and levers**, and translated those into concrete, country-tailored specifications Poland and Slovenia could adopt **within their 2023-2027 CAP Strategic Plans / rural development programmes** to accelerate responsible biogas deployment. CAP already provides the most direct EU funding and regulatory framework that can be repurposed to scale sustainable biogas (investment aid, eco-schemes, agri-environmental measures and rural development/EAFRD). To work for Poland and Slovenia the CAP should be specified to (1) reward cascading use and digestate recycling, (2) fund on-farm and clustered biogas investments, (3) de-risk scale-up and TRL-3-6 demonstration, and (4) build biomass monitoring, training and public-acceptance measures [20]. Much of this is feasible under current CAP instruments and the Strategic Plans these countries already submitted; the key is how national implementing rules and targeting are written.

Eco-schemes (annual payments for climate/environmental practices)

Why use them: Eco-schemes pay farmers for delivering public goods (soil carbon, nutrient management, biodiversity), and can reward the **use of digestate, biochar and carbon-rich soil inputs** – aligning with TOWS suggestions on carbon farming and digestate valorization.



Practical CAP specification ideas

- **Poland:** design an eco-scheme tier that pays per tonne of organic carbon sequestered when certified digestate/biochar is applied and documented under an approved soil carbon protocol. Link payments to verified reduction in mineral fertilizer use and to soil health indicators. This addresses P1's short-term call for payments per organic carbon incorporated.
- **Slovenia:** include an eco-scheme rewarding farms that adopt cascading use pathways (e.g., first extractable compounds, then residuals to anaerobic digestion), with higher rates for documented cascading and for digestate used in lieu of synthetic fertilizer. This supports SL4 long-term cascading incentives.

EAFRD / Rural Development investments – CAP's investment pillar

Why use it: EAFRD can finance **on-farm biogas digesters, biomethane upgrading equipment, shared pre-processing, and cluster infrastructure (biohubs)** – directly answering the TOWS call for regional hubs and investment support.

Practical CAP specification ideas

- **Poland:** ring-fence a portion of investment support for **regional biohub pilots** (aggregation, preprocessing, shared AD units) in high-biomass voivodeships; give higher co-financing rates to multi-farm cooperative projects that include digestate valorization and local heat/CHP off-take agreements. Encourage projects that reduce feedstock transport distances (localization).
- **Slovenia:** allocate EAFRD calls for **SME-scale AD + biomethane upgrading** plus technical assistance grants to create inter-municipal clusters (matching SL4 cluster idea), and provide capital grants for farm-level biomethane injection equipment where local grid access exists.

Agri-environment-climate measures & conditionality

Why use them: These measures can require or reward better manure management and support emission reductions from agriculture (a TOWS short-term and long-term priority). They can also set rules tying CAP payments to sustainable use of biomass.

Practical CAP specification ideas

- **Poland:** include manure & slurry management standards in conditionality plus targeted agri-environment payments for farms that route manure to AD plants and use certified digestate, thus reducing field emissions and creating a stable feedstock stream for AD (addresses P1's emission reduction priority) [21].
- **Slovenia:** make participation in digestate quality-assurance schemes (see "national accreditation" in the experts' long-term list) an eligibility condition for certain CAP investment or eco-scheme payments to ensure safe reuse in agriculture.

Knowledge transfer, advisory services, and training (CAP technical assistance)

Why use it: TOWS highlighted workforce and literacy gaps. CAP technical assistance and knowledge transfer measures can finance training, demonstration farms, and local bioeconomy education.

Practical CAP specification ideas

- **Poland:** fund TRL-3-6 demonstration projects and multi-stakeholder trainings (farmers, local authorities, SMEs), plus a national centre for agricultural emissions and digestate best-practice guidance (responds to P1 long-term actions).
- **Slovenia:** create municipal bioeconomy centres (as the experts suggested) under CAP advisory grants that combine public outreach, vocational training and demonstration digesters to tackle NIMBY risk and improve acceptance.

Targeted market development (public procurement & demand signals)



Why use it: CAP-linked measures can stimulate demand for bio-based products (digestate-based fertilizers, compost), which the TOWS analysis called for to make valorization profitable. Public procurement is a strong lever [22].

Practical CAP specification ideas

- **Both countries:** introduce procurement guidelines for regional/municipal authorities funded under rural development to prefer certified biofertilizers (digestate-derived) and recycled bio-products in public landscaping and restorative agriculture projects. This stabilizes demand and improves off-take for digestate valorization [23].

Monitoring, traceability and biomass registries (compliance + planning)

Why use it: TOWS flagged the lack of systemic biomass monitoring; CAP reporting and indicator frameworks can host a national biomass registry and feedstock traceability system. This improves cascade-first decisions and policy targeting.

Practical CAP specification ideas

- **Poland:** use CAP-funded IT platforms to create a national biomass registry that records volumes, types and ownership of side-streams—data to be used for planning eco-scheme targeting and regional biohub siting. This echoes the experts' short-term action for a biomass monitoring system.
- **Slovenia:** integrate biomass monitoring into CAP performance indicators so RDP investments and eco-schemes can be adjusted annually based on actual feedstock flows and soil outcomes [24].

Regenerative agriculture and precision farming - Policy brief: Aligning CEE Actions with the Common Agricultural Policy (CAP)

The CAP's 2023-2027 structure – especially its **eco-schemes, rural development (EAFRD) funds, and AKIS (Agricultural Knowledge and Innovation Systems)** – provides the most powerful lever for embedding regenerative and precision agriculture in CEE countries.

A. Eco-Schemes and Conditionality

- Introduce **multi-year eco-schemes** paying for soil health outcomes (SOC, biodiversity indices) rather than single-year practices.
- Recognize **precision agriculture tools** (sensors, satellite systems, variable rate application) as enablers of verifiable regenerative outcomes.
- Incentivize **cover cropping, crop rotation, compost application, and adaptive grazing** as measurable eco-scheme components.

B. EAFRD and Investment Support

- Use EAFRD to **co-finance cooperative precision infrastructure** – sensors, drones, smart irrigation, and small-scale biogas units.
- Prioritize **clusters and living labs** demonstrating regenerative-precision synergies for carbon farming.

C. AKIS and Education

- CAP-funded AKIS structures should expand to include **digital literacy, soil science, and ecosystem-service measurement**.



- Facilitate **peer-learning networks** and on-farm demonstrations through CAP technical assistance.

D. Data and Monitoring

- Embed **soil health indicators and digital traceability systems** within CAP's monitoring frameworks.
- Link national data platforms to **EU Soil Mission and Green Data Space** infrastructures for cross-border comparability.

E. Differentiation within the CEE Context

- **Poland:** Integrate regenerative agriculture explicitly into its bioeconomy strategy and CAP eco-schemes, emphasizing data interoperability and certification systems.
- **Slovakia:** Align with the EU Soil Mission by developing soil-carbon certification frameworks and ecosystem-service payments.
- **Slovenia:** Target CAP funds toward soil health and digitalization of small farms, enabling cooperatives for precision technology access.

7. Regional Discussion: The CEE Opportunity

Regenerative and precision agriculture can redefine the CEE agri-food sector's competitiveness by transforming it from a low-cost production model into a resilient, high-value, circular system.

Key systemic benefits include:

- **Carbon sequestration** and climate mitigation (supporting EU Soil Mission targets).
- **Reduced input dependency**, improving profitability amid fertilizer price volatility.
- **Biodiversity enhancement** and ecosystem service monetization.
- **Rural modernization** through digital skills and infrastructure investment.
- **Regional cooperation** on soil, data, and innovation aligning CEE with Western EU standards.

However, achieving this requires a policy pivot:

- From **practice-based** to **outcome-based** CAP measures.
- From **project fragmentation** to **cross-country learning networks**.
- From **subsidy-driven** to **innovation-driven** agricultural models.

CEE countries thus have a window of opportunity to become **Europe's living laboratory for soil regeneration and digital agriculture**, combining their diverse landscapes, strong research communities, and EU cohesion funds.

The CEE region can transform its agricultural systems through **regenerative-precision convergence**, supported by CAP reforms, digital infrastructure, and human capital investment. By aligning national CAP Strategic Plans with the **EU Soil Mission and the Digital Europe Agenda**, CEE governments can build a resilient, circular, and data-driven agricultural future – turning the region into a **leader of sustainable transformation in Europe's bioeconomy**.

Policy Framework Overview for Advancing Bio-Based Sectors in Central and Eastern Europe



Central and Eastern Europe (CEE) stands at the forefront of the EU's green and digital transitions. The region's abundant biomass resources, strong academic base, and emerging innovation ecosystems create a unique opportunity to develop a sustainable bioeconomy. However, systemic barriers—fragmented regulations, limited infrastructure, and low bioeconomy literacy—require coordinated policy action. This chapter synthesizes policy insights across three strategic domains: **bioenergy (biofuels and biogas)**, **regenerative and precision agriculture**, and **bioprocessing and biomaterials**, aligning them with the Common Agricultural Policy (CAP) and EU Green Deal objectives.

Bioenergy: Biofuels and Biogas

Policy Insights

- **Strategic Energy Integration:** Embed biogas into national energy policies as a pillar for distributed, low-carbon power and heat generation.
- **Localization and Circularity:** Promote local biomass use to reduce fossil fuel dependence and strengthen rural economies.
- **Regulatory Simplification:** Introduce fast-track permitting and legal recognition for secondary bio-based products (digestate, biofertilizers).
- **Financial De-risking:** Deploy revolving green funds, credit guarantees, and blended finance tools for SMEs investing in biogas technologies.
- **Public Trust Building:** Implement education campaigns and stakeholder engagement to mitigate NIMBY opposition.

Projected Regional Actions

- Establish **biomass monitoring platforms** and national registries for traceability.
- Create **regional biohubs** for feedstock aggregation and shared biogas infrastructure.
- Incentivize **cascading biomass use** through CAP eco-schemes and soil carbon payments.
- Foster **cross-border cooperation** via a Central European Biogas Knowledge Hub for harmonized standards and investment pipelines.

Regenerative and Precision Agriculture

Policy Insights

- **Eco-Scheme Integration:** Recognize regenerative practices (no-till, cover cropping, adaptive grazing) and precision tools as qualifying measures under CAP eco-schemes.
- **Digital Infrastructure:** Invest in rural broadband and open data platforms to enable AI-driven soil health monitoring and smart farming.
- **Advisory and Education Systems:** Expand AKIS-based training, Living Labs, and certification programs for advisors and technicians.
- **Outcome-Based Payments:** Shift from practice-based to performance-based CAP measures linked to soil carbon and biodiversity indicators.

Projected Regional Actions

- Institutionalize **soil health observatories** and digital traceability platforms feeding into CAP monitoring.
- Develop **regional clusters** aligned with the EU Soil Mission for carbon farming and ecosystem service markets.
- Embed **bioeconomy and precision farming modules** in agricultural education curricula.
- Support **cooperative models** for precision equipment access and blended finance for smallholders.



Bioprocessing and Biomaterials

Policy Insights

- **Cascade-Oriented Bioeconomy:** Prioritize extraction of high-value components (biopolymers, proteins) before energy conversion.
- **Infrastructure Development:** Fund modular biorefineries and biomass aggregation hubs through CAP rural development measures.
- **Certification and Quality Assurance:** Establish national systems for bio-based inputs and compostable materials to build consumer trust.
- **Market Pull Mechanisms:** Introduce green public procurement targets for certified bio-based products in construction, packaging, and textiles.

Projected Regional Actions

- Expand **eco-schemes** rewarding soil carbon enhancement and cascading biomass use.
- Integrate **bioeconomy indicators** into CAP monitoring frameworks (e.g., tonnes of residues valorized, operational biorefineries).
- Create **dedicated bioeconomy investment windows** for SMEs and regional hubs.
- Promote **cross-sectoral cooperation** via BIOEAST to harmonize standards and accelerate technology transfer.

CAP integration rationale

The CAP provides the most powerful lever for embedding bioeconomy objectives in CEE countries:

- **Eco-Schemes (Pillar I):** Reward regenerative practices, precision technologies, and cascading biomass valorization.
- **EAFRD Investments (Pillar II):** Finance biogas plants, modular biorefineries, and cooperative precision infrastructure.
- **AKIS and Technical Assistance:** Support knowledge transfer, advisory services, and demonstration projects.
- **Monitoring and Data Governance:** Embed soil health and biomass traceability indicators in CAP performance frameworks.

By aligning national CAP Strategic Plans with EU Green Deal and Soil Mission objectives, CEE countries can:

- Transform agriculture into a **resilient, high-value, circular system**.
- Achieve **carbon neutrality and biodiversity gains** while improving rural competitiveness.
- Position themselves as **Europe's living laboratory for sustainable bioeconomy**, leveraging cross-border cooperation and EU cohesion funds.



8. Conclusion and Policy Implications

The synthesis of expert-based SWOT analyses across the bioenergy, regenerative agriculture, and bioprocessing sectors demonstrates that Central and Eastern Europe (CEE) occupies a strategically significant position in Europe's bioeconomy transition. Technological readiness in biogas, regenerative soil management, and bioprocessing contrasts sharply with institutional lag in governance and market coordination. To realize its full potential, the region must transition from isolated, sector-specific initiatives toward an integrated, multi-sectoral bioeconomy system that aligns energy, agriculture, and industry within a coherent policy framework.

This transition will require embedding bioeconomy objectives within **national CAP Strategic Plans**, aligning them with EU Green Deal priorities, and establishing mechanisms for transnational coordination through platforms such as **BIOEAST**. The integration of cascading biomass use, carbon farming, and circular material flows can transform the region's comparative resource advantage into a competitive innovation system – positioning CEE not as a supplier of raw materials, but as a producer of high-value, sustainable bioproducts.

Policy Coherence and Governance Innovation

To achieve this, policy coherence must become the cornerstone of regional bioeconomy governance. The analyses highlight that the most significant efficiency gains will stem from integrating existing EU instruments—particularly the Common Agricultural Policy (CAP), the Circular Economy Action Plan, and the Green Deal Industrial Plan—into a unified framework for sustainable rural and industrial development.

Within the CAP architecture, **eco-schemes (Pillar I)** can reward farmers for measurable outcomes in soil carbon sequestration, nutrient cycling, and cascading biomass valorization. **Rural development measures (Pillar II)** can provide investment support for modular biorefineries, biogas clusters, and precision agriculture infrastructure. Simultaneously, **AKIS (Agricultural Knowledge and Innovation Systems)** should be strengthened to facilitate advisory services, capacity-building, and the transfer of innovation to practice.

Governance innovation at both national and regional levels is essential. The creation of **national bioeconomy councils** – supported by a **Central and Eastern European Bioeconomy Coordination Platform** under the BIOEAST framework – would enhance policy alignment and data harmonization. Such institutions could facilitate coordinated funding, common certification standards, and transparent biomass registries, ensuring that regional initiatives are synergistic rather than duplicative.

Financing and Market Instruments

A major policy implication of the expert insights concerns the need for **dedicated financial instruments** to de-risk innovation and stimulate private investment. Establishing **bioeconomy investment windows** within national or EU-level green financing mechanisms could provide revolving funds, credit guarantees, and blended finance to support SMEs, start-ups, and cooperative ventures.

Equally important is the creation of **demand-side incentives** through **green public procurement (GPP)** policies. Mandatory procurement quotas for certified bio-based materials in public construction, packaging, and textile sectors would generate stable domestic markets and improve investor confidence. Fiscal incentives—such as tax credits for bio-based product certification or renewable input substitution—can further accelerate adoption and commercialization.



The development of robust physical, digital, and human capital infrastructures represents another key priority. **Regional biohubs and Living Labs** that integrate bioenergy, regenerative agriculture, and bioprocessing should be established as demonstration ecosystems for circular bioeconomy practices. These can serve as innovation nodes linking farmers, researchers, and industry, thereby bridging the gap between research and market.

Regional Cooperation and the European Dimension

Given the shared structural and institutional characteristics of the CEE countries, **regional cooperation is indispensable**. The BIOEAST initiative provides a foundational platform for knowledge exchange, policy learning, and research coordination. Building upon this, a **Central European Bioeconomy Alliance** could institutionalize collaboration in standardization, technology transfer, and investment mobilization.

Through joint data infrastructures and harmonized sustainability indicators, the CEE region can contribute significantly to EU-wide monitoring systems for the bioeconomy and regenerative farming. This would ensure alignment with overarching objectives such as the EU Green Deal, the Farm to Fork Strategy, and the Soil Mission. In doing so, CEE can emerge not only as a beneficiary of EU cohesion and agricultural funds but as a **proactive policy laboratory for sustainable bio-based transformation**.

The expert-driven roadmap demonstrates that the long-term vision for the CEE bioeconomy should be that of a **distributed, cascade-oriented, and innovation-led system**. In this model, rural territories serve as nodes of both production and innovation—linking local resource bases with global circular value chains. By operationalizing strategic actions proposed, the CEE region can transform its structural heterogeneity into a source of strength, achieving both economic resilience and ecological sustainability. Aligning regional actions with the post-2027 CAP reform and the EU Green Deal would consolidate CEE's role as Europe's **living laboratory for the circular and sustainable bioeconomy**.



ACTION PLAN

Summary

The Action Plan operationalises the strategic orientations developed under BIOECO-UP by translating them into concrete actions, implementation mechanisms, and policy pathways. It defines a structured, six-pillar framework that supports the integration of circular bioeconomy measures into the CAP 2023-2027 and its successor period (2028-2034).

Operational Objectives

The Action Plan aims to:

1. Mainstream bioeconomy principles within CAP instruments and rural policies.
2. Create enabling conditions for innovation, investment, and skill development.
3. Strengthen governance mechanisms and stakeholder collaboration.
4. Accelerate the twin transition - sustainability and digitalisation - in agriculture and rural areas.

Implementation Framework

The plan is built around six strategic pillars, each addressing a core area of intervention:

1. **Governance & AKIS** - building adaptive, integrated knowledge and policy systems, including national bioeconomy coordination platforms and cross-sectoral monitoring frameworks.
2. **Research, Innovation & Digitalisation** - supporting technology deployment (e.g., precision farming, bio-inputs, and digital twins), pilot testing, and transnational knowledge exchange.
3. **Climate & Environmental Sustainability** - linking bioeconomy with carbon farming, soil health, biodiversity, and result-based agri-environmental schemes.
4. **Sustainable Agriculture, Food & Forestry Value Chains** - promoting circular value chains, cascading biomass use, biogas and biomethane clusters, and green public procurement.
5. **Rural Communities & Regional Bioeconomy Hubs** - establishing territorial hubs for bio-based entrepreneurship and local transformation.
6. **Knowledge & Skills for Farmers and Advisors** - developing lifelong learning schemes, certification systems, and capacity-building programmes under AKIS.

Guiding Principles

The Action Plan is grounded in ten guiding principles, including sustainability, innovation, evidence-based policy, inclusiveness, transparency, and transnational cooperation. These ensure alignment with EU priorities and the BIOEAST macro-regional vision.

Expected Impacts

- Economic: stronger regional value chains, new business models, and green jobs creation.
- Environmental: improved resource efficiency, reduced emissions, enhanced soil and ecosystem health.
- Social: empowered rural communities, upskilled workforce, greater citizen engagement.
- Policy: improved coherence between CAP, Green Deal, and Bioeconomy Strategy; enhanced governance innovation.

Feasibility and Timeline



The Plan aligns with the upcoming CAP 2028-2034 reform and European Agri-Food Vision 2040. Implementation could be pursued through existing CAP instruments, national programmes, and EU funding sources (Horizon Europe, LIFE, ERDF, CAP). It provides an adaptable, country-sensitive roadmap that ensures immediate actions (2026-2037) and long-term strategies (2028-2034) are complementary and scalable across BIOEAST countries.

Connection to the Strategy

The Action Plan directly builds upon the strategic assessment from Part 1, providing an operational toolbox for policymakers. It transforms strategic directions into measurable, time-bound interventions while maintaining flexibility for national adaptation. By linking governance, innovation, and community development, it delivers a coherent pathway towards a climate-neutral, adaptive circular bioeconomy in Central Europe.

9. Development of Action Plan

The development of the Central European Bioeconomy Action Plan followed a structured and participatory process aimed at translating the strategic orientations defined in the previous chapter into a coherent set of actionable policy measures. The Action Plan represents the operational dimension of the Strategy, offering policymakers, ministries, and other stakeholders a practical toolbox for integrating circular bioeconomy priorities into the Common Agricultural Policy (CAP) and related frameworks at both national and regional levels.

The process began with the consolidation of analytical and expert evidence from the Strategic Orientation phase (Section 3). Based on the synthesis of desk research results, Delphi Group findings, and expert-based assessments of bioeconomy pathways and key enabling technologies, a comprehensive list of one hundred policy measures was developed by the coordinating institution (IUNG-PIB) in cooperation with project partners. These measures covered six thematic intervention areas—Governance & AKIS; Research, Innovation & Digitalisation; Climate & Environmental Sustainability; Sustainable Agriculture, Food & Forestry Value Chains; Rural Communities & Regional Bioeconomy Hubs; and Knowledge & Skills for Farmers and Advisors.

Each measure was formulated to reflect the multi-level nature of bioeconomy integration within CAP instruments and to ensure practical applicability across diverse policy contexts of Central European countries. The measures were categorised according to their expected timeframe (short-, medium-, and long-term), type of intervention (regulatory, financial, institutional, educational, or technical), and potential funding sources (e.g. CAP Pillar I, Pillar II, Horizon Europe, LIFE, ERDF, national funds).

Subsequently, national partners selected and adapted the most relevant policy measures to reflect their own institutional, socio-economic, and environmental conditions. This process of adaptation, presented in Section 4, demonstrates how shared strategic ideas can be contextualised at country level, while maintaining coherence with the transnational framework developed under BIOECO-UP.

The Action Plan is further structured around a set of guiding principles (Section 4), which underpin the selection, design, and implementation of measures. These include sustainability and climate neutrality, innovation and digitalisation, good governance and cooperation, cascading and circular resource use, local empowerment, and knowledge-based capacity building. The principles serve as cross-cutting enablers ensuring that the proposed actions contribute to the EU Green Deal, the Bioeconomy Strategy, and the Sustainable Development Goals.

In addition, the Action Plan anticipates forthcoming changes in the new CAP 2028-2034 (Section 6), outlining how emerging policy orientations, performance frameworks, and financial mechanisms can provide stronger leverage for circular bioeconomy integration. It also reflects on the CAP Vision Document and the EU Agri-



Food Vision 2040 (Section 7), showing how bioeconomy development can enhance competitiveness, resilience, and sustainability of European agriculture and rural areas.

Finally, the Plan identifies mechanisms for knowledge transfer and policy learning (Section 8), highlighting how the outputs and methodologies developed within BIOECO-UP can support continuous capacity building within the BIOEAST Initiative and among Member States. This includes sharing best practices, establishing peer-learning platforms, and promoting cross-country collaboration in bioeconomy policy design and implementation.

Overall, the Action Plan constitutes the practical implementation framework of the Central European Bioeconomy Strategy. It bridges analytical evidence with policy action, ensuring that the vision of a sustainable, circular, and innovation-driven agricultural sector can be progressively realised through coordinated efforts across the BIOEAST macro-region.

10. Areas of interest

Governance & AKIS

At the centre of all this is the concept of a new kind of agriculture - the European agricultural and bioeconomy. AKIS is the collective resource base: farmers, advisors, researchers, businesses and policymakers who work in a systemic environment of information creation, sharing and utilization to drive innovation and sustainability in agriculture and the agri-food sector (25, 26). Effective governance of AKIS decides how well these interactions work, thus managing the flow of knowledge between science, policy and practice.

AKIS has been elevated to a cross-cutting action in new Common Agricultural Policy (CAP) 2023-2027 to facilitate betterment of agricultural practices enabling development, innovation and digitalization (27, 28). Member States must embed AKIS mechanisms into their CAP Strategic Plans to bridge knowledge flows, bolster advisory systems and increase collaboration among research/education/practice (27). This integrated approach is moving governance away from a top-down to a network-based model, where co-production requires cooperation, collaboration and trust among actors to meet sustainable development goals.

The post-2027 CAP reform may deepen this transformation by strengthening the connected relation of AKIS for both adaptive governance and adaptive leadership in agriculture and bioeconomy. When policy is increasingly results- and performance-oriented the capacity of AKIS to form and test knowledge and to translate it into actionable solutions will be a critical determinant of the success of policy (25, 29). In such an age of governance, governance here also pertains to the mechanisms used to ensure transparency, stakeholder engagement and ongoing learning within multi-actor settings (30).

For the bioeconomy transition that calls for systemic innovation, experimentation and flexible regulatory environments, stronger AKIS governance is especially important. Instruments such as policy labs, living labs and regulatory sandboxes can be used to pilot new solutions and create feedback loops between regulation, technology and practice (27, 29). Moreover, certification systems, digital product passports, and result-based eco-schemes require collaborative action across public authorities, advisory providers, and knowledge providers, thereby indicating the importance of an integrated governance system.

At an operational level, stronger AKIS is underpinned by 4 interconnected pillars:

- Improving of knowledge flows and interlinkages amongst research, education and practice;
- Professionalization of advisory services and independence and digital preparedness;
- Fostering innovation networks (EIP-AGRI Operational Groups, Living Labs);
- Promoting the learning of the cross sector and cooperation with the world (27, 28, 29).



It is emphasised by the OECD and FAO that an effective governance of AKIS will enhance both agricultural productivity and sustainability, as incentives for all stakeholders will be aligned in order to guarantee that innovation is demand led as opposed to supply driven (30, 31). This is particularly relevant in Central and Eastern Europe, where institutional fragmentation and anemic advisory capacity have historically hindered successful transfer of knowledge. Thus, the establishment of national coordination mechanisms, bioeconomy contact points, and micro-credential systems for advisors can close the gap by increasing adoption of circular and regenerative practices.

In conclusion, good Governance & AKIS lays the foundation of bioeconomy transition oriented agribusiness. They connect theory, practice, and policy learning, providing environments supporting innovation, data driven transformation strategies, and climate smart responses. These principles underlay the policy measures proposed in this Action Plan, which will strengthen institutions and stimulate more cooperative and adaptive governance frameworks to drive sustainable agricultural and rural transformation across Central Europe.

Research, innovation & digitalisation

The twin transition towards a sustainable and competitive bioeconomy in Europe relies on research, innovation, and digitalisation as key enablers of systemic change. Together, these pillars provide the foundation for developing knowledge-based solutions that enhance resource efficiency, reduce emissions, and strengthen the resilience of agricultural and rural systems (32, 33).

Research and innovation are at the core of the EU Bioeconomy Strategy, which emphasises the need to mobilise scientific and technological advances to create sustainable value chains, circular production systems, and low-carbon industries (34). The European Commission underlines that bioeconomy-oriented innovation must integrate biotechnology, digital technologies, and advanced data management to achieve environmental and economic goals simultaneously. Strengthening research infrastructures, innovation ecosystems, and cross-sectoral partnerships remains a priority for the period beyond 2027.

Digitalisation, on the other hand, serves as both a catalyst and a connector within this system. The digital transformation of agriculture enables precision management of natural resources, optimised fertilisation and irrigation, traceability of biomass flows, and improved farm-level decision-making (32, 35). The European Commission recognises that digital tools - such as remote sensing, Internet of Things (IoT), artificial intelligence (AI), and digital twins - can significantly enhance monitoring, reporting, and verification (MRV) processes while improving farmers' access to innovation through data interoperability and advisory services (32, 36).

According to the OECD, innovation and digital technologies are essential to achieving sustainable productivity growth in agriculture, enabling better alignment between research, policy, and market incentives (33). However, the diffusion of such innovations depends on governance structures that ensure open data standards, trust, and capacity building across the Agricultural Knowledge and Innovation System (AKIS). In this sense, research, innovation, and digitalisation are inseparable from governance and knowledge exchange mechanisms that translate scientific advances into practice.

FAO's research of the EU digital agriculture framework confirms that the implementation of data-driven agriculture requires not only technology deployment but also institutional readiness, skills development, and coherent policy frameworks (36). It stresses that effective integration of digitalisation into rural development and CAP instruments should prioritise inclusive access, data sovereignty, and long-term interoperability.

In the context of the Interreg Central Europe countries, strengthening research and innovation ecosystems is vital to bridge regional disparities and enhance the absorption of EU and national funds. The establishment of bioeconomy innovation hubs, living labs, and regulatory sandboxes provides safe environments for testing new technologies such as microbial bio-products, biochar systems, and circular nutrient hubs. Investment in precision farming and digital infrastructure - including open data repositories and digital product



passports - is essential to enable evidence-based decision-making and adaptive governance in the agricultural and bioeconomy sectors (34, 35, 37).

Digitalisation also facilitates the creation of bioeconomy digital twins, which can act as the data backbone for adaptive governance, integrating real-time environmental data, farm performance metrics, and socio-economic indicators. Such systems enable simulation of policy impacts and enhance resilience planning at national and regional levels.

Finally, empowering human capital through bioeconomy fellowships, micro-credentials, and innovation vouchers can foster a new generation of digitally skilled farmers, researchers, and entrepreneurs capable of leading the green and digital transition. Aligning these efforts with Horizon Europe missions and CAP priorities will ensure that Central Europe remains at the forefront of research, innovation, and digital transformation within the circular bioeconomy.

Climate & environmental sustainability

Climate and environmental sustainability are core elements of the European Union's transformation to a climate-neutral and resource-efficient economy. In the agricultural and bioeconomy sectors, this transition aims to reduce greenhouse gas (GHG) emissions, regenerate soils, and protect ecosystems while maintaining productivity and rural livelihoods (38, 39, 40). The Common Agricultural Policy (CAP) has become one of the key policy instruments driving this transformation, linking direct payments and rural development support to measurable environmental and climate outcomes (38, 41).

The European Commission recognises that the agri-food system must actively contribute to achieving the EU's climate neutrality goal by 2050. Between 1990 and 2021, agricultural emissions in the EU fell by around 24 %, yet further reductions require systemic changes, including carbon-sequestering farming, nutrient substitution, and renewable energy integration (39, 42). The EU 2040 Climate Target evaluation highlights that agriculture and land use (LULUCF) can provide up to one-third of the total emission reductions if regenerative and circular practices are widely implemented (41).

At the same time, agriculture must enhance its adaptive capacity. Climate change has intensified droughts, floods, and soil degradation, directly threatening food security and rural resilience. The European Environment Agency emphasizes the importance of integrated adaptation policies integrating soil management, water efficiency, and biodiversity restoration in order to ensure long-term productivity under changing climatic conditions (43).

To meet these objectives, the EU promotes result-based agri-environment-climate schemes (AECMs) that reward farmers for measurable ecosystem services such as soil carbon accumulation, nutrient efficiency, or biodiversity enhancement (44). This represents a paradigm shift from compliance-based subsidies to outcome-based incentives. Digital monitoring, reporting, and verification (MRV) systems, supported by the Agricultural Knowledge and Innovation System (AKIS), are becoming essential tools for verifying these results and linking financial support to environmental performance (38, 40).

The role of the bioeconomy is equally critical in the climate transition. The EU Bioeconomy Strategy (2025) emphasises cascading biomass use, renewable materials, and waste valorisation as pathways to reduce emissions while maintaining rural employment (42). Circular bio-based innovations – such as biochar application, compost-based soil regeneration, digestate utilisation, and precision irrigation – align environmental and economic benefits by closing nutrient loops and enhancing carbon storage in soils.

In Central Europe, where agricultural landscapes are diverse and often vulnerable to climate impacts, fostering environmental sustainability requires tailored interventions that combine result-based eco-schemes, cooperative investments, and adaptive governance. These include measures such as carbon farming with organic amendments, mixed crop-livestock systems, agroforestry, and pyrolysis pilots that capture both mitigation and adaptation co-benefits (41, 42, 44).



Investments in soil health, biodiversity, and circular resource use are a climate imperative that is equally an economic opportunity. Innovative financial instruments – such as soil health bonds or green public procurement accelerators – can mobilise private investment for environmental goals. By using the aforementioned strategies, the Action Plan helps develop sustainable, resilient, low-carbon, adaptation and regenerative farming systems that improve ecosystem services, strengthen rural economies, and contribute to the EU’s long-term climate goals.

Sustainable agriculture, food & forestry value chains

The development of sustainable agriculture, food, and forestry value chains lies at the core of Europe’s transition towards a circular and climate-neutral bioeconomy. These value chains are essential for achieving the EU Green Deal objectives of resource efficiency, emission reduction, and rural resilience. They integrate primary production, processing, logistics, and consumption into systems that deliver economic, environmental, and social value (45, 46).

The European Commission identifies sustainable and circular value chains as a cornerstone of agricultural research and innovation, highlighting their role in reducing dependence on fossil resources and ensuring responsible use of natural capital (45). Creating such value chains requires the mobilisation of agricultural residues, forestry by-products, and organic waste as renewable feedstocks for biogas, biomethane, and biobased materials. In this context, pilot investments in biorefineries, modular biomethane plants, and cascading biomass hubs contribute to both energy transition and material substitution, supporting EU priorities on renewable energy and the bioeconomy (46, 47, 48).

In agriculture and food systems, the shift toward short, traceable, and transparent supply chains improves sustainability and trust among consumers. The “Vision for Agriculture and Food” formulated by the European Commission stresses that resilience, food security, and competitiveness can only be achieved by integrating sustainability throughout the entire value chain – from farm to fork – and by supporting farmers and processors in innovation and cooperation (46). The introduction of digital food passports and traceability systems is a key step in this process, enhancing data transparency, sustainability verification, and fair value distribution.

The forestry sector plays an equally important role in the bioeconomy’s circular value chains. According to FAO, sustainable forest governance and wood-based value chains can deliver low-carbon materials, renewable construction products, and cascading use of biomass that align with climate neutrality targets (47). Integrating forestry with agricultural and bioindustrial systems fosters regional synergies, allowing for the use of side streams, such as wood residues and lignocellulosic biomass, in the production of advanced bio-based products like bioplastics, biochar, and green solvents.

Conversely, global efforts towards sustainable commodity supply chains (promoted by the EU and UNEP) highlight the necessity for tools that protect biodiversity and also lead to responsible production through traceability, certification and value-sharing mechanisms (48). These mechanisms are helping to make rural economies better off through fresh sources of incomes such as waste valorisation, biogas or carbon farming while reducing environmental pressure.

In Central Europe, there is an urgent need for sustainable value chains that link fragmented rural industries to new bioeconomy markets. Creating regional bioprocessing hubs, cooperative manure exchange platforms, and insect bioconversion facilities will turn local waste streams into renewable energy, fertilisers, and materials. Such actions do more than address climate change and nutrient recycling – they provide employment, innovation, and investment opportunities for rural people and for those communities.

In general, the transformation of sustainable agricultural, food, and forestry value chains toward sustainable production processes is regarded as a systemic transformation from linear, high-growth resource-based production lines to circular-focused, regenerative systems of management of agriculture, food, and forestry. With the links between agricultural and forestry actors, promoting innovation and establishing traceable,



data-driven value chains, the Action Plan enhances the basis of a solid low-carbon sustainable and competitive bioeconomy for Central Europe.

Rural communities & regional bioeconomy hubs

Regional bioeconomy hubs embedded within rural communities are emerging as critical engines of sustainable development, enabling local resource mobilisation, circular nutrient cycles and inclusive rural transformation. These hubs act as collaborative platforms that bring together farmers, local enterprises, research institutions and public authorities in order to develop value-chains for biomass, bioproducts and renewable materials, generate jobs and strengthen social acceptance of bioeconomy innovations (49, 50).

Evidence shows that bioeconomy strategies must be tailored to regional contexts: local biomass availability, infrastructure, human capital and social structures strongly influence the potential of rural areas to build thriving bio-based industries (5). In this sense, regional hubs provide the infrastructure – both physical (micro-biogas plants, nutrient hubs, biomass mobilisation platforms) and institutional (living labs, cooperation networks, digital tools) – for converting local residues or by-products into renewable energy and high-value materials while retaining value in the local economy (51, 52).

Hubs emphasise circularity and nutrient-cycling: for example, micro-biogas plants combining manure and agricultural residues with digestate recirculation reinforce both local nutrient loops and climate mitigation, while printed networks of biomass supply chains reduce transport losses and strengthen short-chain relationships (2, 3). Moreover, building trust and community acceptance is essential for deploying decentralized infrastructure in rural regions – participatory governance, multi-actor partnerships and local capacity building play a foundational role (49).

Adopting a hub model allows rural regions to benefit from economies of scale and scope without being solely dependent on large industrial facilities. Regional feedstock hubs, insect bioconversion facilities, modular biorefineries or biomass mobilisation corridors create flexibility, generate local revenue streams and avoid centralisation of benefits. They also form ideal platforms to pilot digital provenance tools, local food-waste prevention schemes and circular supply chains that improve margins, reduce waste and strengthen consumer trust (52).

For rural communities in Central Europe, the establishment of bioeconomy hubs offers a strategic pathway to revitalise socio-economic structures, attract investment and deploy circular business models. The Action Plan leverages this by proposing policy measures such as micro-biogas plants under LEADER/EIP cooperation, regional biomass mobilisation platforms, digital farmer wallets for eco-scheme tracking and result-based eco-schemes for material-grade feedstocks – all aimed at enhancing the role of rural communities as hubs of bioeconomy innovation and value creation.

By prioritizing the rural community in the core of the regional bioeconomy ecosystem and creating structurally integrated centres enabling circular flows, local entrepreneurship, and collaborative governance, the Action Plan seeks to guarantee that the shift to a sustainable bioeconomy will be inclusive, locally rooted, and tied to regional development priorities.

Knowledge & skills for farmers and advisors

Knowledge and skills are the foundation of the green and digital transition in agriculture and the bioeconomy. Farmers and advisors are increasingly required to operate within complex systems that integrate sustainability, technology, and innovation. Strengthening their capacities through lifelong learning, modular skill certification, and innovation brokerage is therefore essential for implementing the next generation of agricultural and bioeconomy policies (54, 55).

The European Commission highlights that well-functioning Agricultural Knowledge and Innovation Systems (AKIS) are key to connecting science, advisory services, and practice. Empowering farmers and advisors with up-to-date knowledge supports not only productivity but also environmental performance, circularity, and



carbon efficiency (54). The new CAP framework reinforces this approach by placing knowledge exchange and training at the centre of adaptive governance and result-based policy design (55, 56).

Building future-proof skills requires modular, flexible, and inclusive learning pathways. As defined by the EU CAP Network, capacity building must merge technical expertise - for example precision farming, bioenergy, soil health, circular fertiliser management - and cross-cutting capabilities such as digital skills, sustainability awareness, and systems thinking (55, 57). The development of micro-credentials and bioeconomy-oriented fellowships provides new tools to acknowledge skills and to connect them to innovation ecosystems and employment opportunities (56, 57).

Indeed, innovation brokers and advisory networks perform a crucial function for the translation of the scientific and technological developments into practice. They are intermediaries connecting the research institutions, SMEs, farmers, and policymakers, who can identify needs, stimulate co-creation and accelerate the market uptake of innovations (54, 58). Strengthening AKIS coordination, professionalising advisory services, and integrating digital tools – such as e-learning platforms and data-driven knowledge systems – are key enablers of this process.

Within the context of Central Europe, these measures gain particular relevance: fragmented advisory structures, limited access to upskilling opportunities, and uneven digitalisation remain major challenges. To overcome these, the Action Plan proposes actions including the development of modular skill certificates, innovation brokerage services, and AKIS micro-credentials for the bioeconomy. These interventions will ensure that farmers and advisors are equipped to implement result-based eco-schemes, renewable energy pilots, and circular management practices.

Ultimately, investing in knowledge and skills means investing in resilience, innovation, and sustainability. A well-connected, continuously learning agricultural community will be capable of translating policy ambitions into measurable results – driving the bioeconomy transition forward and ensuring that no rural area is left behind.

11. Guiding Principles

The Central European Bioeconomy Strategy and Action Plan, developed under the BIOECO-UP project, is guided by a coherent set of principles that translate its vision into coordinated, actionable, and measurable policy directions. These principles derive from the analytical evidence produced in Activity A3.1, the Delphi and expert consultations conducted within Activity A3.2, and the overarching ambition of Work Package 3 – to enhance policy learning, strengthen strategic coherence, and accelerate the integration of circular bioeconomy objectives into the Common Agricultural Policy (CAP 2023-2027 and beyond).

They provide a unifying framework for the six thematic intervention areas of this Action Plan and reflect the shared commitment of the BIOECO-UP partnership to foster a sustainable, inclusive, and innovation-driven bioeconomy transition across Central Europe.

Sustainability and climate neutrality

Sustainability is the overarching principle guiding all bioeconomy actions in Central Europe. Each intervention must align with the European Green Deal, Farm to Fork Strategy, and the EU Bioeconomy Strategy (2025), ensuring that production and consumption systems operate within ecological limits. The circular bioeconomy contributes directly to climate-neutrality by 2050, supports ecosystem regeneration, and safeguards soil, water, and biodiversity.

Result-based eco-schemes, carbon-farming models, nutrient substitution, and renewable-energy integration transform environmental objectives into measurable and economically attractive outcomes. In doing so, the region moves decisively from compliance-based towards performance-based policy delivery that rewards climate-positive and regenerative practices.



Food first and nutritional security

Ensuring access to safe, healthy, and affordable food remains a fundamental priority of the circular bioeconomy. The Food First principle recognises that food and nutrition security must take precedence over non-food uses of biomass. Bioeconomy development should strengthen the resilience of local food systems, reduce waste, and guarantee sustainable supply chains that support both producers and consumers.

All resource-use and valorisation pathways proposed under this Action Plan must therefore safeguard primary food production and avoid competition between food, feed, and industrial uses – ensuring that citizens’ basic nutritional needs are met first.

Innovation, digitalisation and evidence-based policy

Innovation and digitalisation are the principal enablers of systemic change. They connect policy, science, and practice, creating data-driven ecosystems that accelerate the transition from fossil-based to bio-based systems.

The Action Plan promotes research excellence, digital technologies, and smart data systems (digital twins, IoT, MRV, and open-data platforms) as foundations for adaptive and transparent governance. Innovation and regulatory sandboxes, Living Labs, and Policy Labs will test emerging bio-based technologies – from microbial inputs to circular nutrient hubs – under real operating conditions.

By embedding digital intelligence in governance, Central Europe can make its policies evidence-based, measurable, and continuously improving.

Good governance and adaptive cooperation

Strong, participatory, and transparent governance is the precondition for a thriving bioeconomy. The Agricultural Knowledge and Innovation System (AKIS) acts as the governance spine connecting science, advisory services, and policymaking, ensuring that innovation responds to real societal and market needs.

BIOECO-UP supports adaptive, multi-actor governance that encourages cooperation among ministries, research institutions, advisory bodies, and private actors. Policy coherence, accountability, and stakeholder dialogue will guide the alignment of CAP instruments, national strategies, and regional initiatives. Governance here also implies an ethos of learning and trust – institutions must remain flexible and receptive to feedback as technologies and contexts evolve.

Cascading and circular resource use

The cascading use of biological resources is a cornerstone of the circular bioeconomy. Biomass should first serve high-value applications – such as food, feed, bio-based materials, and biochemicals – before being used for energy recovery. This hierarchy ensures the maximum value extraction from limited bio-resources and supports multiple actors in the chain, including farmers, foresters, the fishing community, industry, and consumers.

Central Europe’s bioeconomy must be guided by resource efficiency, favouring material-first over energy-first utilisation. Regional biorefineries, nutrient-cycling platforms, and cascading biomass hubs are encouraged to transform agricultural residues and by-products into renewable feedstocks while retaining value locally. This approach reduces environmental pressure, enhances competitiveness, and aligns with the EU’s sustainability taxonomy.

Local empowerment and regional bioeconomy hubs

Rural communities are the backbone of the bioeconomy transition. Establishing regional bioeconomy hubs will strengthen territorial cooperation and enable local resource mobilisation, innovation, and entrepreneurship.



These hubs combine physical infrastructure (micro-biogas plants, biomass-to-substrate hubs, composting and nutrient facilities) with institutional platforms (cooperation networks, living labs, and digital provenance tools) to support local circular ecosystems.

Area-based development through LEADER, EIP, and inter-municipal partnerships ensures that value creation remains in the regions, empowering communities to become active drivers and beneficiaries of the bioeconomy.

Knowledge, skills and human capital

Human capital is the engine of bioeconomy transformation. Farmers, advisors, and entrepreneurs require continuous access to knowledge, training, and innovation brokerage services.

Strengthening AKIS-based learning, modular skill certificates, and micro-credentials in bioeconomy-related domains is vital to bridge the skills gap and ensure that innovation reaches practice. The Action Plan supports lifelong learning, e-learning platforms, and the professionalisation of advisory systems.

Empowered with the right competences – digital, technical, and sustainability-oriented – farmers and advisors can implement regenerative and circular solutions, ensuring that the transition is knowledge-driven and socially inclusive.

Inclusiveness, transparency and social innovation

The circular bioeconomy must be inclusive, fair, and participatory. Women, youth, smallholders, and local entrepreneurs should all benefit from bioeconomy opportunities. Transparency in policy design, participatory governance, and citizen engagement in Living Labs foster public trust and legitimacy.

WP2 of BIOECO-UP demonstrates that citizens can become bioeconomy prosumers – active users, co-creators, and advocates of bio-based products. By integrating social innovation and behavioural change, the bioeconomy transition becomes not only technological but also societal, strengthening cohesion and public ownership.

Transnational cooperation and policy learning

Central Europe's bioeconomy transformation depends on collaboration across borders and sectors. The project reinforces policy learning and capacity building among ministries, research institutions, and regional authorities within the BIOEAST macro-region.

Transnational peer learning, foresight exercises, and mutual recognition of bio-based standards will harmonise national frameworks and enhance regional competitiveness. Coordination with the BIOEAST Initiative ensures that Central Europe acts as a united innovation ecosystem, co-creating solutions, sharing good practices, and influencing the post-2027 CAP and EU bioeconomy agenda.

Summary

Together, these guiding principles form the strategic compass of the Central European Bioeconomy Strategy and Action Plan. They ensure that future measures are:

- Environmentally sustainable and climate-responsible, supporting regenerative land use and carbon neutrality;
- Food-secure, giving priority to nutrition and health before non-food biomass uses;
- Innovative and data-driven, grounded in research, digitalisation, and open knowledge;
- Governed through cooperation, with AKIS as a unifying governance framework;
- Circular and cascading, maximising the material value of every bio-resource;
- Locally empowering and socially inclusive, ensuring benefits for rural communities and citizens; and
- Transnationally coherent, promoting policy learning, shared evidence, and long-term regional cohesion.



These principles embody the vision of BIOECO-UP – bridging policy, business, and society to accelerate the shift from fossil-based to bio-based systems and strengthen Central Europe’s role in delivering the EU Green Deal, the Bioeconomy Strategy, and the CAP post-2027 objectives.

12. Strategic approach - 6 pillars of implementing circular bioeconomy measures to CAP

The strategic approach of the Central European Bioeconomy Strategy and Action Plan builds on six interlinked pillars that together define how circular bioeconomy objectives can be effectively integrated into the Common Agricultural Policy (CAP). Each pillar represents a systemic area of intervention where policy, knowledge, and innovation converge to create sustainable, regenerative, and competitive rural systems.

Below we present the Action Plan, which includes a selection of policy measures drawn from the comprehensive list of 100 measures provided in Annex 3. The measures are organised by the six BIOEAST countries, with shading used to distinguish between them (as illustrated in the table below).

The selected measures represent those considered most relevant for further national-level discussion and joint transnational cooperation. They provide a foundation for aligning policy approaches, identifying synergies, and facilitating the exchange of experience and good practices across the BIOEAST macro-region.

	Croatia
	Czech Republic
	Hungary
	Poland
	Slovakia
	Slovenia

Figure 16. Legend to the tables below

12.1. Governance & AKIS - building adaptive and integrated knowledge systems

Effective governance and well-functioning Agricultural Knowledge and Innovation Systems (AKIS) are the institutional backbone of the bioeconomy transition. They connect farmers, advisors, researchers, businesses, and policymakers in a network-based system of knowledge creation and exchange.

Strengthening AKIS within the CAP enables evidence-based decision-making, professional advisory services, and cross-sector innovation. Policy labs, living labs, and regulatory sandboxes support adaptive governance where regulation and experimentation evolve together.

Through national coordination mechanisms, bioeconomy contact points, and micro-credential systems, Central Europe can overcome institutional fragmentation and empower actors to co-produce solutions that make agricultural and rural systems more sustainable and innovation-driven.



Table 27. Chosen policy measures in the Governance & AKIS area

No.	Policy measure chosen from the Annex 3 (1-100)	Steps to delivery	Timeframe	Responsible	Proposed financing
1	Result-based reduction of GHG emissions in biofuel feedstock crops through regenerative practices and residue-to-biogas systems	Develop methodology for farm-level GHG accounting (kg CO ₂ e/ha), incl. SOC proxy, residue management indicators, and alignment with RED III/NCW requirements	2026-2027 (preparation phase)	Ministry of Environmental Protection and Green Transition Ministry of Agriculture, Forestry, and Fisheries • research institutions in agriculture • national emissions and environmental protection bodies • paying Agency • energy regulatory office	Horizon Europe, LIFE, National Funds, Technical Assistance
		Design eco-scheme payment logic & eligibility rules (result-based €/ha by verified emission cuts; standard-cost fallback; safeguards vs. double funding)	2026-2027 (preparation phase)	• Ministry of Agriculture, Forestry, and Fisheries • paying agency • research institutions in agriculture • climate policy coordination body	CAP Pillar I, GD Clima Pilot funds
		Pilot eco-scheme in selected arable regions (rapeseed/corn producers in manure-surplus & drought districts), testing monitoring and residue-to-biogas linkages	2026-2027 (pilot)	• Ministry of Agriculture, Forestry, and Fisheries • research institutions in agriculture • regional chambers of agriculture • bioenergy associations • cooperatives	Pillar I, Pillar II, Interreg CE
		Develop knowledge transfer & advisory Modules (precision N, low-emission fertilisation, cover crops, rotations, digestate use) with digital tools and training for advisors/farmers	2026-2027 (capacity-building)	• farmer advisory units (Lead) • research institutions in agriculture • universities • private advisory firms	Pillar II HE Erasmus +
		Establish annual monitoring & verification system (digital farm logs,	2028-2030 (early implementation)	• Ministry of Agriculture, Forestry, and	Pillar II, Cohesion Funds / ERDF



		remote sensing, RED sustainability audits) with national reporting to Commission	tation), ongoing to 2034	Fisheries <ul style="list-style-type: none"> • paying agency • research institutions in agriculture • national emissions and environmental protection bodies • IT partners 	
3	Establishment of a national agricultural emissions monitoring system with AKIS support for farmers and advisors	Develop standardised methodologies for on-farm GHG/SOC monitoring, including field protocols and alignment with RED III / NCW verification	2026-2027 (preparation)	<ul style="list-style-type: none"> • Ministry of Environmental Protection and Green Transition • Ministry of Agriculture, Forestry, and Fisheries • research institutions in agriculture • national emissions and environmental protection bodies • universities 	HE, LIFE, TA CAP
		Build AKIS capacity through modular skill certificates in low-emission agronomy and soil carbon management for advisors, farmers, and cooperatives	2026-2027 (capacity-building)	<ul style="list-style-type: none"> • farmer advisory units • universities • NGOs, chambers • producer groups 	AKIS (P2), Erasmus+, HE
		Design national framework for modular skill certificates (systemic methods, portfolio approaches, policy mix, sandboxing, bioeconomy KET use), including recognition across ministries	2026-2027 (preparation)	<ul style="list-style-type: none"> • Ministry of Agriculture, Forestry, and Fisheries • Ministry of education • universities • research institutions in agriculture • advisory centres (farmer advisory units) 	HE, LIFE, Erasmus+
3	Establishment of a national agricultural emissions monitoring system with AKIS support for farmers and advisors	Develop standardised methodologies for on-farm GHG/SOC monitoring, including field protocols and alignment with RED III / NCW verification	2026-2027 (preparation)	<ul style="list-style-type: none"> • Ministry of Agriculture and Rural Development • research institutions in agriculture and related areas: IUNG-PIB, INIG-PIB, IOŚ-PIB • national emissions and environmental protection bodies 	HE, LIFE, TA CAP, National Funds



				<ul style="list-style-type: none"> • National Chamber of Biofuels • Regional Advisory Centres • Farmers Associations 	
		<p>Design and test a digital monitoring and reporting system (open standards, IACS/LPIS/FSDN interoperability, farmer dashboards)</p>	2026-2027 (pilot)	<ul style="list-style-type: none"> • Ministry of Agriculture and Rural Development • ARiMR • IT related public institutes: e.g. NASK • Research institutions in agriculture and related areas: IUNG-PIB, INIG-PIB, IOŚ-PIB • National Chamber of Biofuels • Regional Advisory Centres • Farmers Associations 	DEP, HE, National Funds
		<p>Build AKIS capacity through modular skill certificates in low-emission agronomy and soil carbon management for advisors, farmers, and cooperatives</p>	2026-2027 (capacity-building)	<ul style="list-style-type: none"> • IT related public institutes: e.g. NASK • Research institutions in agriculture and related areas: IUNG-PIB, INIG-PIB, IOŚ-PIB • National Chamber of Biofuels • Regional Advisory Centres • Farmers Associations • Educational Research Institute State Research Institute 	AKIS (P2), Erasmus+, HE
		<p>Establish the National Agricultural Emissions Centre as coordination hub for MRV, training, and RED III</p>	2026-2027 (preparation)	<ul style="list-style-type: none"> • Ministry of Agriculture and Rural Development • ARiMR • IT related public institutes: e.g. NASK • Research institutions in agriculture and related areas: IUNG-PIB, INIG-PIB, IOŚ-PIB • National Chamber of Biofuels • Regional Advisory Centres 	TA CAP, LIFE, National Funds



				<ul style="list-style-type: none"> • Farmers Associations 	
		<p>Roll out advisory & auditing services nationwide (farm-level audits, SOC tracking, nutrient/energy balances), funded under Pillar II KT/advisory</p>	2028-2034 (implementation)	<ul style="list-style-type: none"> • ARiMR • IT related public institutes: e.g. NASK • Research institutions in agriculture and related areas: IUNG-PIB, INIG-PIB, IOŚ-PIB • National Chamber of Biofuels • Regional Advisory Centres 	P2 (Advisory/KT), AKIS
		<p>Deliver large-scale farmer training & communication campaigns to counteract the misinformation and demonstrate verified GHG cuts</p>	2028-2034 (implementation & scaling)	<ul style="list-style-type: none"> • Ministry of Agriculture and Rural Development • Research institutions in agriculture and related areas: IUNG-PIB, INIG-PIB, IOŚ-PIB 	AKIS (P2), Erasmus+, LIFE
		<p>Operate annual reporting & verification system with open-access data (aggregated), linked to CAP monitoring and PEP2040 indicators</p>	2028-2034 (monitoring)	<ul style="list-style-type: none"> • Ministry of Agriculture and Rural Development • Research institutions in agriculture • national emissions and environmental protection bodies • statistical office • IT partners 	P2, DEP, LIFE, HE
4	<p>Creation of bioeconomy policy labs and regulatory sandboxes to accelerate adaptive governance and innovation based on portfolio</p>	<p>Design national framework for policy labs and sandboxes (objectives, eligibility, funding envelopes, evaluation protocols) with portfolio management methods</p>	2026-2027 (preparation)	<ul style="list-style-type: none"> • Research institutions in agriculture and related areas - institutes, universities • NGOs or cooperation platforms as National Bioeconomy Hub in Poland • Ministry of Agriculture and Rural Development, Ministry of Economic Development and Technology, Ministry of Climate and Environment, Ministry of Science and Higher Education 	TA CAP, HE, LIFE



				<ul style="list-style-type: none"> • Regional authorities 	
		<p>Launch 2-3 pilot policy labs in priority regions/value chains (e.g. biomass cascading, soil carbon credits, bioproduct standards)</p>	2026-2027 (pilot)	<ul style="list-style-type: none"> • Ministry of Agriculture and Rural Development • Local action groups, e.g. EIP Groups • Producer organisations • SMEs • Research institutions in agriculture and related areas - institutes, universities 	Interreg, HE, P2 (Cooperation), ERDF
		<p>Establish central support unit for methodology, tooling, and cross-lab learning (developmental evaluation, agile monitoring, adaptive policy design)</p>	2026-2027 (capacity-building)	<ul style="list-style-type: none"> • Research institutions in agriculture and related areas - institutes, universities • National Contact Point for EU Programmes • European Union related institutions • Central and Regional Advisory networks 	TA CAP, LIFE, HE, National Funds
		<p>Scale portfolio pilots across regions and sectors (5-7 labs/sandboxes), integrating lessons learned into regulatory changes, CAP eco-schemes, and national bioeconomy strategy/roadmap</p>	2028-2034 (implementation & scaling)	<ul style="list-style-type: none"> • Ministry of Science and Higher Education • National Contact Point for EU Programmes • Research institutions in agriculture and related areas - institutes, universities • Producer groups • NGOs or cooperation platforms as National Bioeconomy Hub in Poland 	P2 (AECM/eco-schemes), Interreg, HE
		<p>Institutionalise policy labs as part of adaptive governance cycle (regular open calls, annual showcase, mainstreaming tested solutions into CAP and national programmes)</p>	2028-2034 (consolidation)	<ul style="list-style-type: none"> • National Contact Point for EU Programmes • ARiMR • National Centre for Research and Development (NCBiR) 	TA CAP, National Funds, LIFE



				<ul style="list-style-type: none"> • PARP and other financing institutions 	
		<p>Publish annual “Bioeconomy Policy Innovation Report” synthesising tested prototypes, adoption rates, and impacts on farmer income, sustainability and value chains</p>	2028-2034 (reporting & dissemination)	<ul style="list-style-type: none"> • Research institutions in agriculture and related areas - institutes, universities in cooperation with cooperation platforms as National Bioeconomy Hub • Innovation centres in Poland: Science & Technology Parks, Business Incubators and Accelerators, Regional Innovation Hubs / Living Labs 	TA CAP, HE, LIFE
4	Creation of bioeconomy policy labs and regulatory sandboxes to accelerate adaptive governance and innovation based on portfolio	<p>Design national framework for policy labs and sandboxes (objectives, eligibility, funding envelopes, evaluation protocols) with portfolio management methods</p>	2026-2027 (preparation)	<p>-Ministry of Agriculture, Forestry and Food (MKGP) - lead</p> <p>-Administration for Food Safety, Veterinary and Plant Protection (UVHVVR)</p>	Horizon Europe (CSA) EIT & sectoral Knowledge & Innovation Communities (e.g., EIT Food)
		<p>Launch 2-3 pilot policy labs in priority regions/value chains (e.g. biomass cascading, soil carbon credits, bioproduct standards)</p>	2026-2027 (pilot)	<p>- standards and inspection</p> <p>-Ministry of the Environment, Climate and Energy (MOP) - environmental regulation</p>	Horizon Europe R&I grants LIFE (environmental pilots)
		<p>Establish central support unit for methodology, tooling, and cross-lab learning (developmental evaluation, agile monitoring, adaptive policy design)</p>	2026-2027 (capacity-building)	<p>-Slovenian Environment Agency (ARSO) - environmental data and monitoring</p>	
		<p>Scale portfolio pilots across regions and sectors (5-7 labs/sandboxes), integrating lessons learned into regulatory changes, CAP eco-schemes, and national bioeconomy strategy/roadmap</p>	2028-2034 (implementation & scaling)	<p>-Agency for Agricultural Markets and Rural Development (ARSKTRP) - paying agency, IACS integration</p>	InvestEU guarantees SID (Slovenian Development and Export Bank)/EIB loans for infrastructure and operational costs; possible public procurement contracts (PPI) for services;
		<p>Institutionalise policy labs as part of adaptive governance cycle (regular open calls, annual showcase, mainstreaming)</p>	2028-2034 (consolidation)	<p>-Ministry of Higher Education, Science and Innovation (MZVI) - research coordination</p>	



		tested solutions into CAP and national programmes)		-University of Ljubljana Biotechnical Faculty, Jožef Stefan Institute, others - research institutions -Local Action Groups (LAS), producer organizations, NGOs - operational pilots	blended finance where private sector pays fees for sandbox access
		Publish annual “Bioeconomy Policy Innovation Report” synthesising tested prototypes, adoption rates, and impacts on farmer income, sustainability and value chains	2028-2034 (reporting & dissemination)		
11	Establishment of micro-biogas plants and circular manure hubs through LEADER/EIP cooperation for local nutrient cycling and social acceptance	Expand hubs to ≥70 by 2030 , combining modular micro-AD units with shared logistics (collection, storage, pre-treatment)	2028-2030 (early implementation)	<ul style="list-style-type: none"> • Ministry of Agriculture, Forestry, and Fisheries • regional authorities • producer groups • SMEs • advisory services providers chambers 	P2 (Investments), ERDF, CF
		Monitor performance and community acceptance (t residues treated, CH ₄ /N ₂ O avoided, attendance at info events, complaint rates ↓) with annual reporting	2028-2034 (monitoring & evaluation)	<ul style="list-style-type: none"> • Ministry of Agriculture, Forestry, and Fisheries • research institutions in agriculture • statistical office • local action groups • independent evaluators 	P2 (Monitoring), LIFE, DEP
		Conduct regional biomass mapping (municipality → region), identifying dispersed residues/side-streams and potential aggregation nodes	2026-2027 (preparation)	<ul style="list-style-type: none"> • Ministry of Agriculture, Forestry, and Fisheries (Lead) • regional authorities • research institutions in agriculture • cooperatives • universities 	HE, LIFE, TA CAP
42	Establish regional bioeconomy hubs and value-chain cooperation to supply material-grade feedstock for cascades	Deploy CAP Pillar II calls for CAPEX investments in hubs (labs, QA, storage/logistics) under regional authorities	2027-2028	<ul style="list-style-type: none"> • agriculture modernisation units • regional governments • monitoring agency 	P2 (Investments), ERDF, CF, National Funds
		Integrate certified material-grade feedstock into CAP reporting (linking volumes with eco-schemes and AEEM)	2028-2030	<ul style="list-style-type: none"> • research institutions in agriculture • advisory services providers • farmers/coops 	P1 (Eco-schemes), AEEM (P2), LIFE



	before energy use	nutrient/circularity outcomes)			
		Draft certification framework & conformity assessment protocols (biopolymers, advanced materials, bio-inputs) aligned with EU standards	2026-2027 (pre-CAP rollout)	<ul style="list-style-type: none"> • monitoring agency (Lead) • Ministry of Environmental Protection and Green Transition • research institutions in agriculture • standardisation bodies • universities/labs 	HE, LIFE, CBE-JU
		Launch innovation operational groups under EIP pilots to validate testing protocols and sustainability/life cycle assessment modules across product categories	2026-2027	<ul style="list-style-type: none"> • EIP consortia (SMEs, producer groups, labs, advisory) • RTOs • observers from competent authorities 	EIP-OG (P2), HE, Interreg
43	Establish a national bio-based product certification and label interoperable with digital product passport (DPP) standards	Draft certification framework & conformity assessment protocols (biopolymers, advanced materials, bio-inputs) aligned with EU standards	2026-2027 (pre-CAP rollout)	<ul style="list-style-type: none"> • ARiMR • IT public centre: NASK • Service providers • KOWR • Research institutions in agriculture and related areas (e.g. IT, biotechnology) • Ministry of Economic Development and Technology 	HE, LIFE, CBE-JU, National Funds
		Launch innovation operational groups under EIP pilots to validate testing protocols and sustainability/life cycle assessment modules across product categories	2026-2027	<ul style="list-style-type: none"> • ARiMR • Agricultural Advisory Center in Brwinów • EIP consortia (SMEs, producer groups, labs, advisory etc.) • KSOW+ 	EIP-OG (P2), HE, CBE JU
		Deploy national label design, public registry & API infrastructure (DPP-ready) under Technical Assistance	2027-2028	<ul style="list-style-type: none"> • Ministry of Economic Development and Technology • PARP • Institute of Logistics and Warehousing • Central Office of Measures (GUM) or 	TA CAP, DEP, HE



				<p>Polish Committee for Standardization (PKN)</p> <ul style="list-style-type: none"> • GovTech Polska / Chancellery of the Prime Minister (KPRM) • Digital Innovation Hubs and Research Institutes 	
		<p>Train procurers, retailers & advisory services providers on certified bio-based product use, procurement clauses, and digital traceability</p>	2028-2030	<ul style="list-style-type: none"> • Related research institutions • Central and regional advisory bodies (CDR, ODRy) 	Erasmus+, LIFE, HE
		<p>Scale up certification: ≥400 certified product lines, ≥500 trained procurers, ≥200 API integrations with market platforms</p>	2028-2034	<ul style="list-style-type: none"> • ARiMR • Polish Centre for Testing and Certification (PCBC) • Private certifying companies, e.g. SGS Poland • public institutes - e.g. NASK (IT) • Producer groups & product owners 	DEP, LIFE, HE, National Funds
43	<p>Establish a national bio-based product certification and label interoperable with digital product passport (DPP) standards</p>	<p>Draft certification framework & conformity assessment protocols (biopolymers, advanced materials, bio-inputs) aligned with EU standards</p>	2026-2027 (pre-CAP rollout)	<p>MOPE - environmental and climate alignment</p> <p>Research institutions, SIST, universities/labs - certification protocols</p>	Horizon Europe LIFE CBE-JU (framework and pilots)
		<p>Launch innovation operational groups under EIP pilots to validate testing protocols and sustainability/life cycle assessment modules across product categories</p>	2026-2027	<p>EIP consortia (SMEs, producer groups, labs, advisory), research and technology organizations (RTOs) - pilots</p>	CAP P2 EIP Operational Groups (IRP31) LIFE (pilots)
		<p>Deploy national label design, public registry & API infrastructure (DPP-ready) under Technical Assistance</p>	2027-2028	<p>IT/standards partners, GS1 Slovenia - registry and API infrastructure</p> <p>KGZS advisory, public procurement offices, retailer associations - training</p>	CAP TA Digital Europe Programme (DEP) Horizon Europe (registry)
		<p>Train procurers, retailers & advisory services providers on certified bio-based product use,</p>	2028-2030		Erasmus+, LIFE, Horizon Europe (training)



		procurement clauses, and digital traceability		Registry operators, SMEs/producers, retailers/procurers - implementation	
		Scale up certification: ≥20 certified product lines, ≥50 trained procurers, integrations with market platforms	2028-2034		InvestEU guarantees SID (Slovenian Development and Export Bank)/EIB loans for infrastructure and operational costs;
43	Establish a national bio-based product certification and label interoperable with digital product passport (DPP) standards	Deploy national label design, public registry & API infrastructure (DPP-ready) under Technical Assistance	2027-2028	<ul style="list-style-type: none"> • monitoring agency • IT/standards partners • GS1 product identification system • registry operators 	TA CAP, DEP, HE
		Train procurers, retailers & advisory services providers on certified bio-based product use, procurement clauses, and digital traceability	2028-2030	<ul style="list-style-type: none"> • research institutions in agriculture • advisory bodies • public procurement offices • retailer associations 	Erasmus+, LIFE, HE
		Scale up certification: ≥400 certified product lines, ≥500 trained procurers, ≥200 API integrations with market platforms	2028-2034	<ul style="list-style-type: none"> • monitoring agency • registry operators • SMEs/producers • retailers/procurers 	DEP, LIFE, HE
		Define eligible by-product categories, biosafety standards and create the Residue Valorisation Index methodology (tonnes/ha with QA pass)	2026-2027	<ul style="list-style-type: none"> • Ministry of Agriculture, Forestry, and Fisheries • research institutions in agriculture • agriculture modernisation units • inspectorates 	EIP-OG (P2), Interreg, HE
100	Regional bio-based construction pilots	Identify candidate municipalities and local SMEs for straw/wood-based construction pilots	2026-2027	<ul style="list-style-type: none"> • Research institutions in agriculture • CDR Brwinów / KSOW+ • Local authorities • Agriculture associations 	HE, LIFE, NATIONAL Funds



		Support experimental programmes in public buildings (schools, kindergartens, rural admin)	2027-2028	<ul style="list-style-type: none"> Local governments Service providers: SMEs Agriculture modernisation units 	Interreg, ERDF, CF, National Funds
		Develop QA protocols for insulation/panels (fire safety, compostability, thermal)	2027-2029	<ul style="list-style-type: none"> Forest Research Institute (IBL) research institutions: Polish Centre for Testing and Certification (PCBC), Packaging Research Institute (COBRO), Łukasiewicz Research Network - Poznań Institute of Technology Universities 	HE, LIFE, CBE-JU, National Funds
		Develop procurement criteria/playbooks for municipalities & housing co-ops	2028-2029	<ul style="list-style-type: none"> Ministry of Agriculture and Rural Development NGOs Legal advisory service providers 	DEP, LIFE, TA CAP
		Scale to 200+ public/rural housing buildings using bio-based materials	2029-2034	<ul style="list-style-type: none"> National R&D funding agencies Bio-based materials supplier/manufacturer / service providers 	ERDF, National Funds (National Banks), NFOŚiGW, FENG
17	Establishment of national bioproduct certification and activation of green public procurement (GPP) to build market demand	Design/update national certification/label framework for biobased and biodegradable products (performance, durability, biodegradation, life cycle assessment modules, EU taxonomy alignment)	2026-2027 (preparation)	<p>MKGP - lead and certification framework</p> <p>ARSKTRP - Agency for Agricultural Markets and Rural Development</p>	LIFE preparatory grants Horizon Europe national grants
		Pilot validation protocols and certification (≥15 products by 2027) through innovation operational groups under EIP consortia (SMEs + labs + farmers), with independent testing and public registry setup	2026-2027 (pilot)	<p>Slovenian Institute for Standardization (SIST) - standards</p> <p>Research institutions, universities - validation protocols</p>	Horizon Europe (Innovation & Missions / Testbeds / Standardisation-linked calls)
		Develop GPP guidance package (training curricula, template tender clauses, procurement criteria) and train ≥200	2026-2027 (capacity-building)	<p>Ministry of Public Administration (MJU) - GPP criteria and training</p>	European Commission technical & procurement support + GPP tools



		procurers (municipalities, hospitals, schools)		EIP consortia, SMEs - pilot implementation	
		Scale certification scheme nationwide (≥ 20 products certified by 2030), integrate with EU ecolabel/taxonomy, and support SMEs via micro-grants for certification costs	2028-2034 (implementation & scaling)	Local authorities, public institutions - procurement	Slovenian Enterprise Fund (SEF)
		Mainstream GPP pilots (≥ 5 tenders/yr using bioproduct criteria by 2030), monitor share of GPP spend on certified products, and publish annual uptake reports	2028-2034 (market activation & monitoring)		Municipal budgets and PPI (public procurement of innovation)
44	AKIS upskilling and national contact point for the agricultural bioeconomy	Develop national training modules on bioeconomy (cascading use, biomaterials, residue valorisation, legal/finance navigation) and integrate into AKIS curricula	2026-2027	MKGP - policy alignment and modernisation calls Research institutions, universities - training module development KGZS advisory networks - training delivery	Erasmus+ CAP TA CBE-JU Horizon Europe (NCP operation) LIFE for environmental bioeconomy modules
Establish a National Contact Point (NCP) and helpdesk for agricultural bioeconomy to broker projects , funding opportunities (CAP, CBE-JU, Horizon Europe), and inter-ministerial alignment		2026-2027	Slovenian Research and Innovation Agency (ARIS) / National R&D funding agency - funding brokerage MOPE - inter-ministerial cooperation	National funds (MKGP, MZVI)	
Roll out large-scale training of advisors and farmers (bioeconomy modules, digital toolkits, open resources)		2027-2028	Advisory networks, chambers/cooperatives - outreach	CAP P2 AKIS/Knowledge Transfer	
Embed bioeconomy scoring criteria in farm modernisation calls and advisory packages		2028-2030	ARSKTRP - Agency for Agricultural Markets and Rural Development		
Scale up to national coverage: ≥ 50 advisors and $\geq 2,000$ farmers trained; ≥ 60 advisory packages delivered; $\geq 50\%$ of modernisation calls include bioeconomy criteria		2028-2034			



44	AKIS upskilling and national contact point for the agricultural bioeconomy	Develop national training modules on bioeconomy (cascading use, biomaterials, residue valorisation, legal/finance navigation) and integrate into AKIS curricula	2026-2027	<ul style="list-style-type: none"> • Ministry of agriculture and rural development • research institutions in agriculture • universities • farmer advisory networks 	P2 (AKIS/KT), Erasmus+, HE, CAP SP
		Establish a National Contact Point (NCP) and helpdesk for agricultural bioeconomy to broker projects , funding opportunities (CAP, CBE-JU, Horizon Europe), and inter-ministerial alignment	2026-2027	<ul style="list-style-type: none"> • Ministry of agriculture and rural development • Slovak research and development agency • research institutions in agriculture 	TA CAP, CBE-JU, HE
		Roll out large-scale training of advisors and farmers (bioeconomy modules, digital toolkits, open resources)	2027-2028	<ul style="list-style-type: none"> • Ministry of agriculture and rural development • universities • chambers/coops 	P2 (AKIS/KT), Erasmus+, LIFE, CAP SP
		Embed bioeconomy scoring criteria in farm modernisation calls and advisory packages	2028-2030	<ul style="list-style-type: none"> • Ministry of agriculture and rural development • paying agency (agriculture modernisation units) • advisory networks 	P2 (Investments), CAP SP
44	AKIS upskilling and national contact point for the agricultural bioeconomy	Develop national training modules on bioeconomy (cascading use, biomaterials, residue valorisation, legal/finance navigation) and integrate into AKIS curricula	2026-2027	<ul style="list-style-type: none"> • monitoring agency (Lead) • research institutions in agriculture • farmer advisory networks 	P2 (AKIS/KT), Erasmus+, HE
		Establish a National Contact Point (NCP) and helpdesk for agricultural bioeconomy to broker projects , funding opportunities (CAP, CBE-JU, Horizon Europe), and inter-ministerial alignment	2026-2027	<ul style="list-style-type: none"> • monitoring agency • research institutions in agriculture • national R&D funding agency • Ministry of climate & environment 	TA CAP, CBE-JU, HE
		Roll out large-scale training of advisors and farmers (bioeconomy modules, digital toolkits, open resources)	2027-2028	<ul style="list-style-type: none"> • ODR/advisory services providers • universities • chambers/coops 	P2 (AKIS/KT), Erasmus+, LIFE
		Embed bioeconomy scoring criteria in farm	2028-2030	<ul style="list-style-type: none"> • monitoring agency • SZIF • advisory networks 	P2 (Investments)



		modernisation calls and advisory packages			, National Funds
		Scale up to national coverage: ≥3,500 advisors and ≥20,000 farmers trained; ≥600 advisory packages delivered; ≥50% of modernisation calls include bioeconomy criteria	2028-2034	<ul style="list-style-type: none"> • monitoring agency • research institutions in agriculture • advisory networks • agriculture modernisation units 	P2 (AKIS/KT), HE, LIFE
48	Spatial biomass corridors & micro-hubs (material-first logistics)	Establish investment grants for pre-processing, covered storage, drying and QA labs; include performance contracts for material-grade output	2027-2029	<ul style="list-style-type: none"> • agriculture modernisation units • regional governments • Ministry of agriculture 	P2 (Investments), ERDF, CF, National Funds
		Deploy shared logistics assets (short-haul fleets, digital route optimisation) and implement long-term supply contracts with farmers/forest owners	2028-2030	<ul style="list-style-type: none"> • producer groups • cooperatives • logistics SMEs • local authorities 	P2 (Cooperation), LIFE, HE
		Scale-up to ≥25 hubs/corridors delivering ≥250 kt/yr material-grade biomass; monitor QA pass %, km optimised routes, and RED III sustainability compliance	2028-2034	<ul style="list-style-type: none"> • Ministry of Agriculture, Forestry, and Fisheries • agriculture modernisation units • hub operators • certification bodies • inspectorates 	CBE-JU, HE, LIFE
		Develop national certification list and QA protocols for bio-fertilisers/biostimulants, including safety and nutrient-content thresholds	2026-2027	<ul style="list-style-type: none"> • Ministry of agriculture • research institutions in agriculture • plant protection and seed inspection service • certification bodies 	HE, LIFE, CBE-JU
		Design digital MRV templates and farm logbook standards for precision application (variable rate, decision support, invoices as evidence)	2026-2027	<ul style="list-style-type: none"> • research institutions in agriculture • agriculture modernisation units • farmer advisory services providers • IT providers 	DEP, HE, LIFE



66	Result-based eco-scheme: certified algae inputs & precision dosing	Establish national eligibility and soil/nutrient plan requirements for parcels using certified algae biostimulants/ biofertilisers (product certificates, toxin limits)	2026-2027 (pre-rollout)	MKGP - Ministry of Agriculture, Forestry and Food ARSKTRP - Agency for Agricultural Markets and Rural Development: paying agency, operational program approval and payments, monitoring	HE LIFE CBE-JU
		Pilot precision dosing tools and digital logging with early adopter farms; validate Substitution & Soil Benefit Index (nutrient reduction + soil proxy)	2026-2027	KGZS - Chamber of Agriculture and Forestry	Digital Europe Programme (DEP) - MRV platform
		Launch eco-scheme payments under CAP Pillar I, including onboarding top-up for baseline tests/logs	2027-2028	Cooperatives, processing SMEs Ministry of Digital transformation	CAP P1 (Eco-schemes)
		Monitor nutrient substitution and soil benefits using LPIS/IACS data, invoices, certificates and field spot checks	2027-2030	Private sector (eg. Algen d.o.o.)	CAP P1 (Eco-schemes), Digital Europe Programme (DEP) - MRV platform
		Scale-up by 2030 with average $\geq 18\%$ mineral nutrient reduction and verified soil proxy improvements	2028-2034		CAP P1 (Eco-schemes)
83	Rural bioeconomy leader labs	Evaluate pilots, develop scaling guidelines and funding mechanisms for wider rollout	2028-2029	<ul style="list-style-type: none"> Ministry of Agriculture, Forestry, and Fisheries farmers advisory units regional authorities 	HE, LIFE, TA CAP
		Expand network of LEADER Labs to 50+ across Poland; integrate results into CAP reporting	2029-2034	<ul style="list-style-type: none"> Ministry of Agriculture, Forestry, and Fisheries local action groups NGOs 	LEADER/CLLD (P2), ERDF, National Funds
		Design voucher scheme for start-ups to buy advisory/university services (IPR, testing, business models)	2026-2027	<ul style="list-style-type: none"> Ministry of Agriculture, Forestry, and Fisheries national R&D funding agency 	HE, LIFE, Erasmus+



				<ul style="list-style-type: none"> entrepreneurship support agency 	
		Pilot with 50-100 start-ups in agri-food bioeconomy value chains	2027-2028	<ul style="list-style-type: none"> national R&D funding agency Ministry of agriculture incubators 	Interreg, EIT KICs, National Funds
90	Knowledge vouchers for bioeconomy start-ups	Design voucher scheme for start-ups to buy advisory/university services (IPR, testing, business models)	2026-2027	<p>MGRT / SPIRIT Slovenia - lead voucher operation and SME outreach</p> <p>MKGP - agricultural and bioeconomy content focus</p> <p>Ministry of Higher Education, Science and Innovation (MZVI) - research infrastructure access</p>	Circular Bio-based Europe Joint Undertaking (CBE-JU)
		Pilot with 5-10 start-ups in agri-food bioeconomy value chains	2027-2028		Interreg Central Europe
		Evaluate impact and refine eligibility criteria, expand to regional clusters	2028-2029		Cohesion Policy (ESRR) - MZVI/MGRT innovation calls
		Scale to national programme with >500 vouchers per year	2029-2034	<p>Universities (UL Biotechnical Faculty, others), research institutes (IJS, ICP, KIS) - knowledge providers</p> <p>Regional development agencies - regional cluster facilitation</p> <p>SRRS / Slovene Enterprise Fund - complementary financing instruments</p>	<p>SPIRIT Slovenia voucher programmes</p> <p>National funds (MGRT, MKGP) for co-financing</p>
90	Knowledge vouchers for bioeconomy start-ups	Design voucher scheme for start-ups to buy advisory/university services (IPR, testing, business models)	2026-2027	<ul style="list-style-type: none"> Ministry of Economy 	HE, LIFE, Erasmus+, Programme Slovakia
		Evaluate impact and refine eligibility criteria, expand to regional clusters	2028-2029	<ul style="list-style-type: none"> Ministry of Economy Ministry of agriculture and rural development clusters 	HE, CBE-JU, Programme Slovakia
93	National fund for on-farm renewable	Develop advisory toolkits for energy audits and integration with CAP climate objectives	2027-2029	<ul style="list-style-type: none"> farmers advisory units advisory bodies NGOs 	P2 (AKIS/KT), LIFE,



	energy self-sufficiency				National Funds
		Integrate monitoring (energy self-sufficiency %, GHG cuts) into CAP reporting	2028-2029	<ul style="list-style-type: none"> Ministry of Agriculture, Forestry, and Fisheries research institutions in agriculture 	P2 (Monitoring), LIFE, DEP
		Identify candidate municipalities and local SMEs for straw/wood-based construction pilots	2026-2027	<ul style="list-style-type: none"> Ministry of Agriculture, Forestry, and Fisheries national R&D funding agency local authorities 	HE, LIFE, CBE-JU
		Support experimental programmes in public buildings (schools, kindergartens, rural admin)	2027-2028	<ul style="list-style-type: none"> local governments SMEs agriculture modernisation units 	Interreg, ERDF, CF, National Funds
94	Carbon smart labels for farmers	Pilot certification system for verified soil organic carbon gains on farms	2026-2027	<ul style="list-style-type: none"> Ministry of agriculture NGOs research institutions in agriculture 	LIFE CBE-JU Horizon Europe Interreg
		Develop consumer-facing logo/label for farm products with verified climate benefits	2027-2028	<ul style="list-style-type: none"> Ministry of agriculture NGOs retailers 	CAP P2 EIP Operational Groups (IRP31)
		Set certification rules, verification protocols, and monitoring indicators (SOC, biodiversity)	2027-2029	<ul style="list-style-type: none"> research institutions in agriculture certification bodies 	LIFE, CBE-JU, National Funds
		Integrate smart label into CAP AKIS knowledge sharing and eco-scheme reporting	2028-2029	<ul style="list-style-type: none"> Ministry of agriculture advisory services providers 	CAP Technical Assistance - process analytics and integration CAP P2 (AKIS/KT) TA CAP
		Scale adoption across retailers and processors,	2029-2034	<ul style="list-style-type: none"> Ministry of agriculture retailers 	Digital Europe



		covering >20% of labelled agri-food products		<ul style="list-style-type: none"> • producer groups 	Programme (DEP) - platform development LIFE, H
55	Regional bio-input validation hubs & living labs (cooperation + investments)	Establish national framework for regional validation hubs, defining QA protocols, conformity with End-of-Waste law, and selection criteria for pilots	2026-2027	<ul style="list-style-type: none"> • Ministry of agriculture and rural development • Research And Innovation Authority • research institutions in agriculture • environment protection public bodies/ environment protection public bodies • plant protection and seed inspection service • regional governments 	HE, LIFE, TA CAP, RIS3, Programme Slovakia
		Launch first wave of regional hubs (innovation operational groups under EIP consortia with producer groups, SMEs, municipalities, universities) testing bio-leached and circular inputs on demo farms	2026-2027	<ul style="list-style-type: none"> • Ministry of agriculture and rural development • Research And Innovation Authority • EIP consortia • producer groups • SMEs • municipalities • HEIs/advisory 	EIP-OG (P2), Interreg, HE, RIS3, Programme Slovakia
		Develop and validate regional application protocols with AI/RS-based decision support (dose, timing, crop/soil adaptation)	2027-2028	<ul style="list-style-type: none"> • Ministry of agriculture and rural development • Research And Innovation Authority • research institutions in agriculture • universities • farmer advisory services providers • digital SMEs 	HE, LIFE, DEP, RIS3, Programme Slovakia
		Roll out investment grants for small-scale infrastructure (QA labs, drying, storage, logistics) and integrate supply contracts between waste operators and farmers	2028-2030	<ul style="list-style-type: none"> • Ministry of agriculture and rural development • Research And Innovation Authority • regional governments • co-ops/SMEs 	P2 (Investments), ERDF, CF, RIS3, Programme Slovakia



85	Carbon literacy campaign for farmers	Design training modules on carbon farming, soil carbon, and GHG mitigation tailored for a country's conditions	2026-2027	<ul style="list-style-type: none"> Ministry of agriculture research institutions in agriculture, NGOs, National Chamber of Agriculture SMEs specialised for education and trainings 	HE, LIFE
		Roll out training via ODR and universities; combine workshops with online materials	2027-2028	<ul style="list-style-type: none"> Ministry of agriculture National Chamber of Agriculture agricultural universities media partners 	P2 (AKIS/KT), National Funds
		Launch national media campaign with farmer stories, TV/radio spots, and social media presence	2028-2029	<ul style="list-style-type: none"> Ministry of agriculture National Chamber of Agriculture NGOs agricultural press professional events, conferences 	LIFE, National Funds
		Maintain continuous outreach and update training modules with new CAP developments	2029-2034	<ul style="list-style-type: none"> advisory services providers universities 	P2 (AKIS/KT), TA CAP, LIFE
15	Creation of certification and validation schemes for circular bioproducts through EIP pilots and AKIS guidance	Establish national framework for circular bioproduct pilots (eligibility, independence rules, evaluation methods, transparency safeguards)	2026-2027 (preparation)	<ul style="list-style-type: none"> Ministry of agriculture (Lead) Ministry of the Environment -SZIF UKZUZ -plant protection and seed inspection service research institutions in agriculture 	TA CAP, HE, LIFE
		Launch first wave of comparative on-farm trials (≥25 pilots) testing efficacy, input reduction, soil/biodiversity effects; data logged in public registry	2026-2027 (pilot)	<ul style="list-style-type: none"> innovation operational groups under EIP consortia producer groups SMEs advisory centres research labs 	EIP-OG (P2), HE, Interreg
		Develop certification & labelling criteria (performance KPIs, life cycle assessment modules, environmental safeguards) and draft national guidance for advisory	2026-2027 (knowledge base)	<ul style="list-style-type: none"> research institutions in agriculture universities NGOs competent authorities (observer role) 	HE, LIFE, National Funds



		Scale programme to ≥60 pilots and ≥20 certified (national labels) products by 2030 , with milestone bonuses for validated dossiers and labels	2028-2034 (implementation & scaling)	<ul style="list-style-type: none"> • Ministry of agriculture (Lead) • SZIF • innovation operational groups under EIP • producer groups • SMEs 	EIP-OG (P2), P2 (Cooperation), LIFE
		Integrate certification results into AKIS advisory (≥50% trained advisors using guidance; training packages for farmers, demo events, digital tools)	2028-2034 (capacity-building & uptake)	<ul style="list-style-type: none"> • farmers advisory units (Lead) • universities • producer organisations 	P2 (AKIS/KT), Erasmus+
		Operate public registry & reporting system (validated protocols, certified labels, adoption rates, complaint/return trends)	2028-2034 (monitoring & transparency)	<ul style="list-style-type: none"> • Ministry of agriculture • research institutions in agriculture • advisory services providers • IT providers 	DEP, LIFE, HE
71	Biomethane upgrades & digestate circularity (investments + cooperation)	Map existing farm-scale and industrial AD plants; assess upgrade potential and digestate handling gaps; prepare sustainability/QA guidelines.	2026-2027 (pre-rollout)	<ul style="list-style-type: none"> • Ministry of agriculture -Ministry of Industry and Trade • national environmental and water management fund • research institutions in agriculture • regional energy/waste agencies 	HE, LIFE, TA CAP national funds
		Launch pilot innovation operational groups under EIP consortia for AD upgrades with nutrient-management plans and short-haul logistics; test CO ₂ capture readiness	2026-2027	<ul style="list-style-type: none"> • AD operators • farmer clusters • universities/advisory bodies • SMEs 	EIP-OG (P2), Interreg, HE
		Roll out CAPEX calls for biomethane upgrading, CHP/grid injection and digestate processing; include performance top-ups linked to verified biomethane output and digestate use on fields	2027-2028	<ul style="list-style-type: none"> • agriculture modernisation units • Ministry of agriculture • regional governments 	P2 (Investments), ERDF, CF, National Funds
		Integrate plant meters, grid/CHP records and nutrient logs with CAP monitoring; align with	2028-2029	<ul style="list-style-type: none"> • research institutions in agriculture 	P1 (Eco-schemes),



	eco-scheme soil/nutrient outcomes		<ul style="list-style-type: none"> • agriculture modernisation units • advisory services providers 	AECM (P2), LIFE
	Scale to ≥25 upgraded plants delivering ≥1.0 TWh/yr biomethane and ≥70% digestate under field plans by 2030	2028-2034	<ul style="list-style-type: none"> • Ministry of agriculture • AD operators • farmer groups • energy regulators 	P2 (Monitoring), LIFE, DEP

12.2. Research, innovation & digitalisation - accelerating the twin transition

Research, innovation, and digitalisation drive the twin transition toward a climate-resilient and competitive circular bioeconomy. By mobilising science, technology, and data, this pillar enhances resource efficiency, reduces emissions, and connects value chains across sectors.

Digital transformation – including precision farming, IoT, MRV systems, and digital twins – enables transparent, measurable performance and strengthens adaptive governance. Investments in bioeconomy innovation hubs, regulatory sandboxes, and open data infrastructures are essential for accelerating technology diffusion and market uptake.

Empowering human capital through bioeconomy fellowships, micro-credentials, and innovation vouchers ensures that Central Europe develops a digitally skilled generation of farmers, researchers, and entrepreneurs capable of leading the transition.

Table 28. Chosen policy measures in the Research, innovation & digitalisation area

No .	Policy measure	Steps to delivery	Timeframe	Responsible	Proposed financing
8	Testing and regulatory sandboxing of microbial bio-products through EIP pilots and advisory integration	Establish national coordination framework for microbial sandbox pilots (roles of managing/ paying authority, observer role of competent authorities, funding envelopes, evaluation design)	2026-2027 (preparation)	<ul style="list-style-type: none"> • Ministry of Agriculture and Rural development • Research institutions & universities related to agriculture, biotechnology • State Plant Health and Seed Inspection Service (SPHP SIS) • NGOs or cooperation platforms as National Bioeconomy Hub in Poland 	TA CAP, HE, LIFE
		Launch first wave of on-farm pilots (≥20) with farmer groups, SMEs/biotech, advisory	2026-2027 (pilot)	<ul style="list-style-type: none"> • KSOW+ • Agricultural Advisory Center in Brwinów 	EIP-OG (P2), HE, LIFE, CBE JU (HE), NCBiR



		services providers, testing microbial bio-fertilisers/biocontrol under standard protocols		<ul style="list-style-type: none"> • Innovation operational groups under EIP consortia • producer organisations • SMEs • Regional farmer advisory units 	
		Develop evidence base for microbial products (efficacy, safety, soil microbiome monitoring), including dossiers and good-practice definitions	2026-2027 (knowledge base)	<ul style="list-style-type: none"> • Research institutions & universities related to agriculture, biotechnology • NGOs or cooperation platforms as National Bioeconomy Hub in Poland 	HE, LIFE, National Funds
		Scale up sandbox pilots to ≥30 projects with milestone bonuses for validated protocols; ensure results feed directly into advisory guidance and AKIS training	2028-2034 (implementation & scaling)	<ul style="list-style-type: none"> • Funding organisations: e.g. NCBiR, ARiMR, PARP • KSOW+, CDR Brwinów, • Research institutions & universities related to agriculture, biotechnology 	EIP-OG (P2), P2 (AKIS), HE
		Integrate outputs into advisory & training systems (≥5,000 farmers reached by 2030; ≥10 protocols adopted; ≥60% farmers report intent to adopt)	2028-2034 (uptake)	<ul style="list-style-type: none"> • Central and Regional Advisory Centres (CDR, ODRy) • Private training providers 	P2 (AKIS/KT), Erasmus+
		Provide transparent evaluation & annual reporting (pilots completed, protocols validated, adoption rates, regulatory lessons for future rule-making)	2028-2034 (monitoring & evaluation)	<ul style="list-style-type: none"> • Ministry of Agriculture and Rural Development • ARiMR 	HE, LIFE, TA CAP
14	Acceleration of precision and digital farming adoption through investments and	Develop national investment guidelines (eligible precision modules, interoperability/open data requirements, ceilings per holding) and advisory plan templates	2026-2027 (preparation)	<ul style="list-style-type: none"> • Ministry of Agriculture and Rural Development • Ministry of Science and Higher Education • NGOs or 	TA CAP, HE, LIFE



	demonstration networks			cooperation platforms as National Bioeconomy Hub in Poland <ul style="list-style-type: none"> • Research institutions & universities related to agriculture 	
		Launch demo-farm network (universities + advisors + lead farms) showcasing GNSS/autoguidance, VRA, sensing, robotics, and precision irrigation in practice	2026-2027 (pilot)	<ul style="list-style-type: none"> • Research institutions & universities farms related to agriculture • Demonstration farms supported by advisory centres • Research institutions & universities related to agriculture 	HE, Interreg, P2 (Cooperation)
		Provide co-funded investment support for precision equipment/software (≤65% SMEs/coops; ceilings per farm) linked to adoption plans	2028-2034 (implementation)	<ul style="list-style-type: none"> • Funding institutions: PARP, NCBiR • Indirect supporting institutions: e.g. BGK, Foundation for Polish Science • ARiMR 	P2 (Investments), ERDF, NFOŚiGW,
		Deliver large-scale training & advisory curricula (≤80% public funding) integrated with demos; modular skill certificates for advisors and tech specialists	2028-2034 (capacity-building)	<ul style="list-style-type: none"> • Central and Regional Advisory Centres (CDR, ODRy) & other advisory entities (e.g. private) • Research institutions & universities related to agriculture 	P2 (AKIS/KT), Erasmus+
		Monitor adoption & impacts (15k farms by 2027; 35k by 2030; ≥10-15% mean reduction in mineral N with stable yields; input/energy/fuel savings)	2026-2034 (ongoing monitoring)	<ul style="list-style-type: none"> • Ministry of Agriculture and Rural Development • Research institutions & universities related to agriculture • ARiMR 	P2 (Monitoring), LIFE, DEP
14	Acceleration of precision and digital	Develop national investment guidelines (eligible precision	2026-2027 (preparation)	<ul style="list-style-type: none"> • Ministry of agriculture and 	TA CAP, HE, LIFE



	farming adoption through investments and demonstration networks	modules, interoperability/open data requirements, ceilings per holding) and advisory plan templates		rural development <ul style="list-style-type: none"> • paying agency • research institutions in agriculture • IT partners • advisory services providers 	
		Launch demo-farm network (universities + advisors + lead farms) showcasing GNSS/autoguidance, VRA, sensing, robotics, and precision irrigation in practice	2026-2027 (pilot)	<ul style="list-style-type: none"> • Ministry of agriculture and rural development • farmer advisory units • universities • producer groups • SMEs 	HE, Interreg, P2 (Cooperation), CAP SP
		Provide co-funded investment support for precision equipment/software ($\leq 65\%$ SMEs/coops; ceilings per farm) linked to adoption plans	2028-2034 (implementation)	<ul style="list-style-type: none"> • Ministry of agriculture and rural development • paying agency • cooperatives • SMEs • producer groups 	P2 (Investments), ERDF, CF, HE, CAP SP
		Deliver large-scale training & advisory curricula ($\leq 80\%$ public funding) integrated with demos; modular skill certificates for advisors and tech specialists	2028-2034 (capacity-building)	<ul style="list-style-type: none"> • farmers advisory units • farmer advisory units • universities • NGOs • private advisory firms 	P2 (AKIS/KT), Erasmus+,
14	Acceleration of precision and digital farming adoption through investments and demonstration networks	Develop national investment guidelines (eligible precision modules, interoperability/open data requirements, ceilings per holding) and advisory plan templates	2026-2027 (preparation)	<ul style="list-style-type: none"> • Ministry of agriculture (Lead) • SZIF • research institutions in agriculture • IT partners • advisory services providers 	TA CAP, HE, LIFE, national funds
		Launch demo-farm network (universities + advisors + lead farms) showcasing GNSS/autoguidance, VRA, sensing, robotics, and precision irrigation in practice	2026-2027 (pilot)	<ul style="list-style-type: none"> • Ministry of Agriculture -farmer advisory units • producer groups • SMEs 	HE, Interreg, P2 (Cooperation)



		<p>Provide co-funded investment support for precision equipment/software (≤65% SMEs/coops; ceilings per farm) linked to adoption plans</p>	2028-2034 (implementation)	<ul style="list-style-type: none"> • Ministry of agriculture (Lead) -Ministry of Industry and Trade • SZIF • NGOs • SMEs 	P2 (Investments), ERDF, CF
		<p>Deliver large-scale training & advisory curricula (≤80% public funding) integrated with demos; modular skill certificates for advisors and tech specialists</p>	2028-2034 (capacity-building)	<ul style="list-style-type: none"> • farmers advisory units • farmer advisory units • universities • NGOs 	P2 (AKIS/KT), Erasmus+
		<p>Monitor adoption & impacts (15k farms by 2027; 35k by 2030; ≥10-15% mean reduction in mineral N with stable yields; input/energy/fuel savings)</p>	2026-2034 (ongoing monitoring)	<ul style="list-style-type: none"> • Ministry of agriculture • research institutions in agriculture • advisory services providers • statistical office • IT providers 	P2 (Monitoring), LIFE, DEP
38	<p>Residue-to-liquid biofuels pilots (hydrogenation & pyrolysis) with sustainability QA</p>	<p>Establish national QA/MRV standards for residue-to-liquid intermediates (contaminants, life cycle assessment, RED compliance)</p>	2026-2027 (pre-CAP rollout)	<ul style="list-style-type: none"> • Ministry of Agriculture and Rural Development • Research institutions & universities related to agriculture • National Chamber of Biofuels • technical inspection • PCA/labs 	HE, LIFE, TA CAP
		<p>Launch innovation operational groups under EIP pilots for hydrogenation of agri-food wastes and pyrolysis of straw/woody residues, incl. refinery-farmer consortia</p>	2026-2028	<ul style="list-style-type: none"> • EIP consortia (farmers, refiners, SMEs, universities, research institutes) • KSOW+ • ARiMR • NCBiR • National Contact Point for Horizon Europe 	EIP-OG (P2), Interreg, HE, CBE JU (HE)



		Deploy selective investment grants for modular pilot units, feedstock pre-treatment and short-haul logistics	2027-2029	<ul style="list-style-type: none"> • KSOW+ • ARiMR • NCBiR • National Contact Point for Horizon Europe 	P2 (Investments), ERDF, CF, National Funds, NFOŚiGW
		Integrate digital MRV & process-analytics (PAT-AI, digital twins) into pilots for scale-up modelling and sustainability reporting	2028-2030	<ul style="list-style-type: none"> • Ministry of Agriculture and Rural Development • Research institutions & universities • IT/AI providers • Advisory bodies 	HE, DEP, LIFE
		Scale-up to ≥35 pilots with ≥25 validated QA/MRV protocols; prepare RED Annex IX-compliant domestic feedstock chain for SAF/HVO	2028-2034	<ul style="list-style-type: none"> • National Contact Point for Horizon Europe • NCBiR • PARP 	NFOŚiGW, FENG, National Funds (National Banks)
63	Result-based eco-scheme: certified compostable agri inputs & plastic-residue reduction	Develop national eligibility list of EN-certified compostable agri inputs (mulch films, trays, clips) and digital reporting templates.	2026-2027	<p>MKGP - lead eco-scheme design, input register</p> <p>UVHVVR / URSIL - input certification and compliance</p> <p>ARSKTRP - paying agency, digital forms, payments</p> <p>Research institutions, universities - plastic residue methodology</p>	<p>Digital Europe Programme (DEP) - digital reporting platform</p> <p>CAP Technical Assistance - standards and training</p> <p>LIFE Programme - pilot and monitoring methodologies</p>
		Pilot digital collection/delivery note system with authorised composters (chain-of-custody verification)	2026-2027	<p>ARSO - soil monitoring data</p> <p>KGZS advisory units - training and on-farm support</p>	CAP P2 EIP Operational Groups (IRP31) Interreg Horizon Europe (pilots)
		Launch eco-scheme payments based on Plastic-Residue Avoidance Index (area × % certified collection × field cleanliness score)	2027-2028	<p>Producer groups, cooperatives - pilot coordination</p>	CAP P1 Eco-schemes



		Scale enrolment, certified inputs collected with composting certificates	2027-2030	SMEs - certified input suppliers	
		Expand by 2030, reaching $\geq 90\%$ certified collection and field cleanliness pass rate.	2028-2034		
79	National wood traceability & owner cooperation (eudr-ready)	Develop national registry architecture for wood flows, aligned with EUDR due diligence, incl. open APIs and procurement templates	2026-2027 (pre-CAP rollout)	<p>MKGP - Ministry of Agriculture, Forestry and Food: lead for agriculture-forestry coordination</p> <p>Ministry of the Environment, Climate and Energy (MOPE): climate and environment alignment</p> <p>Slovenia Forest Service (ZGS - Zavod za gozdove Slovenije): forest management, owner associations, data systems</p> <p>Slovenian Forestry Institute (IBL - Gozdarski inštitut Slovenije):</p>	<p>Horizon Europe, LIFE, Digital Europe Programme (DEP) - registry architecture development</p> <p>National funds (MKGP, MOP, ZGS) - full deployment and maintenance</p> <p>Cohesion Policy (ESRR) - digital infrastructure for forest sector</p>
		Pilot innovation operational groups under EIP cooperation projects for owner associations, SMEs and processors to test digital traceability tools, templates and contracts	2026-2027	<p>research, methodology, testing</p> <p>Government Digital Office (GovTech SI): digital registry architecture and APIs</p>	CAP P2 EIP Operational Groups (IRP31)
		Roll out national onboarding programme for holdings and processors; integrate advisory/AKIS trainings and due diligence toolkits	2027-2028	<p>Forest-owner groups/associations: pilot implementation and owner onboarding</p>	CAP Technical Assistance (TA CAP), CAP P2 AKIS/Knowledge Transfer LIFE - advisory training and due diligence toolkits



		Scale procurement uptake: embed traceability criteria in public tenders and ensure ≥55% harvest volume tracked	2028-2030	SMEs - wood processors, sawmills: traceability adoption and API integration Universities, research	Digital Europe Programme (DEP), LIFE National funds (MKGP) - public procurement uptake and API deployment
		Full deployment: ≥1,500 holdings onboarded, ≥80% harvest volume tracked, ≥40 API users (buyers/authorities)	2028-2034	institutions: pilot evaluation and training content KGZS advisory services: forestry advisory and owner training	National funds (MKGP, MOP, ZGS) - full deployment and maintenance
79	National wood traceability & owner cooperation (eudr-ready)	Develop national registry architecture for wood flows, aligned with EUDR due diligence, incl. open APIs and procurement templates	2026-2027 (pre-CAP rollout)	<ul style="list-style-type: none"> Ministry of agriculture Ministry of the Environment State Forests 	HE, LIFE, DEP
		Pilot innovation operational groups under EIP cooperation projects for owner associations, SMEs and processors to test digital traceability tools, templates and contracts	2026-2027	<ul style="list-style-type: none"> forest-owner groups SMEs universities advisory services providers 	EIP-OG (P2), Interreg, HE
		Roll out national onboarding programme for holdings and processors; integrate advisory/AKIS trainings and due diligence toolkits	2027-2028	<ul style="list-style-type: none"> agriculture modernisation units farmer advisory bodies agriculture chambers/co-ops 	TA CAP, P2 (AKIS/KT), LIFE
		Scale procurement uptake: embed traceability criteria in public tenders and ensure ≥55% harvest volume tracked	2028-2030	<ul style="list-style-type: none"> Ministry of agriculture regional governments buyers 	DEP, LIFE, National Funds
		Full deployment: ≥15,000 holdings onboarded, ≥80% harvest volume tracked, ≥300 API users (buyers/authorities)	2028-2034	<ul style="list-style-type: none"> Ministry of agriculture agriculture modernisation units registry operator owner associations, processors 	DEP, HE, LIFE



83	Rural bioeconomy leader labs	Create local innovation funds under LEADER for local action groups to pilot circular services (repair hubs, reuse centres, short supply chains)	2026-2027	MKGP - Ministry of Agriculture, Forestry and Food ARSKTRP - Agency for Agricultural Markets and Rural Development Local Action Groups (LAS)	Horizon Europe, LIFE - pilot methodologies and evaluation Interreg Central Europe - cross-border bioeconomy lab exchanges CAP Technical Assistance - evaluation and mainstreaming
		Support 10-15 pilot LEADER Labs testing circular services in rural areas.	2027-2028	Regional authorities, municipalities: spatial planning, infrastructure support, community facilities	EKSRP Pillar 2 - LEADER/CLLD (IRP26) innovation fund allocation
		Evaluate pilots, develop scaling guidelines and funding mechanisms for wider rollout	2028-2029	KGZS - Chamber of Agriculture and Forestry: advisory and technical support	Cohesion Policy (ESRR), National funds
		Expand network of LEADER Labs to 30 across Slovenia; integrate results into CAP reporting	2029-2034	Cooperatives, producer organizations: service delivery and operational management SMEs, social enterprises: circular service providers (repair, logistics, processing) Research institutions, universities: pilot evaluation and methodology NGOs, community organizations: stakeholder engagement and training	SPIRIT Slovenia - SME innovation support for circular services



83	Rural bioeconomy leader labs	Create local innovation funds under LEADER for local action groups to pilot circular services (repair hubs, reuse centres, short supply chains)	2026-2027	<ul style="list-style-type: none"> Ministry of agriculture / Hungarian National Rural Network local action groups NGOs 	LEADER/CLLD (P2), Interreg, National Funds
		Support 10-15 pilot LEADER Labs testing circular services in rural areas.	2027-2028	<ul style="list-style-type: none"> Ministry of agriculture / Hungarian National Rural Network local action groups municipalities entrepreneurs 	LEADER/CLLD (P2), HE, LIFE
		Evaluate pilots, develop scaling guidelines and funding mechanisms for wider rollout	2028-2029	<ul style="list-style-type: none"> Ministry of agriculture / Hungarian National Rural Network farmers advisory units regional authorities 	HE, LIFE, TA CAP
		Expand network of LEADER Labs to 15+ across Hungary integrate results into CAP reporting	2029-2034	<ul style="list-style-type: none"> Ministry of agriculture / Hungarian National Rural Network local action groups NGOs 	LEADER/CLLD (P2), ERDF, National Funds
		Roll out scheme nationally with monitoring and audits	2029-2034	<ul style="list-style-type: none"> Ministry of agriculture / Hungarian National Rural Network agriculture modernisation units advisory services providers 	P1 (Eco-schemes), P2 (Monitoring)
26	Investments in precision farming and establishment of a national open data standard and repository	Develop and adopt national open standard for farm data (schemas, APIs, cataloguing rules) ensuring interoperability and vendor neutrality	2026-2027 (preparation)	<ul style="list-style-type: none"> Ministry of agriculture (Lead) NAZV IT partners standardisation bodies advisory services providers 	HE, DEP, TA CAP, NAZV



	for interoperability	Establish national repository and catalogue of precision tools (≥ 100 by 2027), with open APIs for integration into IACS/LPIS and advisory platforms	2026-2027 (pilot)	<ul style="list-style-type: none"> Ministry of agriculture IT providers research institutions in agriculture advisory centres 	HE, DEP, ERDF, national funds
		Provide investment support for farm precision packages (GNSS/RTK, sensors, VRA kits, RS subscriptions, connectivity upgrades, AI/decision tools)	2026-2034 (implementation)	<ul style="list-style-type: none"> Ministry of agriculture Ministry of Industry and Trade SZIF SMEs producer groups 	P2 (Investments), ERDF, CF, InvestEU, EIB
		Deliver training and modular skill certificates for advisors/farmers on precision adoption, data management and use of interoperable tools	2026-2034 (capacity-building)	<ul style="list-style-type: none"> farmer advisory units universities NGOs producer groups 	P2 (AKIS/KT), Erasmus+
		Scale adoption and data sharing to $\geq 35k$ farms and ≥ 500 API integrations by 2030 , with annual monitoring of precision uptake and repository usage	2028-2034 (scaling & monitoring)	<ul style="list-style-type: none"> Ministry of agriculture research institutions in agriculture advisory services providers IT providers statistical office 	P2 (Monitoring), LIFE, DEP
29	Bio-input pilots and regulatory feedback through innovation operational groups under EIP and AKIS	Develop common guidance dossiers and advisory protocols (validated by ≥ 5 pilots), share with advisory networks and integrate into Living Labs	2028-2029	<ul style="list-style-type: none"> research institutions in agriculture farmers advisory units universities advisory services providers 	HE, EIP-OG (P2), Interreg
		Train advisors and growers via modular skill certificates and demo events , targeting $\geq 4k$ trained by 2030	2027-2034	<ul style="list-style-type: none"> farmers advisory units universities producer groups NGOs 	P2 (AKIS/KT), Erasmus+
		Provide regulatory feedback loop: publish evidence for simplified approval pathways , engage with competent authorities, and support	2027-2034	<ul style="list-style-type: none"> Ministry of agriculture national R&D funding agency SMEs 	HE, LIFE, National Funds



		SMEs with micro-grants for data packages		<ul style="list-style-type: none"> certifying bodies 	
		Develop national guidance on cascading hierarchy and hub eligibility (materials > energy, QA criteria, waste/food/feed law compliance)	2026-2027 (pre-CAP rollout)	<ul style="list-style-type: none"> monitoring agency (Lead) Ministry of climate & environment research institutions in agriculture agriculture support centre standardisation bodies 	HE, LIFE, TA CAP
		Launch innovation operational groups under EIP pilots to map supply , test pre-processing (drying/fractionation) and establish long-term contracts between farms, coops and SMEs	2026-2027	<ul style="list-style-type: none"> EIP consortia (farmer groups, SMEs, RTOs, municipalities) universities advisory 	EIP-OG (P2), Interreg, HE
9	Expansion of precision soil diagnostics and on-farm bio-inputs enablement for nutrient efficiency and resilience	Establish national framework for precision soil diagnostics (testing protocols, subsidy models, links to IACS/LPIS, Nitrogen Act alignment)	2026-2027 (preparation)	<ul style="list-style-type: none"> Ministry of agriculture (Lead) research institutions in agriculture accredited labs advisory services providers 	TA CAP, HE, LIFE, NAZV - National Agency for Agricultural research
		Pilot integrated diagnostic packages (chemical/biological/physical soil data, mapping tools, sensors) on ≥10k farms, linked with fertilisation planning	2026-2027 (pilot)	<ul style="list-style-type: none"> Ministry of agriculture producer groups farmer advisory units research institutions in agriculture SMEs 	HE, EIP-OG (P2), NAZV, National Funds
		Launch investment support for small-scale on-farm fermentation/composting units and precision application equipment (≤65% co-funding)	2028-2034 (implementation)	<ul style="list-style-type: none"> Ministry of agriculture (Lead) Ministry of the Environment Ministry of Industry and Trade paying agency cooperatives SMEs 	P2 (Investments), ERDF, CF, Czech bank sector



		Roll out modular skill certificates for advisors and lead farmers on precision diagnostics, safe bio-input use, and nutrient planning (≤80% public funding)	2028-2034 (capacity-building)	<ul style="list-style-type: none"> • farmer advisory units • research institutions in agriculture • NGOs 	P2 (AKIS/KT), Erasmus+
		Scale nationwide adoption of diagnostics & bio-inputs (≥25k farms by 2030; 12-20% mineral N reduction; yield stability index tracked)	2028-2034 (scaling & monitoring)	<ul style="list-style-type: none"> • Ministry of agriculture • research institutions in agriculture • advisory services providers • IT partners 	P2 (AECM/Monitoring), LIFE, DEP, NAZV

12.3. Climate & environmental sustainability - from compliance to performance

Climate neutrality and environmental sustainability are core ambitions of the circular bioeconomy. This pillar focuses on result-based and performance-oriented CAP measures that reward farmers for delivering measurable ecosystem services – carbon sequestration, soil health improvement, water efficiency, and biodiversity restoration.

Circular and regenerative practices such as carbon farming, nutrient recycling, and agroforestry enhance both mitigation and adaptation outcomes. Digital MRV systems provide the data backbone for tracking environmental results, linking payments directly to verified outcomes.

Integrating climate-smart measures into CAP ensures that environmental goals become economic opportunities, positioning farmers as active contributors to the EU's 2040 and 2050 climate targets.

Table 29. Chosen policy measures in the Climate & environmental sustainability area

No.	Policy measure	Steps to delivery	Timeframe	Responsible	Proposed financing
1	Result-based reduction of GHG emissions in biofuel feedstock crops through regenerative practices and residue-to-biogas systems	Develop methodology for farm-level GHG accounting (kg CO₂e/ha), incl. SOC proxy, residue management indicators, and alignment with RED III/NCW requirements	2026-2027 (preparation phase)	<ul style="list-style-type: none"> • Ministry of Agriculture and Rural Development (Lead) • research institutions in agriculture: e.g. Institute of soil Science and Plant Cultivation state Research Institute (IUNG-PIB) • national emissions and environmental protection 	Horizon Europe, LIFE, National Funds, Technical Assistance, private fund from interested companies (producers)



				<p>bodies: e.g. KOBIZE, GDOŚ, RDOŚ, IOŚ-PIB</p> <ul style="list-style-type: none"> • paying Agency: ARiMR, KOWR • energy regulatory office: URE 	
		<p>Design eco-scheme payment logic & eligibility rules (result-based €/ha by verified emission cuts; standard-cost fallback; safeguards vs. double funding)</p>	<p>2026-2027 (preparation phase)</p>	<ul style="list-style-type: none"> • Ministry of Agriculture and Rural Development (Lead) • paying Agency: ARiMR • research institutions: Institute of Soil Science and Plant Cultivation state Research Institute (IUNG-PIB) • climate policy coordinator: Ministry of Environment 	<p>CAP Pillar II, National Fund for Environmental Protection and Water Management, Technical Assistance of the Strategic Plan for the Common Agricultural Policy</p>
		<p>Pilot eco-scheme in selected arable regions (rapeseed/corn producers in manure-surplus & drought districts), testing monitoring and residue-to-biogas linkages</p>	<p>2026-2027 (pilot)</p>	<ul style="list-style-type: none"> • Ministry of Agriculture and Rural Development (Lead) • research institutions in agriculture: e.g. Institute of soil Science and Plant Cultivation state Research Institute (IUNG-PIB) • regional agricultural chambers • National Chamber of Biofuels 	<p>Pillar II, National Fund for Environmental Protection and Water Management, private-public investment</p>
		<p>Develop knowledge transfer & advisory Modules (precision N, low-emission fertilisation, cover crops, rotations, digestate use) with digital tools and training for advisors/farmers</p>	<p>2026-2027 (capacity-building)</p>	<ul style="list-style-type: none"> • Agricultural Advisory Centre in Brwinów (Lead) with support of regional advisory centres • Sectoral institutes subordinated to the Ministry of Agriculture and Rural Development • Universities of Life Sciences, e.g. the 	<p>Pillar II HE Erasmus + Interreg Central Europe National Funds</p>



				University of Life Sciences in Poznań, Warsaw University of Life Sciences (SGGW), University of Life Sciences in Lublin, etc. • private advisory companies • Educational Research Institute State Research Institute	
		Launch full eco-scheme under CAP Pillar I (nationwide, result-based €/ha, tiered by verified GHG reduction; top-up for testing/plan)	2028-2034 (implementation)	<ul style="list-style-type: none"> • Ministry of Agriculture and Rural Development (Lead) • research institutions in agriculture: e.g. Institute of Soil Science and Plant Cultivation state Research Institute (IUNG-PIB) • national emissions and environmental protection bodies: e.g. KOBIZE, GDOŚ, RDOŚ, IOŚ-PIB • paying Agency: ARiMR, KOWR 	Pillar I CAP with national budget co-financing
		Complement with Pillar II agri-environment-climate interventions for advanced regenerative practices and knowledge transfer (soil SOC monitoring, biogas chain integration, activities for climate change adaptation)	2028-2034 (implementation & scaling)	<ul style="list-style-type: none"> • Ministry of Agriculture and Rural Development (Lead) • Sectoral institutes subordinated to the Ministry of Agriculture and Rural Development • paying Agency: ARiMR 	Pillar II / AECM, EIP-OG, Just Transition Funds, Cohesion Funds
		Establish annual monitoring & verification system (digital farm logs, remote sensing, RED sustainability audits) with	2028-2030 (early implementation), ongoing to 2034	<ul style="list-style-type: none"> • Ministry of Agriculture and Rural Development (Lead) • paying Agency: ARiMR, KOWR 	Pillar II, Cohesion Funds / European Regional Development Fund (ERDF)



		national reporting to Commission		<ul style="list-style-type: none"> • Sectoral institutes subordinated to the Ministry of Agriculture and Rural Development • national emissions and environmental protection bodies: e.g. KOBIZE, IOŚ-PIB • Scientific and Academic Computer Network - National Research Institute (NASK) 	
22	Expansion of perennial biomass and fruit plantations delivering carbon, water and cascading feedstock benefits	Develop eligibility list and guidance for perennial species (industrial/energy + fruit) including soil/water benefits, cascading suitability and biodiversity safeguards	2026-2027 (preparation)	<ul style="list-style-type: none"> • Ministry of agriculture • Research institutes supervised by the Minister of Agriculture and Rural Development • Universities • Producer groups, Associations 	TA CAP, HE, LIFE
		Pilot establishment of perennials (≥40k ha by 2027) in erosion/drought districts, including water-retention micro-works and soil cover protocols	2026-2027 (pilot)	<ul style="list-style-type: none"> • Producer groups • Agricultural chambers • Research institutes supervised by the Minister of Agriculture and Rural Development • Central and Regional Advisory Centres 	AECM (P2), LIFE, National Funds
		Launch full result-based AECM contracts (100-220 €/ha, tiers by SOC gain/erosion risk/water retention) with ≤65% establishment grants (caps by species/ha)	2028-2034 (implementation)	<ul style="list-style-type: none"> • Ministry of Agriculture and Rural Development • ARiMR • Producer organisations • Central and Regional Advisory Centres • Research institutes supervised by the 	AECM (P2), P2 (Investments), ERDF



				Minister of Agriculture and Rural Development	
		Integrate perennial biomass flows into cascading value chains (priority material-grade uses: bioplastics, biochemicals; only residues to energy) via supply contracts	2028-2034 (integration)	<ul style="list-style-type: none"> Ministry of Agriculture and Rural Development NGOs or cooperation platforms as National Bioeconomy Hub in Poland Cooperatives SMEs 	HE, Interreg, CBE-JU
		Monitor ecosystem outcomes and feedstock flows (Δ SOC, infiltration/erosion indices, ha established, tonnes contracted into cascades) with annual reporting	2028-2034 (monitoring & evaluation)	<ul style="list-style-type: none"> Ministry of Agriculture and Rural Development Research institutes supervised by the Minister of Agriculture and Rural Development Statistics Poland Central and Regional Advisory Centres NGOs or cooperation platforms as National Bioeconomy Hub in Poland 	P2 (Monitoring), LIFE, DEP
22	Expansion of perennial biomass and fruit plantations delivering carbon, water and cascading feedstock benefits	Develop eligibility list and guidance for perennial species (industrial/energy + fruit) including soil/water benefits, cascading suitability and biodiversity safeguards	2026-2027 (preparation)	<ul style="list-style-type: none"> Ministry of agriculture (Lead) research institutions in agriculture producer groups NGOs 	TA CAP, HE, LIFE, national funds
		Pilot establishment of perennials (≥ 40 k ha by 2027) in erosion/drought districts, including water-retention micro-works and soil cover protocols	2026-2027 (pilot)	<ul style="list-style-type: none"> producer groups advisory centres local authorities 	AECM (P2), LIFE, National Funds
		Launch full result-based AECM contracts (100-220 €/ha, tiers by SOC gain/erosion risk/water retention) with $\leq 65\%$	2028-2034 (implementation)	<ul style="list-style-type: none"> Ministry of agriculture (Lead) SZIF producer organisations 	AECM (P2), P2 (Investments), ERDF



		establishment grants (caps by species/ha)		<ul style="list-style-type: none"> • advisory services providers 	
		<p>Integrate perennial biomass flows into cascading value chains (priority material-grade uses: bioplastics, biochemicals; only residues to energy) via supply contracts</p>	2028-2034 (integration)	<ul style="list-style-type: none"> • Ministry of agriculture • regional hubs • SMEs • biorefineries 	HE, Interreg, CBE-JU
		<p>Monitor ecosystem outcomes and feedstock flows (ΔSOC, infiltration/erosion indices, ha established, tonnes contracted into cascades) with annual reporting</p>	2028-2034 (monitoring & evaluation)	<ul style="list-style-type: none"> • Ministry of agriculture -Ministry of the Environment • research institutions in agriculture • statistical office • advisory services providers • regional hubs 	P2 (Monitoring), LIFE, DEP
30	Result-based carbon farming with organic amendments (digestate, biochar, compost)	<p>Develop national certification and traceability rules for digestate, biochar and compost (quality, contamination, origin) and define SOC stability factors for payments</p>	2026-2027 (preparation)	<ul style="list-style-type: none"> • Ministry of Agriculture and Rural Development • Research institutes & universities • Standardisation bodies e.g. Polish Committee for Standardization (PKN), Polish Centre for Accreditation (PCA) • ARiMR 	HE, LIFE, TA CAP
		<p>Launch pilot agri-environment-climate interventions contracts with farms in low-SOC/light soils to test protocols for SOC baselining, monitoring and contamination audits</p>	2026-2027 (pilots)	<ul style="list-style-type: none"> • Ministry of Agriculture and Rural Development • Cooperatives • SMEs • Research institutes supervised by the Minister of Agriculture and Rural Development • Producer groups • Central and Regional Advisory Centres 	AECM (P2), LIFE, HE, Interreg



		Establish lab & advisory capacity for SOC testing and farm nutrient-carbon planning; integrate with AKIS training modules	2026-2028	<ul style="list-style-type: none"> • Research institutes supervised by the Minister of Agriculture and Rural • Central and Regional Advisory Centres • Universities • Agricultural chambers 	P2 (AKIS/KT), Erasmus+, HE
		Scale payments for verified SOC gains: expand to ≥180k ha with annual audits; link to amendment producers (AD, pyrolysis, compost hubs) to secure supply	2028-2034	<ul style="list-style-type: none"> • SME • Research institutes supervised by the Minister of Agriculture and Rural 	AECM (P2), P1 (ecoschemes)
		Integrate digital MRV tools (RS, soil sensors, dashboards) to reduce verification costs and ensure transparency for farmers and authorities	2028-2034	<ul style="list-style-type: none"> • SME • Research institutes supervised by the Minister of Agriculture and Rural • IT Publin institutes 	DEP, HE, LIFE, National Funds
		Monitor, evaluate & adjust payment tiers based on SOC outcomes, mineral-N reductions, and contamination pass rates; publish annual performance reports	2028-2034	<ul style="list-style-type: none"> • Ministry of Agriculture and Rural Development • Research institutes supervised by the Minister of Agriculture and Rural • SME (certifying) 	P2 (Monitoring), National Funds
30	Result-based carbon farming with organic amendments (digestate, biochar, compost)	Develop national certification and traceability rules for digestate, biochar and compost (quality, contamination, origin) and define SOC stability factors for payments	2026-2027 (preparation)	<p>MKGP - lead, AECM design</p> <p>MOPE - waste/by-products regulation</p> <p>Research institutions - certification methodology and SOC factors</p>	Horizon Europe Interreg LIFE EKSRP P2 - CAP interventions
		Launch pilot agri-environment-climate interventions contracts with farms in low-SOC/light soils to test protocols for SOC	2026-2027 (pilots)	ARSO - environmental data	Horizon Europe, LIFE, CAP TA (pilot and methodology) CAP P2 EIP Operational Groups (IRP31)



		baselining, monitoring and contamination audits		Regional authorities, producer groups - pilot coordination	
		Establish lab & advisory capacity for SOC testing and farm nutrient-carbon planning; integrate with AKIS training modules	2026-2028	KGZS advisory units - SOC testing, farm planning	CAP P2 - AKIS/Knowledge Transfer
		Scale payments for verified SOC gains: expand; link to amendment producers (AD, pyrolysis, compost hubs) to secure supply	2028-2034	Universities, advisory networks - training AD/pyrolysis/compost plants - amendment supply	CAP P2 Agri-environmental & Climate payments (IRP17)
		Integrate digital MRV tools (RS, soil sensors, dashboards) to reduce verification costs and ensure transparency for farmers and authorities	2028-2034		Digital Europe Programme (DEP) - MRV platform
		Monitor, evaluate & adjust payment tiers based on SOC outcomes, mineral-N reductions, and contamination pass rates; publish annual performance reports	2028-2034		Slovenian Environment Agency (ARSO)
30	Result-based carbon farming with organic amendments (digestate, biochar, compost)	Develop national certification and traceability rules for digestate, biochar and compost (quality, contamination, origin) and define SOC stability factors for payments	2026-2027 (preparation)	<ul style="list-style-type: none"> • Ministry of agriculture (Lead) • research institutions in agriculture • environment protection public bodies • standardisation bodies • SZIF 	HE, LIFE, TA CAP
		Launch pilot agri-environment-climate interventions contracts with farms in low-SOC/light soils to test protocols for SOC baselining, monitoring and contamination audits	2026-2027 (pilots)	<ul style="list-style-type: none"> • Ministry of agriculture • regional authorities • research institutions in agriculture • producer groups • advisory services providers 	AECM (P2), LIFE, National Funds
		Establish lab & advisory capacity for SOC testing and farm nutrient-carbon planning; integrate with AKIS training modules	2026-2028	<ul style="list-style-type: none"> • research institutions in agriculture • farmers advisory units • universities 	P2 (AKIS/KT), Erasmus+, HE



				<ul style="list-style-type: none"> • advisory networks 	
		<p>Scale payments for verified SOC gains: expand to ≥ 180k ha with annual audits; link to amendment producers (AD, pyrolysis, compost hubs) to secure supply</p>	2028-2034	<ul style="list-style-type: none"> • Ministry of agriculture • SZIF • producer organisations • AD/ pyrolysis/ compost plants 	AECM (P2), ERDF, CF
		<p>Integrate digital MRV tools (RS, soil sensors, dashboards) to reduce verification costs and ensure transparency for farmers and authorities</p>	2028-2034	<ul style="list-style-type: none"> • Ministry of agriculture • research institutions in agriculture • IT providers • advisory networks 	DEP, HE, LIFE
		<p>Monitor, evaluate & adjust payment tiers based on SOC outcomes, mineral-N reductions, and contamination pass rates; publish annual performance reports</p>	2028-2034	<ul style="list-style-type: none"> • Ministry of agriculture • research institutions in agriculture • SZIF • statistical office 	P2 (Monitoring), LIFE, National Funds
32	<p>Pilots for pyrolysis and compost heat-recovery with biochar/substrate QA</p>	<p>Identify biomass streams and candidate sites (woody residues, straw, landscape biomass, green waste) with proximity to farms/municipal heat users</p>	2026-2027 (preparation)	<ul style="list-style-type: none"> • Ministry Climate and Environment • Research Institutes (e.g. IBL, Institute of Environmental Protection IOŚ-PIB) & Universities 	TA CAP, HE, National Funds
		<p>Launch EIP pilots of modular pyrolysis units and composting with heat recovery, covering at least 5 regions, with protocols for emissions, odours and social engagement</p>	2026-2027 (pilots)	<ul style="list-style-type: none"> • EIP consortia (farmers, SMEs, municipalities, universities) • KSOW+ • ARiMR 	EIP-OG (P2), CBE JU, NCBiR, NFOŚiGW, FENG
		<p>Develop national QA standards for biochar (stability, contaminants, carbon index) and compost/substrate (metals, plastics, phytotoxicity) linked to carbon-farming agri-environmental-climate measure and substrate hubs</p>	2027-2028	<ul style="list-style-type: none"> • Ministry Climate and Environment • Research Institutes & Universities • Standardisation bodies e.g. Polish Committee for Standardization (PKN), Polish Centre for Accreditation (PCA) 	HE, LIFE, CBE-JU



		<p>Scale pilots and co-finance modular lines (pyrolysis, compost heat capture, QA labs) with investment support and SME micro-grants for certification/ testing</p>	2028-2034	<ul style="list-style-type: none"> • Voivodeship Marshal Offices • ARiMR • KSOW+ • SMEs 	P2 (Investments), ERDF, CF, National Funds
		<p>Link outputs to field use: apply ≥ 10 kt/year certified biochar/compost into agri-environmental-climate measure parcels (SOC outcome contracts, horticulture substrates)</p>	2028-2034	<ul style="list-style-type: none"> • Ministry of Agriculture and Rural Development • Producer groups • NGOs or cooperation platforms as National Bioeconomy Hub in Poland • Research institutions & universities 	AECM (P2), LIFE, HE
		<p>Monitor and report biomass processed, SOC gain potential, MWh heat recovered, contamination rates, and community acceptance (complaints ↓); feed data into CAP performance</p>	2028-2034	<ul style="list-style-type: none"> • Ministry of Agriculture and Rural Development • Research institutions & universities • ARiMR • Regional authorities 	P2 (Monitoring), LIFE, DEP
19	<p>Implementation of a result-based eco-scheme paying for verified ecosystem services with digital MRV and AKIS support</p>	<p>Develop ecosystem service indices and valuation models (SOC, biodiversity habitat, water retention/quality, GHG balance etc.) aligned with CAP performance indicators</p>	2026-2027 (preparation)	<p>MKGP - lead, eco-scheme design</p> <p>ARSKTRP - Agency for Agricultural Markets and Rural Development</p> <p>Research institutions - indices and MRV methodology</p> <p>National soil hub, ARSO - data and monitoring</p>	<p>Horizon Europe Life</p> <p>CAP P2 EIP Operational Groups (IRP31)</p> <p>CAP Strategic Plan Pillar 1 (EKJS) - Eco-schemes</p>
		<p>Design and test digital MRV protocols (RS/GIS, sensors, farm logs, open standards)</p>	2026-2027 (pilot)	<p>Universities, NGOs - validation and evaluation</p>	Digital Europe Programme (DEP) - MRV platform
		<p>Develop training and advisory packages (modular skill certificates for advisors/farmers; demos on regenerative practices, biodiversity)</p>	2026-2027 (capacity-building)	<p>KGZS advisory units - training and on-farm support</p>	CAP P2 - AKIS/Knowledge Transfer



		features, nutrient/water planning)		IT partners - digital platform development	
		Roll out national eco-scheme contracts (180-320 €/ha, tiered by verified outcomes; ≤30 €/ha for baseline tests), prioritising erosion/nutrient-risk catchments and low-SOC districts	2028-2034 (implementation)	Producer groups - advisory uptake	CAP P1 Eco-schemes CAP P2 Agri-environmental & Climate payments (IRP20, 21, 22,23, 33, 34,36,37)
		Integrate optional linkages to bioenergy residue management where it demonstrably improves nutrient/GHG/water outcomes	2028-2034 (integration)		
		Monitor and publish annual eco-service results (ΔSOC, pollinator/habitat index, nitrate risk, m ³ water retained/ha, GHG balance per ha; % farms with MRV adoption)	2028-2034 (monitoring & reporting)		CAP TA
51	Result-based eco-scheme: certified biochar & compost/digestate co-application	Establish national quality standards for biochar, compost and digestate (fixed-C, heavy metals, PAHs, hygiene) and design the Stable-C Index methodology for CAP eco-scheme use	2026-2027	MKGP - eco-scheme design and standards MOPE - waste/by-product regulation	Horizon Europe LIFE CAP TA (standards and pilots)
		Pilot biochar/compost/digestate co-application on arable, grassland and horticultural farms with digital logs and baseline soil/water sampling (innovation operational groups under EIP projects)	2026-2027	Research institutions, National Fertiliser Testing Institutes, certification bodies - standards and Stable-C methodology EIP consortia (farmers, SMEs, universities, research institutes) - pilots	CAP P2 EIP Operational Groups (IRP31) LIFE (pilots) National funds (launch and setup)
		Launch Pillar I eco-scheme with result-based payments linked to the Stable-C Index and infiltration proxies; provide setup support for sampling/logging	2027-2028	KGZS advisory services -	CAP P1 Eco-schemes, CAP P2 Monitoring,



		Scale farm participation through advisory campaigns and integration into nutrient plans/soil-health platforms (incl. synergy with carbon-farming pilots)	2028-2030	advisory campaigns and nutrient plans Regional authorities, farmer organisations - scale-up	CAP P2 AKIS/Knowledge Transfer, LIFE, Horizon Europe (advisory campaigns)
		Monitor & scale-up, using LPIS/lab certificates and verifier audits	2028-2034	ARSKTRP - Agency for Agricultural Markets and Rural Development	Digital Europe Programme (DEP) (scale-up and monitoring) Slovenian Environment Agency (ARSO)
51	Result-based eco-scheme: certified biochar & compost/digestate co-application	Establish national quality standards for biochar, compost and digestate (fixed-C, heavy metals, PAHs, hygiene) and design the Stable-C Index methodology for CAP eco-scheme use	2026-2027	<ul style="list-style-type: none"> • Ministry of agriculture • Ministry of the Environment • research institutions in agriculture • UKZUZ • certification bodies 	HE, LIFE, TA CAP
		Pilot biochar/compost/digestate co-application on arable, grassland and horticultural farms with digital logs and baseline soil/water sampling (innovation operational groups under EIP projects)	2026-2027	<ul style="list-style-type: none"> • EIP consortia (farmers, SMEs, research/advisory) • universities • research institutions in agriculture 	EIP-OG (P2), HE, Interreg
		Launch Pillar I eco-scheme with result-based payments linked to the Stable-C Index and infiltration proxies; provide setup support for sampling/logging	2027-2028	<ul style="list-style-type: none"> • agriculture modernisation units • Ministry of agriculture • farmers advisory services providers 	P1 (Eco-schemes), LIFE, National Funds
		Scale farm participation through advisory campaigns and integration into nutrient plans/soil-health platforms (incl. synergy with carbon-farming pilots)	2028-2030	<ul style="list-style-type: none"> • research institutions in agriculture • farmer advisory bodies • farmer organisations • regional authorities 	P2 (AKIS/KT), LIFE, HE



		Monitor & scale-up to $\geq 140k$ ha with ≥ 30 kt biochar applied and ≥ 50 kt stable C credited by 2030, using LPIS/lab certificates and verifier audits	2028-2034	<ul style="list-style-type: none"> Ministry of agriculture agriculture modernisation units independent auditors farmers/operators 	P1 (Eco-schemes), P2 (Monitoring), DEP
65	National protocols, label & AKIS micro-credentials for compostables (DPP-ready)	Draft and validate national test protocols for compostable agri inputs (EN-aligned, performance, compostability incl. home) and develop conformity assessment templates	2026-2027	<p>MKGP - Ministry of Agriculture, Forestry and Food</p> <p>ARSKTRP - Agency for Agricultural Markets and Rural Development: paying agency, operational program approval and payments, monitoring</p>	Horizon Europe LIFE
		Design and launch a national compostables label and open registry/API with DPP-ready data fields, linked to CAP monitoring tools	2027-2028	operational program approval and payments, monitoring	Digital Europe Programme (DEP) - MRV platform
		Roll out AKIS training and stackable modular skill certificates for farmers, advisors and municipal staff on certified product use, QA/MRV and end-of-life	2027-2029	<p>KGZS - Chamber of Agriculture and Forestry</p> <p>Cooperatives, processing SMEs</p> <p>Ministry of Digital transformation</p>	<p>CAP P2 AKIS/Knowledge Transfer</p> <p>Erasmus+</p> <p>Horizon Europe (training)</p> <p>LIFE</p>
		Develop and disseminate buyer/procurement toolkits to support public and private tenders specifying compostable criteria	2028-2030		
		Scale-up: ≥ 30 protocols validated, ≥ 50 certified product lines, $\geq 3,50$ modular skill certificates issued, ≥ 35 tenders specifying the label by 2030	2028-2034		
77	Side-Stream registry & cascading valorisation pilots (cooperation + AKIS + investments)	Roll out targeted investment grants for pilot lines (QA labs, modular extraction, drying/logistics) with performance-based top-ups linked to certified product lines	2027-2028	<ul style="list-style-type: none"> agriculture modernisation units regional governments Ministry of agriculture 	P2 (Investments), ERDF, CF, National Funds



		Develop AKIS-linked training and stackable modular skill certificates for advisors, SMEs, and municipal staff (QA/MRV, cascading protocols, procurement)	2028-2030	<ul style="list-style-type: none"> • research institutions in agriculture • farmer advisory bodies • universities • chambers/co-ops • SMEs 	P2 (AKIS/KT), Erasmus+, HE
		Scale-up registry coverage and cascading pilots (≥450 processors onboarded; ≥150 certified product lines; >70% non-material fractions to AD)	2028-2034	<ul style="list-style-type: none"> • Ministry of Agriculture, Forestry, and Fisheries • agriculture modernisation units • registry operator • processors • biohub operators 	P2 (Monitoring), DEP, LIFE
		Develop national registry architecture for wood flows, aligned with EUDR due diligence, incl. open APIs and procurement templates	2026-2027 (pre-CAP rollout)	<ul style="list-style-type: none"> • Ministry of Agriculture, Forestry, and Fisheries • Ministry of Environmental Protection and Green Transition • State Forests • IBL • GovTech 	HE, LIFE, DEP
77	Side-Stream registry & cascading valorisation pilots (cooperation + AKIS + investments)	Establish a national side-stream registry (digital platform + API) and draft QA/EoW conformity templates for food-industry residues	2026-2027 (pre-CAP rollout)	<p>MKGP - Ministry of Agriculture, Forestry and Food: lead,</p> <p>ARSKTRP - Agency for Agricultural Markets and Rural Development: paying agency, EIP management, investment calls</p> <p>KGZS - Chamber of Agriculture and Forestry of Slovenia: advisory, capacity-building, training delivery</p> <p>Chamber of Commerce and</p>	<p>EKSRP Pillar 2 - Cooperation (EIP-AGRI IRP31, PO support, sectoral programs)</p> <p>EKSRP P2 - Investments (IRP03, IRP44) for infrastructure and equipment</p> <p>Horizon Europe, LIFE, CBE-JU - innovation pilots, cascading protocols, registry development</p>



				<p>Industry (GZS): business development support and industry linkages</p> <p>Research institutions, universities: technical assistance, LCA, QA protocols, evaluation</p> <p>Local Action Groups: LEADER integration and local pilots</p>	<p>Cohesion Policy (ESRR, CF)</p> <p>Digital Europe Programme (DEP) - digital registry platform and APIs</p> <p>National funds (MKGP) - technical assistance and training</p>
		<p>Launch innovation operational groups under EIP pilots for bioactive extraction, enzymatic fermentation, and fibre-based packaging; integrate cascading protocols (materials-first, residuals to AD)</p>	2026-2027	<p>Producer organizations, cooperatives, ZKŽ (Cooperative Union of Slovenia): service implementation and operational management</p>	<p>CAP P2 EIP Operational Groups (IRP31)</p>
		<p>Roll out targeted investment grants for pilot lines (QA labs, modular extraction, drying/logistics) with performance-based top-ups linked to certified product lines</p>	2027-2028	<p>SMEs: logistics, processing, and technology providers</p>	<p>SPIRIT Slovenia - SME innovation vouchers for technical services</p>
		<p>Develop AKIS-linked training and stackable modular skill certificates for advisors, SMEs, and municipal staff (QA/MRV, cascading protocols, procurement)</p>	2028-2030		<p>CAP P2 AKIS/Knowledge Transfer</p>
		<p>Scale-up registry coverage and cascading pilots (>70% non-material fractions to AD)</p>	2028-2034		
81	<p>Circular investment blending facility for bioeconomy smes</p>	<p>Design facility pooling CAP Pillar II, ERDF, and EIB loan instruments; consult with national banks and stakeholders</p>	2026-2027 (design phase)	<p>MKGP - Ministry of Agriculture, Forestry and Food: lead, facility design and agriculture focus</p>	<p>National budget (MKGP, MOPE, MGRT, Finance Ministry) - CAP Technical Assistance, Horizon Europe</p>



				Ministry of Finance: public capital contribution, fund governance, risk management	LIFE - facility design and evaluation
		Pilot blended finance calls targeting circular bioeconomy SMEs (waste valorisation, biomaterials, renewable energy)	2027-2028	MOPE - Ministry of Environment, Climate and Energy: environmental criteria and climate co-benefits	National budget (MKGP, MOPE, MGRT, Finance Ministry) - EKSRP Pillar 2 Investments - CAP
		Establish risk-sharing mechanisms and monitoring KPIs for supported SMEs	2028-2029	MGRT - Ministry of Economy, Tourism and Sport: business competitiveness and SME focus	Cohesion Policy (ESRR, CF) -
		Scale facility to national coverage, include guarantee schemes and regional investment branches	2029-2034	SRRS / Slovene Enterprise Fund: fund management, financial instruments, SME financing expertise European Investment Bank (EIB) / EIF: guarantees, co-financing, InvestEU blending ARSKTRP: CAP investment coordination and data integration	InvestEU guarantee facility - EIB/EIF Agriculture & Bioeconomy Financing Package SRRS financial instruments - guarantees and portfolio risk-sharing EKO SKLAD green loans and guarantees CAP Technical Assistance, Horizon Europe LIFE - facility design and evaluation
96	Soil health bonds (green finance)	Design pilot bond instrument with Ministry of agriculture & public financing provider, earmarking proceeds for soil-health AECMs	2026-2027	<ul style="list-style-type: none"> • Ministry of agriculture • public financing provider • Ministry of finance • national R&D funding agency 	HE, LIFE, InvestEU



		Develop monitoring indicators (SOC increase, erosion control, nutrient balance) linked to bond payouts	2026-2027	<ul style="list-style-type: none"> • research institutions in agriculture • universities • certification bodies 	National Funds, EIB, public financing provider
		Issue first Soil Health Bonds with partial EU/EIB guarantee	2027-2028	<ul style="list-style-type: none"> • public financing provider • EIB • Ministry of agriculture 	EIB, InvestEU, Innovation Fund
		Allocate bond proceeds to CAP AECM eco-schemes and nutrient management pilots	2028-2029	<ul style="list-style-type: none"> • Ministry of agriculture • agriculture modernisation units 	P1 (Eco-schemes), AECM (P2), LIFE
		Scale bond issuance to multi-regional coverage,	2029-2034	<ul style="list-style-type: none"> • public financing provider • Ministry of agriculture • Ministry of finance 	ERDF, CF, National Funds
96	Soil health bonds (green finance)	Design pilot bond instrument with Ministry of agriculture & public financing provider, earmarking proceeds for soil-health AECMs	2026-2027	<ul style="list-style-type: none"> • Ministry of agriculture • public financing provider • national R&D funding agency 	HE, LIFE, InvestEU
		Develop monitoring indicators (SOC increase, erosion control, nutrient balance) linked to bond payouts	2026-2027	<ul style="list-style-type: none"> • research institutions in agriculture • universities • certification bodies 	National Funds, EIB, public financing provider
		Issue first Soil Health Bonds with partial EU/EIB guarantee	2027-2028	<ul style="list-style-type: none"> • public financing provider • EIB • Ministry of agriculture 	InvestEU, Innovation Fund
		Allocate bond proceeds to CAP AECM eco-schemes and nutrient management pilots	2028-2029	<ul style="list-style-type: none"> • Ministry of agriculture • agriculture modernisation units National Chamber of Agriculture 	P1 (Eco-schemes), AECM (P2), LIFE
		Scale bond issuance to multi-regions coverage, targeting >€100M by 2034	2029-2034	<ul style="list-style-type: none"> • public financing provider • Ministry of agriculture 	ERDF, CF, National Funds



				<ul style="list-style-type: none"> • Ministry of finance 	
7	Adoption of result-based soil-biology practices with support for regenerative techniques and bio-based products	Establish composite Soil Health Score (SOC %, infiltration/aggregate stability, microbial activity proxy) and baseline testing protocols	2026-2027 (preparation)	<ul style="list-style-type: none"> • Ministry of agriculture and rural development • research institutions in agriculture • national soil hub • advisory centres 	HE, LIFE, National Funds, CAP SP
		Pilot agri-environment-climate interventions contracts in priority zones (erosion/drought areas), testing result-based payments (€/ha) and protocols for microbial products and regenerative practices	2026-2027 (pilot)	<ul style="list-style-type: none"> • Ministry of agriculture and rural development • research institutions in agriculture • producer groups • regional chambers of agriculture 	AECM (P2), HE, LIFE, CAP SP
		Develop Knowledge Transfer packages (soil microbiology, cover crops, composting/fermentation, varietal choices) and train advisors & lead farmers	2026-2027 (capacity-building)	<ul style="list-style-type: none"> • farmer advisory units • universities • NGOs 	P2 (AKIS/KT), Erasmus+, CAP SP
		Roll out national result-based scheme under Pillar II agri-environment-climate interventions with tiered payments linked to Soil Health Score improvements; ensure safeguards against double funding	2028-2034 (implementation)	<ul style="list-style-type: none"> • Ministry of agriculture and rural development • paying agency • research institutions in agriculture • advisory services providers 	AECM (P2), TA CAP
		Establish annual monitoring system (IACS/LPIS + lab tests + farm logs) with public dashboards tracking SOC increase, fertiliser cuts, and resilience gains	2028-2034 (monitoring & evaluation)	<ul style="list-style-type: none"> • Ministry of agriculture and rural development • research institutions in agriculture • statistical office • IT partners 	P2 (Monitoring), DEP, LIFE, CAP SP
7	Adoption of result-based soil-biology practices	Establish composite Soil Health Score (SOC %, infiltration/aggregate stability, microbial	2026-2027 (preparation)	<ul style="list-style-type: none"> • Ministry of agriculture (Lead) -Ministry of the Environment 	HE, LIFE, National Funds



	with support for regenerative techniques and bio-based products	activity proxy) and baseline testing protocols		<ul style="list-style-type: none"> • research institutions in agriculture • national soil hub • advisory centres 	
		Pilot agri-environment-climate interventions contracts in priority zones (erosion/drought areas), testing result-based payments (€/ha) and protocols for microbial products and regenerative practices	2026-2027 (pilot)	<ul style="list-style-type: none"> • Ministry of agriculture -Ministry of the Environment • research institutions in agriculture • producer groups • chambers of farmers 	AECM (P2), HE, LIFE, national funds
		Develop Knowledge Transfer packages (soil microbiology, cover crops, composting/fermentation, varietal choices) and train advisors & lead farmers	2026-2027 (capacity-building)	<ul style="list-style-type: none"> • research organisations -farmers associations • NGOs 	P2 (AKIS/KT), Erasmus+, Inter Rec
		Roll out national result-based scheme under Pillar II agri-environment-climate interventions with tiered payments linked to Soil Health Score improvements ; ensure safeguards against double funding	2028-2034 (implementation)	<ul style="list-style-type: none"> • Ministry of agriculture (Lead) -Ministry of the Environment • State Agricultural Intervention Fund (Paying Agency) • research institutions in agriculture • advisory services providers 	AECM (P2), TA CAP
		Establish annual monitoring system (IACS/LPIS + lab tests + farm logs) with public dashboards tracking SOC increase, fertiliser cuts, and resilience gains	2028-2034 (monitoring & evaluation)	<ul style="list-style-type: none"> • Ministry of agriculture • research institutions in agriculture • statistical office • IT partners 	P2 (Monitoring), DEP, LIFE
33	Mixed crop-livestock and agroforestry transitions with result-based outcomes and establishment support	Map candidate regions and farming systems with high erosion/drought risk and underdeveloped mixed/agroforestry potential (permanent grasslands, arable monocultures)	2026-2027 (preparation)	<ul style="list-style-type: none"> • Ministry of agriculture and rural development • research institutions in agriculture • statistical office • regional authorities • producer groups 	HE, LIFE, TA CAP



		Launch pilot agri-environmental-climate measure contracts testing the Agro-Resilience Index (ΔSOC, erosion/cover, microclimate, N balance) and associated monitoring protocols	2026-2027 (pilots)	<ul style="list-style-type: none"> • research institutions in agriculture • farmers advisory units • universities • farmer consortia 	AECM (P2), HE, LIFE
		Provide establishment support for agroforestry rows, tree planting, fencing, watering points, and livestock housing upgrades that cut nutrient/odour losses	2026-2028	<ul style="list-style-type: none"> • Ministry of agriculture and rural development • paying agency • cooperatives • municipalities 	P2 (Investments), ERDF, CF
		Develop value-chain linkages: mobilise lignocellulose from agroforestry thinning into cascading uses, integrate manure cycling into digestate hubs	2028-2034	<ul style="list-style-type: none"> • producer groups • biomass hubs • local action groups • SMEs 	HE, CBE-JU, Interreg
		Monitor, evaluate & report SOC, erosion risk, manure recycling, and adoption intent; publish annual performance reports feeding CAP indicators	2027-2034	<ul style="list-style-type: none"> • Ministry of agriculture and rural development • research institutions in agriculture • paying agency • advisory services providers 	P2 (Monitoring), LIFE, CAP SP
33	Mixed crop-livestock and agroforestry transitions with result-based outcomes and establishment support	Map candidate regions and farming systems with high erosion/drought risk and underdeveloped mixed/agroforestry potential (permanent grasslands, arable monocultures)	2026-2027 (preparation)	<ul style="list-style-type: none"> • Ministry of agriculture (Lead) • research institutions in agriculture • statistical office • regional authorities • producer groups 	HE, LIFE, TA CAP, NAZV
		Launch pilot agri-environmental-climate measure contracts testing the Agro-Resilience Index (ΔSOC, erosion/cover, microclimate, N balance) and associated monitoring protocols	2026-2027 (pilots)	<ul style="list-style-type: none"> • research institutions in agriculture • farmers advisory units • farmer consortia -NGOs 	AECM (P2), HE, LIFE



		Provide establishment support for agroforestry rows, tree planting, fencing, watering points, and livestock housing upgrades that cut nutrient/odour losses	2026-2028	<ul style="list-style-type: none"> Ministry of agriculture -SZIF cooperatives municipalities 	P2 (Investments), ERDF, CF
		Scale AECM payments to ≥60k ha under verified outcome contracts, with annual soil/water tests and RS/GIS-based erosion monitoring	2028-2034	<ul style="list-style-type: none"> Ministry of agriculture SZIF research institutions in agriculture advisory services providers 	AECM (P2), P2 (Monitoring), DEP
		Develop value-chain linkages: mobilise lignocellulose from agroforestry thinning into cascading uses, integrate manure cycling into digestate hubs	2028-2034	<ul style="list-style-type: none"> producer groups biomass hubs local action groups SMEs 	HE, CBE-JU, Interreg
		Monitor, evaluate & report SOC, erosion risk, manure recycling, and adoption intent; publish annual performance reports feeding CAP indicators	2027-2034	<ul style="list-style-type: none"> Ministry of agriculture research institutions in agriculture paying agency advisory services providers 	P2 (Monitoring), LIFE, National Funds
57	Regional hemp-wool micro-factories & qa for soil-returnable panels	Develop national technical guidance for hemp-wool insulation panels (QA thresholds for compostability, soil return, thermal/acoustic performance)	2026-2027	<ul style="list-style-type: none"> Ministry of agriculture and rural development Ministry of Investment, Regional Development and Informatics research institutions in agriculture research institutes standardisation bodies 	HE, LIFE, CBE-JU, CAP SP, Programme Slovakia
		Establish investment grants calls under CAP Pillar II for regional micro-factories (equipment, QA labs, logistics)	2027-2028	<ul style="list-style-type: none"> Ministry of agriculture and rural development Ministry of Investment, 	P2 (Investments), ERDF, CF, CAP



				Regional Development and Informatics • regional authorities	SP, Programme Slovakia
91	Regional composting & soil hub network	Map regional bio-waste streams (farm, municipal, food industry) and identify priority catchments	2026-2027	•Ministry of agriculture and rural development • Ministry of the Environment • municipalities • research institutions in agriculture	HE, LIFE, CBE-JU, Environmental Fund
		Pilot 2-3 compost hubs integrating farmers, municipalities, and SMEs	2027-2028	• local governments • cooperatives •Ministry of agriculture and rural development • Ministry of the Environment	EIP-OG (P2), Interreg, HE, Environmental Fund
		Integrate compost hubs into CAP AECM and eco-schemes (soil C, erosion, nutrient substitution)	2028-2029	• Ministry of agriculture and rural development • Ministry of the Environment	P1 (Eco-schemes), AECM (P2), LIFE, Environmental Fund
91	Regional composting & soil hub network	Map regional bio-waste streams (farm, municipal, food industry) and identify priority catchments	2026-2027	• Ministry of agriculture and national economy • municipalities • research institutions in agriculture	HE, LIFE, national funds, CAP
		Pilot 2-3 compost hubs integrating farmers, municipalities, and SMEs	2027-2028	• local governments • cooperatives • agriculture modernisation units ministry of agriculture	EIP-OG (P2), Interreg, HE, CAP
		Develop QA protocols for compost use in soils (nutrient value, heavy metals, microplastics)	2027-2029	• research institutions in agriculture • accredited labs • certification bodies ministry of agriculture	P2 (Investments), ERDF, CF, National Funds



		Integrate compost hubs into CAP AECM and eco-schemes (soil C, erosion, nutrient substitution)	2028-2029	<ul style="list-style-type: none"> Ministry of agriculture National Chamber of Agriculture agriculture modernisation units 	P1 (Eco-schemes), AECM (P2), LIFE
		Scale hubs across all voivodeships with >150k t/year certified compost flow	2029-2034	<ul style="list-style-type: none"> Ministry of agriculture National Chamber of Agriculture municipalities local action groups 	P2 (Monitoring), LIFE, DEP
86	Green public procurement accelerator for rural schools/hospitals	Pilot procurement of biobased products (food packaging, cleaning agents, insulation) in selected rural schools and hospitals	2026-2027	<ul style="list-style-type: none"> Ministry of agriculture local authorities NGOs local entrepreneurs 	LIFE, national funds
		Develop national green procurement criteria and toolkits for rural public institutions	2027-2028	<ul style="list-style-type: none"> Ministry of agriculture and national economy Public Procurement Office NGOs 	DEP, LIFE, National Funds
		Train procurement officers and local suppliers on criteria and certification	2028-2029	<ul style="list-style-type: none"> Ministry of agriculture and national economy farmers advisory units universities 	Erasmus+, P2 (AKIS/KT), LIFE
		Scale adoption across all voivodeships, monitor uptake and market impact	2029-2034	<ul style="list-style-type: none"> Ministry of Agriculture local governments NGOs 	ERDF, CF, National Funds
13	Deployment of a precision-enabled eco-scheme paying for verified ecosystem services with digital MRV	Develop composite ecosystem service indices (SOC, infiltration/erosion risk, pollinator/biodiversity, irrigation efficiency, GHG balance) and MRV protocols	2026-2027 (preparation)	<ul style="list-style-type: none"> Ministry of agriculture (Lead) research institutions in agriculture national soil hub IT partners 	HE, LIFE, TA CAP
		Pilot result-based eco-scheme (≥... ha) using digital MRV (sensors, RS&GIS, dashboards) in drought/erosion and livestock catchment districts	2026-2027 (pilot)	<ul style="list-style-type: none"> Ministry of agriculture SZIF NGOs producer groups 	P1 (Eco-schemes), HE, DEP



		Build advisory & training capacity (modular skill certificates for advisors/farmers on digital MRV, eco-services, smart irrigation, biodiversity practices)	2026-2027 (capacity-building)	<ul style="list-style-type: none"> farmers advisory units (Lead) universities NGOs SMEs 	P2 (AKIS/KT), Erasmus+
		Roll out nationwide eco-scheme (tiered payments 90-200 €/ha + baseline support ≤30 €/ha; verified outcomes only, no overlap with practice-based schemes)	2028-2034 (implementation)	<ul style="list-style-type: none"> Ministry of agriculture (Lead) DSZIF advisory services providers producer organisations, NGOs 	P1 (Eco-schemes), National Funds
		Integrate optional links to micro-biogas (<50 kW) where it demonstrably improves nutrient cycling and GHG balance, aligned with digestate standards	2028-2034 (integration)	<ul style="list-style-type: none"> Ministry of agriculture local action groups cooperatives SMEs • NGOs 	P2 (Investments), LIFE, ERDF
		Monitor and publish annual eco-service outcomes (ΔSOC, erosion risk, pollinator index, litres/m ³ water saved, GHG balance per ha) through public dashboards	2028-2034 (monitoring & reporting)	<ul style="list-style-type: none"> Ministry of agriculture research institutions in agriculture statistical office advisory services providers IT providers 	P1 (Eco-schemes), DEP, LIFE

12.4. Sustainable agriculture, food & forestry value chains - closing loops across sectors

This pillar focuses on the transformation of agriculture, food, and forestry value chains into circular, traceable, and low-emission systems. By connecting primary production with processing and consumption, it enables resource-efficient production and fair value distribution.

Cascading use of biomass – prioritising food and feed first, followed by materials, chemicals, and energy – ensures maximum value creation from every resource. Investments in biorefineries, modular biomethane plants, circular packaging, and traceable digital food passports strengthen the material-first bioeconomy while maintaining food security.

Short supply chains, certification systems, and local processing hubs will boost consumer trust and regional competitiveness, anchoring Central Europe’s transition toward a low-carbon, regenerative bio-based economy.

No.	Policy measure	Steps to delivery	Timeframe	Responsible	Proposed financing
2	Deployment of	Develop national guidelines for sustainable	2026-2027 (preparation)	<ul style="list-style-type: none"> Ministry of Agriculture and 	TA CAP, LIFE, HE



agricultural biogas and biomethane solutions for residues and manures with nutrient recycling and climate benefits	feedstock use (residues, manures, agri-food by-products) incl. safeguards vs. crop-to-energy displacement		<p>Rural Development</p> <ul style="list-style-type: none"> • Ministry of Climate and Environmental Protection • Research institutes & Universities • NGOs or cooperation platforms as National Bioeconomy Hub in Poland • Producer associations 	
	Establish digestate standards & land-application protocols (nutrient plans, separation, acidification, quality control)	2026-2027 (preparation)	<ul style="list-style-type: none"> • Ministry of Agriculture and Rural Development • Research institutes & Universities • NGOs or cooperation platforms as National Bioeconomy Hub in Poland 	AECM (P2), LIFE, National Funds, ERDF
	Design investment grants & financing models (standard-cost grants, performance-based top-ups, ceilings by plant size)	2026-2027 (preparation)	<ul style="list-style-type: none"> • Ministry of Agriculture and Rural Development • National Contact Point for Horizon Europe (NCP Department) • National Development Bank of Poland, Bank for Environmental Protection • National research and development funding agency 	P2, JTF, InvestEU, EIB
	Launch pilot innovation operational groups under EIP (subprogramme) projects for feedstock logistics (cluster-level collection, transport, pre-treatment) and cooperation on	2026-2027 (pilot)	<ul style="list-style-type: none"> • Ministry of Agriculture and Rural Development • Innovation operational groups under EIP 	EIP-OG (P2), HE



		downstream hydrogenation		<ul style="list-style-type: none"> • Research institutes & Universities • KSOW+ 	
		Roll-out investment support under Pillar II for anaerobic digestion & biomethane units, incl. upgrading, storage, heat recovery	2028-2034 (implementation)	<ul style="list-style-type: none"> • Ministry of Agriculture and Rural Development • ARiMR • Regional authorities • Producers groups • National Development Bank of Poland, Bank for Environmental Protection 	P2, ERDF, CF, National Funds, NFOŚiGW
		Scale-up cooperation models (farm clusters, LAG consortia) with grants up to 500k € for joint feedstock logistics, heat-use plans, and regional digestate processing	2028-2034 (implementation)	<ul style="list-style-type: none"> • Ministry of Agriculture and Rural Development • Local action groups • Producer groups • NGOs or cooperation platforms as National Bioeconomy Hub in Poland 	ERDF, ARiMR, NFOŚiGW
		Establish monitoring system for climate performance (t CO ₂ e-eq avoided), nutrient recycling, and local socio-economic benefits	2028-2030 (early implementation), ongoing to 2034	<ul style="list-style-type: none"> • Ministry of Agriculture and Rural Development • Research institutes & Universities • Statistical office 	National Funds, HE
2	Deployment of agricultural biogas and biomethane solutions for residues and manures with nutrient recycling and climate benefits	Develop national guidelines for sustainable feedstock use (residues, manures, agri-food by-products) incl. safeguards vs. crop-to-energy displacement	2026-2027 (preparation)	<ul style="list-style-type: none"> • Ministry of agriculture (Lead) • Ministry of the Environment • research institutions in agriculture • producer associations -NOGs 	National funds - State Agricultural Intervention Fund (Paying Agency), HE
		Establish digestate standards & land-application protocols (nutrient plans,	2026-2027 (preparation)	<ul style="list-style-type: none"> • Ministry of agriculture • Ministry of the Environment 	National funds, ERDF



		separation, acidification, quality control)		<ul style="list-style-type: none"> • research institutions in agriculture • national soil/agriculture hubs 		
		Design investment grants & financing models (standard-cost grants, performance-based top-ups, ceilings by plant size)	2026-2027 (preparation)	<ul style="list-style-type: none"> • Ministry of agriculture - SZIF - State Agricultural Intervention Fund (Paying Agency) - NAZV 	P2, national funds for research	
		Launch pilot innovation operational groups under EIP (subprogramme) projects for feedstock logistics (cluster-level collection, transport, pre-treatment) and cooperation on downstream hydrogenation	2026-2027 (pilot)	<ul style="list-style-type: none"> • Ministry of agriculture • innovation operators • universities • producer cooperatives 	EIP-OG (P2), HE, Interreg, national funds	EIP
		Roll-out investment support under Pillar II for anaerobic digestion & biomethane units, incl. upgrading, storage, heat recovery	2028-2034 (implementation)	<ul style="list-style-type: none"> • Ministry of agriculture (Lead) - Czech Biogas Association - State Agricultural Intervention Fund (Paying Agency) • paying agency • regional authorities • cooperatives • SMEs 	P2, ERDF, CF, National Funds	
		Scale-up cooperation models (farm clusters, LAG consortia) with grants up to 500k € for joint feedstock logistics, heat-use plans, and regional digestate processing	2028-2034 (implementation)	<ul style="list-style-type: none"> • Ministry of agriculture - Agrarian Chamber • local action groups 	LEADER (P2), Interreg, ERDF	
		Establish monitoring system for climate performance (t CO ₂ e-eq avoided), nutrient recycling, and local socio-economic benefits	2028-2030 (early implementation), ongoing to 2034	<ul style="list-style-type: none"> • Ministry of agriculture - Ministry of the Environment • research institutions in agriculture • statistical office • national environmental 	AKIS (P2), DEP, LIFE, HE	



				and water management fund • advisory services providers	
16	Deployment of regional biorefineries and fermentation pilots for PHA, PLA and green solvents based on agricultural residues	Develop national framework and regional calls for biorefinery pilots (eligibility, cascading rules, biomass sourcing criteria, monitoring)	2026-2027 (preparation)	<ul style="list-style-type: none"> • National research and development funding agency • National Contact Point for Horizon Europe (NCP Department) • PARP • ARiMR • Research institutes & Universities 	TA CAP, HE, LIFE, TA, National Funds
		Launch first wave of fermentation & enzymatic pilots (≥8 lines) valorising agri/food residues into PHA, PLA, DES and bio-additives	2026-2027 (pilot)	<ul style="list-style-type: none"> • National research and development funding agency • National Contact Point for Horizon Europe (NCP Department) • PARP • ARiMR 	HE CBE JU, FENG, NCBiR Funds
		Provide CAPEX and milestone-based support for TRL → MRL progression (e.g. validated quality series, first customer uptake)	2028-2034 (implementation)	<ul style="list-style-type: none"> • National research and development funding agency • National Contact Point for Horizon Europe (NCP Department) • PARP • ARiMR 	P2 (Investments), ERDF, CF, InvestEU, EIB
		Expand regional demonstrators (≥18 lines by 2030, ≥30 kt/yr residues valorised), with local training and advisory packages to build acceptance	2028-2034 (scaling & outreach)	<ul style="list-style-type: none"> • National research and development funding agency • National Contact Point for Horizon Europe (NCP Department) • PARP • ARiMR • Central and Regional Advisory Centres (CDR, ODRy) • Research institutes & Universities 	P2 (Cooperation/A KIS), NFOŚiGW, National Funds (National bank loans)



		Monitor production and impacts (t/yr residues cascaded, kg/yr PHA/DES, % locally sourced biomass, life cycle assessment indicators for fossil substitution) with public reporting	2028-2034 (monitoring & evaluation)	<ul style="list-style-type: none"> Ministry of Agriculture and Rural Development Research institutes & Universities Statistics Poland 	National Funds, Technical Assistance (TA)
39	Facilitate the deployment of a national digital food passport & traceability system (DPP-ready) to strengthen trust, value capture and sustainability verification in agri-food chains	Develop national DPP framework and open-data schema (standard for product identification-compatible, API-based, blockchain-ready) including compliance, quality and culinary layers	2026-2027 (pre-CAP rollout)	<ul style="list-style-type: none"> Ministry of Agriculture and Rural Development National Support Centre for Agriculture (KOWR) Research institutes & Universities SMEs: service providers IT public bodies: e.g. NASK 	HE, Digital Europe Programme (DEP), LIFE
		Pilot DPP protocols and data flows in innovation operational groups under EIP consortia (farmers, processors, retailers, logistics, IT providers) in 3-4 product chains (e.g. dairy, meat, fruit/veg, bakery)	2026-2028	<ul style="list-style-type: none"> Ministry of Agriculture and Rural Development EIP consortia Producer groups/cooperatives, Chambers of Agriculture SMEs: service providers National Support Centre for Agriculture (KOWR) 	EIP-OG (P2), Interreg, HE
		Launch national repository and onboarding portal for operators and product lines, with SME micro-grants for data integration	2027-2029	<ul style="list-style-type: none"> ARiMR National Support Centre for Agriculture (KOWR) Research institutes & Universities Ministry of Agriculture and Rural Development 	DEP, ERDF, National Funds
		Train advisors, SMEs and retailers on DPP tools, consumer communication kits, and MRV-linked reporting for footprints	2027-2030	<ul style="list-style-type: none"> Research institutions & universities Central and Regional Advisory 	P2 (AKIS/KT),



				Centres (CDR, ODRy) • Chambers of agriculture • private advisory companies	Era sm us+ , HE
		Scale passportisation to ≥12k operators and ≥20% of domestic agri-food SKUs; monitor % sales with scannable provenance and data-quality compliance	2028-2034	• Research institutions & universities • Central and Regional Advisory Centres (CDR, ODRy) • Chambers of agriculture • private advisory companies	ARi MR
39	Facilitate the deployment of a national digital food passport & traceability system (DPP-ready) to strengthen trust, value capture and sustainability verification in agri-food chains	Develop national DPP framework and open-data schema (standard for product identification-compatible, API-based, blockchain-ready) including compliance, quality and culinary layers	2026-2027 (pre-CAP rollout)	Ministry of Digital Transformation (MDT) / Government Digital Office (GovTech SI) - digital framework	Horizon Europe, Digital Europe Programme (DEP), LIFE (framework and platform)
		Pilot DPP protocols and data flows in innovation operational groups under EIP consortia (farmers, processors, retailers, logistics, IT providers) in 3-4 product chains (e.g. dairy, meat, fruit/veg, bakery)	2026-2028	Research institutions, GS1 Slovenia (product identification system), IT standards bodies - schema development EIP consortia, producer groups/cooperatives, SMEs, regional governments - pilots	CAP P2 EIP Operational Groups (IRP31) LIFE (pilots)
		Launch national repository and onboarding portal for operators and product lines, with SME micro-grants for data integration	2027-2029	MKGP modernisation units - repository and portal	Eco Fund, Slovenian Environmental Public Fund EKOSKLAD Slovenian Environment Agency (ARSO)
		Train advisors, SMEs and retailers on DPP tools, consumer communication kits, and MRV-linked reporting for footprints	2027-2030	Advisory bodies (KGZS), Chambers of Commerce - training	EKSRP P2 AKIS/Knowledge Transfer (training)
		Scale passportisation to ≥1k operators and ≥15% of domestic agri-food SKUs; monitor % sales with scannable	2028-2034	Certification bodies - data quality	Cohesion Policy (ESRR) - digital infrastructure, SME micro-grants



		provenance and data-quality compliance		ARSKTRP - Agency for Agricultural Markets and Rural Development	
92	Eco-scheme for agrotourism ecosystem services	Design payment logic for agrotourism services linked to landscape/ecosystem maintenance	2026-2027	<ul style="list-style-type: none"> Ministry of Sport and Tourism Ministry of Agriculture and Rural Development NGOs Research institutions & universities Local governments 	HE, LIFE, Erasmus+, NCN, ERDF
		Pilot scheme in Natura 2000 and rural heritage landscapes	2027-2028	<ul style="list-style-type: none"> Local governments Local action groups & NGOs Agricultural Chambers General Directorate for Environmental Protection ARiMR 	P1 (Eco-schemes), LEADER/CLLD (P2)
		Develop monitoring framework (visitor satisfaction, biodiversity proxies, cultural services)	2027-2029	<ul style="list-style-type: none"> Universities NGOs Local tourism organisations 	LIFE, Interreg, National Funds
		Train advisors and local action groups on scheme administration and farmer onboarding	2028-2029	<ul style="list-style-type: none"> Central and Regional Advisory Centres (CDR, ODRy) Local governments 	P2 (AKIS/KT), LEADER/CLLD (P2), TA CAP
		Scale to 5,000+ farms offering ecosystem-based tourism services	2029-2034	<ul style="list-style-type: none"> Ministry of Agriculture and Rural Development Agricultural Chambers Polish Federation of Rural Tourism 'Hospitable Farms' 	P1 (Eco-schemes), P2 (Monitoring), National Funds
24	Cooperation for lignocellulosic biomass	Conduct resource mapping and supply chain assessment for agricultural and forest	2026-2027 (preparation)	MKGP - lead	Horizon Europe Interreg LIFE



	cascading into high-value bioproducts through regional hubs and value-chain contracts	lignocellulosic biomass, identifying residues, perennials, and logistics bottlenecks		Slovenia Forest Service (SFS/ZGS) - forest biomass	CAP TA (mapping)
		Pilot cascading hubs and demo lines (≥ 100 kt/yr material-grade feedstock) testing drying, fractionation, QA protocols, and small-scale polymer/fermentation processing	2026-2027 (pilot)	Research institutions, universities - mapping and processing pilots	CBE-JU for value-chain cooperation
		Develop standard contracts and quality protocols for farm/forest-hub supply, ensuring cascading hierarchy (materials > energy) and environmental safeguards	2026-2027 (framework)	Cooperatives, producer/forest associations - supply organization	CAP P2 EIP Operational Groups (IRP31)
		Roll out investment support for regional cascading hubs ($\leq 65\%$ CAPEX) including pre-processing, storage, separation, QA equipment, and logistics infrastructure	2028-2034 (implementation)	EIP consortia, SMEs, research institutes - demo lines and pilots	EKSRP P2 Investments (IRP03, IRP44)
		Scale cascading mobilisation to with long-term farm/forest contracts feeding into functional biopolymer/biochemical lines	2028-2034 (scaling)	Advisory centres (KGZS) - advisory support	Cohesion Policy (ESRR, CF), InvestEU, EIB loans
		Monitor cascading outcomes (t/yr certified lignocellulosic feedstock, % losses, # new SKUs, GHG substitution) and publish annual performance reports	2028-2034 (monitoring & evaluation)	Regional authorities - spatial coordination	Slovenian Environment Agency (ARSO)
		34	Livestock modernisation and flexible biogas at point of use	Map priority livestock regions and clusters (high slurry/manure surplus + processors as energy users) and develop siting/odour protocols under innovation operational groups under EIP pilots	2026-2027 (preparation/pilots)



		Launch housing modernisation support: retrofits with welfare/nutrient capture (slurry separation, covers, scrubbers) and odour control	2026-2028 (initial rollout)	Research institutions, National Environmental and Water Fund - pilots and protocols	CAP P2 EIP Operational Groups (IRP31) LIFE (pilots)
		Provide investment support for flexible anaerobic digestion units at farm/cluster scale with on-site energy use (CHP, local heat networks, optional upgrading)	2026-2034	Producer groups, cooperatives - cluster organization Local authorities - spatial planning and permits	CAP P2 Investments (IRP36 biogas) InvestEU / EIB for larger upgrades
		Integrate digestate flows into carbon-farming and nutrient AECMs through certified nutrient plans and advisory audits	2028-2034	MOP - energy and environmental permits ARSO - monitoring	
		Develop and certify logistics protocols for short-haul feedstock collection and nutrient return, scaling through EIP cooperation projects	2027-2030	Slovenian energy system operator (SODO), gas operators - grid connections	Cohesion Policy (ESRR, CF), National funds (MKGP, MOP)
		Monitor performance & acceptance: track Nm ³ biogas/yr, on-site use ratio (>70%), odour complaint rates, welfare compliance, and digestate application quality	2027-2034	UVHVVR - substrate quality SMEs - technology suppliers Chamber of Agriculture and Forestry - advisory service	Slovenian Environment Agency (ARSO)
34	Livestock modernisation and flexible biogas at point of use	Map priority livestock regions and clusters (high slurry/manure surplus + processors as energy users) and develop siting/odour protocols under innovation operational groups under EIP pilots	2026-2027 (preparation/pilots)	<ul style="list-style-type: none"> Ministry of agriculture (Lead) Ministry of the Environment research institutions in agriculture national environmental and water management fund producer groups local authorities 	EIP-OG (P2), HE
		Launch housing modernisation support: retrofits with welfare/nutrient capture	2026-2028 (initial rollout)	<ul style="list-style-type: none"> SZIF Ministry of agriculture producer coops 	P2 (Investments),



		(slurry separation, covers, scrubbers) and odour control		<ul style="list-style-type: none"> • SMEs 	ERDF, CF, National Funds
		Provide investment support for flexible anaerobic digestion units at farm/cluster scale with on-site energy use (CHP, local heat networks, optional upgrading)	2026-2034	<ul style="list-style-type: none"> • Ministry of agriculture • SZIF • producer organisations • municipalities 	P2 (Investments), LIFE, CF
		Integrate digestate flows into carbon-farming and nutrient AECMs through certified nutrient plans and advisory audits	2028-2034	<ul style="list-style-type: none"> • research institutions in agriculture • advisory services providers • producer groups 	AECM (P2), LIFE, HE
		Develop and certify logistics protocols for short-haul feedstock collection and nutrient return, scaling through EIP cooperation projects	2027-2030	<ul style="list-style-type: none"> • producer organisations • logistics SMEs • advisory services providers 	EIP-OG (P2), Interreg, HE
		Monitor performance & acceptance: track Nm ³ biogas/yr, on-site use ratio (>70%), odour complaint rates, welfare compliance, and digestate application quality	2027-2034	<ul style="list-style-type: none"> • Ministry of agriculture • research institutions in agriculture • SZIF • NGOs (observer role) 	P2 (Monitoring), LIFE, DEP
37	Farm & Cluster Biogas/Biomethane with Digestate Circularity	Establish national digestate quality standards & permitting guidance (metals, microplastics, hygiene) + mandatory heat-use planning criteria	2026-2027 (pre-CAP rollout)	ARSKTRP - Agency for Agricultural Markets and Rural Development MOP - permitting guidance Research institutions - standards development	Horizon Europe, LIFE, CAP TA (standards and pilots) Cohesion Policy (ESRR, CF), National funds
		Innovation operational groups under EIP pilots for feedstock logistics & siting (short-haul clusters, contracts, odour mitigation protocols)	2026-2027	KGZS (biogas section) advisory, certification bodies - quality assurance	CAP P2 EIP Operational Groups (IRP31) LIFE (pilots)
		Launch investment grants scheme under CAP Pillar II (paying agency calls, performance-based contracts)	2027-2028	Inspectorates - compliance	CAP P2 Investments (IRP36)
		Integrate digestate into CAP nutrient planning	2028-2030		EKJS P1 Eco-schemes, EKSRP



		tools (link with eco-schemes/AECM for SOC & nutrient substitution)		EIP consortia (farmers, municipalities, logistics SMEs, universities) - pilots	P2 AECM (digestate integration)
		Scale-up & monitoring (≥20 installations with nutrient plans; ≥70% on-site heat utilisation; verified substitution of mineral N/P)	2028-2034	MKGP modernisation units - investment calls	Digital Europe Programme (DEP) for monitoring
				Regional governments - coordination	
				Advisory bodies, farmers - nutrient planning integration	
				Operators - biogas/biomethane plants	
53	National biochar guidelines, certification & AKIS micro-credentials	Develop national biochar application guidelines (quality thresholds, safe use, co-application rules, MRV templates) with stakeholder consultation	2026-2027	MKGP - lead guidelines and registry	Horizon Europe, LIFE, CBE-JU (guidelines)
				MOPE - environmental and climate aspects	CAP P2 EIP Operational Groups (IRP31) Interreg, Horizon Europe (pilots)
				Research institutions, ARSO (environmental monitoring), certification bodies - guidelines, protocols, MRV	CAP TA, LIFE, National funds (registry/helpdesk)
		Pilot validation of protocols and MRV templates under innovation operational groups under EIP consortia (field trials, advisory pilots, municipal-farm cooperation)	2026-2027	EIP consortia (farmers, SMEs, municipalities, universities, advisory networks) - pilots	Digital Europe Programme (DEP) - MRV platform
		Launch registry/helpdesk under Technical Assistance to manage certification templates and track protocols	2027-2028	ARSKTRP - Agency for Agricultural Markets and Rural Development	CAP TA (standards and pilots)
		Roll out AKIS training with modular skill	2027-2030	Research institutions, KGZS advisory bodies, farmer	CAP P2 AKIS/Knowledge



		certificates (biochar basics, compost/digestate co-application, QA/MRV, procurement & claims) for advisors, farmers, municipal staff		organisations - training Chambers of commerce, regional authorities - outreach	Transfer, Erasmus+, Horizon Europe (training)
		Scale-up adoption: ≥ 25 validated protocols, credentials issued, $\geq 70\%$ of trained advisors/farmers applying practices	2028-2034		
10	Development of enabling framework and pilot investments for farm and cluster biomethane with digestate circularity	Prepare national biomethane roadmap (regulatory changes, grid adaptation needs, sustainability safeguards, digestate standards, heat-use requirements)	2026-2027 (preparation)	<ul style="list-style-type: none"> Ministry of agriculture and rural development Ministry of Investment, Regional Development and Informatics Slovak Innovation and Energy Agency gas operators research institutions in agriculture 	TA CAP, LIFE, HE, National Fund - Programme Slovakia
		Launch demonstration projects (first wave) combining AD units with biomethane upgrading, local heat grids and certified digestate use (farmer coops + SMEs)	2028-2030 (early implementation)	<ul style="list-style-type: none"> Ministry of agriculture and rural development Ministry of Investment, Regional Development and Informatics paying agency cooperatives SMEs advisory services providers 	P2 (Investments), CF, LIFE, National Fund - Programme Slovakia
		Establish feed-in/market framework (tariffs or guarantees of origin for biomethane, contracts with transport sector) aligned with RED III and national energy strategy	2028-2032 (regulatory & market scaling)	<ul style="list-style-type: none"> Ministry of agriculture and rural development Ministry of Investment, Regional Development and Informatics Slovak Innovation and Energy Agency 	National Funds, InvestEU, EIB, National Fund - Programme Slovakia



10	Development of enabling framework and pilot investments for farm and cluster biomethane with digestate circularity	Prepare national biomethane roadmap (regulatory changes, grid adaptation needs, sustainability safeguards, digestate standards, heat-use requirements)	2026-2027 (preparation)	<ul style="list-style-type: none"> • Ministry of agriculture (Lead) • Ministry of the environment • energy regulatory office • gas operators • research institutions in agriculture -Czech Biogas Association	TA CAP, LIFE, HE, national funds
		Establish pilot support scheme for 5-10 farm or cluster biomethane plants in manure-surplus districts, including CAPEX grants and feasibility studies	2026-2027 (pilot)	<ul style="list-style-type: none"> • Ministry of agriculture • regional authorities • producer groups -Czech Biogas Association	P2 (Investments), National Funds, ERDF
		Launch demonstration projects (first wave) combining AD units with biomethane upgrading, local heat grids and certified digestate use (farmer coops + SMEs)	2028-2030 (early implementation)	<ul style="list-style-type: none"> • Ministry of agriculture • SZIF • NGOs • SMEs • advisory services providers 	P2 (Investments), CF, LIFE, national funds
		Establish feed-in/market framework (tariffs or guarantees of origin for biomethane, contracts with transport sector) aligned with RED III and national energy strategy	2028-2032 (regulatory & market scaling)	<ul style="list-style-type: none"> • Ministry of the Environment • energy regulatory office • energy agencies 	National Funds, InvestEU, EIB
		Expand biomethane network stepwise to ~50 operational plants by 2034, focusing on manure-rich districts and integrating digestate nutrient substitution into CAP nutrient planning	2030-2034 (scaling)	<ul style="list-style-type: none"> • Ministry of agriculture (Lead) • regional authorities • cooperatives • energy companies • research institutions in agriculture 	P2 (AECM/Nutrient planning), LIFE
87	Regional carbon farming living labs	Select 4-5 priority regions (different soil/climate types) for Carbon Farming Living Labs	2026-2027	<ul style="list-style-type: none"> • Ministry of agriculture and rural development • Research And Innovation Authority • research institutions in agriculture • regional authorities 	HE, LIFE, CBE-JU, RIS3, Programme Slovakia, Environmental Fund



		Co-design practices with farmers, SMEs, advisors, and researchers in pilot labs	2027-2028	<ul style="list-style-type: none"> •Ministry of agriculture and rural development • Research And Innovation Authority • research institutions in agriculture • universities • farmer groups 	EIP-OG (P2), Interreg, HE, RIS3, Programme Slovakia, Environmental Fund
		Integrate monitoring (soil C, biodiversity, water retention) and economic assessment into lab activities	2028-2029	<ul style="list-style-type: none"> •Ministry of agriculture and rural development • Research And Innovation Authority • research institutions in agriculture • Ministry of agriculture • NGOs 	P2 (AKIS/KT), Erasmus+, LIFE, RIS3, Programme Slovakia, Environmental Fund
		Maintain operational labs as permanent innovation and advisory centres	2029-2034	<ul style="list-style-type: none"> •Ministry of agriculture and rural development • Research And Innovation Authority • research institutions in agriculture • regional hubs 	P2 (Monitoring), TA CAP, RIS3, Programme Slovakia, Environmental Fund
87	Regional carbon farming living labs	Select 4-5 priority regions (different soil/climate types) for Carbon Farming Living Labs	2026-2027	<ul style="list-style-type: none"> • research institutions in agriculture • regional authorities universities National Chamber of Agriculture 	HE, LIFE, CBE-JU
		Co-design practices with farmers, SMEs, advisors, and researchers in pilot labs	2027-2028	<ul style="list-style-type: none"> • research institutions in agriculture • universities • farmer groups National Chamber of Agriculture 	EIP-OG (P2), Interreg, HE



		Integrate monitoring (soil C, biodiversity, water retention) and economic evaluation into lab activities	2028-2029	<ul style="list-style-type: none"> • research institutions in agriculture • Ministry of agriculture • NGOs 	P2 (AKIS/KT), Erasmus+, LIFE
		Maintain operational labs as permanent innovation and advisory centres	2029-2034	<ul style="list-style-type: none"> • Ministry of agriculture • research institutions in agriculture • regional hubs 	P2 (Monitoring), TA CAP, National Funds
98	Circular manure exchange platform	Develop national digital platform for surplus-deficit matching (GIS-based)	2026-2027	<ul style="list-style-type: none"> • Ministry of agriculture • research institutions in agriculture • IT partners 	DEP, HE, LIFE
		Pilot with high livestock densities	2027-2028	<ul style="list-style-type: none"> • Agriculture modernisation units • advisory bodies • municipalities 	EIP-OG (P2), Interreg, HE
		Integrate with CAP nutrient planning tools (eco-schemes/AECM)	2028-2029	<ul style="list-style-type: none"> • Ministry of agriculture • National Chamber of Agriculture • agriculture modernisation units • agricultural research institution 	P1 (Eco-schemes), AECM (P2), LIFE
		Develop logistics and quality-assurance protocols (storage, odour, hygiene)	2028-2029	<ul style="list-style-type: none"> • research institutions in agriculture • inspectorates 	P2 (Investments), ERDF, CF, National Funds
		Scale nationwide with >1 Mt nutrient flows annually matched digitally	2029-2034	<ul style="list-style-type: none"> • Ministry of agriculture • agriculture modernisation units • IT operators 	P2 (Monitoring), DEP, LIFE
		Support experimental programmes in public buildings (schools, kindergartens, rural admin)	2027-2028	<ul style="list-style-type: none"> • local governments • SMEs • agriculture modernisation units 	Interreg, ERDF, CF, National Funds



				<ul style="list-style-type: none"> ministry of agriculture ministry of education 	
		Develop QA protocols for insulation/panels (fire safety, compostability, thermal)	2027-2029	<ul style="list-style-type: none"> • IBL • research institutions in agriculture • universities 	HE, LIFE, CBE-JU
		Develop procurement criteria/playbooks for municipalities & housing co-ops	2028-2029	<ul style="list-style-type: none"> • Ministry of agriculture • NGOs • certification bodies 	DEP, LIFE, TA CAP
		Scale to 50+ public/rural housing buildings using bio-based materials	2029-2034	<ul style="list-style-type: none"> • Ministry of agriculture ministry of national economy • municipalities • national R&D funding agency • public financing provider 	ERDF, CF, National Funds
31	Local biogas from waste biomass with on-site energy use and odour control	Map priority regions and clusters with high waste-biomass availability (segregated bio-waste, manure, crop residues) and local energy demand (farms/processors)	2026-2027 (preparation)	<ul style="list-style-type: none"> • Ministry of agriculture (Lead) -Ministry of the Environment • statistical office • regional authorities • municipalities 	HE, LIFE, TA CAP
		Launch EIP pilots for siting, short-haul logistics and odour/abatement protocols with farm/municipal consortia	2026-2027 (pilots)	<ul style="list-style-type: none"> • Ministry of agriculture • research institutions in agriculture • producer groups • SMEs • local governments 	EIP-OG (P2), Interreg, HE
		Provide investment support for anaerobic digestion units, CHP/heat networks, digestate storage & processing, and best-available odour/leachate control	2028-2034	<ul style="list-style-type: none"> • Ministry of agriculture • SZIF • producer groups/coops • SMEs • municipalities 	P2 (Investments), ERDF, CF, National Funds
		Integrate digestate flows into result-based agri-environmental-climate measure (carbon farming, nutrient substitution) via	2028-2034	<ul style="list-style-type: none"> • research institutions in agriculture • advisory services providers 	AECM (P2), LIFE, HE NAZV



		certified nutrient plans and soil contracts		<ul style="list-style-type: none"> • producer organisations 	
		Engage communities and monitor acceptance through information events, transparent reporting of odour/complaints, and co-design of projects with local action groups	2027-2034	<ul style="list-style-type: none"> • local action groups • NGOs • municipalities • producer groups 	LEADER (P2), LIFE, Interreg
		Track energy/digestate outputs and GHG abatement via plant meters, nutrient plans, and annual audits; adjust support where on-site use <70%	2028-2034	<ul style="list-style-type: none"> • Ministry of agriculture • paying agency • research institutions in agriculture • energy regulators 	P2 (Monitoring), LIFE, DEP

12.5. Rural communities & regional bioeconomy hubs - empowering local transformation

Rural communities are at the heart of the bioeconomy transition. Establishing regional bioeconomy hubs connects local actors – farmers, SMEs, municipalities, and research institutions – to create territorial ecosystems for innovation, value creation, and nutrient circularity.

These hubs integrate physical infrastructures (micro-biogas plants, biomass mobilisation hubs, compost and digestate systems) with institutional cooperation networks (LEADER, EIP, and digital provenance tools).

They promote local entrepreneurship, decentralised renewable energy, and social acceptance while ensuring that economic value stays within the region. In Central Europe, this approach revitalises rural areas, enhances circular business models, and strengthens social cohesion across communities.

No.	Policy measure	Steps to delivery	Timeframe	Responsible	Proposed financing
18	Organisation of biomass mobilisation and regional feedstock hubs for high-value material-grade uses	Develop standard contracts and quality protocols for farm-hub supply, ensuring cascading priority (materials before energy) and compliance with waste/OSH rules	2026-2027 (framework)	<ul style="list-style-type: none"> • Ministry of Agriculture, Forestry, and Fisheries • plant protection and seed inspection service • producer associations • legal/standards bodies 	HE, LIFE, National Funds



	Roll out investment support for regional hubs ($\leq 65\%$ CAPEX), including pre-processing, storage, drying and logistics equipment	2028-2034 (implementation)	<ul style="list-style-type: none"> • Ministry of Agriculture, Forestry, and Fisheries (Lead) • paying agency • cooperatives • regional authorities 	P2 (Investments), ERDF, CF
	Monitor flows and impacts (t/yr material-grade biomass, logistics loss %, GHG footprint of chains) and publish annual progress reports	2028-2034 (monitoring & evaluation)	<ul style="list-style-type: none"> • Ministry of Agriculture, Forestry, and Fisheries • research institutions in agriculture • statistical office • regional hubs • independent evaluators 	DEP, LIFE, HE
	Conduct regional biomass mapping and clustering to identify priority residues/side-streams and candidate hub locations	2026-2027 (preparation)	<ul style="list-style-type: none"> • Ministry of Agriculture, Forestry, and Fisheries (Lead) • regional authorities • research institutions in agriculture • producer groups • universities 	HE, LIFE, TA CAP
	Launch investment support for regional hubs ($\leq 65\%$ CAPEX for drying, milling, separation, storage, logistics infrastructure)	2028-2034 (implementation)	<ul style="list-style-type: none"> • Ministry of Agriculture, Forestry, and Fisheries (Lead) • paying agency • cooperatives • regional authorities • SMEs 	P2 (Investments), ERDF, CF
	Monitor feedstock quality and cascading outcomes (t/yr certified streams, logistics loss %, GHG footprint, share of material vs. energy use)	2028-2034 (monitoring & evaluation)	<ul style="list-style-type: none"> • Ministry of agriculture • research institutions in agriculture • statistical office • independent evaluators • regional hubs 	DEP, LIFE, HE



		Identify priority crops and input categories (berries, orchards, greenhouse veg; biostimulants, biocontrols, compost/digestate blends) and launch first EIP calls	2026-2027 (preparation)	<ul style="list-style-type: none"> • Ministry of Agriculture, Forestry, and Fisheries (Lead) • research institutions in agriculture • farmers advisory units • producer groups • SMEs 	EIP-OG (P2), HE, LIFE
		Conduct on-farm comparative pilots with common efficacy and safety protocols, covering yield, input substitution and soil indicators	2026-2028 (pilots)	<ul style="list-style-type: none"> • EIP consortia (growers, SMEs, advisors, labs) • universities 	HE, LIFE, National Funds
18	Organisation of biomass mobilisation and regional feedstock hubs for high-value material-grade uses	Conduct regional biomass mapping (municipality → region), identifying dispersed residues/side-streams and potential aggregation nodes	2026-2027 (preparation)	<ul style="list-style-type: none"> • Ministry of Agriculture and Rural Development • Regional authorities • Research institutions & universities • NGOs or cooperation platforms as National Bioeconomy Hub in Poland • SMEs 	HE, LIFE, TA CAP
		Pilot 5-7 feedstock hubs with cooperatives/local action groups, testing segregation, drying, fractionation, quality assurance and digital traceability tools	2026-2027 (pilot)	<ul style="list-style-type: none"> • Local action groups • Producer groups • SMEs (logistics/pre-processing) • Central and Regional Advisory Centres (CDR, ODRy) • KSOW+ • ARiMR 	LEADER (P2), EIP-OG (P2), NCBiR, FENG
		Develop standard contracts and quality protocols for farm-hub supply, ensuring cascading priority (materials before energy)	2026-2027 (framework)	<ul style="list-style-type: none"> • Ministry of Agriculture and Rural Development • Main Inspectorate of Plant 	HE, LIFE, National Funds



		and compliance with waste/OSH rules		Health and Seed Inspection (PIORiN) • Producer associations • Research institutes supervised by the Minister of Agriculture and Rural Development	
		Roll out investment support for regional hubs ($\leq 65\%$ CAPEX), including pre-processing, storage, drying and logistics equipment	2028-2034 (implementation)	• National research and development funding agency	P2 (Investments), ERDF, NFOŚiGW, National Banks
		Scale mobilisation to ≥ 250 kt/yr biomass with ≥ 200 farm-hub contracts, lowering unit costs and stabilising input streams for PHA/DES bioprocessing	2028-2034 (scaling)	• National Contact Point for Horizon Europe (NCP Department)	P2 (Cooperation), HE, LIFE
		Monitor flows and impacts (t/yr material-grade biomass, logistics loss %, GHG footprint of chains) and publish annual progress reports	2028-2034 (monitoring & evaluation)	• Ministry of Agriculture and Rural Development • Research institutes & Universities • Statistics Poland	DEP, LIFE, HE, National Funds
18	Organisation of biomass mobilisation and regional feedstock hubs for high-value material-grade uses	Conduct regional biomass mapping (municipality \rightarrow region), identifying dispersed residues/side-streams and potential aggregation nodes	2026-2027 (preparation)	MKGP - lead, mapping, investment schemes	Horizon Europe LIFE, CAP TA (mapping phase)
		Pilot 5-7 feedstock hubs with cooperatives/local action groups, testing segregation, drying, fractionation, quality assurance and digital traceability tools	2026-2027 (pilot)	ARSKTRP - Agency for Agricultural Markets and Rural Development - payments	CAP P2 EIP Operational Groups (IRP31)
		Develop standard contracts and quality protocols for farm-hub supply, ensuring cascading priority (materials before energy)	2026-2027 (framework)	Regional authorities - coordination and spatial planning	



		and compliance with waste/OSH rules		Research institutions, universities - mapping methodology	
		Roll out investment support for regional hubs ($\leq 65\%$ CAPEX), including pre-processing, storage, drying and logistics equipment	2028-2034 (implementation)	Cooperatives, producer groups - hub operation	CAP P2 Investments (IRP03, IRP44) Cohesion Policy (ERDF, CF) - shared infrastructure
		Scale mobilisation with farm-hub contracts, lowering unit costs and stabilising input streams for PHA/DES bioprocessing	2028-2034 (scaling)	Local Action Groups - pilot facilitation	Municipal budgets and PPI (public procurement of innovation)
		Monitor flows and impacts (t/yr material-grade biomass, logistics loss %, GHG footprint of chains) and publish annual progress reports	2028-2034 (monitoring & evaluation)	SMEs - logistics and pre-processing services	
18	Organisation of biomass mobilisation and regional feedstock hubs for high-value material-grade uses	Conduct regional biomass mapping (municipality \rightarrow region), identifying dispersed residues/side-streams and potential aggregation nodes	2026-2027 (preparation)	<ul style="list-style-type: none"> Ministry of agriculture (Lead) Ministry of Regional Development regional authorities research institutions in agriculture cooperatives 	HE, LIFE, TA CAP, national funds
		Pilot 5-7 feedstock hubs with cooperatives/local action groups, testing segregation, drying, fractionation, quality assurance and digital traceability tools	2026-2027 (pilot)	<ul style="list-style-type: none"> local action groups NGOs SMEs (logistics/pre-processing) advisory centres 	LEADER (P2), EIP-OG (P2), Interreg
		Develop standard contracts and quality protocols for farm-hub supply, ensuring cascading priority (materials before energy) and compliance with waste/OSH rules	2026-2027 (framework)	<ul style="list-style-type: none"> Ministry of agriculture UKZUZ producer associations legal/standards bodies 	HE, LIFE, National Funds
		Roll out investment support for regional hubs ($\leq 65\%$ CAPEX), including pre-processing, storage, drying and logistics equipment	2028-2034 (implementation)	<ul style="list-style-type: none"> Ministry of agriculture (Lead) SZIF cooperatives regional authorities 	P2 (Investments), ERDF, CF



		Scale mobilisation to ≥ 250 kt/yr biomass with ≥ 200 farm-hub contracts, lowering unit costs and stabilising input streams for PHA/DES bioprocessing	2028-2034 (scaling)	<ul style="list-style-type: none"> Ministry of agriculture cooperatives producer groups SMEs advisory services providers 	P2 (Cooperation), HE, LIFE
40	Facilitate the creation of trusted short supply chains and local partnerships using digital provenance tools to improve margins, reduce waste and strengthen consumer trust	Monitor flows and impacts (t/yr material-grade biomass, logistics loss %, GHG footprint of chains) and publish annual progress reports	2028-2034 (monitoring & evaluation)	<ul style="list-style-type: none"> Research institutions & universities Producer Groups Agricultural Chambers SMEs: certifying entities Central and Regional Advisory Centres (CDR, ODRy) 	HE, LIFE, TA CAP, National Funds
		Launch pilot partnerships under innovation operational groups under EIP and LEADER (farmer-processor-logistics-retail/HORECA) with shared storefronts, storytelling, and logistics pooling	2026-2028	<ul style="list-style-type: none"> KSOW+ Central and Regional Advisory Centres (CDR, ODRy) ARiMR EIP groups candidates 	EIP-OG (P2), LEADER (P2), Interreg
		Develop consumer communication and training modules for marketing/storytelling, including passport-enabled smart labels and waste-reduction campaigns	2027-2029	<ul style="list-style-type: none"> Ministry of Agriculture and Rural Development KOWR SMEs: service providers NGOs or cooperation platforms as National Bioeconomy Hub in Poland 	HE, LIFE, FENG
		Scale digital-enabled partnerships to ≥ 800 by 2030, ensuring measurable farmer price premiums and waste reductions, with annual monitoring via e-commerce and sales data	2028-2034	<ul style="list-style-type: none"> ARiMR PARP Marshal Offices of the Regional Governments 	P2 (Cooperation), DEP, National Funds, NFOŚiGW



40	Facilitate the creation of trusted short supply chains and local partnerships using digital provenance tools to improve margins, reduce waste and strengthen consumer trust	Design national framework for digital-enabled short supply chains (integration with DPP layers: compliance, quality, culinary) and prepare cooperation call templates	2026-2027 (pre-CAP rollout)	<ul style="list-style-type: none"> Ministry of Investment, Regional Development and Informatics research institutions in agriculture advisory bodies 	HE, LIFE, TA CAP, Interreg programmes, National Fund - Programme Slovakia
		Launch pilot partnerships under innovation operational groups under EIP and LEADER (farmer-processor-logistics-retail/HORECA) with shared storefronts, storytelling, and logistics pooling	2026-2028	<ul style="list-style-type: none"> producer groups coops local action groups SMEs Regional authorities 	EIP-OG (P2), LEADER (P2), Interreg, National Fund - Programme Slovakia
		Develop consumer communication and training modules for marketing/storytelling, including passport-enabled smart labels and waste-reduction campaigns	2027-2029	<ul style="list-style-type: none"> research institutions in agriculture agricultural universities advisory centres NGOs 	Erasmus+, HE, LIFE, Interreg programmes, National Fund - Programme Slovakia
40	Facilitate the creation of trusted short supply chains and local partnerships using digital provenance tools to improve margins, reduce waste and strengthen consumer trust	Design national framework for digital-enabled short supply chains (integration with DPP layers: compliance, quality, culinary) and prepare cooperation call templates	2026-2027 (pre-CAP rollout)	<ul style="list-style-type: none"> monitoring agency (Lead) agriculture modernisation units research institutions in agriculture GS1 product identification system advisory bodies 	HE, LIFE, TA CAP
		Launch pilot partnerships under innovation operational groups under EIP and LEADER (farmer-processor-logistics-retail/HORECA) with shared storefronts, storytelling, and logistics pooling	2026-2028	<ul style="list-style-type: none"> NGOs producer groups coops local action groups SMEs Regional authorities 	EIP-OG (P2), LEADER (P2), Interreg
		Develop consumer communication and training modules for	2027-2029	<ul style="list-style-type: none"> research institutions in agriculture 	Erasmus+, HE, LIFE



		marketing/storytelling, including passport-enabled smart labels and waste-reduction campaigns		<ul style="list-style-type: none"> • agricultural universities • advisory centres • NGOs 	
		Scale digital-enabled partnerships to ≥800 by 2030, ensuring measurable farmer price premiums and waste reductions, with annual monitoring via e-commerce and sales data	2028-2034	<ul style="list-style-type: none"> • monitoring agency • agriculture modernisation units • producer groups • retailers • certification bodies 	P2 (Cooperation), DEP, National Funds
62	AKIS living labs, diagnostics & micro-credentials for regenerative transition	Co-design national soil-health diagnostic toolkit (cover %, infiltration, SOC/biology) and benchmarking registry	2026-2027	<ul style="list-style-type: none"> • Ministry of Agriculture and Rural Development • Research institutions 	HE, LIFE, NCBiR programs
		Establish living lab demo farms and peer-learning groups in priority regions (erosion/drought)	2026-2028	<ul style="list-style-type: none"> • Central and Regional Advisory Centres (CDR, ODRy) • Research institutions • Universities • Producer Groups • Agricultural Chambers 	EIP-OG (P2), Interreg, HE
		Roll out micro-credential training modules for farmers/advisors (regenerative agronomy, grazing design, monitoring/data use)	2027-2029	<ul style="list-style-type: none"> • Research institutions • Universities • Central and Regional Advisory Centres (CDR, ODRy) 	P2 (AKIS/KT), Erasmus+, LIFE, HE
		Deploy digital registry and benchmarking tools with TA support, integrated with CAP monitoring	2028-2030	<ul style="list-style-type: none"> • Ministry of Agriculture and Rural Development • ARiMR • Research institutions • Central and Regional Advisory Centres (CDR, ODRy) 	TA CAP, DEP, HE



		Scale up: $\geq 4,000$ credentials issued and $\geq 6,000$ farms using diagnostics with $\geq 70\%$ uptake rate by 2030	2028-2034	<ul style="list-style-type: none"> • Central and Regional Advisory Centres (CDR, ODRy) • Research institutions • Universities • Producer Groups • Agricultural Chambers 	P2 (AKIS/KT), NFOŚiGW, FENG
62	AKIS living labs, diagnostics & micro-credentials for regenerative transition	Co-design national soil-health diagnostic toolkit (cover %, infiltration, SOC/biology) and benchmarking registry	2026-2027	<ul style="list-style-type: none"> • Ministry of the Environment • Ministry of agriculture and rural development • universities/labs • farmer advisory services providers 	HE, LIFE, Soil Mission, Environmental Fund
		Establish living lab demo farms and peer-learning groups in priority regions (erosion/drought)	2026-2028	<ul style="list-style-type: none"> • Ministry of the Environment • Ministry of agriculture and rural development • advisory services providers • farmer groups/coops • universities 	EIP-OG (P2), Interreg, HE, Environmental Fund
		Roll out micro-credential training modules for farmers/advisors (regenerative agronomy, grazing design, monitoring/data use)	2027-2029	<ul style="list-style-type: none"> • Ministry of the Environment • Ministry of agriculture and rural development • universities • advisory services providers • vocational schools • chambers/coops 	P2 (AKIS/KT), Erasmus+, LIFE, Environmental Fund



		Deploy digital registry and benchmarking tools with TA support, integrated with CAP monitoring	2028-2030	<ul style="list-style-type: none"> Ministry of the Environment Ministry of agriculture and rural development paying agency research institutions in agriculture advisory networks 	TA CAP, DEP, HE
11	Establishment of micro-biogas plants and circular manure hubs through LEADER/EIP cooperation for local nutrient cycling and social acceptance	Develop guidelines for micro-biogas hubs (modular AD units, simple digestate protocols, odour/leachate safeguards, environmental screening)	2026-2027 (preparation)	<ul style="list-style-type: none"> MKGP - lead policy and funding ARSKTRP - Agency for Agricultural Markets and Rural Development 	Horizon Europe, Interreg
		Launch pilot LEADER/EIP projects (≥30 hubs) in diffuse biomass/manure-surplus zones; integrate with local training & info sessions for communities	2026-2027 (pilot)	<ul style="list-style-type: none"> payments and monitoring 	CAP P2 EIP Operational Groups (IRP31) CAP P2 LEADER (IRP26)
		Expand hubs to ≥7 by 2030, combining modular micro-AD units with shared logistics (collection, storage, pre-treatment)	2028-2030 (early implementation)	MOP (Ministry of the Environment, Climate and Energy) - environmental permits and renewable energy	Cohesion Policy (ESRR) - complementary infrastructure
		Integrate manure hubs into circular economy plans (local nutrient recycling, compost/digestate valorisation, farm-municipality partnerships)	2028-2034 (scaling & integration)	Local Action Groups (LAS) - LEADER implementation	National funds (MKGP, municipal co-financing)
		Monitor performance and community acceptance (t residues treated, CH ₄ /N ₂ O avoided, attendance at info events, complaint rates ↓) with annual reporting	2028-2034 (monitoring & evaluation)	Producer organizations, cooperatives - operational management Municipalities - spatial planning and local partnerships	InvestEU guarantees SID (Slovenian Development and Export Bank)/EIB loans for infrastructure and operational costs;



				Chamber for Agriculture and Forestry - advisory services	
74	Sectoral (fruit & vegetables po): circular packaging & by-product certification + AKIS micro-credentials	Integrate circular packaging, by-product certification, and training actions into recognised Fruit & Vegetable POs' operational programmes; draft protocols and open criteria	2026-2027	MKGP - Ministry of Agriculture, Forestry and Food ARSKTRP - Agency for Agricultural Markets and Rural	LIFE Programme, Horizon Europe - circular bioeconomy pilot projects CAP P2 EIP Operational Groups (IRP31)
		Launch pilots with POs and SMEs: set up fibre-based packaging lines, validate protocols for residue-derived ingredients, test DPP-ready templates, and roll out first micro-credential modules	2027-2028	Development: paying agency, operational program approval and payments, monitoring Producer Organizations (POs): fruit/vegetable	CAP P2 EIP Operational Groups (IRP31) Circular Bio-based Europe Joint Undertaking (CBE-JU) - by-product valorisation innovation, cascading protocols, biorefinery technologies
		Scale up certification and labelling system; expand registry/API for DPP-ready data; onboard more POs and processors into procurement-ready schemes	2028-2029	Research institutions, universities (UL Biotechnical Faculty, KIS, Institute for cellulose and paper Slovenia)	Digital Europe Programme (DEP) EKJS Pillar 1 - Sectoral Programs
		By 2030 achieve ≥25 certified lines, ≥25 validated protocols, and ≥300 modular skill certificates; embed green procurement and circular packaging criteria in PO programmes nationwide	2029-2030	KGZS - Chamber of Agriculture and Forestry Cooperatives, processing SMEs Ministry of Digital transformation	Cohesion Policy (ESRR) - processing infrastructure, biorefinery pilot lines, packaging equipment



80	Engineered wood & biorefinery pilots with chp+biochar return	Identify candidate SMEs/processors, owner groups and municipalities for pilot engineered wood/biorefinery lines, map low-grade hardwood supply, and prepare feasibility studies	2026-2027 (pre-CAP rollout)	<p>MKGP - Ministry of Agriculture, Forestry and Food: lead for agriculture-forest integration</p> <p>Ministry of the Environment, Climate and Energy (MOPE): climate, energy, bioeconomy</p> <p>Slovenia Forest Service (ZGS): forest supply mapping and owner coordination</p>	<p>Horizon Europe, LIFE, CBE-JU - pilot lines, biorefinery R&D, biochar certification</p> <p>EIP Operational Groups (EKSRP P2), Horizon Europe, LIFE - QA protocols and pilot cooperation</p> <p>CAP P2 Investments, Cohesion Policy (ESRR, CF), National funds (MKGP, MOPE) - investment grants for pilot lines</p> <p>Horizon Europe, LIFE, CBE-JU, EIB - scale-up financing for integrated lines</p>
		Launch experimental programmes (LVL/CLT incl. beech, wood modification, modular biorefinery/extractives) integrated with CHP+biochar units, including QA/testing labs	2027-2028	Slovenian Forestry Institute (IBL): research, QA protocols, biochar testing	CAP P2 EIP Operational Groups (IRP31) CAP P2 Investments, Cohesion Policy (ESRR, CF), National funds (MKGP, MOPE) - investment grants for pilot lines
		Develop national QA/certification protocols for engineered wood products and biochar (soil-safety thresholds, conformity testing) with innovation operational groups under EIP pilots	2027-2029	<p>Research institutions, universities: feasibility studies, certification methodology</p> <p>ARSKTRP: paying agency for investment grants (agriculture modernisation units)</p>	CAP P2 Investments, Cohesion Policy (ESRR, CF), National funds (MKGP, MOPE) - investment grants SID Bank / InvestEU loans or guarantees
		Train operators/advisors under AKIS (modular skill certificates, procurement/standardisation playbooks) to scale adoption and ensure compliance with EU standards	2028-2030	<p>KGZS: advisory for nutrient/soil plans integrating biochar</p>	CAP P2 AKIS/Knowledge Transfer
		Scale-up to ≥7 lines with integrated CHP+biochar return, ensuring ≥100k m ³ /yr capacity and ≥6 kt	2028-2034		CAP P2 Investments, Cohesion Policy (ESRR, CF), National funds (MKGP, MOPE)



		certified biochar applied to farms under nutrient/soil plans			- investment grants SID Bank / InvestEU loans or guarantees
89	Digital farmer wallet for eco-scheme tracking	Develop app linked to IACS/LPIS that issues digital eco-credits for eco-scheme practices.	2026-2027	MKGP - policy owner and process design ARSKTRP - IACS/LPIS integration, data architecture Ministry of Public Administration (MJU) / GovTech	Digital Europe Programme (DEP) - platform development CAP Technical Assistance - process analytics and integration Horizon Europe / LIFE - prototypes and pilots
		Pilot in 2-3 regions with farmers receiving digital credits.	2027-2028	Slovenia - digital platform development and e-government integration	CAP P2 EIP Operational Groups (IRP31)
		Integrate with carbon market platforms and cooperative schemes.	2028-2029		Cohesion Policy (ESRR) - IT infrastructure
		Scale nationwide, enabling transparent farmer reporting and credit trading.	2029-2034	ARSO - environmental data linkages Research institutions, IT developers - app development and blockchain pilots Cooperatives, producer organizations - operational testing KGZS advisory - user training and support	National funds (MKGP, MJU)
97	Eco-scheme for crop diversification & local protein sources	Define monitoring indicators (protein crops share, rotation diversity index)	2026-2027	MKGP - Ministry of Agriculture, Forestry and Food: lead, eco-scheme design and indicators	Digital Europe Programme (DEP), LIFE Horizon Europe - digital log templates CAP P2 EIP Operational Groups (IRP31) (crop



				<p>Ministry of Finance: payment authorization and budget allocation</p> <p>ARSKTRP - Agency for Agricultural Markets and Rural Development: paying agency, LPIS integration, digital logs, field verification</p> <p>Research institutions (e.g., KIS, UL Biotechnical Faculty): rotation diversity methodology, indigenous varieties, protein crop agronomy</p> <p>KGZS - Chamber of Agriculture and Forestry: advisory on crop planning, legume management, protein value chains</p> <p>Seed companies, gene banks: indigenous variety seed supply and preservation</p> <p>Processing cooperatives, SMEs: protein crop processing</p>	<p>diversification and protein incentives)</p> <p>EKSRP Pillar 2 - AKIS/Knowledge Transfer (advisory and training)</p> <p>and remote sensing tools</p> <p>CAP Technical Assistance - monitoring and evaluation</p> <p>EIP Operational Groups (EKSRP P2), Horizon Europe - protein crop innovation and processing</p> <p>Cohesion Policy (ESRR) - protein processing infrastructure</p> <p>National funds (MKGP) - coordination, indigenous variety programs</p>
		Pilot eco-scheme contracts with 20 farms in 3 regions	2027-2028		
		Develop digital log templates and field-verifier protocols	2027-2028		
		Integrate scheme with national protein strategy and CAP eco-scheme menu	2028-2029		
		Scale to with $\geq 20\%$ average mineral protein substitution by 2034	2029-2034		



				<p>and marketing infrastructure</p> <p>EIP consortia: innovation projects on protein crop systems and food innovation</p> <p>Universities, advisory networks: AKIS training and skill certificates</p>	
97	Eco-scheme for crop diversification & local protein sources	Define monitoring indicators (protein crops share, rotation diversity index)	2026-2027	<ul style="list-style-type: none"> Ministry of agriculture research institutions in agriculture universities 	HE, LIFE, TA CAP
		Pilot eco-scheme contracts with 100 farms	2027-2028	<ul style="list-style-type: none"> agriculture modernisation units National Chamber of Agriculture advisory services providers producer groups 	P1 (Eco-schemes), EIP-OG (P2), HE
		Develop digital log templates and field-verifier protocols	2027-2028	<ul style="list-style-type: none"> Ministry of agriculture agriculture modernisation units IT providers 	DEP, LIFE, HE
		Integrate scheme with national protein strategy and CAP eco-scheme menu	2028-2029	<ul style="list-style-type: none"> Ministry of agriculture agriculture modernisation units 	P1 (Eco-schemes), National Funds
		Scale to >300k ha with ≥20% average mineral protein substitution by 2034	2029-2034	<ul style="list-style-type: none"> Ministry of agriculture producer groups agriculture modernisation units 	P1 (Eco-schemes), P2 (Monitoring), LIFE



97	Eco-scheme for crop diversification & local protein sources	Define monitoring indicators (protein crops share, rotation diversity index)	2026-2027	<ul style="list-style-type: none"> Ministry of agriculture research institutions in agriculture universities 	HE, LIFE, TA CAP
		Pilot eco-scheme contracts with 500 farms in 3 regions	2027-2028	<ul style="list-style-type: none"> agriculture modernisation units advisory services providers producer groups 	P1 (Eco-schemes), EIP-OG (P2), HE
		Develop digital log templates and field-verifier protocols	2027-2028	<ul style="list-style-type: none"> Ministry of agriculture agriculture modernisation units IT providers 	DEP, LIFE, HE
		Integrate scheme with national protein strategy and CAP eco-scheme menu	2028-2029	<ul style="list-style-type: none"> Ministry of agriculture agriculture modernisation units 	P1 (Eco-schemes), National Funds
		Scale to >300k ha with $\geq 20\%$ average mineral protein substitution by 2034	2029-2034	<ul style="list-style-type: none"> Ministry of agriculture producer groups agriculture modernisation units 	P1 (Eco-schemes), P2 (Monitoring), LIFE
54	Result-based eco-scheme: certified bio-fertilisers with precision application	Develop national certification list and QA protocols for bio-fertilisers/biostimulants, including safety and nutrient-content thresholds	2026-2027	<ul style="list-style-type: none"> Ministry of agriculture and rural development research institutions in agriculture plant protection and seed inspection service certification bodies 	HE, LIFE, CBE-JU, CAP SP, EIP OGs
		Design digital MRV templates and farm logbook standards for precision application (variable rate, decision	2026-2027	<ul style="list-style-type: none"> Ministry of agriculture and rural development 	DEP, HE, LIFE, CAP SP, EIP OGs



		support, invoices as evidence)		<ul style="list-style-type: none"> • research institutions in agriculture • farmer advisory services providers • IT providers 	
		Pilot eco-scheme under innovation operational groups under EIP /demo farms to validate the N-Substitution & Soil-Benefit Index (linking % mineral N reduction with soil-health proxies)	2027	<ul style="list-style-type: none"> • EIP consortia (farmers, SMEs, universities, advisors) 	EIP-OG (P2), Interreg, HE
		Launch national roll-out of result-based eco-scheme with digital onboarding and one-off support for baseline soil/management tests	2028-2029	<ul style="list-style-type: none"> • Ministry of agriculture and rural development • regional advisory networks 	P1 (Eco-schemes), LIFE, CAP SP, EIP OGs
54	Result-based eco-scheme: certified bio-fertilisers with precision application	Develop national certification list and QA protocols for bio-fertilisers/biostimulants, including safety and nutrient-content thresholds	2026-2027	<ul style="list-style-type: none"> • Ministry of agriculture • research institutions in agriculture • plant protection and seed inspection service • UKZUZ - certification body 	HE, LIFE, CBE-JU
		Design digital MRV templates and farm logbook standards for precision application (variable rate, decision support, invoices as evidence)	2026-2027	<ul style="list-style-type: none"> • research institutions in agriculture • agriculture modernisation units • farmer advisory services providers • IT providers 	DEP, HE, LIFE
		Pilot eco-scheme under innovation operational groups under EIP /demo farms to validate the N-Substitution & Soil-Benefit Index (linking % mineral N reduction with soil-health proxies)	2027	<ul style="list-style-type: none"> • EIP consortia (farmers, SMEs, universities, advisors) 	EIP-OG (P2), Interreg, HE



		Launch national roll-out of result-based eco-scheme with digital onboarding and one-off support for baseline soil/management tests	2028-2029	<ul style="list-style-type: none"> • agriculture modernisation units (Lead) • Ministry of agriculture • regional advisory networks 	P1 (Eco-schemes), LIFE, National Funds
		Scale-up to $\geq 280k$ ha by 2030, with average $\geq 18\%$ mineral N reduction and verified soil-health improvements (infiltration/microbial proxies)	2028-2034	<ul style="list-style-type: none"> • Ministry of agriculture • agriculture modernisation units • farmers • advisory services providers 	P1 (Eco-schemes), P2 (Monitoring), DEP
42	Establish regional bioeconomy hubs and value-chain cooperation to supply material-grade feedstock for cascades before energy use	Develop national guidance on cascading hierarchy and hub eligibility (materials > energy, QA criteria, waste/food/feed law compliance)	2026-2027 (pre-CAP rollout)	<ul style="list-style-type: none"> • monitoring agency (Lead) • NGOs • research institutions in agriculture 	HE, LIFE, TA CAP
		Launch innovation operational groups under EIP pilots to map supply, test pre-processing (drying/fractionation) and establish long-term contracts between farms, coops and SMEs	2026-2027	<ul style="list-style-type: none"> • EIP consortia (farmer groups, SMEs, RTOs, municipalities) • universities • advisory 	EIP-OG (P2), Interreg, HE
		Deploy CAP Pillar II calls for CAPEX investments in hubs (labs, QA, storage/logistics) under regional authorities	2027-2028	<ul style="list-style-type: none"> • agriculture modernisation units • regional governments • monitoring agency 	P2 (Investments), ERDF, CF, National Funds
		Integrate certified material-grade feedstock into CAP reporting (linking volumes with eco-schemes and AECM nutrient/circularity outcomes)	2028-2030	<ul style="list-style-type: none"> • research institutions in agriculture • advisory services providers • farmers/coops 	P1 (Eco-schemes), AECM (P2), LIFE
		Scale up to ≥ 25 regional hubs supplying ≥ 250 kt/yr of certified material-grade biomass; monitor % logistics loss, number of new SKUs and SME participation	2028-2034	<ul style="list-style-type: none"> • monitoring agency • agriculture modernisation units • operators 	P2 (Cooperation), CBE-JU, LIFE



				<ul style="list-style-type: none"> • hub consortia • SMEs 	
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Table 30. Chosen policy measures in the Rural communities & regional bioeconomy hubs area

12.6. Knowledge & skills for farmers and advisors - enabling lifelong learning and innovation

Human capital is the engine of bioeconomy implementation. Farmers and advisors need new competences to manage circular, digital, and regenerative systems.

The CAP’s knowledge exchange and advisory frameworks provide the foundation for lifelong learning, modular certification, and innovation brokerage. Micro-credentials, e-learning platforms, and bioeconomy fellowships help professionalise advisory services and align training with emerging technologies and sustainability goals.

Strengthened AKIS coordination ensures that innovation is demand-driven and inclusive, empowering farmers to apply precision and circular practices effectively. Investing in knowledge and skills means investing in the capacity of rural actors to deliver on Europe’s sustainability ambitions.

Together, these six pillars provide a strategic roadmap for embedding circular bioeconomy principles into the CAP. They connect governance, innovation, and human capital to environmental and economic outcomes – ensuring that the next generation of agricultural and rural policies in Central Europe is:

- Evidence-based and participatory, through adaptive AKIS governance;
- Innovative and digital, powered by science and data-driven tools;
- Climate-resilient and regenerative, linking payments to performance;
- Circular and cascading, maximising resource efficiency and food security;
- Locally rooted, empowering rural communities and regional hubs; and
- Knowledge-driven, equipping farmers and advisors with future skills.

These pillars form the operational backbone of the Central European Bioeconomy Strategy and Action Plan, ensuring that the transition from fossil-based to bio-based systems becomes systemic, inclusive, and irreversible.

Table 31. Chosen policy measures in the Knowledge & skills for farmers and advisors area

No.	Policy measure	Steps to delivery	Timeframe	Responsible	Proposed financing
6	Development of modular skill certificates and innovation brokerage	Establish innovation brokerage services linking SMEs/start-ups with farmers, producer groups and public buyers	2026-2027 (pilot)	<ul style="list-style-type: none"> • Ministry of agriculture • local action groups • producer groups 	HE, LIFE, CBE-JU



	services to strengthen AKIS capacity for the bioeconomy	through challenge-driven calls		<ul style="list-style-type: none"> • innovation operational groups under EIP consortia 	
		Roll out national programme of modular skill certificates with regional hubs, blended learning, and remote access for LFAs	2028-2034 (implementation)	<ul style="list-style-type: none"> • Ministry of Agriculture, Forestry, and Fisheries (Lead) • universities • advisory services providers • NGOs • regional authorities 	Erasmus+, HEI Alliances, LIFE
		Conduct evaluation & feedback loops (before-after evaluation, network density mapping, surveys on practice uptake $\geq 50\%$)	2028-2034 (monitoring & evaluation)	<ul style="list-style-type: none"> • Ministry of Agriculture, Forestry, and Fisheries • research institutions in agriculture • universities • independent evaluators 	HE, LIFE, Erasmus+
		Develop guidelines for micro-biogas hubs (modular AD units, simple digestate protocols, odour/leachate safeguards, environmental screening)	2026-2027 (preparation)	<ul style="list-style-type: none"> • Ministry of Agriculture, Forestry, and Fisheries (Lead) • local action groups • research institutions in agriculture • plant protection and seed inspection service • NGOs 	TA CAP, LIFE, HE
6	Development of modular skill certificates and innovation brokerage services to strengthen AKIS capacity for the bioeconomy	Design national framework for modular skill certificates (systemic methods, portfolio approaches, policy mix, sandboxing, bioeconomy KET use), including recognition across ministries	2026-2027 (preparation)	<ul style="list-style-type: none"> • Ministry of Agriculture and Rural Development • Research institutions • Educational Research Institute State Research Institute • Central and Regional Advisory Centres (CDR, ODRy) 	HE, LIFE, Erasmus+, National Funds
		Pilot delivery of modular skill certificates with	2026-2027 (pilot)	<ul style="list-style-type: none"> • Central and Regional Advisory 	P2 (AKIS/KT), Interreg, HE



		<p>accredited providers (5,000 participants trained by 2027; open access materials)</p>		<p>Centres (CDR, ODRy)</p> <ul style="list-style-type: none"> • Research institutions • Universities • Producer Groups • Agricultural Chambers 	
		<p>Establish innovation brokerage services linking SMEs/start-ups with farmers, producer groups and public buyers through challenge-driven calls</p>	2026-2027 (pilot)	<ul style="list-style-type: none"> • Research institutions • Universities • Central and Regional Advisory Centres (CDR, ODRy) • PARP • Innovation support centres: e.g. Science and Technology Parks, the National Centre for Research and Development (NCBR) - relevant programmes 	HE, LIFE, CBE-JU, FENG
		<p>Roll out national programme of modular skill certificates (12,000 by 2030) with regional hubs, blended learning, and remote access for LFAs</p>	2028-2034 (implementation)	<ul style="list-style-type: none"> • Central and Regional Advisory Centres (CDR, ODRy) • NGOs or cooperation platforms as National Bioeconomy Hub in Poland • Agricultural Chambers • Producer Groups • Research institutes 	Erasmus+, HEI Alliances, LIFE
		<p>Scale innovation brokerage networks to ≥600 matches by 2030, with monitoring of uptake and fair-</p>	2028-2034 (implementation & scaling)	<ul style="list-style-type: none"> • Central and Regional Advisory Centres (CDR, ODRy) • Research institutions 	P2 (AKIS/KT), TA CAP, National Funds



		value safeguards for farmers		Innovation support centres: e.g. Science and Technology Parks, the National Centre for Research and Development (NCBR) - relevant programmes <ul style="list-style-type: none"> • PARP • Agricultural Chambers 	
		Conduct evaluation & feedback loops (before-after evaluation, network density mapping, surveys on practice uptake $\geq 50\%$)	2028-2034 (monitoring & evaluation)	<ul style="list-style-type: none"> • Research institutions • Central and Regional Advisory Centres (CDR, ODRy) 	HE, LIFE, Erasmus+, P2 (AKIS/KT)
6	Development of modular skill certificates and innovation brokerage services to strengthen AKIS capacity for the bioeconomy	Design national framework for modular skill certificates (systemic methods, portfolio approaches, policy mix, sandboxing, bioeconomy KET use), including recognition across ministries	2026-2027 (preparation)	<ul style="list-style-type: none"> -MKGP - lead AKIS coordination -Ministry of Education (MIZŠ) - accreditation framework -Chamber of Agriculture and Forestry of Slovenia (KGZS) - advisory services -University of Ljubljana, research institutes - curriculum development -Local Action Groups, EIP Operational Groups, producer organizations - delivery partners 	<ul style="list-style-type: none"> -Horizon Europe / LIFE for pilot modules -Erasmus+ / European Universities Alliances
		Pilot delivery of modular skill certificates with accredited providers (150 participants trained by 2027; open access materials)	2026-2027 (pilot)		<ul style="list-style-type: none"> -CBE-JU for innovation brokerage -National funds (MKGP, MZVI) for co-financing
		Establish innovation brokerage services linking SMEs/start-ups with farmers, producer groups and public buyers through challenge-driven calls	2026-2027 (pilot)		
		Roll out national programme of modular skill certificates (150 by 2030) with regional	2028-2034 (implementation)		<ul style="list-style-type: none"> -CAP P2 (EKSRP) - AKIS/Knowledge Transfer interventions



		hubs, blended learning, and remote access for LFAs		-Chamber of Commerce and Industry (GZS) -	
		Scale innovation brokerage networks to ≥600 matches by 2030, with monitoring of uptake and fair-value safeguards for farmers	2028-2034 (implementation & scaling)	industry linkages	
		Conduct evaluation & feedback loops (before-after evaluation, network density mapping, surveys on practice uptake ≥50%)	2028-2034 (monitoring & evaluation)		
47	AKIS modular skill certificates & bioeconomy coordination for LLL	Co-design modular curricula (non-thermal extraction, QA/standards, IoT/analytics, IPR/TT, bioprocess basics) with HEIs, SMEs, advisory and farmer groups	2026-2027	<ul style="list-style-type: none"> • Research institutions • Educational Research Institute State Research Institute • Central and Regional Advisory Centres (CDR, ODRy) 	HE, LIFE, National Funds, ARIMR
		Develop national registry of modular skill certificates with digital badges aligned to EU LLL frameworks	2026-2027	<ul style="list-style-type: none"> • Ministry of Agriculture and Rural Development • Central and Regional Advisory Centres (CDR, ODRy) • Research institutions • Universities 	HE, National Funds
		Pilot modular skill certificates in innovation operational groups under EIP demo projects and farm/SME placements to test practice-readiness	2027-2028	<ul style="list-style-type: none"> • Research institutions • KSOW+ • Central and Regional Advisory Centres (CDR, ODRy) • PARP • Innovation support centres: e.g. Science and Technology Parks, the National Centre 	EIP-OG (P2), Interreg, HE



				for Research and Development (NCBR) - relevant programmes • ARiMR	
		Scale-up credential roll-out via AKIS/advisory training, with portable recognition across regions	2028-2030	<ul style="list-style-type: none"> • Central and Regional Advisory Centres (CDR, ODRy) • NGOs or cooperation platforms as National Bioeconomy Hub in Poland • Agricultural Chambers • Producer Groups • Research institutes, e.g. Educational Research Institute State Research Institute 	P2 (AKIS/KT), ERDF, HE
		Establish structured coordination platform (policy roundtables, briefs, evidence-based campaigns) to link advisors/HEIs with ministries and counter misinformation	2027-2034	<ul style="list-style-type: none"> • Ministry of Agriculture and Rural Development • Research institutions 	TA CAP, HE, LIFE
		Reach ≥5,000 modular skill certificates with ≥70% utilisation by 2030, ≥30 structured policy engagements, and regular evaluation through registry logs and surveys	2028-2034	<ul style="list-style-type: none"> • Research institutes, e.g. Educational Research Institute State Research Institute, NASK • Central and Regional Advisory Centres (CDR, ODRy) 	P2 (AKIS/KT)
93	National fund for on-farm renewable	Design investment grants scheme for PV, heat pumps,	2026-2027	<ul style="list-style-type: none"> • Ministry of Agriculture and 	National Funds



	energy self-sufficiency	and small wind dedicated to farms		Rural Development <ul style="list-style-type: none"> • Funding institutions: NFOŚiGW, National Development Bank of Poland, Bank for Environmental Protection • Research institutions 	
		Pilot installations in mixed farms (livestock, horticulture, arable)	2027-2028	<ul style="list-style-type: none"> • Funding institutions: ARiMR, NCBiR, PARP • KSOW+ • Research institutions 	P2 (Investments), ERDF, NFOŚiGW, National Funds - Subsidised loans from national banks, ARiMR
		Develop advisory toolkits for energy audits and integration with CAP climate objectives	2027-2029	<ul style="list-style-type: none"> • Ministry of Agriculture and Rural Development • Research institutions 	P2 (AKIS/KT), LIFE, National Funds - Subsidised loans from national banks
		Integrate monitoring (energy self-sufficiency %, GHG cuts) into CAP reporting	2028-2029	<ul style="list-style-type: none"> • Ministry of Agriculture and Rural Development • Research institutions • ARiMR 	P2 (Monitoring), National Funds
		Scale to >20,000 farms nationwide with verified self-sufficiency gains	2029-2034	<ul style="list-style-type: none"> • Central and Regional Advisory Centres (CDR, ODRy) • Research institutions • Agricultural Chambers • Group producers • NGOs or cooperation platforms as National Bioeconomy Hub in Poland 	NFOŚiGW, National Funds. Preferential loans from national banks
93	National fund for on-farm	Design investment grants scheme for PV, heat pumps,	2026-2027	<ul style="list-style-type: none"> • Ministry of agriculture 	HE, LIFE, CAP, , Innovation



	renewable energy self-sufficiency	and small wind dedicated to farms		Ministry of Energy • national environmental and water management fund • public financing provider	Fund, national funds
		Pilot installations in mixed farms (livestock, horticulture, arable)	2027-2028	• agriculture modernisation units • local authorities	P2 (Investments), ERDF, CF, National Funds
		Develop advisory toolkits for energy audits and integration with CAP climate objectives	2027-2029	• farmers advisory units • advisory bodies • NGOs	P2 (AKIS/KT), LIFE, National Funds
		Integrate monitoring (energy self-sufficiency %, GHG cuts) into CAP reporting	2028-2029	• Ministry of agriculture Ministry of Energy Ministry of Energy • research institutions in agriculture	P2 (Monitoring), LIFE, DEP
		Scale to >20,000 farms nationwide with verified self-sufficiency gains	2029-2034	• Ministry of agriculture • national environmental and water management fund • agriculture modernisation units	Innovation Fund, National Funds
95	Bioeconomy fellowships for young farmers	Design fellowship programme linking universities with circular farms/SMEs	2026-2027	• Ministry of Agriculture and Rural Development • Funding institutions: NCBiR, ARiMR, PARP • NGOs or cooperation platforms as National Bioeconomy Hub in Poland	Technical Assistance (TA)



				<ul style="list-style-type: none"> • Central and Regional Advisory Centres (CDR, ODRy) 	
		<p>Launch first cohort of 200 fellows in 3-4 thematic areas (bioenergy, biomaterials, carbon farming, digital)</p>	2027-2028	<ul style="list-style-type: none"> • Ministry of Agriculture and Rural Development • Ministry of Science and Higher Education • Agricultural Chambers • Producer groups • Central and Regional Advisory Centres (CDR, ODRy) 	P2 (AKIS/KT), Interreg, HE, FENG
		<p>Provide structured placements (6-12 months) with evaluation of skills uptake</p>	2027-2029	<ul style="list-style-type: none"> • Ministry of agriculture • Central and Regional Advisory Centres (CDR, ODRy) 	Erasmus+, HE, National Funds
		<p>Expand programme to include international mobility (Erasmus-style) and start-up incubation</p>	2028-2029	<ul style="list-style-type: none"> • NCBiR • KSOW+ • EU CAP Network in Poland • ARiMR • Research institutions • Foundation for the Development of the Education System (FRSE) • Innovation centres, e.g. Science and Technology Parks 	Erasmus+, HEI Alliances, LIFE
		<p>Scale to 2,000 fellows by 2034 with verified employment/start-up outcomes</p>	2029-2034	<ul style="list-style-type: none"> • NCBiR • KSOW+ • EU CAP Network in Poland • ARiMR • Research institutions 	HE, Erasmus+, National Funds



				<ul style="list-style-type: none"> • Foundation for the Development of the Education System (FRSE) • Innovation centres, e.g. Science and Technology Parks 	
95	Bioeconomy fellowships for young farmers	Design fellowship programme linking universities with circular farms/SMEs	2026-2027	<ul style="list-style-type: none"> • Ministry of agriculture • National Chamber of Agriculture • universities 	HE, LIFE, Erasmus+,
		Launch first cohort of 200 fellows in 3-4 thematic areas (bioenergy, biomaterials, carbon farming, digital)	2027-2028	<ul style="list-style-type: none"> • universities • research institutions in agriculture • farmer groups 	P2 (AKIS/KT), Interreg, HE
		Provide structured placements (6-12 months) with evaluation of skills uptake	2027-2029	<ul style="list-style-type: none"> • Ministry of agriculture • agriculture modernisation units • chambers 	Erasmus+, HE, National Funds
		Expand programme to include international mobility (Erasmus-style) and start-up incubation	2028-2029	<ul style="list-style-type: none"> • Ministry of agriculture • national R&D funding agency • NGOs 	Erasmus+, HEI Alliances, LIFE
		Scale to 2,000 fellows by 2034 with verified employment/start-up outcomes	2029-2034	<ul style="list-style-type: none"> • Ministry of agriculture • Ministry of education • universities • incubators 	HE, Erasmus+, National Funds
84	Eco-scheme for hedgerows & buffer strips with carbon/water co-benefits	Define indicators (SOC, erosion control, biodiversity species counts) and draft eco-scheme contracts	2026-2027	MKGP - Ministry of Agriculture, Forestry and Food: lead, eco-scheme design and indicators	Horizon Europe, LIFE, CAP TA - indicators, MRV protocols
		Pilot result-based contracts in 3-4 regions with high erosion and biodiversity priority	2027-2028	ARSKTRP - Agency for Agricultural Markets and	CAP P2 EIP Operational Groups (IRP31)



		Develop CRCF - compliant templates for hedgerows as carbon removals	2028-2029	Rural Development: paying agency, LPIS integration, payments	CAP P1 - Eco-schemes CAP P2 - AECM interventions CAP P2 AKIS/Knowledge Transfer Erasmus+ Horizon Europe - training and skill certificates
		Roll out scheme nationally with monitoring and audits	2029-2034	Research institutions (e.g., UL Biotechnical Faculty, KIS): indicators, MRV methodology, CRCF templates ARSO - Slovenian Environment Agency: environmental monitoring, water quality, erosion data KGZS - Chamber of Agriculture and Forestry: advisory, farmer training, on-farm planning Farmers, cooperatives	Climate Fund - climate adaptation and mitigation co-benefits
75	Biomethane pilots & digestate circularity (investments + cooperation)	Develop legal/regulatory framework for biomethane (grid injection rules, guarantees of origin, RENenergy regulatory office digestate classification, permitting & QA guidance)	2026-2027 (pre-CAP rollout)	<ul style="list-style-type: none"> • Ministry of agriculture • Ministry of the Environment • energy regulatory office • research institutions in agriculture • agriculture support centre • environment protection public bodies 	HE, LIFE, Innovation Fund
		Launch 2-3 demonstration biomethane pilots from existing large biogas plants	2027-2028	<ul style="list-style-type: none"> • Agriculture modernisation units • Ministry of agriculture 	P2 (Investments), TA CAP, National Funds



		(CAPEX calls + TA support); include digestate QA & nutrient plans		<ul style="list-style-type: none"> • regional governments • pilot operators 	
		Establish short-haul logistics models and farmer/processor cooperation protocols (innovation operational groups under EIP consortia, contracts for feedstock & digestate use)	2027-2029	<ul style="list-style-type: none"> • innovation operational groups under EIP consortia (farmers, municipalities, processors) • farmers advisory bodies • universities, institutes 	EIP-OG (P2), Interreg, HE
		Scale up biomethane capacity with investment grants under Pillar II; embed digestate nutrient planning in CAP advisory/eco-schemes	2028-2030	<ul style="list-style-type: none"> • agriculture modernisation units • Ministry of agriculture • advisory services providers • farmers 	P2 (Investments), ERDF, CF, National Funds
		Monitoring & verification system operational: biomethane metering, digestate application logs, RENenergy regulatory office compliance	2028-2034	<ul style="list-style-type: none"> • Ministry of agriculture • agriculture modernisation units • research institutions in agriculture • operators 	P2 (Monitoring), LIFE, DEP

13. The Future Shape of the EU Common Agricultural Policy (CAP) after 2027

Based on the presentation by the Ministry of Agriculture and Rural Development of Poland (4th Agricultural Science Congress, Puławy 2025) [59]

The upcoming reform of the Common Agricultural Policy (CAP) will take place in a context of significant social, economic and environmental transformation. Entering its seventh decade, the CAP remains guided by its traditional objectives—improving agricultural productivity through technological progress, ensuring a fair standard of living for the farming community, stabilising markets, guaranteeing food security, and providing reasonable consumer prices. However, the policy has gradually evolved from a purely sectoral framework to a broader instrument addressing rural development, product quality, animal welfare, and environmental and climate protection.

Strategic vision for EU agriculture and food systems 2040



The long-term vision for EU agriculture and food systems sets ambitious goals for 2040. It highlights food security and sovereignty, agricultural competitiveness, sustainability, and thriving rural areas as key pillars. The policy will support young and new farmers, reinforce protection against unfair competition, and stabilise agricultural markets. Reducing dependence on imported inputs—particularly fertilisers and plant-based proteins—will be a strategic priority, alongside the development of a coherent livestock strategy and an ambitious investment programme emphasising the role of the CAP as a cornerstone of EU policy. Effective coordination between various policy domains and the introduction of a “rural proofing” mechanism will be essential, backed by adequate funding.

Structural reorganisation of the EU budget 2028-2034

The next Multiannual Financial Framework (MFF 2028-2034) will introduce a new structural architecture. Instead of over 500 regional programmes, National and Regional Partnership Plans (NRPPs) will integrate funding streams related to cohesion, agriculture, fisheries and social policy—tailored to each Member State’s territorial specificities.

A newly established European Competitiveness Fund and the Horizon Europe Programme will remain key engines of innovation, growth and technological leadership, concentrating resources on green transformation, decarbonisation, digitalisation, resilience, health, biotechnology, agriculture, and the bioeconomy.

The total MFF envelope (current prices) is projected at €1 985 billion, of which €783 billion will be channelled through NRPPs, including approximately €747 billion for CAP and cohesion-related measures. Around 43 % of overall EU expenditure will be earmarked for climate and environmental actions—providing strong justification for aligning bioeconomy measures with CAP objectives.

The new CAP architecture

Under the proposed structure, the CAP will move beyond its traditional two-pillar model. Agricultural policy will form a dedicated chapter within each NRPP, combining income support, environmental actions, and rural development under one strategic framework. The list of eligible interventions (worth ≈ €294 billion EU-wide) includes:

- Degressive area-based income support and coupled income support for specific sectors;
- Compensatory payments for less-favoured areas (LFA/ANC);
- Agri-environment-climate measures and farm resilience tools;
- Investment aid for farmers and forest holders;
- Support for young and new farmers, small farms, and women in agriculture;
- Crisis payments in case of natural disasters or adverse climate events.

Measures such as LEADER, knowledge-exchange, cooperation projects, and school schemes will continue but will no longer be ring-fenced—requiring national allocation decisions.

Key policy orientations after 2027

The CAP will increasingly focus on performance-based management and strategic planning, with simplified procedures and broader use of lump-sum payments. Policy orientation will prioritise:

- Directing support towards active farmers who contribute to food security;
- Enforcing mandatory degressivity (from €20 000 per farm) and payment capping (at €100 000 per farm);
- Strengthening farm resilience through comprehensive risk-management strategies and climate-resilient practices;
- Promoting generational renewal, including start-up packages for young farmers and measures facilitating work-life balance;



- Integrating social conditionality and updated Good Agricultural and Environmental Conditions (GAEC) into the new “Farm Stewardship” framework.

Relevance for bioeconomy-related action

The reformed CAP and the new financial architecture will provide a coherent framework for integrating bioeconomy measures at both national and regional levels. The emphasis on green transformation, innovation, and resilience offers strong synergies with the objectives of Interreg Central Europe programmes. Bioeconomy-related interventions—such as circular resource use, biobased value-chain development, carbon farming, and knowledge transfer—fit naturally within CAP’s priorities for competitiveness, sustainability, and rural vitality.

In this context, the Action Plan builds upon the forthcoming CAP reform to propose complementary activities aimed at supporting innovation ecosystems, multi-actor cooperation, and investment in sustainable, biobased solutions contributing to the resilience of Central European agriculture and rural communities.

14. CAP Vision document - insights related to bioeconomy

EU bioeconomy

Bioeconomy concept

There is no uniform definition for the bioeconomy concept, and available definitions illustrate the complexity of the concept, for instance:

“Sustainable & Circular: Bioeconomy the European way. The bioeconomy covers all sectors and systems that rely on biological resources (animals, plants, micro-organisms and derived biomass, including organic waste), their functions and principles. It includes and interlinks: land and marine ecosystems and the services they provide; all primary production sectors that use and produce biological resources (agriculture, forestry, fisheries and aquaculture); and all economic and industrial sectors that use biological resources and processes to produce food, feed, bio-based products, energy and services. To be successful, the European bioeconomy needs to have sustainability and circularity at its heart. This will drive the renewal of our industries, the modernisation of our primary production systems, the protection of the environment and will enhance biodiversity.” [67]

“The bioeconomy is an enabler for implementing green transitions in a sustainable, competitive and just way. Sustainability calls for a holistic view, taking into account biomass scarcity, biodiversity, climate mitigation and de-fossilisation, ecosystem services and the needs of future generations. Competitiveness requires less dependency on third countries, thereby enhancing the strategic autonomy of the EU. The circular economy has a key role in increasing resource efficiency, improving biomass recovery, valorising secondary feedstock, fostering innovation, and creating circular business models and green jobs. The main aim of the sustainable, circular, and competitive bioeconomy is to create more added value using fewer natural resources. The just way needs the involvement of all citizens, urban and rural populations, leaving no-one behind, and providing the required education, re-skilling and up-skilling of the workforce.” [73].

Naturally, there are numerous commonalities between the general bioeconomy concept and the of the Agri-food vision 2040 [see chapter 4].

Bioeconomy policy

The EU proactively deals with the development of the EU bioeconomy by means of numerous bioeconomy-relevant policies and initiatives, dedicated bioeconomy objectives, actions and monitoring.

The **objectives** as defined in the EU bioeconomy strategies 2012 and 2018 [67] are:

- “Objective 1: Ensuring food and nutrition security
- Objective 2: Managing natural resources sustainably
- Objective 3: Reducing dependence on non-renewable unsustainable resources
- Objective 4: Mitigating and adapting to climate change
- Objective 5: Strengthening European competitiveness and creating jobs”



The EU bioeconomy action plan 2018 foresees 14 actions in 3 action clusters [67]:

- “Strengthen and scale-up the bio-based sectors, unlock investments and markets
- Deploy local bioeconomies rapidly across Europe
- Understand the ecological boundaries of the bioeconomy”

An updated EU bioeconomy strategy is expected end of 2025 [63].

Bioeconomy-relevant policies and initiatives are defined and implemented at different **spatial levels**: at the EU, macro-regional (e.g. BIOEAST), national or sub-national level [73]. Out of 33 European countries: 12 countries have a dedicated national bioeconomy strategy (AT, GE, ES, EE, FI, FR, IE, IT, LV, NO, NL, PT); 10 countries have a dedicated national bioeconomy strategy under development (CH, CZ, DK, HR, HU, LI, PL, SE, SK, SI); 9 countries have other policy initiatives dedicated to the bioeconomy; 12 countries have other bioeconomy-related strategies at the national level [72].

The 12 countries with a dedicated bioeconomy strategy have defined a variety of policy actions, and **3 policy actions** were addressed by all of them:

- “Encouraging investments in bioeconomy research, innovation, and market development
- Supporting the principles of cascading use, circularity, and resource efficiency for biomass
- Promoting communication campaigns to raise awareness”. [72]

Monitoring information on the EU and national bioeconomies is made available via the EU Bioeconomy Monitoring System (EU-BMS) for value chain steps, sustainability pillars and primary production sectors [Korosuo et al., 2024] or through datasets and other reports on agricultural biomass (e.g. Eurostat, EC Data and analysis, EC Agri-Food Data Portal, FAOSTAT [70]).

Bioeconomy sectors

A variety of **economic sectors** as well as economic, civil and policy stakeholders are active in the (circular) bioeconomy in the EU and its member states [see e.g. BIOECO-UP A.1.1 national reports, BIOECO-UP D.1.1.1 synthesis report]. The **biomass producing and converting sectors** can be clustered into: agriculture; forestry; fishing and aquaculture; food, beverage and tobacco; bio-based textiles; wood products and furniture; paper; bio-based chemicals, pharmaceuticals, plastics and rubber (excl. biofuels); liquid biofuels; bio-based electricity [71]. **Agriculture and food** are core bioeconomy sectors in the EU, and their primary products and sidestreams are diverse [BIOECO-UP D.3.1.1: Executive summary]. The agri-food sector accounted for 77 % of employment and 63 % of value added in the EU-27’s biomass-producing and converting sectors in 2022 [Table].

Table 32. Employment and value added in biomass-producing and -converting sectors, EU-27, 2022

Economic activities (NACE Rev.2)	People employed		Value added	
	million EUR	%	million EUR	%
Agriculture	8.526.100	49,5	234.552	28,9
Food, beverage and tobacco	4.759.008	27,6	274.033	33,7
Wood products and furniture	1.402.762	8,1	71.716	8,8
Bio-based textiles	697.788	4,1	28.079	3,5
Paper	626.662	3,6	59.881	7,4
Bio-based chemicals, pharmaceuticals, plastics, rubber (excl. biofuels)	502.487	2,9	94.120	11,6
Forestry	476.260	2,8	29.526	3,6
Fishing and aquaculture	158.240	0,9	6.370	0,8
Bio-based electricity	37.544	0,2	8.375	1,0
Liquid biofuels	37.080	0,2	5.415	0,7
Total	17.223.930	100,0	812.067	100,0



Source: Own figure based on Jobs and Wealth in the European Union Bioeconomy, Data-modelling platform of resource economics [EC-JRC, 2025d, accessed 26.08.2025].

EU Common Agricultural Policy

CAP 2023-2027

The Common Agricultural Policy (CAP) provides a policy framework primarily for agriculture and food as well as the rural, but also has an effect on forestry and fisheries. EU countries implement the CAP 2023-2027 through their national CAP strategic plans, which were developed based on 10 key policy objectives of the CAP period 2023-2027. [BIOECO-UP D.3.1.1: chapter 2]

The **10 key policy objectives** of the CAP 2023-2027 are [64]:

- “to ensure a fair income for farmers;
- to increase competitiveness;
- to improve the position of farmers in the food chain;
- climate change action;
- environmental care;
- to preserve landscapes and biodiversity;
- to support generational renewal;
- vibrant rural areas;
- to protect food and health quality;
- fostering knowledge and innovation.“

CAP 2028-2034

According to the EC [62], the CAP 2028-2034 will supposedly be designed to be simpler and more flexible, fairer and more targeted, and facilitate synergies. Examples for components and other aspects foreseen for the CAP 2028-2034 period [66]:

- CAP income support: area-based income support, agro-environmental actions, on-farm investments (e.g. farm modernisation, diversification, uptake of new practices and technologies)
- CAP crisis support for farmers: Unity Safety Net
- National and Regional Partnership Plans: financing LEADER rural projects
- Competitiveness Fund: financing research and innovation in the agricultural sector
- safe and affordable food for consumers
- balanced mix of incentives, investments and obligations
- more flexibility for EU member states, accounting for diversity of farming sector and rural areas
- addressing sector-specific challenges
- a fairer and more targeted support for farmers, particularly young farmers
- a more flexible, results-driven policy, through simplification and tailored targeted support
- support for environmental action, climate action, farm resilience; through incentives, tailoring to local conditions and production systems, risk management, preventative measures, crisis payments, co-financed measures
- revision of the Common Market Organisation provisions (e.g. consumer education and awareness, new marketing standards for certain products, improving preparedness and availability of agricultural supplies during emergencies)

EU Agri-food vision 2040

Overview



The EC’s “vision for agriculture and food - Shaping together an attractive farming and agri-food sector for future generations” (herein-after referred to as “of the Agri-food vision 2040”) is formulated for the period until 2040 [60]. It considers agriculture including fisheries as well as the food sector as **strategic sectors** in the EU and its member states which is underlined by statements such as [60]:

- “European food security, safety and food sovereignty are non-negotiable.”
- “Food is also part of our competitiveness.”
- “Farming and food are essential to sustaining vibrant and economically prosperous communities in rural and coastal areas.”
- “Farmers and fishers [...] are a vital part of the solution to the protection and resilience of our nature, soils, water, air, biodiversity, oceans and climate.”
- “Farmers, fishers and food businesses are innovators and entrepreneurs.”

The Agri-food vision 2040 states that the EU agri-food sector must build on its **strengths** - such as health, safety, quality, sustainability and innovation - in order to support strategic autonomy, food sovereignty, nature protection and decarbonisation [60]. It seeks to pursue an **inclusive working mode** across the EU and global entire agri-food system based on trust and dialogue [60]. It aims to develop **territorial and tailored approaches**, relying on **current and succeeding generations** of farmers, agri-food operators, informed consumers and rural communities as well as on **all levels of governance** from EU to local authorities and international partners [60]. It further seeks to create an **enabling environment** by means of research, innovation, knowledge and skills [60].

The Agri-food vision 2040 aspires **future-oriented and coherent policies** for a central question: “how to build an agri-food system that is economically, socially and environmentally sustainable, and thus attractive, competitive, future-proof and fair for current and future generations?” [60]. Consequently, 4 **objectives** or **priority areas** are defined for the agri-food sector [60]:

- **Attractiveness:** “An attractive and predictable agri-food sector where incomes enable farmers to thrive”; “Making farming a viable and appealing career”
- **Competitiveness:** “An agri-food sector that is competitive and resilient in the face of rising global competition and shocks”
- **Future-proofing:** “A future proof agri-food sector that is functioning within planetary boundaries”; “Embracing innovation and sustainability for long-term resilience”
- **Connection:** “An agri-food sector that values food, fosters fair working and living conditions and vibrant and well-connected rural and coastal areas”.

The Agri-food vision 2040 elaborates its 4 priorities with background information, relevant policies and actors, aspired goals, exemplary measures, etc. Given the nature of a vision document, the indicated measures refer to a superordinate level, allowing for a wide variety of concrete measures which need to be **specified and operationalised in an action plan**. A brief summary by priority is given below.

Attractiveness priority

The attractiveness priority aims at: fair and equitable food chains; fairer and better targeted CAP support; leveraging the opportunities of innovation; building an ambitious investment agenda; fostering entrepreneurship and generational renewal [see table below].

Table 33. “Attractiveness” priority goals and exemplary measures

Attractiveness goals	Exemplary measures
Fair and equitable food chains	increasing market revenues improving transparency



Fairer and better targeted CAP support	balancing regulatory and incentives-based policies prioritising farmers actively producing food or agricultural products which are essential for the EU's strategic autonomy and resilience simplifying income support tools better targeting specific beneficiaries (e.g. farms with natural constraints, young and new farmers, mixed farms)
Leveraging the opportunities of innovation	additional sources of farm income from a climate-neutral, nature-positive economy economically, environmentally and socially sustainable practices (e.g. organic farming; agroecological farming bioeconomy and circular economy carbon farming renewable energy production and delivery digitalisation)
Building an ambitious investment agenda	CAP support for investments promoting a modern, competitive, sustainable and resilient agricultural sector risk insurance schemes for primary producers public-private partnerships for promoting agri-food SMEs and value chains
Fostering entrepreneurship and generational renewal	addressing key barriers (e.g. access to land, investments, skills) developing a generational renewal strategy or national toolboxes (including e.g. retirement schemes, tax incentives)

Source: Own figure based on EC [60].

Competitiveness priority

The competitiveness priority aims at: diversifying supply chains and promoting transformative resilience; a fairer global competition; preparedness and risk-proofing agri-food sector; supporting the resilience of agricultural markets; reducing bureaucratic and regulatory burdens to foster a competitive agri-food sector [see table].

Table 34. "Competitiveness" priority goals and exemplary measures

Competitiveness goals	Exemplary measures
Diversifying supply chains and promoting transformative resilience	diversifying supply chains reducing strategic dependencies (e.g. protein supply, imports of raw materials and fertilisers)
Fairer global competition	Global and bilateral cooperation: export of EU products agri-food economic diplomacy policy partnership dialogues EU framework for a competitive agri-food sector: SME and competitiveness check in policies production standards for imported products - particularly regarding hazardous pesticides and animal welfare protective tools for unfair and unlawful actions export credits policy simplification country of origin labelling
Preparedness and risk-proofing agri-food sector	reviewing and strengthening toolbox for EU risk and crisis management climate-relevant agricultural policies accounting for local, regional and national needs
Supporting the resilience of agricultural markets	long-term vision for a diverse and sustainable EU livestock sector (e.g. excellence livestock production chain).
Reducing bureaucratic and regulatory burdens to foster a competitive agri-food sector	simplification of agricultural frameworks simplification of cross-cutting legislative frameworks

Source: Own figure based on EC [60].

Future-proofing priority

The future-proofing priority aims at decarbonisation combined with competitiveness, incentivising sustainability, farming and nature [see table].



Table 35. “Future-proofing” priority goals and exemplary measures

Future-proofing goals	Exemplary measures
Decarbonisation combined with competitiveness	agricultural activities which remove carbon from the atmosphere into soils and biomass while focusing on competitiveness, food security, bioeconomy effective policies and incentives which reward good practices and tailored approaches (e.g. promoting innovation and bioeconomy as well as healthy, affordable and sustainable food)
Incentivising sustainability	simplifying and streamlining EU requirements (e.g. recording sustainability data only once) developing a voluntary benchmarking system for on-farm sustainability assessments (e.g. bottom-up, participatory, consumer-driven)
Farming and nature	incentives and new market-based tools to promote a better implementation, streamlining and enforcement of existing legislation (e.g. by reducing the use of harmful pesticides, accelerating access to biopesticides, speeding up risk assessment for plant protection products). supporting agricultural practices which recover, maintain or improve soil health (e.g. support for organic farming and integrated approaches installing independent advisory services) addressing water scarcity, use, pollution, other challenges and resilience increasing nutrients circularity, managing nutrients from livestock farming, reducing the use of synthetic fertilisers

Source: Own figure based on EC [60].

Connection priority

The connection priority aims at: fair living and working conditions across rural and coastal areas; reestablishing the link between farming, food, territory, seasonality, cultures and traditions [see figure 5].

Table 36. “Connection” priority goals and exemplary measures

Connection goals	Exemplary measures
Fair living and working conditions across rural and coastal areas	policies addressing preconditions for vital rural areas and attractive employment in the food sector (e.g. making available adequate or better education, quality jobs, career opportunities, mobility, basic health services, connectivity) supporting mental health of farmers contributing to social, economic and territorial cohesion enhancing synergies and complementarities (e.g. coordination of funding) involving civil society and rural communities in policy discussions and implementation addressing disinformation advancing the circular bioeconomy in rural areas advancing the concept of functional rural areas (e.g. availability and affordability of services for rural citizens) providing specific support for outermost regions promoting women’s engagement and equal opportunities in farming discussing good practices
Reestablishing the link between farming, food, territory, seasonality, cultures and traditions	providing consumers access to trustworthy information respecting national/regional competences in health policy, freedom to choose strengthening community-led initiatives to foster dialogue and exchange good practices related to affordability and availability of healthy, high-quality food implementing an annual food dialogue with the food system’s actors (e.g. entire value chain, authorities, civil society) studying the impact of “ultra-processed foods” promoting short food supply chains, local and seasonal consumption, a “best value” approach in public procurement) enhancing consumer awareness promoting uptake of geographical indicators developing business models strengthening every part of the value chain - regarding competitiveness, innovation, resilience and sustainability facilitating SME networking and virtual innovation hubs



studying the impact of certain advertising and marketing practices on consumer health and well-being (e.g. on children)
 inclusively discussing and promoting food innovation, factoring in social, ethical, economic, environmental and cultural aspects
 accounting for new societal expectations (e.g. by revising animal welfare legislation and labelling) reducing food loss and food waste

Source: Own figure based on EC [60].

References to the bioeconomy

Since the agri-food sector produces, processes and consumes biomass, all 4 priorities are directly related to the bioeconomy. The of the Agri-food vision 2040 explicitly mentions the term “bioeconomy” 8 times, i.e. in the context of the priorities “attractiveness”, “future-proofing” and “connection”. Overall, the of the Agri-food vision 2040 takes the position that the (circular) bioeconomy offers notable potentials for agriculture, forestry, the entire food system as well as innovation and rural areas. [see table]

Table 37. Explicit references to the bioeconomy

Priority	Explicit reference to the bioeconomy
Attractiveness: innovation opportunities [EC, 2025a: 8]	“ bioeconomy and circularity offer a great potential for agriculture, forestry and the entire food system, as well as for reducing our critical dependencies. The new Bioeconomy Strategy , to be presented by the end of 2025, will aim at positioning the European Union as a global leader in the rapidly expanding bioeconomy market. We must accelerate the commercialization of bio-based and circular solutions, scale up breakthrough biotechnologies, capture emerging market opportunities and bridge investment gaps. This will be particularly beneficial for the farming community by enabling diversification of value streams, valorisation of farm residues, strengthening the role of primary producers in the value chain and generating new jobs in the rural areas. The Commission will work with international partners, in particular through the Food and Agriculture Organisation (FAO), to together identify sustainable ways of mobilising the potential of the bioeconomy for farmers not only in Europe but also worldwide.”
Future-proofing: decarbonisation and competitiveness [EC, 2025a: 18]	“The Commission expects agriculture to achieve the emissions cuts in alignment with the EU climate target for 2030. Building on this, the Commission will consider pathways for the contribution of the agricultural sector to the EU’s 2040 climate target, taking into account the specificities of the sector and focusing on its competitiveness, the need to ensure food security and to strengthen the bioeconomy , and in dialogue with the sector and the Member States. This approach will be reflected in the review of the relevant legislation regulating GHG emissions and removals from the agriculture and the Land Use, Land Use Change and Forestry sectors. [...] Clear policies and incentives should be put in place to realise the innovation potential in the food system and the bioeconomy at large and to deliver healthy, affordable and sustainable food to EU citizens.”
Connection: fair living and working conditions [EC, 2025a: 21]	Furthermore, circular economy contains significant potential for the economy of rural areas, in particular through the bioeconomy . In the long-term Vision for rural areas, the Commission estimated that the further development of the bioeconomy will lead to the creation of 400,000 new highly skilled jobs by 2035 and up to 700,000 by 2050, mostly in rural areas.

Source: Own figure based on [60].

Reflections on the agri-food sector and circular bioeconomy

Agri-food vision 2040 and circular bioeconomy

Based on selected documents - i.a. the EU bioeconomy strategy 2018 [EC-DGRI, 2018], the EU of the Agri-food vision 2040 [EC, 2025a] and the policy assessment of circular bioeconomy measures [BIOECO-UP D.3.1.1] - the authors of this report exemplify in a brainstorming exercise some key aspects and commonalities of the of the Agri-food vision 2040 and the circular bioeconomy in general:



- The agri-food sector is a core sector in the (circular) bioeconomy.
- A notable part of the of the Agri-food vision 2040, the CAP, the circular bioeconomy, as well as the agri-food sector identifies with or aspires core elements or ambitions such as:
 - transition to sustainable systems (e.g. ecological, social, economic sustainability)
 - future orientation (e.g. succession)
 - use of research and innovation (e.g. technology, society, finance)
 - diversification of activities and sources of income (e.g. food, energy, services)
 - inclusion of smaller-scale entities (e.g. small-scale farms, SMEs, start-ups, lateral entrants)
 - participatory approaches including multiple actors (e.g. production, processing, trade, consumption, policy, science, civil society)
 - cooperation (e.g. along value chain, across sectors, across borders)
 - activities in rural areas
 - targeted and tailored approaches
- At the same time, the the agri-food sector as a part of the (circular) bioeconomy is confronted with certain challenges and limitations:
 - limited availability of land and resources in the required quantity and quality (e.g. materials, knowledge, skills, finance, infrastructure)
 - substantial resources required for the transition to a new system (e.g. finance, actions, time, skills, innovation, cooperation, materials)
 - changes to legal and institutional infrastructure required for the aspired transition
 - complex systems with a diversity of actors and often conflicting interests and priorities
 - long-term orientation, difficult to communicate concepts (e.g. bioeconomy concept, CAP logic) and lacking immediate visibility of interrelationships and effects (e.g. present actions and their effects in the future, own actions and their effects on overall society)
 - uncertainty (e.g. crises, shocks) and the need to make decisions based on incomplete information, resulting in risk and learning processes

Agri-food vision 2040, CAP 2028-2034 and circular bioeconomy

The Agri-food vision 2040 takes a long-term perspective beyond a single CAP period, it provides strategic considerations for the CAP 2028-2034 and it also references policies other than the CAP. Since the agri-food sector produces and processes biomass, all priority goals of the Agri-food vision 2040 are bioeconomy-relevant.

At the BIOECO-UP A.3.1 policy workshop, experts discussed the bioeconomy in the context of the future CAP. Some key findings were: In the EU countries, the bioeconomy is developed to different stages, and CAP funding is already used for advancing the bioeconomy and implementing bioeconomy measures. Since EU countries have integrated markets, it makes sense to coordinate activities and policies. More actors should be involved in value chain (beyond primary production) for adding value. Cooperation is important (e.g. along the value chain, across sectors, across countries; e.g. for sharing best practices, exchanging knowledge). Ideally, policies and institutional framework are coordinated and based on national needs and potentials (e.g. what producers can contribute). Developing bioeconomy policy is more sustainable if key positions in the managing authority remain the same over a longer period of time. There is a need for coordinating and integrating experience and knowledge at the policy-making level (e.g. through involvement of practitioners, businesses, researchers, education). There is also a need for developing coordination mechanisms and capacities for the bioeconomy (e.g. value chains, sectors, transnational action).

Compilation of bioeconomy measures and topics in different policy frameworks



The policy frameworks presented in this report have numerous thematic intersections and propose a wealth of measures. Bioeconomy measures and topics may take different foci, e.g.: topics which are addressed in all policy frameworks, measures which could be implemented in the short run, cost-efficient measures, measures with sustainability gains, measures for a specific sector or value chain segment etc. According to different sources in the (circular) bioeconomy discussion, there is a preference or need for flexibility in the bioeconomy strategy and action plan as different countries have different endowments, strengths and agendas [e.g.60 A.3.4 round table AT].

Table 38. Compilation of bioeconomy measures and topics in different policy frameworks

[EC, 2025a]	EU Agri-food vision 2040
Priorities	Priority goals
Attractiveness	<ul style="list-style-type: none"> ▪ Fair and equitable food chains ▪ Fairer and better targeted CAP support ▪ Leveraging the opportunities of innovation ▪ Building an ambitious investment agenda ▪ Fostering entrepreneurship and generational renewal
Competitiveness	<ul style="list-style-type: none"> ▪ Diversifying supply chains and promoting transformative resilience ▪ Fairer global competition ▪ Preparedness and risk-proofing agri-food sector ▪ Supporting the resilience of agricultural markets <p>Reducing bureaucratic and regulatory burdens to foster a competitive agri-food sector</p>
Future-proofing	<ul style="list-style-type: none"> ▪ Decarbonisation combined with competitiveness ▪ Incentivising sustainability <p>Farming and nature</p>
Connection	<ul style="list-style-type: none"> ▪ Fair living and working conditions across rural and coastal areas ▪ Reestablishing the link between farming, food, territory, seasonality, cultures and traditions
[EC, 2018]	EU Bioeconomy strategy 2018
	Objectives
	<ul style="list-style-type: none"> ▪ Objective 1: Ensuring food and nutrition security ▪ Objective 2: Managing natural resources sustainably ▪ Objective 3: Reducing dependence on non-renewable unsustainable resources ▪ Objective 4: Mitigating and adapting to climate change ▪ Objective 5: Strengthening European competitiveness and creating jobs
[EC, 2018]	EU Bioeconomy action plan 2018
Action cluster	Actions
1 Strengthen and scale-up the bio-based sectors, unlock investments and markets	<ul style="list-style-type: none"> ▪ 1.1 Mobilise public and private stakeholders, in research, demonstration and deployment of sustainable, inclusive and circular bio-based solutions ▪ 1.2 Launch of the EUR 100 million Circular Bioeconomy Thematic Investment Platform ▪ 1.3 Study of enablers and bottlenecks and provide voluntary guidance to the deployment of bio-based innovations ▪ 1.4 Promote and/or develop standards and emerging market-based incentives, and improve labels applicable to bio-based products on the basis of reliable and comparable data on environmental and climate performance ▪ 1.5 Facilitate the development of new sustainable biorefineries and confirm the type and estimated potential ▪ 1.6 Research and innovation investments for the development of substitutes to fossil based materials that are bio-based, recyclable and marine-biodegradable, and of bio-remediation methods by mobilising the key actors in the relevant value chains including the plastics value chain and to contribute to plastic-free, healthy and productive European seas and oceans
2 Deploy local bioeconomies	<ul style="list-style-type: none"> ▪ 2.1 A Strategic Deployment Agenda for sustainable food and farming systems, forestry and bio-based production in a circular bioeconomy



rapidly across Europe	<ul style="list-style-type: none"> ■ 2.2 Pilot actions to support local bioeconomy development (rural, coastal, urban) via Commission instruments and programmes ■ 2.3 Set up an EU Bioeconomy policy support facility and a European Bioeconomy Forum for Member States ■ 2.4 Promote education, training and skills across the bioeconomy States
3 Understand the ecological boundaries of the bioeconomy	<ul style="list-style-type: none"> ■ 3.1 Enhance the knowledge on the bioeconomy, including on biodiversity and ecosystems, to deploy it within safe ecological limits and make it accessible through the Knowledge Centre for Bioeconomy ■ 3.2 Increase observation, measurement, monitoring and reporting capabilities and build an EU-wide, internationally coherent monitoring system to track economic, environmental and social progress towards a sustainable bioeconomy ■ 3.3 Provide voluntary guidance to operate the bioeconomy within safe ecological limits ■ 3.4 Better integrate the benefits of biodiversity-rich ecosystems in primary production through a specific support to agro-ecology, the development of microbiome-based solutions, and new tools to integrate pollinators in supply value chains
[EC-KCB, 2025: 4]	EU member states national bioeconomy strategies
Policy actions	<ul style="list-style-type: none"> ■ Embed the bioeconomy into new legislative frameworks ■ Revisit existing regulatory frameworks to include bioeconomy concepts/priorities ■ Promote the establishment of intra-governmental groups to support policy coherence or collaboration amongst different bioeconomy stakeholders ■ Promote labels and standards for bio-based products ■ Promote public procurement of bio-based products ■ Enhance land management for new production systems and ecosystem functions ■ Promote specific bioeconomy sectors ■ Promote the principles of "cascading use", "circularity" and "resource efficiency" for biomass ■ Enhance the knowledge on bioeconomy by setting-up knowledge hubs, observatories, information systems, web portals, conferences, etc. ■ Implement specific studies (feasibility, impact assessments, land use, territorial development analyses, market analyses, foresight studies etc). ■ Develop monitoring systems for the bioeconomy ■ Promote communication campaigns for awareness raising (e.g. bioeconomy awards, information systems, events, etc.) ■ Promote educational/training programmes ■ Promote investments in bioeconomy research, innovation, market development ■ Market incentives for bio-based production/consumption (e.g. subsidies, taxes)
[EC, 2025e]	CAP 2023-2027
	Key policy objectives
	<ul style="list-style-type: none"> ■ to ensure a fair income for farmers; ■ to increase competitiveness; ■ to improve the position of farmers in the food chain; ■ climate change action; ■ environmental care; ■ to preserve landscapes and biodiversity; ■ to support generational renewal; ■ vibrant rural areas; ■ to protect food and health quality; ■ fostering knowledge and innovation.
	CAP 2028-2034
[EC-DGAgri, 2025b]	components and other aspects foreseen for the CAP 2028-2034 period
	<ul style="list-style-type: none"> ■ CAP income support: area-based income support, agro-environmental actions, on-farm investments (e.g. farm modernisation, diversification, uptake of new practices and technologies) ■ CAP crisis support for farmers: Unity Safety Net ■ National and Regional Partnership Plans: financing LEADER rural projects ■ Competitiveness Fund: financing research and innovation in the agricultural sector ■ safe and affordable food for consumers ■ balanced mix of incentives, investments and obligations



- more flexibility for EU member states, accounting for diversity of farming sector and rural areas
- addressing sector-specific challenges
- a fairer and more targeted support for farmers, particularly young farmers
- a more flexible, results-driven policy, through simplification and tailored targeted support
- support for environmental action, climate action, farm resilience; through incentives, tailoring to local conditions and production systems, risk management, preventative measures, crisis payments, co-financed measures
- revision of the Common Market Organisation provisions (e.g. consumer education and awareness, new marketing standards for certain products, improving preparedness and availability of agricultural supplies during emergencies)

Source: Own figure based on [60], [67], [72], [64], [66].

15. How to approach BIOEAST members with the bioeconomy action plan?

The successful uptake of the Central European Bioeconomy Action Plan among BIOEAST member states requires a coordinated, inclusive, and evidence-based approach that builds trust, creates ownership, and aligns national priorities with the transnational strategic framework. The aim is not only to disseminate project outcomes but to co-produce policy learning and stimulate national adaptation of proposed measures within the Common Agricultural Policy (CAP) and related strategic documents.

The following approach outlines how to effectively engage Croatia, Czech Republic, Hungary, Poland, Slovakia, and Slovenia, ensuring that the Action Plan translates from a project deliverable into a living policy reference supporting future CAP programming (2028-2034) and broader bioeconomy governance in the BIOEAST macro-region.

1. Policy alignment and ministerial dialogue

High-level coordination: Initiate bilateral meetings with ministries of agriculture and research bodies participating in BIOEAST to present the Action Plan's strategic rationale, evidence base, and relevance to the EU's "Vision for the Future of the CAP (2028-2034)" and national Bioeconomy Strategies.

Integration pathways: Tailor national briefing notes summarising how the proposed measures can be embedded into each country's CAP Strategic Plan revision or other policy instruments (e.g., RDPs, innovation programmes, or green finance mechanisms).

Link to BIOEAST governance: Present the Action Plan to the BIOEAST Board and Thematic Working Groups, ensuring institutional recognition and formal endorsement within the macro-regional framework.

2. Transnational policy learning and peer exchange

BIOEAST Policy Roundtable: Organise a transnational seminar involving senior officials and experts from all six partner countries to discuss lessons learned, implementation barriers, and potential pilot actions for the post-2027 period.

Peer-learning clusters: Group countries by similar challenges (e.g., innovation ecosystems, advisory services, or biogas infrastructure) to facilitate targeted exchanges and mutual learning.

Joint foresight exercises: Engage BIOEAST's Policy Support Facility to conduct foresight sessions that translate Action Plan priorities into long-term policy roadmaps consistent with EU climate, digital, and rural development targets.



3. Knowledge brokerage through AKIS and BIOEAST Hubs

National AKIS coordination: Leverage existing AKIS coordination units and CAP networks to translate the Action Plan's thematic measures into operational guidelines for advisory systems, EIP-AGRI groups, and living labs.

BIOEAST Hubs as multipliers: Use national BIOEAST HUBs (e.g., in Poland, Hungary, Slovenia) as outreach platforms to disseminate the Action Plan's tools and inspire cross-sector engagement between farmers, researchers, and policymakers.

Innovation brokerage: Support national contact points in creating innovation brokerage sessions linking SMEs and research actors to funding opportunities aligned with Action Plan priorities (Horizon Europe, CBE-JU, LIFE, ERDF).

4. Targeted communication and capacity building

Policy brief series: Develop concise, country-tailored policy briefs (4-6 pages each) summarising how the Action Plan supports national goals, illustrated by relevant measures and pilot examples.

Learning webinars: Host thematic webinars in cooperation with BIOEAST's Thematic Working Groups on Education, Food Systems, and Bio-based Materials, focusing on actionable recommendations from the Action Plan.

Visual tools: Prepare infographics, storytelling videos, and short explanatory materials for CAP planners, advisory organisations, and ministries to ensure accessibility of complex information.

5. Pilot implementation and feedback loops

Policy sandbox pilots: Encourage BIOEAST members to select 1-2 measures from the Action Plan for piloting under CAP eco-schemes, cooperation measures, or innovation calls.

Monitoring and evaluation: Establish a feedback loop where pilot results are reported to the BIOEAST Board and used to refine the Action Plan's measures and indicators.

Continuous learning: Promote a culture of "learning by doing" through iterative updates of the Action Plan every two years, ensuring it remains aligned with emerging EU priorities and scientific knowledge.

6. Strategic positioning and long-term impact

EU-level advocacy: Present the Action Plan as a regional contribution to the European Bioeconomy Strategy and CAP post-2027 design, positioning the BIOEAST region as a collective voice in EU policymaking.

Inter-ministerial cooperation: Foster linkages between agriculture, environment, energy, and innovation ministries to ensure coherent implementation across policy domains.

Sustainability of outcomes: Institutionalise the Action Plan within BIOEAST governance structures (e.g., via a standing Bioeconomy Policy Forum) to secure long-term ownership and policy continuity beyond project duration.

In practice, approaching BIOEAST members with the Bioeconomy Action Plan requires a combination of policy diplomacy, knowledge brokerage, and practical implementation tools.

By engaging ministries, BIOEAST hubs, and CAP networks through structured dialogue, tailored materials, and pilot testing, the project ensures that the Action Plan is not merely communicated – but embedded, adapted, and owned by the Member States.

This collaborative process strengthens BIOEAST's role as a macro-regional policy accelerator, advancing circular bioeconomy integration within the CAP and contributing to the EU's broader Green Deal and climate neutrality/adaptation goals.



REFERENCES

1. European Commission - Joint Research Centre (JRC). (2024). Trends in the EU bioeconomy - update 2024. Luxembourg: Publications Office of the European Union. <https://publications.jrc.ec.europa.eu/repository/handle/JRC140285>
2. JRC. (2023). EU Bioeconomy Monitoring System indicators update. Luxembourg: Publications Office of the European Union. <https://ideas.repec.org/p/ipt/iptwpa/jrc133484.html>
3. European Environment Agency (EEA). (2018). EEA Report No 8/2018: The circular economy and the bioeconomy – Partners in sustainability. Luxembourg: Publications Office of the European Union. <https://task42.ieabioenergy.com/publications/eea-report-no-8-2018-the-circular-economy-and-the-bioeconomy-partners-in-sustainability>
4. European Environment Agency (EEA). (2022). The benefits to biodiversity of a strong circular economy. Luxembourg: Publications Office of the European Union. <https://www.eea.europa.eu/publications/the-benefits-to-biodiversity>
5. EEA. (n.d.). Europe's circular economy in facts and figures. Copenhagen: European Environment Agency. <https://www.eea.europa.eu/en/analysis/publications/europes-circular-economy-in-facts>
6. Grime, M., Write G., (2016), Delphi Method, „Wiley StatsRef: Statistics Reference Online”, https://www.researchgate.net/publication/305909817_Delphi_Method [dostęp: 15.07.2021].
7. Devaney, Liam. 2018. “Who Is a Delphi ‘Expert’? Reflections on a Bioeconomy Delphi Study.” *Technological Forecasting and Social Change* 133: 155-64. <https://doi.org/10.1016/j.techfore.2017.10.018>
8. European Commission. 2012. A European Strategy for Key Enabling Technologies - A Bridge to Growth and Jobs. Brussels.
9. Waßenhoven, Anna, Michael Rennings, Natalie Laibach, and Stefanie Bröring. 2023. “What Constitutes a ‘Key Enabling Technology’ for Transition Processes: Insights from the Bioeconomy’s Technological Landscape.” *Technological Forecasting and Social Change* 197: 122873. <https://doi.org/10.1016/j.techfore.2023.122873>
10. Laibach, Natalie, Jan Börner, and Stefanie Bröring. 2019. “Exploring the Future of the Bioeconomy: An Expert-Based Scoping Study Examining Key Enabling Technology Fields with Potential to Foster the Transition Toward a Bio-Based Economy.” *Technology in Society* 58: 101118.
11. Kulišić, Biljana, Mauro Capaccioni, and others. 2020. “Bioeconomy Development in Central and Eastern Europe: The Role of Research and Innovation for Policy Alignment.” In *Proceedings of the BIOEASTsUP Workshop on Bioeconomy Policy Integration*, Budapest: BIOEAST Initiative and FAO.
12. Niang, Amadou, André Torre, and Sébastien Bourdin. 2022. “Territorial Governance and Actors’ Coordination in a Local Project of Anaerobic Digestion: A Social Network Analysis.” *European Planning Studies* 30 (7): 1251-1270. <https://doi.org/10.1080/09654313.2021.1891208>
13. Furmankiewicz, Marek, Áine Macken-Walsh, and Joanna Stefańska. 2014. “Territorial Governance, Networks and Power: Cross-Sectoral Partnerships in Rural Poland.” *Geografiska Annaler: Series B, Human Geography* 96 (4): 345-361. <https://doi.org/10.1111/geob.12056>
14. Harrahill, Kieran, Áine Macken-Walsh, and Eoin O’Neill. 2023. “Identifying Primary Producers’ Positioning in the Irish Bioeconomy Using Social Network Analysis.” *Cleaner and Circular Bioeconomy* 5:100042. <https://doi.org/10.1016/j.ccbe.2023.100042>
15. Bergek, Anna, Staffan Jacobsson, Bo Carlsson, Sven Lindmark, and Annika Rickne. 2008. “Analyzing the functional dynamics of technological innovation systems: A scheme of analysis.” *Research Policy* 37 (3): 407-429.



16. Imbert, Enrica, Luana Ladu, Piergiuseppe Morone, and Rainer Quitzow. 2017. "Policy Strategies for a Transition to a Bioeconomy in Europe: The Case of Italy and Germany." MPRA Paper 78143. Munich: University Library of Munich.
17. Brunnhofer, Magdalena, Natasha Gabriella, Josef-Peter Schögl, Tobias Stern, and Alfred Posch. 2020. "The Biorefinery Transition in the European Pulp and Paper Industry: A Three-Phase Delphi Study Including a SWOT-AHP Analysis." *Forest Policy and Economics* 110: 101882. <https://doi.org/10.1016/j.forpol.2019.02.006>
18. Siegfried K., Blümel L., Riedel F., Moosmann D., Cyffka K.-F., Richters M., Reumerman P., Vos J., Matisons M., Thrän D. Plating the hot potato: how to make intermediate bioenergy carriers an accelerator to a climate-neutral Europe (2023) *Energy, Sustainability and Society*, 13 (1), art. no. 37
19. Rozakis, Stelios, Katerina Troullaki, and Piotr Jurga. 2023. "Theory and Practice in Strategic Niche Planning: The Polish Biogas Case." In *Biogas Plants: Waste Management, Energy Production and Carbon Footprint Reduction*, 243-278. Hoboken, NJ: Wiley.
20. European Commission. Eco-schemes. European Union, accessed October 31 2025. https://agriculture.ec.europa.eu/common-agricultural-policy/income-support/eco-schemes_en
21. Midler, E., Hobeika, M., Riedel, A., & Pagnon, J. 2022. *Environment and Climate Assessment of Poland's CAP Strategic Plan*. London: Institute for European Environmental Policy; Berlin: Ecologic Institute.
22. EBA position paper https://www.europeanbiogas.eu/wp-content/uploads/2025/10/20250623_EBA-Position-Paper_Circular-bioeconomy.pdf
23. RES4LIVE Project. 2024. Policy Brief No. 1: Policy Recommendations for the Common Agricultural Policy (CAP). Horizon 2020 Research & Innovation Programme, Grant Agreement No. 101000785. https://res4live.eu/wp-content/uploads/2024/09/Policy-Brief-1_RES4LIVE-PDF.pdf
24. European Commission. 2024. At a Glance: Slovenia's CAP Strategic Plan. Brussels: Directorate-General for Agriculture and Rural Development. https://agriculture.ec.europa.eu/system/files/2024-01/csp-at-a-glance-slovenia_en.pdf
25. European Innovation Partnership for Agricultural Productivity and Sustainability (EIP-AGRI). *Agricultural Knowledge and Innovation Systems: Boosting Innovation and Knowledge Flows Across Europe*. Brussels: European Commission, 2022. https://ec.europa.eu/eip/agriculture/sites/default/files/eip-agri_agricultural_knowledge_and_innovation_systems_akis_2021_en_web.pdf
26. Standing Committee on Agricultural Research (SCAR). *Agricultural Knowledge and Innovation Systems Towards 2020: An Orientation Paper*. Brussels: European Commission, 2014. <https://op.europa.eu/en/publication-detail/-/publication/41e77b27-5202-42af-9a0e-d70447b3bc1b>
27. European Commission. *Building Stronger Agricultural Knowledge and Innovation Systems(AKIS) to Foster advice, knowledge and innovation in agriculture and rural areas*. Brussels: European Commission, 2019. https://agriculture.ec.europa.eu/system/files/2019-04/building-stronger-akis_en_0.pdf
28. EU CAP Network. "AKIS - Agricultural Knowledge and Innovation Systems." Accessed October 22, 2025. https://eu-cap-network.ec.europa.eu/support/innovation-knowledge-exchange-eip-agri/akis_en
29. SEFARI Gateway. "What Can We Learn from AKIS Policies in Europe?" 2023. Accessed October 22, 2025. <https://sefari.scot>.
30. Organisation for Economic Co-operation and Development (OECD). "Agricultural Productivity and Innovation." Accessed October 22, 2025. <https://www.oecd.org/en/topics/policy-issues/agricultural-productivity-and-innovation.html>



31. Food and Agriculture Organization of the United Nations (FAO). Assessing Agricultural Innovation Systems for Action at Country Level. Rome: FAO, 2021. <https://openknowledge.fao.org/items/bb80757a-15ab-45a2-81c4-81c556cea3cc>
32. European Commission. Digitalisation - Agriculture and Rural Development. https://agriculture.ec.europa.eu/overview-vision-agriculture-food/digitalisation_en
33. OECD. Innovation and Digital in Agriculture. <https://www.oecd.org/en/topics/sub-issues/innovation-and-digital-in-agriculture.html>
34. European Commission. Bioeconomy: Research and Innovation on the Bioeconomy. https://research-and-innovation.ec.europa.eu/research-area/environment/bioeconomy_en
35. Giotis, T. Digital Farming in Europe: Costs, Benefits, and Big Questions Ahead. Horizon CODECS (2025). <https://www.horizoncodecs.eu/digital-farming-in-europe-costs-benefits-and-big-questions-ahead>
36. FAO. Meeting the European Union's Digital Agriculture Requirements. <https://openknowledge.fao.org/items/955b91dc-6a70-4e1c-b43a-bd7471b9f359>
37. BEAMING Project Consortium. Report on Institutional Practices in Bioeconomy Research. (2025). <https://beamingproject.eu/wp-content/uploads/2025/04/D5.2-Report-Institutional-Practices-Bioeconomy-Research-compressed-1.pdf>
38. European Commission. Sustainability - Agriculture and Rural Development. Brussels: European Commission. https://agriculture.ec.europa.eu/cap-my-country/sustainability_en
39. European Commission. Climate Change - Agriculture. Brussels: European Commission. https://agriculture.ec.europa.eu/cap-my-country/sustainability/environmental-sustainability/climate-change_en
40. European Commission. Sustainable Agriculture - Agriculture and Rural Areas. Brussels: European Commission. https://commission.europa.eu/food-farming-fisheries/sustainable-agriculture_en
41. Ecologic Institute. 2024. EU 2040 Climate Target: Contributions of the Agriculture Sector. Berlin: Ecologic Institute. <https://www.ecologic.eu/sites/default/files/project/2024/60028-EU2040-Sector-Paper-agriculture.pdf>
42. European Commission. 2025. Bioeconomy Strategy. Brussels: European Commission. https://environment.ec.europa.eu/strategy/bioeconomy-strategy_en
43. European Environment Agency. Agriculture - Sector Policies Adaptation to Climate Change. Copenhagen: EEA. <https://climate-adapt.eea.europa.eu/en/eu-adaptation-policy/sector-policies/agriculture>
44. Cardwell, M., et al. 2023. "Results-Based Agri-Environmental Scheme Design: Legal and Economic Features." Land Use Policy 141: 107120. <https://doi.org/10.1016/j.landusepol.2024.107120>
45. European Commission. Sustainable, Circular and Innovative Value Chains (Agri-Research Factsheet). Brussels: European Commission. https://agriculture.ec.europa.eu/system/files/2023-05/factsheet-agriresearch-sustainable-circular-innovative-value-chains_en.pdf
46. European Commission. 2025. Vision for Agriculture and Food - Shaping the Future of Farming and the Agri-Food Sector. Brussels: European Commission. https://agriculture.ec.europa.eu/overview-vision-agriculture-food/vision-agriculture-and-food_en
47. Food and Agriculture Organization of the United Nations (FAO). EU Forest Governance and Value Chains Programme. Rome: FAO. <https://www.fao.org/in-action/legal-sustainable-wood-assurance-programme/forest-governance-value-chains/en/>



48. UNEP-WCMC (United Nations Environment Programme - World Conservation Monitoring Centre). 2025. TRADE Hub Advanced Sustainable Agricultural Commodity Supply Chains Across the EU and Beyond. Cambridge: UNEP-WCMC. <https://www.unep-wcmc.org/en/news/trade-hub-advanced-sustainable-agricultural-commodity-supply-chains-across-the-eu-and-beyond>
49. European Commission. 2025. Bioeconomy & Circular Economy - Rural Pact. Brussels: European Commission. https://ruralpact.rural-vision.europa.eu/topics/bioeconomy-circular-economy_en
50. BioRural. 2025. "Empowering the Rural Bioeconomy with Innovative Circular Solutions." CORDIS. <https://cordis.europa.eu/article/id/460085-empowering-the-rural-bioeconomy-with-innovative-circular-solutions>
51. SCALE-UP. 2025. Concepts, Tools and Applications for Community-Driven Bioeconomy Development in European Rural Areas. <https://www.scaleup-bioeconomy.eu/en/home/>
52. Bioregions Network. 2025. "How can European Regions Help Develop the Bioeconomy?" <https://bioregions.efi.int/european-regions-help-develop-the-bioeconomy/>
53. Jurga, P., Loizou, E., & Rozakis, S. 2021. "Comparing Bioeconomy Potential at National vs. Regional Level Employing Input-Output Modeling." *Energies* 14 (6): 1714. <https://doi.org/10.3390/en14061714>
54. European Commission. 2019. Building Stronger Agricultural Knowledge and Innovation Systems (AKIS) to Foster Advice, Knowledge and Innovation in Agriculture and Rural Areas. Brussels: European Commission. https://agriculture.ec.europa.eu/system/files/2019-04/building-stronger-akis_en_0.pdf
55. EU CAP Network. 2024. Skills and Lifelong Learning for Agricultural Advisory and Knowledge Exchange. Brussels: EU CAP Network. <https://eu-cap-network.ec.europa.eu/sites/default/files/publications/2024-09/eu-cap-network-event-report-seminar-on-skills.pdf>
56. European Commission. 2022. Promoting Education, Training and Skills Across the Bioeconomy. Luxembourg: Publications Office of the European Union. <https://biobec.eu/wp-content/uploads/2022/10/promoting-education-training-skills-in-the-bioeconomy.pdf>
57. Trienekens, Jacques, Francesca Sanna, Patrizia Busato, and Remigio Berruto. 2022. "A European Skills Strategy for the Agri-Food and Forestry Sectors - Key Challenges and Prerequisites." *International Journal on Food System Dynamics* 13 (4): 395-410. <https://doi.org/10.18461/ijfsd.v13i4.D2>
58. EU CAP Network. 2024. Good Practices in Nurturing Agricultural Skills. Brussels: EU CAP Network. <https://eu-cap-network.ec.europa.eu/sites/default/files/publications/2024-04/eu-cap-network-report-good-practices-in-nurturing-agricultural-skills.pdf>
59. Ministry of Agriculture and Rural Development of Poland. 2025. Presentation at the 4th Agricultural Science Congress, Puławy, Poland. (w pliku jest że jest to pozycja 55)
60. EC - European Commission (2025a): A Vision for Agriculture and Food - Shaping together an attractive farming and agri-food sector for future generations. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. COM(2025) 75 final. Brussels, 19.05.2025. URL: eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52025DC0075 (01.07.2025).
61. EC - European Commission (2025b): A Vision for Agriculture and Food - Shaping together an attractive farming and agri-food sector for future generations. Factsheet. February 2025. URL: agriculture.ec.europa.eu/document/download/16558b9e-afed-4596-bf7c-16359d9979c7_en?filename=factsheet-vision-agriculture-food_en.pdf (accessed 01.07.2025).
62. EC - European Commission (2025c): Europe's Budget - For a resilient, competitive and sustainable EU agriculture. July 2025. Luxembourg: Publications Office of the European Union. URL:



- commission.europa.eu/document/download/ad322c15-f867-4989-b39b-697607fb7b10_en?filename=MFF_Factsheet-Agri-16-07-2025_0.pdf (accessed 21.10.2025).
63. EC - European Commission (2025d): Factual summary report on the public consultation for the new Bioeconomy Strategy. Ref. Ares(2025)6923844 - 27/08/2025. URL: ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/14555-Towards-a-Circular-Regenerative-and-Competitive-Bioeconomy/public-consultation_en (accessed 21.10.2025).
64. EC - European Commission (2025e): Key policy objectives of the CAP 2023-27. Website. URL: agriculture.ec.europa.eu/common-agricultural-policy/cap-overview/cap-glance/key-policy-objectives-cap-2023-27_en (accessed 21.10.2025).
65. EC-DGAgri - European Commission, Directorate-General for Agriculture and Rural Development (2025a): Catalogue of CAP interventions. URL: agridata.ec.europa.eu/extensions/DashboardCapPlan/catalogue_interventions.html (accessed 21.10.2025).
66. EC-DGAgri - European Commission, Directorate-General for Agriculture and Rural Development (2025b): The next chapter for the CAP. News article dated 17.07.2025. URL: https://agriculture.ec.europa.eu/media/news/next-chapter-cap-2025-07-17_en (accessed 21.10.2025).
67. EC-DGRI - European Commission, Directorate-General for Research and Innovation, Unit F Bioeconomy (2018): A sustainable bioeconomy for Europe: strengthening the connection between economy, society and the environment. Updated Bioeconomy Strategy. Manuscript completed in October 2018. Luxembourg: Publications Office of the European Union. DOI:10.2777/792130. URL: data.europa.eu/doi/10.2777/792130.
68. EC-JRC - European Commission, Joint Research Centre, Knowledge4Policy (2025a): Data on agricultural biomass. Data set as of 01.04.2025. URL: knowledge4policy.ec.europa.eu/dataset/k4p-dataset-78556_en (accessed 07.07.2025).
69. EC-JRC - European Commission, Joint Research Centre, Knowledge4Policy (2025b): EU Bioeconomy Monitoring System dashboards. Visualisation last updated 21.03.2025. URL: knowledge4policy.ec.europa.eu/visualisation/eu-bioeconomy-monitoring-system-dashboards_en (accessed 07.07.2025).
70. EC-JRC - European Commission, Joint Research Centre (2025c): EU Biomass supply, uses, governance and regenerative actions. Luxembourg: Publications Office of the European Union. DOI:10.2760/6511190. URL: publications.jrc.ec.europa.eu/repository/handle/JRC140117 (03.07.2025).
71. EC-JRC - European Commission, Joint Research Centre (2025d): Jobs and Wealth in the European Union Bioeconomy (Biomass producing and converting sectors). Data-modelling platform of resource economics. URL: datam.jrc.ec.europa.eu/datam/mashup/BIOECONOMICS/, accessed 26.08.2025.
72. EC-KCB - European Commission, Knowledge Centre for Bioeconomy (2025): National bioeconomy strategies in Europe. State of play in January 2025, Bioeconomy country dashboard, European Commission's Knowledge Centre for Bioeconomy. URL: knowledge4policy.ec.europa.eu/sites/default/files/factsheet_national_BE_strategies_25072025.pdf (accessed 28.08.2025).
73. Korosuo, A.; Borzacchiello, M.T.; Giuntoli, J.; Lasarte Lopez, J.; M'barek, R.; Mubareka, S.B.; Camia, A. (2024): Trends in the EU bioeconomy - update 2024. European Commission, Joint Research Centre. Luxembourg: Publications Office of the European Union. DOI: 10.2760/0141556. URL: publications.jrc.ec.europa.eu/repository/handle/JRC140285 (accessed 03.07.2025).



74. Arnič, D., Loizou, E., Ščap, Š., Prislan, P., & Juvančič, L. (2024). Evaluating alternative transformation pathways of wood-based bioeconomy: application of an input-output model. *Forests*, 15(12) article 2084, 1-20.
75. Arnič, D., Prislan, P., & Juvančič, L. (2019). Use of wood in Slovenian bioeconomy = Raba lesa v slovenskem biogospodarstvu. *Gozdarski vestnik: slovenska strokovna revija za gozdarstvo*, 77(10), 375-393.
76. Krajnc, L., Arnič, D., & Prislan, P. (2023). Analiza kakovostne strukture okroglega lesa listavcev. *Les*, 72(1), 49-58.
77. Prislan, P., Ščap, Š., Triplat, M., Krajnc, N., Krajnc, L., Arnič, D., Straže, A., Gornik Bučar, D., Kropivšek, J., & Juvančič, L. (2023). Možnosti rabe lesa listavcev v slovenskem biogospodarstvu: vsebinsko poročilo = The potential use of hardwood in the Slovenian bioeconomy: project report. Gozdarski inštitut Slovenije; <https://dirros.openscience.si/lzpisGradiva.php?lang=slv&id=17761>



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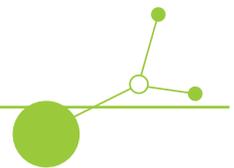


ANNEX 1. TEMPLATE FOR DESK RESEARCH ON THE COUNTRY-LEVEL BIOECONOMY MEASURES IN THE CONTEXT OF COMMON AGRICULTURAL POLICY

Desk Research on the Country-Level Bioeconomy Measures in the Context of Common Agricultural Policy

A3.2 Development of strategy and action plan for implementing bioeconomy measures

Template for the Preparation of Country-Level Measures Report





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Please mention the barriers, challenges and limitations of bioeconomy implementation tools according to your knowledge and the following examples: .. 266

Additional Guidelines for Completing the Template:

1. **Country-Specific Data:** Include national CAP policies, government reports, and research findings.
2. **CAP and Agriculture Programs Integration:** Clearly connect bioeconomy measures with CAP's financial instruments or other programs financing agriculture.
3. **Concrete Examples:** Provide case studies of real-world CAP related or agriculture-funded bioeconomy projects.
4. **Balanced Coverage:** Ensure the 8-10 page limit is met with proportionate focus on CAP, agriculture, policy frameworks, and Activity A3.1 findings (with national context).



Introduction on national status (1-1.5 page)

Objective of the National Report

The objectives of this report encompass in particular the following perspectives:

- *Analysis of CAP implementation in the country.*
- *Review of existing bioeconomy strategies and policy frameworks.*
- *Identification of gaps, challenges, and opportunities in integrating circular bioeconomy measures into CAP.*

You are asked to complete the following points based on your knowledge and national policies (maximum 1-1.5 page per whole section 1).

National Context and Importance

Please provide a brief description of measures undertaken in your country in the context of:

- *The circular bioeconomy as a key driver of sustainable agriculture, resource efficiency, and climate resilience.*
- *The role of the European Green Deal, Farm to Fork Strategy, Fit for 55 and other programs in shaping bioeconomy-related policies.*

The Role of CAP in Supporting Circular Bioeconomy

Please highlight the role of CAP in shaping the circular bioeconomy measures in your country in the following aspects:

- *CAP as a major policy framework influencing agricultural and rural bioeconomy initiatives.*
- *The two-pillar structure of CAP:*
 - ✓ *Pillar I: Direct payments & eco-schemes incentivizing sustainable farming.*
 - ✓ *Pillar II: Rural development funds supporting innovation and infrastructure.*

Project Background with National Context

Please describe the role of the BIOECO-UP project and its influence on mainstreaming bioeconomy policies in Central and Eastern Europe, taking into account Activity A3.1 as a foundational analysis of circular bioeconomy measures at the national level.

Organization of the Common Agricultural Policy (CAP) in [Name of the Country] (3 pages)

You are requested to complete the following points based on your knowledge and national policy documents in the area of bioeconomy and CAP (maximum 2.5 pages per whole section 2).

CAP Structure and National Implementation (1 page)

Overview of CAP Governance

Please include information on the following aspects of CAP implementation in your country:

- *National institutions responsible for CAP implementation, funding distribution, and oversight.*



- *The role of Ministries of Agriculture, Rural Development, and Environment in shaping CAP policies.*
- *CAP's alignment with national rural development priorities and sustainability goals.*

National CAP Strategic Plan (2023-2027)

Please provide data on the priorities and targets of the following aspects in your country:

- *Country-specific priorities in climate action, biodiversity protection, and bio-based innovation.*
- *Key targets related to sustainable agriculture, bioeconomy integration, and rural resilience.*

CAP Instruments Supporting Circular Bioeconomy (1.5 pages)

Pillar I: Direct Payments and Eco-Schemes

Please provide information concerning direct payment and eco-schemes relevant to your country on:

- *How eco-schemes encourage climate-smart and circular agricultural practices.*
- *Examples of incentives for carbon sequestration, precision farming, agroforestry.*

Pillar II: Rural Development Programs

Please provide comment on the funding system in the rural development programmes and role of European Agricultural Fund with special reference to:

- *Funding for bio-based industries, green technology, and circular supply chains.*
- *Role of European Agricultural Fund for Rural Development (EAFRD) in financing bioeconomy initiatives.*

European Innovation Partnership (EIP-AGRI) and Knowledge Transfer Networks

Please provide data on EIP-AGRI and Knowledge Transfer Networks according to the following aspects:

- *CAP's role in fostering agricultural innovation through multi-actor cooperation.*
- *Examples of knowledge-sharing initiatives supporting bio-based production.*

Challenges and Opportunities in CAP Implementation (0.5 pages)

Please include information on challenges and opportunities of CAP implementation on your country in the relevant sections below.

Challenges (examples):

- *Bureaucratic complexities in accessing CAP funds for bio-based projects.*
- *Lack of integration between CAP instruments and circular bioeconomy measures.*
- *Insufficient awareness and engagement among farmers, cooperatives, and SMEs.*

Opportunities (examples):

- *CAP as a lever for driving large-scale investments in bio-based solutions.*



- *Potential for cross-border collaboration in CEE region to improve CAP's impact on bioeconomy.*
- *Expanding eco-schemes and green investments under CAP's future reform agenda.*

Key Policy Documents and Existing Bioeconomy Measures (3.5 pages)

National Strategies and Legislative Framework (1 page)

Please enumerate Key Policy Documents:

- *National Bioeconomy Strategy or related documents (if applicable).*
- *Circular Economy Action Plan and its connection to CAP.*
- *Agricultural, forestry, and marine strategies linked to bio-based value chains.*

Please describe how national bioeconomy policies align with EU CAP reforms and sustainability objectives.

Circular Economy and Renewable Energy Policies (1 page)

Please provide information on circular economy and renewable energy policies:

- *Policies promoting biomass, bio-waste utilization, and bio-based energy.*
- *The role of bio-based sectors in achieving EU renewable energy targets.*
- *Synergies between CAP eco-schemes and national energy transition plans.*

Existing Circular Bioeconomy Measures and Funding Mechanisms (1 page)

Please provide examples of projects and funding mechanisms for circular bioeconomy measures implementation in relation to:

- *National and EU funding programs for bio-based industry development.*
- *Examples of successful projects funded through CAP or national policies.*
- *Public-private partnerships (PPPs) supporting bio-based innovation.*

Gaps Between CAP and National Bioeconomy Policies (0.5 pages)

Please provide feedback on gaps and incoherence between CAP and national bioeconomy policies, e.g.:

- *Misalignment between CAP instruments and national circular economy goals.*
- *Lack of funding streams dedicated to emerging bioeconomy sectors.*
- *Need for stronger policy coherence and multi-level governance.*

Insights from Activity A3.1: Country-Level Analysis (2.5 pages)

Key Findings from Literature and Policy Review (1 page)

Please provide information on key findings from literature and policy review which may be relevant as:



- *Summary of findings from national-level bioeconomy studies.*
- *Assessment of policy coherence between CAP, bioeconomy, and sustainability objectives.*

Best Practices and Transferable Measures (1 page)

Please enumerate best practices examples which may be source of inspiration for policy implementation in other countries, such as:

- *Successful examples of CAP-driven circular bioeconomy measures.*
- *Case studies from other CEE countries that can inform national policy improvements.*
- *Policy innovations supporting bio-based production and resource efficiency.*

Identified Gaps and Challenges in Bioeconomy Implementation (0.5 pages)

Please mention the barriers, challenges and limitations of bioeconomy implementation tools according to your knowledge and the following examples:

- *Regulatory barriers and policy fragmentation.*
- *Financial constraints and low uptake of CAP-supported bioeconomy initiatives.*
- *Limited private sector engagement in CAP-financed bio-based projects.*

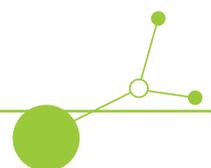


ANNEX 2. TEMPLATE FOR EXPERT REPORT ON RECOMMENDATIONS FOR THE BIOECONOMY AND CAP IMPLEMENTATION IN CE COUNTRIES

Expert report Recommendations for the _____ (name of the country) Bioeconomy and CAP Implementation

BIOECO-UP: A3.2 Development of strategy and action
plan for implementing bioeconomy measures

Guidelines for the Preparation of Expert Reports





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General Guidelines for Experts:

Experts are requested to:

1. Use data and references to national policies to derive recommendations in line to the Strategic Plan for the Common Agricultural Policy (CAP) for Poland and priorities for your country.
2. Present feasible innovative alternatives appropriate to national conditions and funding opportunities.
3. Support recommendations with case studies, best practices, or stakeholder insights where possible.
4. Ensure clarity and action-oriented insights in the report.



1. Expert's Area of Specialization

Experts are asked to complete the following points based on their knowledge and experience (maximum one page per whole section 1).

1.1. Concise Description of the Specialization Area

Please provide a brief description of your expertise area in the bioeconomy sector (e.g., regenerative agriculture, biogas, biomethane, biofuels, precision agriculture, bio-products development, biomaterials, biomanufacturing, waste valorization, environmental impact assessment etc., orientation of policies supporting the development of bioeconomy).

1.2. Main Identified Trends, Challenges, and Opportunities

Please highlight key current trends, challenges, and opportunities within your area of expertise (max 200 words).

1.3. Ongoing Research, Current Technologies, or Regulatory Changes

Please mention the ongoing research topics, emerging technologies, or policy developments relevant to your specialization. (max 200 words)

1.4. Potential of Expertise for Bioeconomy Development

Please briefly describe how your expertise aligns with bioeconomy concepts, including circular economy, or CAP-related funding mechanisms. Is your area of specialisation related to agriculture and activities and how much is affected by the Common Agricultural Policy?



2. Transformation Pathways for Bioeconomy Development and Strategy Formulation

Experts are requested to complete the following points based on their knowledge and experience (maximum one page for justification - point 2.2).

2.1. Key Transformation Pathways for the Bioeconomy

Select the key transformation pathways relevant for your country's bioeconomy by marking the selected options with an "X." Descriptions of pathways can be found in Annex 2 of these guidelines.

- Pathway I (PI):** Substitution of Fossil-based Materials with Bio-based Alternatives
- Pathway II (PII):** Enhancing Agricultural Sector Efficiency
- Pathway III (PIII):** Increasing Biomass Utilization and Efficiency
- Pathway IV (PIV):** Developing High-Value Bio-based Applications
- Pathway V (PV):** Valorization of Ecosystem Services

2.2. Justification for the Selection of Transformation Pathways

Please provide justification for the recommended economy transformation pathways, taking into account the bioeconomy concept, in relation to national political priorities defined in strategic/policy documents, market potential and integration with the financing mechanisms of the Common Agricultural Policy (CAP) (maximum 1 page of text).

3. Key Enabling Technologies (KET) for Bioeconomy Development. Linking the expert's activity to the relevant pathway(s)

Please link the activity from your expert area (KET/biomass type/technology category/target sector) to the appropriate transformation pathway(s). You can mark the selected pathway with an 'X'.

Key Enabling Technology	Biomass input Category	Technology Category	Destination sector of the economy the products of the technology are directed	Transformation Pathway				
				PI: Fossil fuel substitution	PII: Boosting primary sector productivity	PIII: New/efficient biomass use	PIV: Low bulk/high value biobased products	PV: Valorisation of ecosystem services
Select from Annex 2	Select from Annex 1 (column1)	Select from Annex 1 (column 2)	Select from Annex 1 (column 3)					
.....	Livestock residues	Anaerobic digestion/flexible biogas	Energy, organic waste management	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

4. Assessment of KETs for Development Pathways

Please analyse the impact and sustainability of each technology identified in section 3 (Key Enabling Technologies for KETs) using the following two matrices:

Action Priority Matrix: Impact vs Effort and

Sustainability Matrix: Policy Support vs Profit Potential.

Your task is to enter the technologies of your choice into specific fields of both matrices. The following matrices indicate, for example, that with a high input and high impact, a given technology can be described as long-term strategic. You can assign more than one technology to one place in the array.

Model matrices as a reference:

Action Priority Matrix: Impact vs. Effort

	Effort (input)		
Impact (outcome)		Low	High
Low		Synergistic	Future Potential
High		Short Term Priority	Long Term Strategic

Table to be filled in with your selected technologies:

Action Priority Matrix: Impact vs. Effort

	Effort (input)		
Impact (outcome)		Low	High
Low		Insert a technology name	Insert a technology name
High		Insert a technology name	Insert a technology name



Sustainability Matrix: Policy Support vs. Profit Potential

	Policy support (input)		
Profit (outcome)		Low	High
Low		Niche	Public Funding Needed
High		Emerging	Market ready

Table to be filled in with your selected technologies:

Sustainability Matrix: Policy Support vs. Profit Potential

	Policy support (input)		
Profit (outcome)		Low	High
Low		Insert a technology name	Insert a technology name
High		Insert a technology name	Insert a technology name



5. PESTEL-I Analysis: External Factors Influencing Bioeconomy Development

Please identify and assess key external factors influencing bioeconomy development at the national level in terms of CAP and your expertise area.

Factor	Key Elements	Impact on Bioeconomy Development (please indicate a potential impact)	Driving factors (what favours the development from the perspective of your specialization area in a given factor type)	Inhibiting factors (what hinders the development from the perspective of your specialization area in a given factor type)
Political	CAP policy, documents connected with bioeconomy, regulatory framework	Defines investment and funding priorities.		
Economic	Market demand, investment support instruments, subsidy schemes	Determines financial feasibility of bio-based industries.		
Social	Consumer acceptance, workforce skills, rural engagement	Influences adoption of bio-based innovations.		
Technological	Infrastructure, digitalization, R&D capacity	Determines feasibility of advanced bio-based processes.		
Environmental	Climate policies, sustainability goals, resource availability	Influences policy-driven incentives for green innovation.		
Legal-Institutional	Regulations, intellectual property law, funding mechanisms	Affects ease of implementation and commercial scaling.		



6. SWOT and TOWS Analysis

6.1. SWOT Analysis

Please specify the strengths, weaknesses, opportunities and threats for your recommendation in the context of increasing the share of bioeconomy in agriculture (related to your area of specialisation - e.g. biogas, biofuels, biologisation of agriculture (bioproducts), precision agriculture - reducing the use of mineral fertilisers or plant protection products etc.).

Strengths (S)	Weaknesses (W)
<i>Example 1: Strong R&D Potential</i>	<i>Example 1: Lack of Specialized Workforce</i>

Opportunities (O)	Threats (T)
<i>Example 1: Large Biomass Resources</i>	<i>Example 1: High Infrastructure Adaptation Costs</i>

6.2. TOWS Analysis (Threats-Opportunities-Weaknesses-Strengths)

The TOWS analysis facilitates the development of action strategies based on the strengths and weaknesses, opportunities, and threats identified in the SWOT analysis. It encourages the integration of internal factors (strengths and weaknesses) with external factors (opportunities and threats) in order to generate strategic options. Four strategic approaches are defined:

- Utilize your strengths to capitalize on opportunities (SO)
- Overcome weaknesses by leveraging opportunities (WO)
- Use your strengths to avoid threats (ST)
- Minimize weaknesses and avoid threats (WT)

Based on the SWOT analysis conducted by you and the identified internal and external factors, we kindly request you to indicate potential strategic actions that may be undertaken within the framework of each approach.



SO (Strength-Opportunity) Strategies	<i>Example 1: Leverage strong R&D to develop bio-based substitutes with policy support.</i>
WO (Weakness-Opportunity) Strategies	<i>Example 1: Invest in training programs to address workforce shortages in bioeconomy sectors.</i>
ST (Strength-Threat) Strategies	<i>Example 1: Use funding mechanisms to mitigate market risks for bio-based startups.</i>
WT (Weakness-Threat) Strategies	<i>Example 1: Improve regulatory clarity to support smoother transition to solutions using biomass or bioprocesses.</i>

7. Recommendations and Strategic Actions

Please enter recommendations for actions to integrate bioeconomy measures into the CAP and national bioeconomy regulations.

7.1. Immediate Actions (Short-Term Priorities)

Examples:

- Expand eco-schemes to include incentives for bio-based agriculture.*
- Support pilot projects for biorefinery infrastructure and circular economy solutions.*

Other:

7.2. Long-Term Strategic Actions

Examples:

- Establish a national bioeconomy hub to facilitate collaboration between research, industry, and policy.*
- Develop a financial support framework tailored to high-impact KET applications.*
- Integrate bioeconomy metrics into CAP's monitoring and evaluation systems.*

Other:



8. Annexes

Annex 1. Biomass category, technology and economic sector

Microbial biomass	BIOCHEMICAL	Agriculture
Residues from agriculture production	Aerobic conversion (composting)	Forestry and hunting
Residues from forestry and forest-based industry	Anaerobic digestion	Fisheries, Aquaculture & Algae
Residues from natural and landscape resources management	Upgrading biomass	Food products, beverages, and tobacco
Residues from recycled bio-based products	Fermentation	Textiles, wearing apparel and leather
Residues from livestock production	Insect-based bioconversion	Wood and wood products
Other organic residues	cultivation mushrooms	Paper and paper products
	Cultivation algae	Chemicals and chemical products
	MECHANICAL & THERMOCHEMICAL	Pharmaceutical products
	Blending/mixing	Rubber and plastic products
	Extraction & separation processes	Other non-metallic mineral products
	Disruption & fractionation	Machinery and equipment
	Mechanical pulping	Construction
	THERMOCHEMICAL	Renewable energy
	Combustion	Organic waste management
	Gasification	Green care, nature tourism and recreation
	Hydrochemical liquefaction	Other: please add if the list is not complete
	Pyrolysis	
	Torrefaction & carbonization	
	Bioprocessing	
	Precision agriculture	
	Regeneration agriculture	
	Biomaterials development	



	Other: please add if the list is not complete	
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Annex 2. Key Enabling Technologies (KET)

<i>Transformation pathways</i>	<i>PI Fossil Substitution</i>	<i>PII Agriculture</i>	<i>PIII Biomass Use/Processing</i>	<i>PIV High Value</i>	<i>PV Valorisation of Ecosystem services</i>
	Substitution of fossil by bio-based resources	Increases in primary sector productivity	Increases in biomass use efficiency and new biomass uses	Bio-based value added in low-volume/high value industries	Valorisation of Ecosystem services
Key Enabling Technologies (KET)	Fermentation C1 technologies Bio-ethanol/bio-chemicals Biofuels/bioenergy Functional biopolymers/bioplastics (PLA/PEF)	Digitalization/ICT Breeding advances Genome editing Genomics/genetic engineering Renewable energy not bio-based Bioinformatics* Robotics/AI Water management Satellite/LIFI technologies City/urban/vertical/alternative farming methods Bio-fertilizer/biocontrol Organic agriculture Ecology/plant physiology Biological nutrient supply Warning systems/bio sensors	Biomass processing New biomass uses Alternative biomass Organosolv/biomass pretreatments Cascading/circular biosystems Utilization of lignocellulose Aquatic biomass (general. fish etc.) Algae (incl. Cyanob.) Insects Animal protein/meat alternatives Bioremediation Waste reuse/processing Utilization of wood Bio-refineries/bio-ccs/biogas plants	Synthetic biology Special/fine chemicals Enzyme technologies Biotechnology/metabolic engineering Bio-electrochemistry/artificial photosynthesis Medicinal applications Bionics/biomimicry Advanced technologies (Space science; extreme Os) Advanced materials (packaging. construction etc.) Biochemistry/cell biology Nanotechnology Pharmaceuticals/biopharming	Remote Sensing and GIS Technologies Big Data and Ecosystem Analytics Blockchain for Transparency and Ecosystem Certification Sensor Technologies and Internet of Things (IoT) Smart resource management systems Integrated monitoring and response systems for environmental degradation Digital Modeling and Ecosystem Digital Twins Artificial Intelligence and Machine Learning



		<p>Precision farming / agricultural systems</p>	<p>Transport technologies/logistics</p> <p>Social/organizational innovations</p> <p>Utilization of enzymes/MOs for biomass processing</p>	<p>Functional food/nutraceuticals</p> <p>Chemistry advance/green chemistry</p> <p>Metabol-; Prote-; Gen) Omics/systems biology</p> <p>Big Data</p>	<p>AI-based modeling of climate policy impacts on ecosystem services</p> <p>Algorithms for estimating the economic value of ecosystem services</p> <p>ICT Solutions for Community Engagement and Citizen Science</p> <p>Mobile applications for monitoring and reporting ecosystem changes</p> <p>Crowdsourcing tools for collecting ecological data</p> <p>Digital platforms</p>
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Annex 3. Transformation paths - description

PI: Fossil fuel substitution: national experts are asked to assess whether the biomass streams available on the domestic and foreign markets of a given sector offer adequate potential for advanced energy use, substituting conventional energy sources and conventional products (by increasing the share of e.g. biofuels, biogas, green electricity, increasing the share of bioproducts, etc.).

PII: Boosting primary sector productivity: the extent to which the sector concerned exploits resources (e.g. investment in technologically advanced and/or digital solutions, business process optimization, skills & competence improvements) in order to achieve growth in productivity.

PIII: New & more efficient biomass uses: The range of possible alternative uses of biomass expands with the cascading use of biomass and its biorefining. In the primary sectors, 'conventional' industries broadening potentials is concerned with the supply side (e.g. mobilization of side-streams of biomass, biorefining). Elsewhere, the assessment of potentials usually applies to the demand side (e.g. availability and cost-efficiency of biobased technologies, market demand).

PIV: Low bulk / high-value biobased products: Biological principles and processes can be used largely independently of biomass streams' industrial applications, such as in the case of enzymatic synthesis and "biomimicry". Corresponding transformative processes result, inter alia, from providing cheaper and more environmentally friendly production methods or completely new products. In this transformation pathway we assess the untapped potential for improving product functionalities and adding value within a given sector with technologically advanced biobased solutions.

PV: Valorisation of Ecosystem services: In an economic sense, ecosystem services often have characteristics of public goods, they can also serve as attributes for adding market value to commodities through e.g. eco-branding, social sustainability, etc.



ANNEX 3. A LIST OF 100 POLICY MEASURES IDENTIFIED FOR THE ACTION PLAN



List of recommended policy measures *(to be adapted to other countries' status quo)*

Areas of intervention and policy measures assigned to each area from different countries:

1. **Governance & AKIS**
2. **Research, Innovation & Digitalisation**
3. **Climate & Environmental Sustainability**
4. **Sustainable Agriculture, Food & Forestry Value Chains**
5. **Rural Communities & Regional Bioeconomy Hubs**
6. **Knowledge & Skills for Farmers and Advisors**



Table. Proposed catalogue of policy measures (summary table)

No.	Policy measure	Steps to delivery	Timeframe	Responsible (examples below)	Area of intervention	Proposed financing
1	Result-based reduction of GHG emissions in biofuel feedstock crops through regenerative practices and residue-to-biogas systems	Develop methodology for farm-level GHG accounting (kg CO ₂ e/ha), incl. SOC proxy, residue management indicators, and alignment with RED III/NCW requirements	2026-2027 (preparation phase)	<ul style="list-style-type: none"> Ministry of agriculture (Lead) research institutions in agriculture national emissions and environmental protection bodies paying Agency energy regulatory office 	Climate Environmental Sustainability &	Horizon Europe, LIFE, National Funds, Technical Assistance
		Design eco-scheme payment logic & eligibility rules (result-based €/ha by verified emission cuts; standard-cost fallback; safeguards vs. double funding)	2026-2027 (preparation phase)	<ul style="list-style-type: none"> Ministry of agriculture paying agency research institutions in agriculture climate policy coordination body 		CAP Pillar I, GD Clima Pilot funds
		Pilot eco-scheme in selected arable regions (rapeseed/corn producers in manure-surplus & drought districts), testing monitoring and residue-to-biogas linkages	2026-2027 (pilot)	<ul style="list-style-type: none"> Ministry of agriculture research institutions in agriculture regional chambers of agriculture bioenergy associations cooperatives 		Pillar I, Pillar II, Interreg CE
		Develop knowledge transfer & advisory Modules (precision N, low-emission fertilisation, cover crops, rotations, digestate use) with digital tools and training for advisors/farmers	2026-2027 (capacity-building)	<ul style="list-style-type: none"> farmer advisory units (Lead) research institutions in agriculture universities private advisory firms 		Pillar II HE Erasmus +



		Launch full eco-scheme under CAP Pillar I (nationwide, result-based €/ha, tiered by verified GHG reduction; top-up for testing/plan)	2028-2034 (implementation)	<ul style="list-style-type: none"> • Ministry of agriculture (Lead) • paying agency • research institutions in agriculture • advisory services providers 		Pillar I CAP national budget co-financing
		Complement with Pillar II agri-environment-climate interventions for advanced regenerative practices and knowledge transfer (soil SOC monitoring, biogas chain integration, activities for climate change adaptation)	2028-2034 (implementation & scaling)	<ul style="list-style-type: none"> • Ministry of agriculture • research institutions in agriculture • Ministry of energy, energy regulatory office • producer groups • advisory services providers 		Pillar II / AECM, EIP-OG, LIFE, Just Transition Funds
		Establish annual monitoring & verification system (digital farm logs, remote sensing, RED sustainability audits) with national reporting to Commission	2028-2030 (early implementation), ongoing to 2034	<ul style="list-style-type: none"> • Ministry of agriculture • paying agency • research institutions in agriculture • national emissions and environmental protection bodies • IT partners 		Pillar II, Cohesion Funds / ERDF
2	Deployment of agricultural biogas and biomethane solutions for residues and manures with	Develop national guidelines for sustainable feedstock use (residues, manures, agri-food by-products) incl. safeguards vs. crop-to-energy displacement	2026-2027 (preparation)	<ul style="list-style-type: none"> • Ministry of agriculture (Lead) • Ministry of climate and environment • research institutions in agriculture • plant protection and seed inspection service • producer associations 	Sustainable Agriculture, Food & Forestry Value Chains	TA CAP, LIFE, HE
		Establish digestate standards & land-application protocols (nutrient plans, separation, acidification, quality control)	2026-2027 (preparation)	<ul style="list-style-type: none"> • Ministry of agriculture • research institutions in agriculture • national soil/agriculture hubs • environmental inspectorate 		AECM (P2), LIFE, National Funds, ERDF



nutrient recycling and climate benefits	Design investment grants & financing models (standard-cost grants, performance-based top-ups, ceilings by plant size)	2026-2027 (preparation)	<ul style="list-style-type: none"> • Ministry of agriculture • paying agency • national development bank • national research and development funding agency • national energy fund 	agriculture under EIP	P2, JTF, InvestEU, EIB
	Launch pilot innovation operational groups under EIP (subprogramme) projects for feedstock logistics (cluster-level collection, transport, pre-treatment) and cooperation on downstream hydrogenation	2026-2027 (pilot)	<ul style="list-style-type: none"> • Ministry of agriculture • innovation operational groups under EIP • universities • producer cooperatives 		EIP-OG (P2), HE, Interreg
	Roll-out investment support under Pillar II for anaerobic digestion & biomethane units, incl. upgrading, storage, heat recovery	2028-2034 (implementation)	<ul style="list-style-type: none"> • Ministry of agriculture (Lead) • paying agency • regional authorities • cooperatives • SMEs 		P2, ERDF, CF, National Funds, KPO
	Scale-up cooperation models (farm clusters, LAG consortia) with grants up to 500k € for joint feedstock logistics, heat-use plans, and regional digestate processing	2028-2034 (implementation)	<ul style="list-style-type: none"> • Ministry of agriculture • local action groups • producer groups • energy agencies 		LEADER (P2), Interreg, ERDF
	Establish monitoring system for climate performance (t CO ₂ e-eq avoided), nutrient recycling, and local socio-economic benefits	2028-2030 (early implementation), ongoing to 2034	<ul style="list-style-type: none"> • Ministry of agriculture • research institutions in agriculture • statistical office • national environmental and water management fund • advisory services providers 		AKIS (P2), DEP, LIFE, HE



3	Establishment of a national agricultural emissions monitoring system with AKIS support for farmers and advisors	Develop standardised methodologies for on-farm GHG/SOC monitoring, including field protocols and alignment with RED III / NCW verification	2026-2027 (preparation)	<ul style="list-style-type: none"> Ministry of agriculture (Lead) research institutions in agriculture national emissions and environmental protection bodies universities 	Governance & AKIS	HE, LIFE, TA CAP
		Design and test a digital monitoring and reporting system (open standards, IACS/LPIS/FSDN interoperability, farmer dashboards)	2026-2027 (pilot)	<ul style="list-style-type: none"> Ministry of agriculture paying agency research institutions in agriculture IT partners 		DEP, HE, ERDF
		Build AKIS capacity through modular skill certificates in low-emission agronomy and soil carbon management for advisors, farmers, and cooperatives	2026-2027 (capacity-building)	<ul style="list-style-type: none"> farmer advisory units universities NGOs producer groups 		AKIS (P2), Erasmus+, HE
		Establish the National Agricultural Emissions Centre as coordination hub for MRV, training, and RED III	2026-2027 (preparation)	<ul style="list-style-type: none"> Ministry of agriculture research institutions in agriculture national emissions and environmental protection bodies Ministry of energy/climate and environment protection) 		TA CAP, LIFE, National Funds
		Roll out advisory & auditing services nationwide (farm-level audits, SOC tracking, nutrient/energy balances),	2028-2034 (implementation)	<ul style="list-style-type: none"> Ministry of agriculture (Lead) advisory services providers producer groups NGOs 		P2 (Advisory/KT), AKIS



		funded under Pillar II KT/advisory				
		Deliver large-scale farmer training & communication campaigns to counteract the misinformation and demonstrate verified GHG cuts	2028-2034 (implementation & scaling)	<ul style="list-style-type: none"> Ministry of agriculture farmer advisory units producer associations media partners 		AKIS (P2), Erasmus+, LIFE
		Operate annual reporting & verification system with open-access data (aggregated), linked to CAP monitoring and PEP2040 indicators	2028-2034 (monitoring)	<ul style="list-style-type: none"> Ministry of agriculture research institutions in agriculture national emissions and environmental protection bodies statistical office IT partners 		P2, DEP, LIFE, HE
4	Creation of bioeconomy policy labs and regulatory sandboxes to accelerate adaptive governance and innovation based on portfolio	Design national framework for policy labs and sandboxes (objectives, eligibility, funding envelopes, evaluation protocols) with portfolio management methods	2026-2027 (preparation)	<ul style="list-style-type: none"> Ministry of agriculture (Lead) managing authority • paying agency research institutions in agriculture universities NGOs 	Governance & AKIS	TA CAP, HE, LIFE
Launch 2-3 pilot policy labs in priority regions/value chains (e.g. biomass cascading, soil carbon credits, bioproduct standards)		2026-2027 (pilot)	<ul style="list-style-type: none"> Ministry of agriculture local action groups producer organisations SMEs research institutes 	Interreg, HE, P2 (Cooperation)		
Establish central support unit for methodology, tooling, and cross-lab learning (developmental evaluation, agile monitoring, adaptive policy design)		2026-2027 (capacity-building)	<ul style="list-style-type: none"> Ministry of agriculture research institutions in agriculture international experts • advisory networks 	TA CAP, LIFE, HE		



		Scale portfolio pilots across regions and sectors (5-7 labs/sandboxes), integrating lessons learned into regulatory changes, CAP eco-schemes, and national bioeconomy strategy/roadmap	2028-2034 (implementation & scaling)	<ul style="list-style-type: none"> Ministry of agriculture (Lead) regional authorities producer groups hubs advisory services providers NGOs 		P2 (AECM/eco-schemes), Interreg, HE
		Institutionalise policy labs as part of adaptive governance cycle (regular open calls, annual showcase, mainstreaming tested solutions into CAP and national programmes)	2028-2034 (consolidation)	<ul style="list-style-type: none"> Ministry of agriculture paying agency bioeconomy hubs evaluation units (financing institutions, universities) 		TA CAP, National Funds, LIFE
		Publish annual “Bioeconomy Policy Innovation Report” synthesising tested prototypes, adoption rates, and impacts on farmer income, sustainability and value chains	2028-2034 (reporting & dissemination)	<ul style="list-style-type: none"> Ministry of agriculture research institutions in agriculture bioeconomy hubs media /communication partners 		TA CAP, HE, LIFE
5	Deployment of a national monitoring and reporting system and bioeconomy digital twin as the AKIS data spine	Develop technical concept for national MRV & digital twin (scope, governance model, GDPR compliance, integration with IACS/LPIS/FSDN)	2026-2027 (preparation)	<ul style="list-style-type: none"> Ministry of agriculture (Lead) paying agency research institutions in agriculture statistical office IT partners 	Research, Innovation & Digitalisation	HE, DEP, ERDF
		Launch pilot data partnerships with farms, producer groups, and advisory services providers to test data flows (farm logs,	2026-2027 (pilot)	<ul style="list-style-type: none"> Ministry of agriculture producer organisations farmer advisory centres universities NGOs 		HE, Interreg, P2 (Cooperation)



for adaptive governance	IoT, RS&GIS, citizen-science apps)				
	Build core monitoring and reporting system infrastructure (cloud backbone, open APIs, analytics, dashboards), financed as adigital public good	2026-2027 (capacity-building)	<ul style="list-style-type: none"> • Ministry of agriculture • national R&D funding agency • IT consortia • research institutions in agriculture 		DEP, ERDF, CF
	Roll out farm onboarding programme nationwide (standard costs per dataset/farm; integration with eco-schemes)	2028-2034 (implementation)	<ul style="list-style-type: none"> • Ministry of agriculture • paying agency • advisory services providers • producer groups 		P1 (eco-schemes), P2, TA CAP
	Deploy bioeconomy digital twin modules (soil/biomass flows, GHG, nutrient cycles, market value chains) to support investment de-risking and adaptive evaluation	2028-2034 (scaling)	<ul style="list-style-type: none"> • Ministry of agriculture • research institutions in agriculture • statistical office • universities • industry partners 		HE, InvestEU, EIB
	Operate public dashboards & citizen-science layer (apps, local monitoring, open data) to strengthen transparency and trust	2028-2034 (implementation & outreach)	<ul style="list-style-type: none"> • Ministry of agriculture • NGOs • advisory networks • media partners 		LIFE, DEP, HE
	Issue annual report on agricultural emissions and bioeconomy feeding CAP evaluations, RED III/NCW compliance, and PEP2040 indicators	2028-2034 (monitoring & reporting)	<ul style="list-style-type: none"> • Ministry of agriculture • research institutions in agriculture • national emissions and environmental protection bodies • statistical office 		TA CAP, HE, LIFE



6	Development of modular skill certificates and innovation brokerage services to strengthen AKIS capacity for the bioeconomy	Design national framework for modular skill certificates (systemic methods, portfolio approaches, policy mix, sandboxing, bioeconomy KET use), including recognition across ministries	2026-2027 (preparation)	<ul style="list-style-type: none"> • Ministry of agriculture (Lead) • Ministry of education • universities • research institutions in agriculture • advisory centres (farmer advisory units) 	Knowledge & Skills for Farmers and Advisors	HE, LIFE, Erasmus+
		Pilot delivery of modular skill certificates with accredited providers (5,000 participants trained by 2027; open access materials)	2026-2027 (pilot)	<ul style="list-style-type: none"> • universities • AKIS providers • producer organisations • NGOs 		P2 (AKIS/KT), Interreg, HE
		Establish innovation brokerage services linking SMEs/start-ups with farmers, producer groups and public buyers through challenge-driven calls	2026-2027 (pilot)	<ul style="list-style-type: none"> • Ministry of agriculture • local action groups • producer groups • innovation operational groups under EIP consortia 		HE, LIFE, CBE-JU
		Roll out national programme of modular skill certificates (12,000 by 2030) with regional hubs, blended learning, and remote access for LFAs	2028-2034 (implementation)	<ul style="list-style-type: none"> • Ministry of agriculture (Lead) • universities • advisory services providers • NGOs • regional authorities 		Erasmus+, HEI Alliances, LIFE
		Scale innovation brokerage networks to ≥600 matches by 2030, with monitoring of uptake and fair-value safeguards for farmers	2028-2034 (implementation & scaling)	<ul style="list-style-type: none"> • Ministry of agriculture • producer organisations • SMEs • public procurement agencies 		P2 (AKIS/KT), TA CAP, National Funds
		Conduct evaluation & feedback loops (before-after analysis, network density mapping, surveys on practice uptake ≥50%)	2028-2034 (monitoring & evaluation)	<ul style="list-style-type: none"> • Ministry of agriculture • research institutions in agriculture • universities • independent evaluators 		HE, LIFE, Erasmus+

7	Adoption of result-based soil-biology practices with support for regenerative techniques and bio-based products	Establish composite Soil Health Score (SOC %, infiltration/aggregate stability, microbial activity proxy) and baseline testing protocols	2026-2027 (preparation)	<ul style="list-style-type: none"> Ministry of agriculture (Lead) research institutions in agriculture national soil hub advisory centres 	Climate Environmental Sustainability &	HE, LIFE, National Funds
		Pilot agri-environment-climate interventions contracts in priority zones (erosion/drought areas), testing result-based payments (€/ha) and protocols for microbial products and regenerative practices	2026-2027 (pilot)	<ul style="list-style-type: none"> Ministry of agriculture research institutions in agriculture producer groups regional chambers of agriculture 		AECM (P2), HE, LIFE
		Develop Knowledge Transfer packages (soil microbiology, cover crops, composting/fermentation, varietal choices) and train advisors & lead farmers	2026-2027 (capacity-building)	<ul style="list-style-type: none"> farmers advisory units (Lead) farmer advisory units universities NGOs 		P2 (AKIS/KT), Erasmus+
		Roll out national result-based scheme under Pillar II agri-environment-climate interventions with tiered payments linked to Soil Health Score improvements; ensure safeguards against double funding	2028-2034 (implementation)	<ul style="list-style-type: none"> Ministry of agriculture (Lead) paying agency research institutions in agriculture advisory services providers 		AECM (P2), TA CAP
		Establish annual monitoring system (IACS/LPIS + lab tests + farm logs) with public	2028-2034 (monitoring)	<ul style="list-style-type: none"> Ministry of agriculture research institutions in agriculture 		P2 (Monitoring), DEP, LIFE



		dashboards tracking SOC increase, fertiliser cuts, and resilience gains	& evaluation)	<ul style="list-style-type: none"> • statistical office • IT partners 		
8	Testing and regulatory sandboxing of microbial bio-products through EIP pilots and advisory integration	Establish national coordination framework for microbial sandbox pilots (roles of managing/ paying authority, observer role of competent authorities, funding envelopes, evaluation design)	2026-2027 (preparation)	<ul style="list-style-type: none"> • Ministry of agriculture (Lead) • managing/ paying authority • plant protection and seed inspection service • research institutions in agriculture • universities 	Research, Innovation & Digitalisation	TA CAP, HE, LIFE
		Launch first wave of on-farm pilots (≥20) with farmer groups, SMEs/biotech, advisory services providers, testing microbial bio-fertilisers/biocontrol under standard protocols	2026-2027 (pilot)	<ul style="list-style-type: none"> • innovation operational groups under EIP consortia • producer organisations • SMEs • farmer advisory units • research institutions in agriculture 		EIP-OG (P2), HE, LIFE
		Develop evidence base for microbial products (efficacy, safety, soil microbiome monitoring), including dossiers and good-practice definitions	2026-2027 (knowledge base)	<ul style="list-style-type: none"> • research institutions in agriculture • universities • SMEs • advisory networks 		HE, LIFE, National Funds
		Scale up sandbox pilots to ≥30 projects with milestone bonuses for validated protocols; ensure results feed directly into advisory guidance and AKIS training	2028-2034 (implementation & scaling)	<ul style="list-style-type: none"> • Ministry of agriculture • paying agency • farmer advisory units • producer organisations • NGOs 		EIP-OG (P2), P2 (AKIS), HE
		Integrate outputs into advisory & training systems (≥5,000 farmers reached by 2030; ≥10	2028-2034 (uptake)	<ul style="list-style-type: none"> • farmers advisory units (Lead) • producer groups • SMEs • NGOs 		P2 (AKIS/KT), Erasmus+



		protocols adopted; ≥60% farmers report intent to adopt)				
		Provide transparent evaluation & annual reporting (pilots completed, protocols validated, adoption rates, regulatory lessons for future rule-making)	2028-2034 (monitoring & evaluation)	<ul style="list-style-type: none"> Ministry of agriculture independent evaluators research institutions in agriculture advisory services providers 		HE, LIFE, TA CAP
9	Expansion of precision soil diagnostics and on-farm bio-inputs enablement for nutrient efficiency and resilience	Establish national framework for precision soil diagnostics (testing protocols, subsidy models, links to IACS/LPIS, Nitrogen Act alignment)	2026-2027 (preparation)	<ul style="list-style-type: none"> Ministry of agriculture (Lead) research institutions in agriculture accredited labs advisory services providers 	Research, Innovation & Digitalisation	TA CAP, HE, LIFE
		Pilot integrated diagnostic packages (chemical/biological/physical soil data, mapping tools, sensors) on ≥10k farms, linked with fertilisation planning	2026-2027 (pilot)	<ul style="list-style-type: none"> Ministry of agriculture producer groups farmer advisory units universities SMEs 		HE, EIP-OG (P2), National Funds
		Launch investment support for small-scale on-farm fermentation/composting units and precision application equipment (≤65% co-funding)	2028-2034 (implementation)	<ul style="list-style-type: none"> Ministry of agriculture (Lead) paying agency cooperatives • SMEs 		P2 (Investments), ERDF, CF
		Roll out modular skill certificates for advisors and lead farmers on precision diagnostics, safe bio-input use, and nutrient planning (≤80% public funding)	2028-2034 (capacity-building)	<ul style="list-style-type: none"> farmer advisory units universities NGOs 		P2 (AKIS/KT), Erasmus+



		Scale nationwide adoption of diagnostics & bio-inputs ($\geq 25k$ farms by 2030; 12-20% mineral N reduction; yield stability index tracked)	2028-2034 (scaling & monitoring)	<ul style="list-style-type: none"> Ministry of agriculture research institutions in agriculture advisory services providers IT partners 		P2 (AECM/Monitoring), LIFE, DEP
10	Development of enabling framework and pilot investments for farm and cluster biomethane with digestate circularity	Prepare national biomethane roadmap (regulatory changes, grid adaptation needs, sustainability safeguards, digestate standards, heat-use requirements)	2026-2027 (preparation)	<ul style="list-style-type: none"> Ministry of agriculture (Lead) Ministry of climate and environment protection energy regulatory office gas operators research institutions in agriculture 	Sustainable Agriculture, Food & Forestry Value Chains	TA CAP, LIFE, HE
		Establish pilot support scheme for 5-10 farm or cluster biomethane plants in manure-surplus districts, including CAPEX grants and feasibility studies	2026-2027 (pilot)	<ul style="list-style-type: none"> Ministry of agriculture national environmental and water management fund regional authorities producer groups 		P2 (Investments), National Funds, ERDF
		Launch demonstration projects (first wave) combining AD units with biomethane upgrading, local heat grids and certified digestate use (farmer coops + SMEs)	2028-2030 (early implementation)	<ul style="list-style-type: none"> Ministry of agriculture paying agency cooperatives SMEs advisory services providers 		P2 (Investments), CF, LIFE
		Establish feed-in/market framework (tariffs or guarantees of origin for biomethane, contracts with transport sector) aligned with RED III and national energy strategy	2028-2032 (regulatory & market scaling)	<ul style="list-style-type: none"> Ministry of climate and environment protection energy regulatory office Ministry of Infrastructure energy agencies 		National Funds, InvestEU, EIB
		Expand biomethane network stepwise to ~50 operational plants by 2034 , focusing on manure-rich districts and	2030-2034 (scaling)	<ul style="list-style-type: none"> Ministry of agriculture (Lead) regional authorities cooperatives energy companies 		P2 (AECM/Nutrient planning), LIFE

		integrating digestate nutrient substitution into CAP nutrient planning		<ul style="list-style-type: none"> research institutions in agriculture 		
11	Establishment of micro-biogas plants and circular manure hubs through LEADER/EIP cooperation for local nutrient cycling and social acceptance	Develop guidelines for micro-biogas hubs (modular AD units, simple digestate protocols, odour/leachate safeguards, environmental screening)	2026-2027 (preparation)	<ul style="list-style-type: none"> Ministry of agriculture (Lead) local action groups research institutions in agriculture plant protection and seed inspection service NGOs 	Rural Communities & Regional Bioeconomy Hubs	TA CAP, LIFE, HE
		Launch pilot LEADER/EIP projects (≥30 hubs) in diffuse biomass/manure-surplus zones; integrate with local training & info sessions for communities	2026-2027 (pilot)	<ul style="list-style-type: none"> local action groups producer groups municipalities advisory centres 		LEADER (P2), EIP-OG (P2), Interreg
		Expand hubs to ≥70 by 2030 , combining modular micro-AD units with shared logistics (collection, storage, pre-treatment)	2028-2030 (early implementation)	<ul style="list-style-type: none"> Ministry of agriculture regional authorities producer groups SMEs advisory services providers 		P2 (Investments), ERDF, CF
		Integrate manure hubs into circular economy plans (local nutrient recycling, compost/digestate valorisation, farm-municipality partnerships)	2028-2034 (scaling & integration)	<ul style="list-style-type: none"> Ministry of agriculture local action groups cooperatives municipalities NGOs 		P2 (Cooperation/LEADER), LIFE
		Monitor performance and community acceptance (t residues treated, CH ₄ /N ₂ O avoided, attendance at info	2028-2034 (monitoring & evaluation)	<ul style="list-style-type: none"> Ministry of agriculture research institutions in agriculture statistical office local action groups 		P2 (Monitoring), LIFE, DEP

		events, complaint rates ↓) with annual reporting		<ul style="list-style-type: none"> • independent evaluators 		
12	Implementation of a result-based agri-environment-climate interventions rewarding nutrient substitution through certified digestate use	Develop/update national methodology for digestate-based substitution (kg N/P replaced, soil co-benefits, groundwater safeguards), incl. alignment with GAEC/SMR	2026-2027 (preparation)	<ul style="list-style-type: none"> • Ministry of agriculture (Lead) • research institutions in agriculture • plant protection and seed inspection service • national soil hub • advisory services providers 	Climate Environmental Sustainability &	TA CAP, HE, LIFE
		Pilot agri-environment-climate interventions contracts (≥60k ha) in manure-surplus zones, testing result-based payments (€/ha linked to verified substitution + soil indicators)	2026-2027 (pilot)	<ul style="list-style-type: none"> • Ministry of agriculture • paying agency • producer groups • advisory services providers 		AECM (P2), HE, LIFE
		Provide knowledge transfer & advisory support (digestate nutrient plans, soil testing, precision spreading, separation/composting options)	2026-2027 (capacity-building)	<ul style="list-style-type: none"> • farmers advisory units (Lead) • farmer advisory units • universities • NGOs 		P2 (AKIS/KT), Erasmus+
		Roll out full result-based scheme nationwide, scaling to ≥150k ha by 2030 with tiered payments (€/ha) + setup support for baseline tests	2028-2034 (implementation)	<ul style="list-style-type: none"> • Ministry of agriculture (Lead) • paying agency • advisory networks • cooperatives 		AECM (P2), National Funds
		Monitor nutrient substitution and soil outcomes (kg N/P replaced, Δ SOC, infiltration, nitrate risk index), with annual public reporting	2028-2034 (monitoring & evaluation)	<ul style="list-style-type: none"> • Ministry of agriculture • research institutions in agriculture • statistical office • advisory services providers 		P2 (Monitoring), LIFE, DEP



13	Deployment of a precision-enabled eco-scheme paying for verified ecosystem services with digital MRV	Develop composite ecosystem service indices (SOC, infiltration/erosion risk, pollinator/biodiversity, irrigation efficiency, GHG balance) and MRV protocols	2026-2027 (preparation)	<ul style="list-style-type: none"> • Ministry of agriculture (Lead) • research institutions in agriculture • national soil hub • universities • IT partners 	Climate Environmental Sustainability	&	HE, LIFE, TA CAP
		Pilot result-based eco-scheme (≥... ha) using digital MRV (sensors, RS&GIS, dashboards) in drought/erosion and livestock catchment districts	2026-2027 (pilot)	<ul style="list-style-type: none"> • Ministry of agriculture • paying agency • farmer advisory centres • producer groups 			P1 (Eco-schemes), HE, DEP
		Build advisory & training capacity (modular skill certificates for advisors/farmers on digital MRV, eco-services, smart irrigation, biodiversity practices)	2026-2027 (capacity-building)	<ul style="list-style-type: none"> • farmers advisory units (Lead) • universities • NGOs • SMEs 			P2 (AKIS/KT), Erasmus+
		Roll out nationwide eco-scheme (tiered payments 90-200 €/ha + baseline support ≤30 €/ha; verified outcomes only, no overlap with practice-based schemes)	2028-2034 (implementation)	<ul style="list-style-type: none"> • Ministry of agriculture (Lead) • paying agency • advisory services providers • producer organisations 			P1 (Eco-schemes), National Funds
		Integrate optional links to micro-biogas (<50 kW) where it demonstrably improves nutrient cycling and GHG balance, aligned with digestate standards	2028-2034 (integration)	<ul style="list-style-type: none"> • Ministry of agriculture • local action groups • cooperatives • SMEs • NGOs 			P2 (Investments), LIFE, ERDF



		Monitor and publish annual eco-service outcomes (Δ SOC, erosion risk, pollinator index, litres/m ³ water saved, GHG balance per ha) through public dashboards	2028-2034 (monitoring & reporting)	<ul style="list-style-type: none"> Ministry of agriculture research institutions in agriculture statistical office advisory services providers IT providers 		P1 (Eco-schemes), DEP, LIFE
14	Acceleration of precision and digital farming adoption through investments and demonstration networks	Develop national investment guidelines (eligible precision modules, interoperability/ open data requirements, ceilings per holding) and advisory plan templates	2026-2027 (preparation)	<ul style="list-style-type: none"> Ministry of agriculture (Lead) paying agency research institutions in agriculture IT partners advisory services providers 	Research, Innovation & Digitalisation	TA CAP, HE, LIFE
		Launch demo-farm network (universities + advisors + lead farms) showcasing GNSS/autoguidance, VRA, sensing, robotics, and precision irrigation in practice	2026-2027 (pilot)	<ul style="list-style-type: none"> farmer advisory units universities producer groups SMEs 		HE, Interreg, P2 (Cooperation)
		Provide co-funded investment support for precision equipment/software (\leq 65% SMEs/coops; ceilings per farm) linked to adoption plans	2028-2034 (implementation)	<ul style="list-style-type: none"> Ministry of agriculture (Lead) paying agency cooperatives SMEs producer groups 		P2 (Investments), ERDF, CF
		Deliver large-scale training & advisory curricula (\leq 80% public funding) integrated with demos; modular skill certificates for advisors and tech specialists	2028-2034 (capacity-building)	<ul style="list-style-type: none"> farmers advisory units farmer advisory units universities NGOs private advisory firms 		P2 (AKIS/KT), Erasmus+
		Monitor adoption & impacts (15k farms by 2027; 35k by 2030; \geq 10-15% mean reduction in	2026-2034 (ongoing monitoring)	<ul style="list-style-type: none"> Ministry of agriculture research institutions in agriculture 		P2 (Monitoring), LIFE, DEP



		mineral N with stable yields; input/energy/fuel savings)		<ul style="list-style-type: none"> • advisory services providers • statistical office • IT providers 		
15	Creation of certification and validation schemes for circular bioproducts through EIP pilots and AKIS guidance	Establish national framework for circular bioproduct pilots (eligibility, independence rules, evaluation methods, transparency safeguards)	2026-2027 (preparation)	<ul style="list-style-type: none"> • Ministry of agriculture (Lead) • managing/ paying authority • plant protection and seed inspection service • research institutions in agriculture • universities 	Governance & AKIS	TA CAP, HE, LIFE
		Launch first wave of comparative on-farm trials (≥25 pilots) testing efficacy, input reduction, soil/biodiversity effects; data logged in public registry	2026-2027 (pilot)	<ul style="list-style-type: none"> • innovation operational groups under EIP consortia • producer groups • SMEs • advisory centres • research labs 		EIP-OG (P2), HE, Interreg
		Develop certification & labelling criteria (performance KPIs, life cycle assessment modules, environmental safeguards) and draft national guidance for advisory	2026-2027 (knowledge base)	<ul style="list-style-type: none"> • research institutions in agriculture • universities • NGOs • competent authorities (observer role) 		HE, LIFE, National Funds
		Scale programme to ≥60 pilots and ≥20 certified (national labels) products by 2030 , with milestone bonuses for validated dossiers and labels	2028-2034 (implementation & scaling)	<ul style="list-style-type: none"> • Ministry of agriculture (Lead) • paying agency • innovation operational groups under EIP • producer groups • SMEs 		EIP-OG (P2), P2 (Cooperation), LIFE
		Integrate certification results into AKIS advisory (≥50% trained advisors using guidance; training packages for farmers, demo events, digital tools)	2028-2034 (capacity-building & uptake)	<ul style="list-style-type: none"> • farmers advisory units (Lead) • universities • producer organisations 		P2 (AKIS/KT), Erasmus+



		Operate public registry & reporting system (validated protocols, certified labels, adoption rates, complaint/return trends)	2028-2034 (monitoring & transparency)	<ul style="list-style-type: none"> Ministry of agriculture research institutions in agriculture advisory services providers IT providers 		DEP, LIFE, HE
16	Deployment of regional biorefineries and fermentation pilots for PHA, PLA and green solvents based on agricultural residues	Develop national framework and regional calls for biorefinery pilots (eligibility, cascading rules, biomass sourcing criteria, monitoring)	2026-2027 (preparation)	<ul style="list-style-type: none"> Ministry of agriculture (Lead) national R&D funding agency regional authorities universities producer groups 	Sustainable Agriculture, Food & Forestry Value Chains	TA CAP, HE, LIFE
		Launch first wave of fermentation & enzymatic pilots (≥8 lines) valorising agri/food residues into PHA, PLA, DES and bio-additives	2026-2027 (pilot)	<ul style="list-style-type: none"> innovation operational groups under EIP consortia SMEs universities local authorities farmers 		HE, Interreg, National Funds
		Provide CAPEX and milestone-based support for TRL → MRL progression (e.g. validated quality series, first customer uptake)	2028-2034 (implementation)	<ul style="list-style-type: none"> Ministry of agriculture paying agency national R&D funding agency regional authorities cooperatives SMEs 		P2 (Investments), ERDF, CF, InvestEU, EIB
		Expand regional demonstrators (≥18 lines by 2030, ≥30 kt/yr residues valorised), with local training and advisory packages to build acceptance	2028-2034 (scaling & outreach)	<ul style="list-style-type: none"> Ministry of agriculture farmer advisory centres universities producer groups NGOs 		P2 (Cooperation/AKIS), LIFE, Erasmus+
		Monitor production and impacts (t/yr residues cascaded, kg/yr PHA/DES, % locally sourced biomass, life cycle assessment indicators for fossil substitution) with public reporting	2028-2034 (monitoring & evaluation)	<ul style="list-style-type: none"> Ministry of agriculture research institutions in agriculture statistical office life cycle assessment experts regional hubs 		HE, LIFE, DEP

17	Establishment of national bioproduct certification and activation of green public procurement (GPP) to build market demand	Design/update national certification/label framework for biobased and biodegradable products (performance, durability, biodegradation, life cycle assessment modules, EU taxonomy alignment)	2026-2027 (preparation)	<ul style="list-style-type: none"> • Ministry of agriculture (Lead) • managing/ paying authority • national standardisation body • research institutions in agriculture • universities 	Governance & AKIS	TA CAP, HE, LIFE
		Pilot validation protocols and certification (≥15 products by 2027) through innovation operational groups under EIP consortia (SMEs + labs + farmers), with independent testing and public registry setup	2026-2027 (pilot)	<ul style="list-style-type: none"> • innovation operational groups under EIP groups • SMEs • research labs • universities • competent authorities (observer role) 		EIP-OG (P2), HE, National Funds
		Develop GPP guidance package (training curricula, template tender clauses, procurement criteria) and train ≥200 procurers (municipalities, hospitals, schools)	2026-2027 (capacity-building)	<ul style="list-style-type: none"> • Ministry of agriculture • local authorities • NGOs • advisory services providers 		Erasmus+, LIFE, Interreg
		Scale certification scheme nationwide (≥40 products certified by 2030), integrate with EU ecolabel/taxonomy, and support SMEs via micro-grants for certification costs	2028-2034 (implementation & scaling)	<ul style="list-style-type: none"> • Ministry of agriculture (Lead) • paying agency • SMEs • universities • producer organisations 		P2 (Cooperation), HE, LIFE
		Mainstream GPP pilots (≥50 tenders/yr using bioproduct criteria by 2030), monitor share of GPP spend on certified products, and publish annual uptake reports	2028-2034 (market activation & monitoring)	<ul style="list-style-type: none"> • Ministry of agriculture • local authorities • statistical office • advisory services providers • NGOs 		National Funds, ERDF,



18	Organisation of biomass mobilisation and regional feedstock hubs for high-value material-grade uses	Conduct regional biomass mapping (municipality → region), identifying dispersed residues/side-streams and potential aggregation nodes	2026-2027 (preparation)	<ul style="list-style-type: none"> Ministry of agriculture (Lead) regional authorities research institutions in agriculture cooperatives universities 	Rural Communities & Regional Bioeconomy Hubs	HE, LIFE, TA CAP
		Pilot 5-7 feedstock hubs with cooperatives/local action groups , testing segregation, drying, fractionation, quality assurance and digital traceability tools	2026-2027 (pilot)	<ul style="list-style-type: none"> local action groups producer groups SMEs (logistics/pre-processing) advisory centres 		LEADER (P2), EIP-OG (P2), Interreg
		Develop standard contracts and quality protocols for farm-hub supply , ensuring cascading priority (materials before energy) and compliance with waste/OSH rules	2026-2027 (framework)	<ul style="list-style-type: none"> Ministry of agriculture plant protection and seed inspection service producer associations legal/standards bodies 		HE, LIFE, National Funds
		Roll out investment support for regional hubs (≤65% CAPEX), including pre-processing, storage, drying and logistics equipment	2028-2034 (implementation)	<ul style="list-style-type: none"> Ministry of agriculture (Lead) paying agency cooperatives regional authorities 		P2 (Investments), ERDF, CF
		Scale mobilisation to ≥250 kt/yr biomass with ≥200 farm-hub contracts , lowering unit costs and stabilising input streams for PHA/DES bioprocessing	2028-2034 (scaling)	<ul style="list-style-type: none"> Ministry of agriculture cooperatives producer groups SMEs advisory services providers 		P2 (Cooperation), HE, LIFE
		Monitor flows and impacts (t/yr material-grade biomass, logistics loss %, GHG footprint of chains)	2028-2034 (monitoring)	<ul style="list-style-type: none"> Ministry of agriculture research institutions in agriculture 		DEP, LIFE, HE



		and publish annual progress reports	& evaluation)	<ul style="list-style-type: none"> • statistical office • regional hubs • independent evaluators 		
19	Implementation of a result-based eco-scheme paying for verified ecosystem services with digital MRV and AKIS support	Develop ecosystem service indices and valuation models (SOC, biodiversity habitat, water retention/quality, GHG balance etc.) aligned with CAP performance indicators	2026-2027 (preparation)	<ul style="list-style-type: none"> • Ministry of agriculture (Lead) • research institutions in agriculture • national soil hub • universities • NGOs 	Climate & Environmental Sustainability	
		Design and test digital MRV protocols (RS/GIS, sensors, farm logs, open standards) with baseline onboarding on ≥120k ha	2026-2027 (pilot)	<ul style="list-style-type: none"> • Ministry of agriculture • paying agency • IT partners • producer groups • advisory services providers 		HE, LIFE, TA CAP
		Develop training and advisory packages (modular skill certificates for advisors/farmers; demos on regenerative practices, biodiversity features, nutrient/water planning)	2026-2027 (capacity-building)	<ul style="list-style-type: none"> • farmers advisory units (Lead) • farmer advisory units • universities • producer groups • NGOs 		P1 (Eco-schemes), DEP, HE
		Roll out national eco-scheme contracts (100-220 €/ha, tiered by verified outcomes; ≤30 €/ha for baseline tests), prioritising erosion/nutrient-risk catchments and low-SOC districts	2028-2034 (implementation)	<ul style="list-style-type: none"> • Ministry of agriculture (Lead) • paying agency • advisory services providers • producer organisations 		P2 (AKIS/KT), Erasmus+
		Integrate optional linkages to bioenergy residue management	2028-2034 (integration)	<ul style="list-style-type: none"> • Ministry of agriculture • cooperatives • SMEs 		P1 (Eco-schemes), National Funds



		where it demonstrably improves nutrient/GHG/water outcomes		<ul style="list-style-type: none"> • advisory services providers 		
		Monitor and publish annual eco-service results (Δ SOC, pollinator/habitat index, nitrate risk, m ³ water retained/ha, GHG balance per ha; % farms with MRV adoption)	2028-2034 (monitoring & reporting)	<ul style="list-style-type: none"> • Ministry of agriculture • research institutions in agriculture • statistical office • independent evaluators 		P2 (AECM/Cooperation), LIFE
20	Cooperation for certification, standards and pilots enabling trust and market uptake of high-value bioproducts	Establish validation framework for bioproduct performance, durability and environmental impact (life cycle assessment-based), aligned with EU law and taxonomy	2026-2027 (preparation)	<ul style="list-style-type: none"> • Ministry of agriculture (Lead) • national standardisation body • research institutions in agriculture • universities • SMEs (observer role: competent authorities) 	Governance & AKIS	HE, LIFE, TA CAP
		Launch innovation operational groups under EIP pilots (≥ 20 by 2027) testing biopolymers, bioplastics and biomaterials on farms and pilot-scale facilities; results to feed into public registry	2026-2027 (pilot)	<ul style="list-style-type: none"> • innovation operational groups under EIP consortia • producer groups • SMEs • research labs • universities 		EIP-OG (P2), Interreg
		Develop certification criteria & labels (safety, efficacy, sustainability), and provide training for buyers/procurers and advisors on verified bioproduct use	2026-2027 (knowledge base & capacity-building)	<ul style="list-style-type: none"> • Ministry of agriculture • farmer advisory units • universities • NGOs 		HE, LIFE, Erasmus+



		Scale programme to ≥50 pilots and ≥25 certified products/labels by 2030 , integrating certification into AKIS advisory materials and procurement guidance	2028-2034 (implementation & scaling)	<ul style="list-style-type: none"> • Ministry of agriculture (Lead) • paying agency • producer groups • SMEs • advisory networks 		P2 (AKIS/KT), National Funds, LIFE
		Operate transparent registry & annual reporting system (validated products, certified labels, adoption/complaint data) to build farmer and buyer trust	2028-2034 (monitoring & transparency)	<ul style="list-style-type: none"> • Ministry of agriculture 		DEP, LIFE, HE
21	Development of biomass cascading hubs and biorefinery-ready feedstock supply chains	Conduct regional biomass mapping and clustering to identify priority residues/side-streams and candidate hub locations	2026-2027 (preparation)	<ul style="list-style-type: none"> • Ministry of agriculture (Lead) • regional authorities • research institutions in agriculture • producer groups • universities 	Sustainable Agriculture, Food & Forestry Value Chains	HE, LIFE, TA CAP
		Pilot 5-7 cascading hubs testing segregation, drying, fractionation and QA protocols for material-grade feedstock (PLA/PEF, biochemicals)	2026-2027 (pilot)	<ul style="list-style-type: none"> • cooperatives • local action groups • SMEs (logistics, pre-processing) • producer organisations • advisory services providers 		EIP-OG (P2), Interreg, HE
		Develop standard contracts and traceability protocols (farm-hub agreements, digital QA, cascading priority, waste/environmental compliance)	2026-2027 (framework)	<ul style="list-style-type: none"> • Ministry of agriculture • plant protection and seed inspection service • standardisation bodies • producer associations 		HE, LIFE, National Funds



		Launch investment support for regional hubs ($\leq 65\%$ CAPEX for drying, milling, separation, storage, logistics infrastructure)	2028-2034 (implementation)	<ul style="list-style-type: none"> Ministry of agriculture (Lead) paying agency cooperatives regional authorities SMEs 		P2 (Investments), ERDF, CF
		Scale supply mobilisation to ≥ 250 kt/yr with ≥ 200 farm-hub contracts , ensuring verified material-grade tonnage flows to bioprocessing chains	2028-2034 (scaling)	<ul style="list-style-type: none"> Ministry of agriculture cooperatives producer groups SMEs universities 		P2 (Cooperation), LIFE, HE
		Monitor feedstock quality and cascading outcomes (t/yr certified streams, logistics loss %, GHG footprint, share of material vs. energy use)	2028-2034 (monitoring & evaluation)	<ul style="list-style-type: none"> Ministry of agriculture research institutions in agriculture statistical office independent evaluators regional hubs 		DEP, LIFE, HE
22	Expansion of perennial biomass and fruit plantations delivering carbon, water and cascading feedstock benefits	Develop eligibility list and guidance for perennial species (industrial/energy + fruit) including soil/water benefits, cascading suitability and biodiversity safeguards	2026-2027 (preparation)	<ul style="list-style-type: none"> Ministry of agriculture (Lead) research institutions in agriculture universities producer groups NGOs 	Climate Environmental Sustainability &	TA CAP, HE, LIFE
Pilot establishment of perennials (≥ 40 k ha by 2027) in erosion/drought districts, including water-retention micro-works and soil cover protocols		2026-2027 (pilot)	<ul style="list-style-type: none"> producer groups advisory centres cooperatives local authorities 	AECM (P2), LIFE, National Funds		
Launch full result-based AECM contracts (100-220 €/ha, tiers by SOC gain/erosion risk/water retention) with $\leq 65\%$		2028-2034 (implementation)	<ul style="list-style-type: none"> Ministry of agriculture (Lead) paying agency producer organisations advisory services providers 	AECM (P2), P2 (Investments), ERDF		



		establishment grants (caps by species/ha)				
		Integrate perennial biomass flows into cascading value chains (priority material-grade uses: bioplastics, biochemicals; only residues to energy) via supply contracts	2028-2034 (integration)	<ul style="list-style-type: none"> • Ministry of agriculture • regional hubs • cooperatives • SMEs • biorefineries 		HE, Interreg, CBE-JU
		Monitor ecosystem outcomes and feedstock flows (Δ SOC, infiltration/erosion indices, ha established, tonnes contracted into cascades) with annual reporting	2028-2034 (monitoring & evaluation)	<ul style="list-style-type: none"> • Ministry of agriculture • research institutions in agriculture • statistical office • advisory services providers • regional hubs 		P2 (Monitoring), LIFE, DEP
23	Establishment of insect bioconversion hubs for agricultural residues through EIP pilots and modular investments	Develop regulatory and technical guidance for insect bioconversion (residue eligibility, hygiene, feed/fertiliser compliance, environmental safeguards)	2026-2027 (preparation)	<ul style="list-style-type: none"> • Ministry of agriculture (Lead) • plant protection and seed inspection service • research institutions in agriculture • universities • NGOs 	Sustainable Agriculture, Food & Forestry Value Chains	TA CAP, HE, LIFE
		Launch first wave of insect hubs/pilots (≥ 20 by 2027) with modular breeding/bioconversion units, residue pre-treatment and quality/safety protocols	2026-2027 (pilot)	<ul style="list-style-type: none"> • innovation operational groups under EIP consortia • cooperatives • SMEs • advisory services providers • local authorities 		EIP-OG (P2), Interreg, HE
		Design and roll out workforce training programmes (technical staff, advisors, farmers) to close skills gaps; link to AKIS modular skill certificates	2026-2027 (capacity-building)	<ul style="list-style-type: none"> • farmers advisory units (Lead) • universities • vocational schools • NGOs 		Erasmus+, (AKIS/KT), LIFE



		Provide investment grants for modular facilities and logistics (≤65% for SMEs/cooperatives; micro-grants for certification/ testing)	2028-2034 (implementation)	<ul style="list-style-type: none"> • Ministry of agriculture • paying agency • regional authorities • producer groups • SMEs 		P2 (Investments), ERDF, CF, National Funds
		Scale insect hub network to ≥50 operational hubs by 2030 , processing ≥30 kt/yr residues into insect products (meals, oils, frass), with verified markets and community engagement plans	2028-2034 (scaling & integration)	<ul style="list-style-type: none"> • Ministry of agriculture • cooperatives • SMEs • regional hubs • local authorities 		P2 (Cooperation), CBE-JU, LIFE
		Monitor performance and acceptance (residues converted, products sold, staff trained, complaint rates ↓, nutrient cycling indicators) with annual reporting	2028-2034 (monitoring & evaluation)	<ul style="list-style-type: none"> • Ministry of agriculture • research institutions in agriculture • statistical office • independent evaluators 		DEP, LIFE, HE
24	Cooperation for lignocellulosic biomass cascading into high-value bioproducts through regional hubs and value-chain contracts	Conduct resource mapping and supply chain analysis for agricultural and forest lignocellulosic biomass , identifying residues, perennials, and logistics bottlenecks	2026-2027 (preparation)	<ul style="list-style-type: none"> • Ministry of agriculture (Lead) • State Forests • research institutions in agriculture • universities • cooperatives • SMEs 	Sustainable Agriculture, Food & Forestry Value Chains	HE, LIFE, TA CAP
		Pilot cascading hubs and demo lines (≥100 kt/yr material-grade feedstock) testing drying, fractionation, QA protocols, and small-scale	2026-2027 (pilot)	<ul style="list-style-type: none"> • producer groups • forest owners • SMEs • research institutes • advisory centres 		EIP-OG (P2), Interreg, HE



		polymer/fermentation processing				
		Develop standard contracts and quality protocols for farm/forest-hub supply, ensuring cascading hierarchy (materials > energy) and environmental safeguards	2026-2027 (framework)	<ul style="list-style-type: none"> • Ministry of agriculture • plant protection and seed inspection service • standardisation bodies • producer/forest associations 		HE, LIFE, National Funds
		Roll out investment support for regional cascading hubs (≤65% CAPEX) including pre-processing, storage, separation, QA equipment, and logistics infrastructure	2028-2034 (implementation)	<ul style="list-style-type: none"> • Ministry of agriculture • paying agency • cooperatives • SMEs • regional authorities 		P2 (Investments), ERDF, CF, InvestEU, EIB
		Scale cascading mobilisation to ≥250 kt/yr with ≥200 long-term farm/forest contracts feeding into functional biopolymer/biochemical lines	2028-2034 (scaling)	<ul style="list-style-type: none"> • Ministry of agriculture • cooperatives • producer groups • national forests • SMEs • biorefineries 		P2 (Cooperation), CBE-JU, LIFE
		Monitor cascading outcomes (t/yr certified lignocellulosic feedstock, % losses, # new SKUs, GHG substitution) and publish annual performance reports	2028-2034 (monitoring & evaluation)	<ul style="list-style-type: none"> • Ministry of agriculture • research institutions in agriculture • statistical office • independent evaluators 		DEP, LIFE, HE
25	Implementation of a precision-enabled result-based eco-scheme	Develop composite outcome indicators (kg/ha N saved, % PPP active ingredient reduced, m³/ha water saved, ΔSOC proxy) with MRV protocols and baselines	2026-2027 (preparation)	<ul style="list-style-type: none"> • Ministry of agriculture (Lead) • research institutions in agriculture • universities • national soil hub • IT partners 	Climate & Environmental Sustainability	HE, LIFE, TA CAP



	rewarding nutrient, PPP and water efficiency outcomes	Pilot eco-scheme contracts (≥120k ha by 2027) with digital MRV tools (RS/GIS, sensors, decision support, biosensors) in nitrate-risk and drought districts	2026-2027 (pilot)	<ul style="list-style-type: none"> Ministry of agriculture paying agency producer groups cooperatives advisory centres 		P1 (Eco-schemes), DEP, HE
		Develop training and onboarding packages (modular skill certificates for advisors, farmer workshops on precision MRV and nutrient/PPP optimisation)	2026-2027 (capacity-building)	<ul style="list-style-type: none"> farmer advisory units universities NGOs SMEs 		P2 (AKIS/KT), Erasmus+
		Roll out full-scale eco-scheme (90-210 €/ha by outcome tier; ≤30 €/ha baseline tests; ceilings to prevent windfalls), with integration into IACS/LPIS	2028-2034 (implementation)	<ul style="list-style-type: none"> Ministry of agriculture (Lead) paying agency producer groups advisory services providers IT providers 		P1 (Eco-schemes), National Funds
		Monitor outcomes and publish annual results (kg/ha N & PPP saved, m ³ water saved, ΔSOC proxy, share of MRV adoption) with CAP performance links	2028-2034 (monitoring & reporting)	<ul style="list-style-type: none"> Ministry of agriculture research institutions in agriculture statistical office independent evaluators 		P1 (Eco-schemes), DEP, LIFE
26	Investments in precision farming and establishment of a national open data standard and repository	Develop and adopt national open standard for farm data (schemas, APIs, cataloguing rules) ensuring interoperability and vendor neutrality	2026-2027 (preparation)	<ul style="list-style-type: none"> Ministry of agriculture (Lead) national R&D funding agency IT partners standardisation bodies advisory services providers 	Research, Innovation & Digitalisation	HE, DEP, TA CAP
		Establish national repository and catalogue of precision tools (≥100 by 2027), with open APIs for integration into IACS/LPIS and advisory platforms	2026-2027 (pilot)	<ul style="list-style-type: none"> Ministry of agriculture IT providers universities advisory centres 		HE, DEP, ERDF



	for interoperability	Provide investment support for farm precision packages (GNSS/RTK, sensors, VRA kits, RS subscriptions, connectivity upgrades, AI/decision tools)	2026-2034 (implementation)	<ul style="list-style-type: none"> • Ministry of agriculture • paying agency • cooperatives • SMEs • producer groups 		P2 (Investments), ERDF, CF, InvestEU, EIB
		Deliver training and modular skill certificates for advisors/farmers on precision adoption, data management and use of interoperable tools	2026-2034 (capacity-building)	<ul style="list-style-type: none"> • farmer advisory units • universities • NGOs • producer groups 		P2 (AKIS/KT), Erasmus+
		Scale adoption and data sharing to ≥35k farms and ≥500 API integrations by 2030, with annual monitoring of precision uptake and repository usage	2028-2034 (scaling & monitoring)	<ul style="list-style-type: none"> • Ministry of agriculture • research institutions in agriculture • advisory services providers • IT providers • statistical office 		P2 (Monitoring), LIFE, DEP
27	Result-based horticulture soil regeneration and peat-free substrate adoption	Baseline mapping of horticultural holdings (berries, orchards) including peat use, soil health, PPP intensity, and available local biomass (spent mushroom substrate, beet pulp, compost, digestate)	2026-2027 (preparation)	<ul style="list-style-type: none"> • Ministry of agriculture • research institutions in agriculture • statistical office • producer organisations (berries, apples) 	Climate Environmental Sustainability &	HE, LIFE, TA CAP
		Launch pilot agri-environment-climate interventions contracts in priority regions (light soils, high peat dependency), rewarding verified soil health	2026-2027 (pilot)	<ul style="list-style-type: none"> • Ministry of agriculture • paying agency • farmer advisory units 		AECM (P2), LIFE, National Funds



		gains and peat substitution with result-based payments				
		Develop national protocols and certification for peat-free substrate mixes and bio-inputs (compost, digestate, microbial biocontrol), ensuring safety and farmer confidence	2027-2028	<ul style="list-style-type: none"> • research institutions in agriculture • universities • NGOs • certification bodies 		HE, LIFE, CBE-JU
		Scale contracts nationally with tiered payments linked to SOC gain, peat substitution rate, and reductions in mineral fertiliser/PPP intensity	2028-2034	<ul style="list-style-type: none"> • Ministry of agriculture • paying agency • producer groups 		AECM (P2), P2 (Monitoring), DEP
		Provide advisory modular skill certificates & demos on regenerative horticulture, composting/fermentation techniques, and safe bio-input use; connect with EIP pilots for innovation transfer	2026-2034	<ul style="list-style-type: none"> • farmer advisory units • universities • producer organisations 		P2 (AKIS/KT), Erasmus+, EIP-OG (P2)
		Monitor outcomes with composite Horticulture Soil & Input Index (SOC, infiltration, % peat substitution, mineral input reductions), feeding data into CAP performance framework	2027-2034	<ul style="list-style-type: none"> • research institutions in agriculture • advisory services providers • independent labs 		P2 (Monitoring), LIFE, DEP



28	Local biomass-to-substrate hubs for peat-free horticulture	Map regional biomass streams and candidate sites (SMS, beet pulp, digestate, perennial grasses) to identify priority clusters for substrate hubs	2026-2027 (preparation)	<ul style="list-style-type: none"> • Ministry of agriculture • research institutions in agriculture • producer organisations (berries/apples) • mushroom & sugar industry associations 	Rural Communities & Regional Bioeconomy Hubs	HE, LIFE, TA CAP
		Launch 5-6 demonstration hubs under innovation operational groups under EIP with universities/advisory + private partners, testing composting/blending protocols and quality assurance	2026-2027 (pilot)	<ul style="list-style-type: none"> • Ministry of agriculture • paying agency • EIP consortia • SMEs/coops 		EIP-OG (P2), Interreg, HE
		Develop national QA standards and certification for peat-reduced substrates , aligned with EU taxonomy and fertiliser regulation; publish open access guidelines	2027-2028	<ul style="list-style-type: none"> • research institutions in agriculture • research institutes • certifying bodies • NGOs 		HE, LIFE, CBE-JU
		Scale up to ≥25 hubs with investment grants (aerobic composting, drying/fractionation, QA labs, logistics) and long-term supply contracts with horticultural farms	2028-2034	<ul style="list-style-type: none"> • Ministry of agriculture • Regional authorities • producer coops • SMEs 		P2 (Investments), ERDF, CF, National Funds
		Integrate hubs with Living-Lab demo farms showing horticulture soil regeneration and peat substitution in	2028-2034	<ul style="list-style-type: none"> • farmers advisory units • universities • producer organisations 		P2 (Cooperation/AKS), LIFE, Erasmus+



		practice; link with AECM contracts to reward verified outcomes				
		Monitor adoption & peat substitution via hub logs, farm contracts, and audits; feed data into CAP performance indicators (R.2, R.34, peat % reduction)	2027-2034	<ul style="list-style-type: none"> • research institutions in agriculture • paying agency • advisory services providers 		P2 (Monitoring), LIFE, DEP
29	Bio-input pilots and regulatory feedback through innovation operational groups under EIP and AKIS	Identify priority crops and input categories (berries, orchards, greenhouse veg; biostimulants, biocontrols, compost/digestate blends) and launch first EIP calls	2026-2027 (preparation)	<ul style="list-style-type: none"> • Ministry of agriculture (Lead) • research institutions in agriculture • farmers advisory units • producer groups • SMEs 	Research, Innovation & Digitalisation	EIP-OG (P2), HE, LIFE
		Conduct on-farm comparative pilots with common efficacy and safety protocols, covering yield, input substitution and soil indicators	2026-2028 (pilots)	<ul style="list-style-type: none"> • EIP consortia (growers, SMEs, advisors, labs) • universities 		HE, LIFE, National Funds
		Develop common guidance dossiers and advisory protocols (validated by ≥5 pilots), share with advisory networks and integrate into Living Labs	2028-2029	<ul style="list-style-type: none"> • research institutions in agriculture • farmers advisory units • universities • advisory services providers 		HE, EIP-OG (P2), Interreg
		Train advisors and growers via modular skill certificates and demo events, targeting ≥4k trained by 2030	2027-2034	<ul style="list-style-type: none"> • farmers advisory units • universities • producer groups • NGOs 		P2 (AKIS/KT), Erasmus+



		Provide regulatory feedback loop: publish evidence for simplified approval pathways, engage with competent authorities, and support SMEs with micro-grants for data packages	2027-2034	<ul style="list-style-type: none"> • Ministry of agriculture • national R&D funding agency • SMEs • certifying bodies 		HE, LIFE, National Funds
		Scale adoption and track uptake via farm logs, advisory audits and surveys (CAP indicators + adoption intent/use rates)	2028-2034	<ul style="list-style-type: none"> • Ministry of agriculture • research institutions in agriculture • paying agency • advisory services providers 		P2 (Monitoring), LIFE, DEP
30	Result-based carbon farming with organic amendments (digestate, biochar, compost)	Develop national certification and traceability rules for digestate, biochar and compost (quality, contamination, origin) and define SOC stability factors for payments	2026-2027 (preparation)	<ul style="list-style-type: none"> • Ministry of agriculture (Lead) • research institutions in agriculture • environment protection public bodies • standardisation bodies • paying agency 	Climate Environmental Sustainability &	HE, LIFE, TA CAP
		Launch pilot agri-environment-climate interventions contracts with farms in low-SOC/light soils to test protocols for SOC baselining, monitoring and contamination audits	2026-2027 (pilots)	<ul style="list-style-type: none"> • Ministry of agriculture • regional authorities • research institutions in agriculture • producer groups • advisory services providers 		AECM (P2), LIFE, National Funds
		Establish lab & advisory capacity for SOC testing and farm nutrient-carbon planning; integrate with AKIS training modules	2026-2028	<ul style="list-style-type: none"> • research institutions in agriculture • farmers advisory units • universities • advisory networks 		P2 (AKIS/KT), Erasmus+, HE



		Scale payments for verified SOC gains: expand to ≥ 180 k ha with annual audits; link to amendment producers (AD, pyrolysis, compost hubs) to secure supply	2028-2034	<ul style="list-style-type: none"> • Ministry of agriculture • paying agency • producer organisations • AD/ pyrolysis/ compost plants 		AECM (P2), ERDF, CF
		Integrate digital MRV tools (RS, soil sensors, dashboards) to reduce verification costs and ensure transparency for farmers and authorities	2028-2034	<ul style="list-style-type: none"> • Ministry of agriculture • research institutions in agriculture • IT providers • advisory networks 		DEP, HE, LIFE
		Monitor, evaluate & adjust payment tiers based on SOC outcomes, mineral-N reductions, and contamination pass rates; publish annual performance reports	2028-2034	<ul style="list-style-type: none"> • Ministry of agriculture • research institutions in agriculture • paying agency • statistical office 		P2 (Monitoring), LIFE, National Funds
31	Local biogas from waste biomass with on-site energy use and odour control	Map priority regions and clusters with high waste-biomass availability (segregated bio-waste, manure, crop residues) and local energy demand (farms/processors)	2026-2027 (preparation)	<ul style="list-style-type: none"> • Ministry of agriculture (Lead) • national environmental and water management fund • statistical office • regional authorities • municipalities 	Sustainable Agriculture, Food & Forestry Value Chains	HE, LIFE, TA CAP
		Launch EIP pilots for siting, short-haul logistics and odour/abatement protocols with farm/municipal consortia	2026-2027 (pilots)	<ul style="list-style-type: none"> • Ministry of agriculture • research institutions in agriculture • producer groups • SMEs • local governments 		EIP-OG (P2), Interreg, HE

		Provide investment support for anaerobic digestion units, CHP/heat networks, digestate storage & processing, and best-available odour/leachate control	2028-2034	<ul style="list-style-type: none"> Ministry of agriculture paying agency producer groups/coops SMEs municipalities 		P2 (Investments), ERDF, CF, National Funds
		Integrate digestate flows into result-based agri-environmental-climate measure (carbon farming, nutrient substitution) via certified nutrient plans and soil contracts	2028-2034	<ul style="list-style-type: none"> research institutions in agriculture advisory services providers producer organisations 		AECM (P2), LIFE, HE
		Engage communities and monitor acceptance through information events, transparent reporting of odour/complaints, and co-design of projects with local action groups	2027-2034	<ul style="list-style-type: none"> local action groups NGOs municipalities producer groups 		LEADER (P2), LIFE, Interreg
		Track energy/digestate outputs and GHG abatement via plant meters, nutrient plans, and annual audits; adjust support where on-site use <70%	2028-2034	<ul style="list-style-type: none"> Ministry of agriculture paying agency research institutions in agriculture energy regulators 		P2 (Monitoring), LIFE, DEP
32	Pilots for pyrolysis and compost heat-	Identify biomass streams and candidate sites (woody residues, straw, landscape biomass, green waste) with proximity to farms/municipal heat users	2026-2027 (preparation)	<ul style="list-style-type: none"> Ministry of agriculture (Lead) national environmental and water management fund municipalities producer groups 	Climate Environmental Sustainability &	HE, LIFE, TA CAP



recovery with biochar/substrate QA			<ul style="list-style-type: none"> research institutions in agriculture 	
	Launch EIP pilots of modular pyrolysis units and composting with heat recovery, covering at least 5 regions, with protocols for emissions, odours and social engagement	2026-2027 (pilots)	<ul style="list-style-type: none"> EIP consortia (farmers, SMEs, municipalities, universities) NGOs (observer role) 	EIP-OG (P2), Interreg, HE
	Develop national QA standards for biochar (stability, contaminants, carbon index) and compost/substrate (metals, plastics, phytotoxicity) linked to carbon-farming agri-environmental-climate measure and substrate hubs	2027-2028	<ul style="list-style-type: none"> research institutions in agriculture environment protection public bodies universities standardisation bodies 	HE, LIFE, CBE-JU
	Scale pilots and co-finance modular lines (pyrolysis, compost heat capture, QA labs) with investment support and SME micro-grants for certification/ testing	2028-2034	<ul style="list-style-type: none"> Ministry of agriculture paying agency regional authorities producer groups 	P2 (Investments), ERDF, CF, National Funds
	Link outputs to field use: apply ≥ 10 kt/year certified biochar/compost into agri-environmental-climate measure parcels (SOC outcome contracts, horticulture substrates)	2028-2034	<ul style="list-style-type: none"> research institutions in agriculture producer groups advisory services providers 	AECM (P2), LIFE, HE



		Monitor and report biomass processed, SOC gain potential, MWh heat recovered, contamination rates, and community acceptance (complaints ↓); feed data into CAP performance	2028-2034	<ul style="list-style-type: none"> • Ministry of agriculture • research institutions in agriculture • paying agency • municipalities 		P2 (Monitoring), LIFE, DEP
33	Mixed crop-livestock and agroforestry transitions with result-based outcomes and establishment support	Map candidate regions and farming systems with high erosion/drought risk and underdeveloped mixed/agroforestry potential (permanent grasslands, arable monocultures)	2026-2027 (preparation)	<ul style="list-style-type: none"> • Ministry of agriculture (Lead) • research institutions in agriculture • statistical office • regional authorities • producer groups 	Climate Environmental Sustainability &	HE, LIFE, TA CAP
		Launch pilot agri-environmental-climate measure contracts testing the Agro-Resilience Index (Δ SOC, erosion/cover, microclimate, N balance) and associated monitoring protocols	2026-2027 (pilots)	<ul style="list-style-type: none"> • research institutions in agriculture • farmers advisory units • universities • farmer consortia 		AECM (P2), HE, LIFE
		Provide establishment support for agroforestry rows, tree planting, fencing, watering points, and livestock housing upgrades that cut nutrient/odour losses	2026-2028	<ul style="list-style-type: none"> • Ministry of agriculture • paying agency • cooperatives • municipalities 		P2 (Investments), ERDF, CF
		Scale AECM payments to ≥ 60 k ha under verified outcome contracts, with annual	2028-2034	<ul style="list-style-type: none"> • Ministry of agriculture • paying agency 		AECM (P2), (Monitoring), DEP

P2

		soil/water tests and RS/GIS-based erosion monitoring		<ul style="list-style-type: none"> • research institutions in agriculture • advisory services providers 		
		Develop value-chain linkages: mobilise lignocellulose from agroforestry thinning into cascading uses, integrate manure cycling into digestate hubs	2028-2034	<ul style="list-style-type: none"> • producer groups • biomass hubs • local action groups • SMEs 		HE, CBE-JU, Interreg
		Monitor, evaluate & report SOC, erosion risk, manure recycling, and adoption intent; publish annual performance reports feeding CAP indicators	2027-2034	<ul style="list-style-type: none"> • Ministry of agriculture • research institutions in agriculture • paying agency • advisory services providers 		P2 (Monitoring), LIFE, National Funds
34	Livestock modernisation and flexible biogas at point of use	Map priority livestock regions and clusters (high slurry/manure surplus + processors as energy users) and develop siting/odour protocols under innovation operational groups under EIP pilots	2026-2027 (preparation /pilots)	<ul style="list-style-type: none"> • Ministry of agriculture (Lead) • research institutions in agriculture • national environmental and water management fund • producer groups • local authorities 	Sustainable Agriculture, Food & Forestry Value Chains	EIP-OG (P2), HE, LIFE
		Launch housing modernisation support: retrofits with welfare/nutrient capture (slurry separation, covers, scrubbers) and odour control	2026-2028 (initial rollout)	<ul style="list-style-type: none"> • paying agency • Ministry of agriculture • producer coops • SMEs 		P2 (Investments), ERDF, CF, National Funds
		Provide investment support for flexible anaerobic digestion units at farm/cluster scale with	2026-2034	<ul style="list-style-type: none"> • Ministry of agriculture • paying agency • producer organisations 		P2 (Investments), LIFE, CF



		on-site energy use (CHP, local heat networks, optional upgrading)		<ul style="list-style-type: none"> • municipalities 		
		Integrate digestate flows into carbon-farming and nutrient AECMs through certified nutrient plans and advisory audits	2028-2034	<ul style="list-style-type: none"> • research institutions in agriculture • advisory services providers • producer groups 		AECM (P2), LIFE, HE
		Develop and certify logistics protocols for short-haul feedstock collection and nutrient return , scaling through EIP cooperation projects	2027-2030	<ul style="list-style-type: none"> • producer organisations • logistics SMEs • advisory services providers 		EIP-OG (P2), Interreg, HE
		Monitor performance & acceptance: track Nm ³ biogas/yr, on-site use ratio (>70%), odour complaint rates, welfare compliance, and digestate application quality	2027-2034	<ul style="list-style-type: none"> • Ministry of agriculture • research institutions in agriculture • paying agency • NGOs (observer role) 		P2 (Monitoring), LIFE, DEP
35	Digital MRV and resource-efficient production for low-carbon food systems	Map existing MRV initiatives and digital tools (RS/GIS, IoT, farm platforms) and identify gaps in protocols/coverage (soil, water, nutrients, biodiversity)	2026-2027 (preparation)	<ul style="list-style-type: none"> • Ministry of agriculture (Lead) • research institutions in agriculture • farmers advisory units • IT partners • advisory services providers 	Research, Innovation & Digitalisation	HE, LIFE, DEP
		Launch innovation operational groups under EIP pilots to co-develop and validate MRV protocols (parcel-level SOC, N	2026-2027 (pilots)	<ul style="list-style-type: none"> • EIP consortia • research institutions in agriculture • universities 		EIP-OG (P2), Interreg, HE



		losses, water indices) and integrate ES valuation models		<ul style="list-style-type: none"> farmer groups 		
		Provide investment support for farm/cooperative adoption of digital MRV devices (sensors, biosensors, RS subscriptions, smart irrigation kits) and precision/regenerative upgrades	2027-2034	<ul style="list-style-type: none"> Ministry of agriculture paying agency producer groups SMEs 		P2 (Investments), ERDF, CF, National Funds
		Establish a national open data standard & dashboards for parcel/farm-level results, interoperable with IACS/LPIS/FSDN and advisory platforms	2027-2029	<ul style="list-style-type: none"> Ministry of agriculture research institutions in agriculture national R&D funding agency IT consortia 		DEP, HE, LIFE
		Train advisors and farmers (modular skill certificates) in MRV use, ES valuation tools, and regenerative precision practices, targeting ≥20k users by 2030	2026-2034	<ul style="list-style-type: none"> farmers advisory units universities NGOs producer groups 		P2 (AKIS/KT), Erasmus+, LIFE
		Scale integration with AECM and eco-schemes: ensure all result-based contracts use validated MRV protocols and support annual performance reporting	2028-2034	<ul style="list-style-type: none"> Ministry of agriculture paying agency advisory services providers research institutions in agriculture 		P1 (Eco-schemes), AECM (P2), LIFE
36	Result-based eco-scheme for low-carbon	Develop methodology and baseline factors for field GHG intensity (kg CO ₂ e/ha; N ₂ O from fertiliser) consistent with RED sustainability criteria	2026-2027	<ul style="list-style-type: none"> Ministry of agriculture research institutions in agriculture national R&D funding agency fuel entities 	Climate Environmental Sustainability &	HE, LIFE, TA CAP



	biofuel feedstocks			<ul style="list-style-type: none"> • certifiers 		
		Pilot test on rapeseed & maize parcels in cooperation with biofuel processors/collectors; verify compatibility with SDC proof-of-compliance	2026-2027	<ul style="list-style-type: none"> • innovation operational groups under EIP consortia • farmers • biofuel companies 		P1 (Eco-schemes), Interreg, HE
		Roll out eco-scheme contracts (farm-level enrolment via IACS/LPIS; support for baseline soil/N data and optional MRV tools)	2027-2028	<ul style="list-style-type: none"> • paying agency • advisory services providers • farmers 		P1 (Eco-schemes), National Funds
		Establish MRV framework & digital link to certifiers/first collectors (ensure data flows for RED documentation without duplication)	2027-2029	<ul style="list-style-type: none"> • Ministry of agriculture • IT partners • certifiers 		DEP, HE, LIFE
		Scale-up and integrate with national CAP reporting; expand to other feedstocks where relevant (sunflower, cereals for ethanol)	2028-2034	<ul style="list-style-type: none"> • Ministry of agriculture • farmer groups • biofuel processors 		P1 (Eco-schemes), LIFE, TA CAP
37	Farm & Cluster Biogas/Biomethane with Digestate Circularity	Establish national digestate quality standards & permitting guidance (metals, microplastics, hygiene) + mandatory heat-use planning criteria	2026-2027 (pre-CAP rollout)	<ul style="list-style-type: none"> • monitoring agency • Ministry of climate & environment • research institutions in agriculture • farmers support bodies • inspectorates • certification bodies 	Sustainable Agriculture, Food & Forestry Value Chains	HE, LIFE, TA CAP



		Innovation operational groups under EIP pilots for feedstock logistics & siting (short-haul clusters, contracts, odour mitigation protocols)	2026-2027	<ul style="list-style-type: none"> EIP consortia (farmers, municipalities, logistics SMEs, universities) 		EIP-OG (P2), Interreg, HE
		Launch investment grants scheme under CAP Pillar II (paying agency calls, performance-based contracts)	2027-2028	<ul style="list-style-type: none"> agriculture modernisation units monitoring agency regional governments 		P2 (Investments), ERDF, CF, National Funds
		Integrate digestate into CAP nutrient planning tools (link with eco-schemes/AECM for SOC & nutrient substitution)	2028-2030	<ul style="list-style-type: none"> research institutions in agriculture advisory bodies farmers 		P1 (Eco-schemes), AECM (P2), LIFE
		Scale-up & monitoring (≥130 installations with nutrient plans; ≥70% on-site heat utilisation; verified substitution of mineral N/P)	2028-2034	<ul style="list-style-type: none"> monitoring agency agriculture modernisation units operators farmers 		P2 (Monitoring), LIFE, DEP
38	Residue-to-liquid biofuels pilots (hydrogenation & pyrolysis) with sustainability QA	Establish national QA/MRV standards for residue-to-liquid intermediates (contaminants, life cycle assessment, RED compliance)	2026-2027 (pre-CAP rollout)	<ul style="list-style-type: none"> monitoring agency Ministry of Climate & Environment research institutions in agriculture technical inspection PCA/labs 	Research, Innovation & Digitalisation	HE, LIFE, TA CAP
		Launch innovation operational groups under EIP pilots for hydrogenation of agri-food	2026-2028	<ul style="list-style-type: none"> EIP consortia (farmers, refiners, SMEs, universities, research institutes) 		EIP-OG (P2), Interreg, HE



		wastes and pyrolysis of straw/woody residues, incl. refinery-farmer consortia				
		Deploy selective investment grants for modular pilot units, feedstock pre-treatment and short-haul logistics	2027-2029	<ul style="list-style-type: none"> • agriculture modernisation units • monitoring agency • regional governments • national R&D funding agency 		P2 (Investments), ERDF, CF, National Funds
		Integrate digital MRV & process-analytics (PAT-AI, digital twins) into pilots for scale-up modelling and sustainability reporting	2028-2030	<ul style="list-style-type: none"> • research institutions in agriculture • technical universities • IT/AI providers • advisory bodies 		HE, DEP, LIFE
		Scale-up to ≥35 pilots with ≥25 validated QA/MRV protocols; prepare RED Annex IX-compliant domestic feedstock chain for SAF/HVO	2028-2034	<ul style="list-style-type: none"> • monitoring agency • refiners • operators • certification bodies 		Innovation Fund, CEF Energy, HE
39	Facilitate the deployment of a national digital food passport & traceability system (DPP-ready) to strengthen	Develop national DPP framework and open-data schema (standard for product identification-compatible, API-based, blockchain-ready) including compliance, quality and culinary layers	2026-2027 (pre-CAP rollout)	<ul style="list-style-type: none"> • monitoring agency (Lead) • Ministry of digital affairs • research institutions in agriculture • GS1 product identification system • IT standards bodies 	Sustainable Agriculture, Food & Forestry Value Chains	HE, DEP, LIFE
		Pilot DPP protocols and data flows in innovation operational groups under EIP consortia (farmers, processors, retailers,	2026-2028	<ul style="list-style-type: none"> • EIP consortia • producer groups/coops • SMEs • Regional governments 		EIP-OG (P2), Interreg, HE



	trust, value capture and sustainability verification in agri-food chains	logistics, IT providers) in 3-4 product chains (e.g. dairy, meat, fruit/veg, bakery)				
		Launch national repository and onboarding portal for operators and product lines, with SME micro-grants for data integration	2027-2029	<ul style="list-style-type: none"> • agriculture modernisation units • monitoring agency • GS1 product identification system • advisory bodies (ODR) 		DEP, ERDF, National Funds
		Train advisors, SMEs and retailers on DPP tools, consumer communication kits, and MRV-linked reporting for footprints	2027-2030	<ul style="list-style-type: none"> • research institutions in agriculture • agricultural universities • advisory centres • chambers of commerce 		P2 (AKIS/KT), Erasmus+, HE
		Scale passportisation to ≥12k operators and ≥20% of domestic agri-food SKUs; monitor % sales with scannable provenance and data-quality compliance	2028-2034	<ul style="list-style-type: none"> • monitoring agency • agriculture modernisation units • operators • certification bodies 		DEP, LIFE, HE
40	Facilitate the creation of trusted short supply chains and local partnerships using digital	Design national framework for digital-enabled short supply chains (integration with DPP layers: compliance, quality, culinary) and prepare cooperation call templates	2026-2027 (pre-CAP rollout)	<ul style="list-style-type: none"> • monitoring agency (Lead) • agriculture modernisation units • research institutions in agriculture • GS1 product identification system • advisory bodies 	Rural Communities & Regional Bioeconomy Hubs	HE, LIFE, TA CAP



	provenance tools to improve margins, reduce waste and strengthen consumer trust	Launch pilot partnerships under innovation operational groups under EIP and LEADER (farmer-processor-logistics-retail/HORECA) with shared storefronts, storytelling, and logistics pooling	2026-2028	<ul style="list-style-type: none"> • producer groups • coops • local action groups • SMEs • Regional authorities 		EIP-OG (P2), LEADER (P2), Interreg
		Develop consumer communication and training modules for marketing/storytelling, including passport-enabled smart labels and waste-reduction campaigns	2027-2029	<ul style="list-style-type: none"> • research institutions in agriculture • agricultural universities • advisory centres • NGOs 		Erasmus+, HE, LIFE
		Scale digital-enabled partnerships to ≥800 by 2030, ensuring measurable farmer price premiums and waste reductions, with annual monitoring via e-commerce and sales data	2028-2034	<ul style="list-style-type: none"> • monitoring agency • agriculture modernisation units • producer groups • retailers • certification bodies 		P2 (Cooperation), DEP, National Funds
41	Support residue-to-biogas systems with digital MRV and traceable digestate flows to	Establish national digestate traceability and MRV standards (digital protocols, compliance thresholds, data-sharing rules)	2026-2027 (pre-CAP rollout)	<ul style="list-style-type: none"> • monitoring agency (Lead) • Ministry of climate & environment • research institutions in agriculture • GS1 product identification system • certification bodies 	Sustainable Agriculture, Food & Forestry Value Chains	HE, LIFE, TA CAP



	deliver circularity, verified nutrient recycling, and fossil substitution	Launch innovation operational groups under EIP pilots for short-haul feedstock logistics, odour mitigation, and digital passportisation of biomass/digestate flows	2026-2027	<ul style="list-style-type: none"> • EIP consortia (farmers, coops, municipalities, SMEs) • research institutes • advisory services providers 		EIP-OG (P2), Interreg, HE
		Deploy investment grants scheme for anaerobic digestion units with integrated digital MRV and heat-use planning	2027-2028	<ul style="list-style-type: none"> • agriculture modernisation units • monitoring agency • regional governments 		P2 (Investments), ERDF, CF, National Funds
		Integrate verified digestate data into CAP nutrient planning tools and eco-scheme/AECM monitoring (SOC & nutrient substitution outcomes)	2028-2030	<ul style="list-style-type: none"> • research institutions in agriculture • advisory bodies • farmers 		P1 (Eco-schemes), AECM (P2), LIFE
		Scale up to ≥100 projects with full MRV traceability and ≥0.6-0.9 TWh/yr renewable energy, ensuring ≥70% plants apply digestate under certified nutrient plans	2028-2034	<ul style="list-style-type: none"> • monitoring agency • agriculture modernisation units • operators • certification bodies • farmers 		P2 (Monitoring), LIFE, DEP
42	Establish regional bioeconomy hubs and value-chain cooperation to supply	Develop national guidance on cascading hierarchy and hub eligibility (materials > energy, QA criteria, waste/food/feed law compliance)	2026-2027 (pre-CAP rollout)	<ul style="list-style-type: none"> • monitoring agency (Lead) • Ministry of climate & environment • research institutions in agriculture • agriculture support centre • standardisation bodies 	Rural Communities & Regional Bioeconomy Hubs	HE, LIFE, TA CAP



	material-grade feedstock for cascades before energy use	Launch innovation operational groups under EIP pilots to map supply, test pre-processing (drying/fractionation) and establish long-term contracts between farms, coops and SMEs	2026-2027	<ul style="list-style-type: none"> EIP consortia (farmer groups, SMEs, RTOs, municipalities) universities advisory 		EIP-OG (P2), Interreg, HE
		Deploy CAP Pillar II calls for CAPEX investments in hubs (labs, QA, storage/logistics) under regional authorities	2027-2028	<ul style="list-style-type: none"> agriculture modernisation units regional governments monitoring agency 		P2 (Investments), ERDF, CF, National Funds
		Integrate certified material-grade feedstock into CAP reporting (linking volumes with eco-schemes and AECM nutrient/circularity outcomes)	2028-2030	<ul style="list-style-type: none"> research institutions in agriculture advisory services providers farmers/coops 		P1 (Eco-schemes), AECM (P2), LIFE
		Scale up to ≥25 regional hubs supplying ≥250 kt/yr of certified material-grade biomass; monitor % logistics loss, number of new SKUs and SME participation	2028-2034	<ul style="list-style-type: none"> monitoring agency agriculture modernisation units operators hub consortia SMEs 		P2 (Cooperation), CBE-JU, LIFE
43	Establish a national bio-based product certification and label interoperable with	Draft certification framework & conformity assessment protocols (biopolymers, advanced materials, bio-inputs) aligned with EU standards	2026-2027 (pre-CAP rollout)	<ul style="list-style-type: none"> monitoring agency (Lead) Ministry of climate & environment research institutions in agriculture standardisation bodies universities/labs 	Governance & AKIS	HE, LIFE, CBE-JU



	digital product passport (DPP) standards	Launch innovation operational groups under EIP pilots to validate testing protocols and sustainability/life cycle assessment modules across product categories	2026-2027	<ul style="list-style-type: none"> • EIP consortia (SMEs, producer groups, labs, advisory) • RTOs • observers from competent authorities 		EIP-OG (P2), Interreg	HE,
		Deploy national label design, public registry & API infrastructure (DPP-ready) under Technical Assistance	2027-2028	<ul style="list-style-type: none"> • monitoring agency • IT/standards partners • GS1 product identification system • registry operators 		TA CAP, DEP, HE	
		Train procurers, retailers & advisory services providers on certified bio-based product use, procurement clauses, and digital traceability	2028-2030	<ul style="list-style-type: none"> • research institutions in agriculture • advisory bodies • public procurement offices • retailer associations 		Erasmus+, LIFE, HE	
		Scale up certification: ≥400 certified product lines, ≥500 trained procurers, ≥200 API integrations with market platforms	2028-2034	<ul style="list-style-type: none"> • monitoring agency • registry operators • SMEs/producers • retailers/procurers 		DEP, LIFE, HE	
44	AKIS upskilling and national contact point for the agricultural bioeconomy	Develop national training modules on bioeconomy (cascading use, biomaterials, residue valorisation, legal/finance navigation) and integrate into AKIS curricula	2026-2027	<ul style="list-style-type: none"> • monitoring agency (Lead) • research institutions in agriculture • universities • farmer advisory networks 	Governance & AKIS	P2 (AKIS/KT), Erasmus+, HE	
		Establish a National Contact Point (NCP) and helpdesk for agricultural bioeconomy to	2026-2027	<ul style="list-style-type: none"> • monitoring agency • research institutions in agriculture 		TA CAP, CBE-JU, HE	



		broker projects , funding opportunities (CAP, CBE-JU, Horizon Europe), and inter-ministerial alignment		<ul style="list-style-type: none"> • national R&D funding agency • Ministry of climate & environment 		
		Roll out large-scale training of advisors and farmers (bioeconomy modules, digital toolkits, open resources)	2027-2028	<ul style="list-style-type: none"> • ODR/advisory services providers • universities • chambers/coops 		P2 (AKIS/KT), Erasmus+, LIFE
		Embed bioeconomy scoring criteria in farm modernisation calls and advisory packages	2028-2030	<ul style="list-style-type: none"> • monitoring agency • paying agency (agriculture modernisation units) • advisory networks 		P2 (Investments), National Funds
		Scale up to national coverage: ≥3,500 advisors and ≥20,000 farmers trained; ≥600 advisory packages delivered; ≥50% of modernisation calls include bioeconomy criteria	2028-2034	<ul style="list-style-type: none"> • monitoring agency • research institutions in agriculture • advisory networks • agriculture modernisation units 		P2 (AKIS/KT), HE, LIFE
45	Regional circular bioprocess pilots for by-product upgrading	Map priority by-product streams (e.g. edible leaves, processing residues) and identify SME/HEI/farm clusters for pilot participation	2026-2027	<ul style="list-style-type: none"> • research institutions in agriculture • monitoring agency • universities/RTOs • sector associations 	Sustainable Agriculture, Food & Forestry Value Chains	HE, LIFE, CBE-JU
		Design and launch innovation operational groups under EIP pilots combining farms, SMEs, HEIs and advisors for non-thermal extraction,	2026-2028	<ul style="list-style-type: none"> • EIP consortia (farms, SMEs, universities) • advisory services providers 		EIP-OG (P2), Interreg, HE



		fermentation/biocatalysis, and QA protocols				
		Establish pilot infrastructure (pre-processing, IoT monitoring, QA labs) with investment grants under Pillar II	2027-2029	<ul style="list-style-type: none"> • agriculture modernisation units • regional governments • SMEs/cooperatives 		P2 (Investments), ERDF, CF, National Funds
		Develop procurement-aligned standards and validated SOPs for bio-based ingredients , including life cycle assessment-based KPIs	2028-2030	<ul style="list-style-type: none"> • standardisation bodies • universities • research institutions in agriculture • SMEs 		HE, LIFE, SMP
		Scale up regional coverage to ≥35 pilots valorising ≥50 kt/yr residues with certified ingredients meeting procurement specs	2028-2034	<ul style="list-style-type: none"> • monitoring agency • agriculture modernisation units • regional governments • industry clusters 		HE, LIFE, CBE-JU
46	Result-based eco-scheme: verified on-farm by-product separation & IoT traceability	Define eligible by-product categories , biosafety standards and create the Residue Valorisation Index methodology (tonnes/ha with QA pass)	2026-2027	<ul style="list-style-type: none"> • Ministry of agriculture • research institutions in agriculture • agriculture modernisation units • inspectorates 	Climate Environmental Sustainability &	EIP-OG (P2), Interreg, HE
		Develop digital MRV protocols and sensor/e-log integration for on-farm traceability and delivery documentation	2026-2027	<ul style="list-style-type: none"> • research institutions in agriculture • advisory services providers (ODR) • IT providers • farmers' groups 		P2 (Investments), ERDF, CF, National Funds



		Roll out Eco-scheme call under Pillar I with AKIS-supported onboarding and training for farmers	2027-2028	<ul style="list-style-type: none"> • agriculture modernisation units • Ministry of agriculture • advisory services providers 		HE, LIFE, SMP
		Pilot and validate annual verification through IACS/LPIS, sensor logs and certified delivery docketts	2027-2029	<ul style="list-style-type: none"> • agriculture modernisation units • certifiers • farmer cooperatives 		P1 (Eco-schemes), LIFE, DEP
		Scale-up to $\geq 12,000$ farms enrolled and ≥ 1.0 t/ha valorised by 2030 with full traceability, feeding certified valorisation chains and procurement/DPP	2028-2034	<ul style="list-style-type: none"> • Ministry of agriculture • agriculture modernisation units • farmers • cooperatives • industry users 		P1 (Eco-schemes), HE, SMP
47	AKIS modular skill certificates & bioeconomy coordination for LLL	Co-design modular curricula (non-thermal extraction, QA/standards, IoT/analytics, IPR/TT, bioprocess basics) with HEIs, SMEs, advisory and farmer groups	2026-2027	<ul style="list-style-type: none"> • HEIs • research institutions in agriculture • advisory services providers • industry associations 	Knowledge & Skills for Farmers and Advisors	Erasmus+, HE, LIFE
		Develop national registry of modular skill certificates with digital badges aligned to EU LLL frameworks	2026-2027	<ul style="list-style-type: none"> • Ministry of agriculture • Ministry of education • National Accreditation Agency • HEIs 		Erasmus+, DEP, HE
		Pilot modular skill certificates in innovation operational groups under EIP demo projects	2027-2028	<ul style="list-style-type: none"> • HEIs • EIP consortia • farmer groups • SMEs 		EIP-OG (P2), Interreg, HE



		and farm/SME placements to test practice-readiness				
		Scale-up credential roll-out via AKIS/advisory training , with portable recognition across regions	2028-2030	<ul style="list-style-type: none"> • advisory services providers (ODR) • HEIs • agriculture modernisation units (support in calls) 		P2 (AKIS/KT), Erasmus+, LIFE
		Establish structured coordination platform (policy roundtables, briefs, evidence-based campaigns) to link advisors/HEIs with ministries and counter misinformation	2027-2034	<ul style="list-style-type: none"> • Ministry of agriculture • Ministry of climate • research institutions in agriculture • advisory services providers • farmer chambers 		TA CAP, HE, LIFE
		Reach ≥5,000 modular skill certificates with ≥70% utilisation by 2030, ≥30 structured policy engagements, and regular evaluation through registry logs and surveys	2028-2034	<ul style="list-style-type: none"> • Ministry of agriculture • HEIs • advisory networks • National Accreditation Agency 		P2 (AKIS/KT), HE, Erasmus+
48	Spatial biomass corridors & micro-hubs (material-first logistics)	Map biomass resources and designate priority corridors/micro-hub sites using GIS/remote sensing (incl. Renewables Acceleration Areas where relevant)	2026-2027	<ul style="list-style-type: none"> • Ministry of agriculture • Ministry of climate & environment • research institutions in agriculture • environment protection inspectorate • local authorities 	Rural Communities & Regional Bioeconomy Hubs	HE, LIFE, TA CAP



		Launch innovation operational groups under EIP pilots to test feedstock aggregation, certification protocols under RED III, and biodiversity/erosion safeguards	2026-2028	<ul style="list-style-type: none"> • EIP consortia (farmer/forest groups, SMEs, RTOs, municipalities) • research institutions in agriculture • universities 		EIP-OG (P2), Interreg, HE
		Establish investment grants for pre-processing, covered storage, drying and QA labs; include performance contracts for material-grade output	2027-2029	<ul style="list-style-type: none"> • agriculture modernisation units • regional governments • Ministry of agriculture 		P2 (Investments), ERDF, CF, National Funds
		Deploy shared logistics assets (short-haul fleets, digital route optimisation) and implement long-term supply contracts with farmers/forest owners	2028-2030	<ul style="list-style-type: none"> • producer groups • cooperatives • logistics SMEs • local authorities 		P2 (Cooperation), LIFE, HE
		Scale-up to ≥25 hubs/corridors delivering ≥250 kt/yr material-grade biomass; monitor QA pass %, km optimised routes, and RED III sustainability compliance	2028-2034	<ul style="list-style-type: none"> • Ministry of agriculture • agriculture modernisation units • hub operators • certification bodies • inspectorates 		CBE-JU, HE, LIFE
49	CRCF-ready agroforestry & forest-edge carbon farming (result-based AECM)	Develop national MRV protocols for agroforestry/forest-edge systems aligned with CRCF/LULUCF (RS, Tier-2 SOC, tree allometrics)	2026-2027	<ul style="list-style-type: none"> • Ministry of agriculture • Ministry of climate & environment • research institutions in agriculture • environment protection inspectorate • universities 	Climate Environmental Sustainability &	HE, LIFE, TA CAP



		Launch pilot AECM contracts with farms for shelterbelts, hedgerows, and silvopasture designs; include biodiversity/erosion safeguards	2026-2028	<ul style="list-style-type: none"> • agriculture modernisation units • farmer groups/coops • advisory services providers (ODR) • NGOs 		AECM (P2), Interreg, HE
		Roll out establishment support under Pillar II for planting, fencing, and protection of native species; integrate buffers and habitat corridors	2027-2029	<ul style="list-style-type: none"> • agriculture modernisation units • regional governments • forest inspectorates 		P2 (Investments), ERDF, CF, National Funds
		Introduce result-based payments per t CO ₂ e sequestered (with proxy tiers where annual direct measurement is not feasible)	2028-2030	<ul style="list-style-type: none"> • agriculture modernisation units • Ministry of agriculture • research institutions in agriculture • advisory services providers 		AECM (P2), LIFE, National Funds
		Scale up to ≥50k ha with verified removals (≥0.7 Mt CO ₂ e cumulatively by 2030) and embed carbon-credit readiness in national CAP reporting	2028-2034	<ul style="list-style-type: none"> • Ministry of agriculture • agriculture modernisation units • farmers/coops • certification bodies • independent verifiers 		P2 (Monitoring), LIFE, DEP
50	Modular biogas/biomethane for smallholders & clusters (investment)	Develop siting & logistics protocols for modular AD in Renewable Energy Acceleration Areas, using GIS and RED III sustainability guidance	2026-2027	<ul style="list-style-type: none"> • Ministry of agriculture • Ministry of climate & environment • research institutions in agriculture • energy Institutions 	Sustainable Agriculture, Food & Forestry Value Chains	HE, LIFE, TA CAP



	s cooperation)			<ul style="list-style-type: none"> • regional governments 		
		Launch innovation operational groups under EIP pilots to test feedstock aggregation, odour mitigation, and community engagement models for smallholder clusters	2026-2027	<ul style="list-style-type: none"> • EIP consortia (farmers, SMEs, municipalities) • universities/advisory services providers 		EIP-OG (P2), Interreg, HE
		Roll out investment grants under CAP Pillar II for modular AD/biomethane units, storage, CHP and grid injection, with performance-based top-ups	2027-2028	<ul style="list-style-type: none"> • agriculture modernisation units • Ministry of agriculture • regional authorities 		P2 (Investments), ERDF, CF, National Funds
		Integrate digestate nutrient plans into CAP advisory and eco-scheme/AECM tools, ensuring traceability and soil carbon monitoring	2028-2030	<ul style="list-style-type: none"> • research institutions in agriculture • farmers advisory bodies • farmers • certification bodies 		P1 (Eco-schemes), AECM (P2), LIFE
		Scale-up to ≥120 units by 2030, with ≥70% on-site energy use and verified digestate application; establish monitoring system linking plant meters and nutrient logs	2028-2034	<ul style="list-style-type: none"> • Ministry of agriculture • agriculture modernisation units • plant operators • farmer cooperatives • independent auditors 		P2 (Monitoring), LIFE, DEP
51	Result-based eco-scheme: certified biochar &	Establish national quality standards for biochar, compost and digestate (fixed-C, heavy metals, PAHs, hygiene) and design the Stable-C Index	2026-2027	<ul style="list-style-type: none"> • Ministry of agriculture • Ministry of climate & environment • research institutions in agriculture 	Climate Environmental Sustainability &	HE, LIFE, TA CAP



	compost/digestate co-application	methodology for CAP eco-scheme use		<ul style="list-style-type: none"> National Fertiliser Testing Institutes certification bodies 		
		Pilot biochar/compost/digestate co-application on arable, grassland and horticultural farms with digital logs and baseline soil/water sampling (innovation operational groups under EIP projects)	2026-2027	<ul style="list-style-type: none"> EIP consortia (farmers, SMEs, research/advisory) universities research institutions in agriculture 		EIP-OG (P2), HE, Interreg
		Launch Pillar I eco-scheme with result-based payments linked to the Stable-C Index and infiltration proxies; provide setup support for sampling/logging	2027-2028	<ul style="list-style-type: none"> agriculture modernisation units Ministry of agriculture farmers advisory services providers 		P1 (Eco-schemes), LIFE, National Funds
		Scale farm participation through advisory campaigns and integration into nutrient plans/soil-health platforms (incl. synergy with carbon-farming pilots)	2028-2030	<ul style="list-style-type: none"> research institutions in agriculture farmer advisory bodies farmer organisations regional authorities 		P2 (AKIS/KT), LIFE, HE
		Monitor & scale-up to ≥140k ha with ≥30 kt biochar applied and ≥50 kt stable C credited by 2030, using LPIS/lab certificates and verifier audits	2028-2034	<ul style="list-style-type: none"> Ministry of agriculture agriculture modernisation units independent auditors farmers/operators 		P1 (Eco-schemes), (Monitoring), DEP

52	Municipal biowaste - biochar community hubs (material-first, end-of-waste)	Develop national End-of-Waste (EoW) criteria for biochar from municipal/green biowaste, incl. QA protocols (emissions, metals, stability indices)	2026-2027	<ul style="list-style-type: none"> Ministry of agriculture Ministry of climate & environment research institutions in agriculture environment protection public bodies certification bodies 	Research, Innovation & Digitalisation	HE, LIFE, TA CAP
		Launch pilot hubs in municipalities/co-ops with modular pyrolysis, QA labs and logistics planning under innovation operational groups under EIP consortia	2026-2027	<ul style="list-style-type: none"> municipalities coops/producer groups SMEs RTOs/advisory bodies 		EIP-OG (P2), Interreg, HE
		Open CAP Pillar II calls for investment grants (pyrolysis, drying, storage, logistics) with performance-based contracts	2027-2028	<ul style="list-style-type: none"> agriculture modernisation units Ministry of agriculture regional authorities 		P2 (Investments), ERDF, CF, National Funds
		Establish supply contracts linking hubs with farms, urban greening actors and soil-improvement schemes (integration into CAP eco-schemes/carbon farming)	2028-2030	<ul style="list-style-type: none"> research institutions in agriculture farmer advisory bodies farmers municipalities 		P1 (Eco-schemes), AECM (P2), LIFE
		Scale-up & monitor ≥30 hubs with ≥50 kt/yr biowaste diverted and ≥12 kt/yr certified biochar delivered by 2030	2028-2034	<ul style="list-style-type: none"> Ministry of agriculture agriculture modernisation units operators farmers/municipal users 		P2 (Monitoring), LIFE, DEP



53	National biochar guidelines, certification & AKIS micro-credentials	Develop national biochar application guidelines (quality thresholds, safe use, co-application rules, MRV templates) with stakeholder consultation	2026-2027	<ul style="list-style-type: none"> Ministry of agriculture Ministry of climate & environment research institutions in agriculture environment protection public bodies certification bodies 	Sustainable Agriculture, Food & Forestry Value Chains	HE, LIFE, CBE-JU	
		Pilot validation of protocols and MRV templates under innovation operational groups under EIP consortia (field trials, advisory pilots, municipal-farm cooperation)	2026-2027	<ul style="list-style-type: none"> EIP consortia (farmers, SMEs, municipalities, universities) advisory networks 			EIP-OG (P2), Interreg, HE
		Launch registry/helpdesk under Technical Assistance to manage certification templates and track protocols	2027-2028	<ul style="list-style-type: none"> Ministry of agriculture (Lead) research institutions in agriculture agriculture modernisation units 			TA CAP, LIFE, National Funds
		Roll out AKIS training with modular skill certificates (biochar basics, compost/digestate co-application, QA/MRV, procurement & claims) for advisors, farmers, municipal staff	2027-2030	<ul style="list-style-type: none"> advisory services providers (ODR) universities chambers/co-ops 			P2 (AKIS/KT), Erasmus+, HE
		Scale-up adoption: ≥25 validated protocols, ≥4,000	2028-2034	<ul style="list-style-type: none"> Ministry of agriculture 			P2 (AKIS/KT), LIFE, HE



		credentials issued, $\geq 70\%$ of trained advisors/farmers applying practices		<ul style="list-style-type: none"> • research institutions in agriculture • advisory bodies • municipalities • farmers 		
54	Result-based eco-scheme: certified bio-fertilisers with precision application	Develop national certification list and QA protocols for bio-fertilisers/biostimulants, including safety and nutrient-content thresholds	2026-2027	<ul style="list-style-type: none"> • Ministry of agriculture • research institutions in agriculture • plant protection and seed inspection service • certification bodies 	Rural Communities & Regional Bioeconomy Hubs	HE, LIFE, CBE-JU
		Design digital MRV templates and farm logbook standards for precision application (variable rate, decision support, invoices as evidence)	2026-2027	<ul style="list-style-type: none"> • research institutions in agriculture • agriculture modernisation units • farmer advisory services providers • IT providers 		DEP, HE, LIFE
		Pilot eco-scheme under innovation operational groups under EIP /demo farms to validate the N-Substitution & Soil-Benefit Index (linking % mineral N reduction with soil-health proxies)	2027	<ul style="list-style-type: none"> • EIP consortia (farmers, SMEs, universities, advisors) 		EIP-OG (P2), Interreg, HE
		Launch national roll-out of result-based eco-scheme with digital onboarding and one-off support for baseline soil/management tests	2028-2029	<ul style="list-style-type: none"> • agriculture modernisation units (Lead) • Ministry of agriculture • regional advisory networks 		P1 (Eco-schemes), LIFE, National Funds



		Scale-up to ≥280k ha by 2030, with average ≥18% mineral N reduction and verified soil-health improvements (infiltration/microbial proxies)	2028-2034	<ul style="list-style-type: none"> • Ministry of agriculture • agriculture modernisation units • farmers • advisory services providers 		P1 (Eco-schemes), P2 (Monitoring), DEP
55	Regional bio-input validation hubs & living labs (cooperation + investments)	Establish national framework for regional validation hubs, defining QA protocols, conformity with End-of-Waste law, and selection criteria for pilots	2026-2027	<ul style="list-style-type: none"> • Ministry of agriculture • research institutions in agriculture • environment protection public bodies/ environment protection public bodies • plant protection and seed inspection service • regional governments 	Governance & AKIS	HE, LIFE, TA CAP
		Launch first wave of regional hubs (innovation operational groups under EIP consortia with producer groups, SMEs, municipalities, universities) testing bio-leached and circular inputs on demo farms	2026-2027	<ul style="list-style-type: none"> • EIP consortia • producer groups • SMEs • municipalities • HEIs/advisory 		EIP-OG (P2), Interreg, HE
		Develop and validate regional application protocols with AI/RS-based decision support (dose, timing, crop/soil adaptation)	2027-2028	<ul style="list-style-type: none"> • research institutions in agriculture • universities • farmer advisory services providers • digital SMEs 		HE, LIFE, DEP
		Roll out investment grants for small-scale infrastructure (QA	2028-2030	<ul style="list-style-type: none"> • agriculture modernisation units 		P2 (Investments), ERDF, CF, National Funds



		labs, drying, storage, logistics) and integrate supply contracts between waste operators and farmers		<ul style="list-style-type: none"> • Ministry of agriculture • regional governments • co-ops/SMEs 		
		Scale-up to ≥18 hubs and ≥3,000 ha of validated trials with functioning contracts and QA pass rate >85%	2028-2034	<ul style="list-style-type: none"> • Ministry of agriculture • agriculture modernisation units • hub operators • farmers • advisory bodies 		P2 (Cooperation), LIFE, HE
56	National registry & AKIS micro-credentials for circular bio-inputs	Establish national registry of certified/field-tested bio-inputs with open access criteria, templates, and API interface	2026-2027 (pre-CAP rollout)	<ul style="list-style-type: none"> • Ministry of agriculture • research institutions in agriculture • plant protection and seed inspection service • environment protection public bodies • standardisation bodies 	Research, Innovation & Digitalisation	HE, LIFE, DEP
		Co-develop modular curricula and stackable modular skill certificates (bioleaching basics, QA/MRV, precision application, claims/procurement) with HEIs, advisors, SMEs, and municipalities	2026-2027	<ul style="list-style-type: none"> • universities • farmer advisory services providers • producer groups • SMEs • municipalities 		Erasmus+, HE, LIFE
		Pilot micro-credential training in innovation operational groups under EIP projects and	2027-2028	<ul style="list-style-type: none"> • EIP consortia • HEIs • advisory networks • farmers/SMEs 		EIP-OG (P2), Interreg, HE



		Living Labs with on-farm/SME placements				
		Roll out national credential registry and helpdesk under Technical Assistance, linked with CAP/AKIS	2028-2029	<ul style="list-style-type: none"> • Ministry of agriculture • agriculture modernisation units • research institutions in agriculture • advisory services providers 		TA CAP, P2 (AKIS/KT), LIFE
		Scale-up: ≥3,000 credentials issued, ≥30 validated protocols, ≥70% utilisation rate by trained advisors/farmers	2028-2034	<ul style="list-style-type: none"> • Ministry of agriculture • farmer advisory services providers • universities • farmer/SME organisations 		P2 (AKIS/KT), Erasmus+, HE
57	Regional hemp-wool micro-factories & qa for soil-returnable panels	Develop national technical guidance for hemp-wool insulation panels (QA thresholds for compostability, soil return, thermal/acoustic performance)	2026-2027	<ul style="list-style-type: none"> • Ministry of agriculture • Ministry of development & technology • research institutions in agriculture • research institutes • standardisation bodies 	Climate Environmental Sustainability &	HE, LIFE, CBE-JU
		Launch 3-4 innovation operational groups under EIP pilots (regional consortia of hemp/wool holders, SMEs, municipalities, universities) to validate pre-processing, felting, panel-forming and QA protocols	2026-2027	<ul style="list-style-type: none"> • EIP consortia • agricultural chambers • local governments 		EIP-OG (P2), Interreg, HE



		Establish investment grants calls under CAP Pillar II for regional micro-factories (equipment, QA labs, logistics)	2027-2028	<ul style="list-style-type: none"> • agriculture modernisation units • Ministry of agriculture • regional authorities 		P2 (Investments), ERDF, CF, National Funds
		Integrate certified panel use into public green-procurement schemes (municipal construction/ renovation tenders)	2028-2030	<ul style="list-style-type: none"> • Ministry of development & technology • municipalities • procurement agencies 		SMP, LIFE, National Funds
		Scale up to ≥18 micro-factories with ≥30 kt residues processed into certified panels; monitor QA pass rates and soil-return compliance	2028-2034	<ul style="list-style-type: none"> • Ministry of agriculture • agriculture modernisation units • operators • certification bodies • municipalities 		P2 (Cooperation), HE, LIFE
58	Result-based eco-scheme: material-grade wool & hemp feedstock mobilisation	Establish national quality thresholds for wool and hemp stalks (moisture, contamination, animal-welfare safeguards) and digital delivery-note templates	2026-2027	<ul style="list-style-type: none"> • Ministry of agriculture • research institutions in agriculture • agriculture modernisation units • Veterinary Inspectorates • standardisation bodies 	Sustainable Agriculture, Food & Forestry Value Chains	HE, LIFE, TA CAP
		Pilot eco-scheme contracts on selected farms to test feedstock quality index (t delivered × quality factor) and digital e-dockets	2026-2027	<ul style="list-style-type: none"> • agriculture modernisation units • farmers/producer groups • farmer advisory services providers 		EIP-OG (P2), Interreg



		Roll out full eco-scheme under CAP pillar I with result-based €/ha payments and setup top-ups for storage/conditioning	2027-2028	<ul style="list-style-type: none"> • agriculture modernisation units • Ministry of agriculture • Paying agency • IT systems 		P1 (Eco-schemes), LIFE, National Funds
		Integrate deliveries into certified processor chains linked with regional micro-factories (Measure 41.1)	2028-2030	<ul style="list-style-type: none"> • coops/producer groups • SMEs • municipalities • certification bodies 		P2 (Cooperation), LIFE, HE
		Scale up to ≥9,000 farms enrolled, ≥1.0 t/ha material-grade feedstock delivered with ≥90% QA pass rate	2028-2034	<ul style="list-style-type: none"> • Ministry of agriculture • agriculture modernisation units • farmers • processors • certification bodies 		P1 (Eco-schemes), LIFE, DEP
59	Natural insulation standards, DPP-ready traceability & AKISmicro-credentials	Draft and validate national test protocols for hemp-wool insulation panels (thermal/acoustic, compostability, soil-return safety)	2026-2027	<ul style="list-style-type: none"> • Ministry of agriculture • research institutions in agriculture • standardisation bodies • universities/labs 	Knowledge & Skills for Farmers and Advisors	HE, LIFE, CBE-JU
		Develop DPP-ready traceability templates and open registry/APIs for certified products, ensuring interoperability with EU Digital Product Passport	2026-2027	<ul style="list-style-type: none"> • Ministry of digitalisation • Ministry of agriculture • certification bodies • IT providers 		DEP, HE, LIFE
		Pilot innovation operational groups under EIP projects to test standards/registry in	2026-2028	<ul style="list-style-type: none"> • EIP consortia (farmer coops, SMEs, municipalities, RTOs) • agriculture modernisation units 		EIP-OG (P2), Interreg, HE



		practice and integrate with regional micro-factories				
		Roll out AKIS training with stackable modular skill certificates for farmers, SMEs, architects, advisors; publish procurement playbooks for public buyers	2027-2029	<ul style="list-style-type: none"> farmer advisory services providers universities/ HEIs municipalities chambers of architects 		P2 (AKIS/KT), Erasmus+, LIFE
		Scale up adoption: ≥25 validated protocols, ≥4,000 credentials issued, ≥400 operators onboarded; integration of bio-based panel criteria into national green procurement.	2028-2034	<ul style="list-style-type: none"> Ministry of agriculture Ministry of development & technology agriculture modernisation units municipalities procurement agencies 		SMP, LIFE, HE
60	Result-based eco-scheme: regenerative arable bundles (no-till + multi-species covers + intercropping)	Develop Soil-Health Bundle Index and simple field diagnostics (cover %, infiltration tests, no-till verification).	2026-2027	<ul style="list-style-type: none"> Ministry of agriculture research institutions in agriculture farmer advisory services providers universities 	Governance & AKIS	HE, LIFE, TA CAP
		Design eco-scheme contract framework (parcel-based enrolment, tiered €/ha payments, yield-safeguard clause).	2026-2027	<ul style="list-style-type: none"> Ministry of agriculture agriculture modernisation units research institutions in agriculture 		P1 (Eco-schemes), LIFE, National Funds
		Pilot test in erosion/drought-prone regions through early	2027-2028	<ul style="list-style-type: none"> agriculture modernisation units advisory bodies 		P1 (Eco-schemes), DEP, HE



		eco-scheme calls, with remote sensing and spot checks		<ul style="list-style-type: none"> farmer groups 		
		Launch national roll-out under CAP pillar I with onboarding support (baseline tests, digital logs)	2028-2030	<ul style="list-style-type: none"> agriculture modernisation units Ministry of agriculture producer groups/coops 		P1 (Eco-schemes), CAP, LIFE TA
		Scale-up monitoring & reporting: ≥420k ha by 2030; ≥60% parcels at tier-2+; national integration of RS-based verification	2028-2034	<ul style="list-style-type: none"> Ministry of agriculture agriculture modernisation units research institutions in agriculture independent verifiers 		P1 (Eco-schemes), P2 (Monitoring), DEP
61	AECM (result-based): adaptive grazing & permanent grassland resilience	Develop pasture condition index (groundcover %, sward height, indicator species) and monitoring protocols	2026-2027	<ul style="list-style-type: none"> Ministry of agriculture research institutions in agriculture universities farmer advisory services provider 	Climate Environmental Sustainability &	HE, LIFE, TA CAP
		Design AECM contract framework (tiered €/ha payments, transition CAPEX for fencing/water points, yield safeguard)	2026-2027	<ul style="list-style-type: none"> Ministry of agriculture agriculture modernisation units research institutions in agriculture 		AECM (P2), LIFE, National Funds
		Launch pilots in erosion/drought-prone grassland districts with training for advisors and farmers	2027-2028	<ul style="list-style-type: none"> agriculture modernisation units advisory services providers farmer groups/coops 		P2 (AKIS/KT), Erasmus+, LIFE



		Roll out national AECM scheme under Pillar II, including Natura-compatible guidance and habitat safeguards	2028-2030	<ul style="list-style-type: none"> • Ministry of agriculture • agriculture modernisation units • regional governments 		AECM (P2), LIFE, Interreg
		Scale-up and monitor: $\geq 320k$ ha enrolled by 2030; $\geq 75\%$ parcels meet tier-1 condition; national RS/field verification system operational	2028-2034	<ul style="list-style-type: none"> • Ministry of agriculture • agriculture modernisation units • research institutions in agriculture • independent verifiers 		P2 (Monitoring), LIFE, DEP
62	AKIS living labs, diagnostics & micro-credentials for regenerative transition	Co-design national soil-health diagnostic toolkit (cover %, infiltration, SOC/biology) and benchmarking registry	2026-2027	<ul style="list-style-type: none"> • Ministry of agriculture • research institutions in agriculture • universities/labs • farmer advisory services providers 	Rural Communities & Regional Bioeconomy Hubs	HE, LIFE, Soil Mission
		Establish living lab demo farms and peer-learning groups in priority regions (erosion/drought)	2026-2028	<ul style="list-style-type: none"> • advisory services providers • farmer groups/coops • universities 		EIP-OG (P2), Interreg, HE
		Roll out micro-credential training modules for farmers/advisors (regenerative agronomy, grazing design, monitoring/data use)	2027-2029	<ul style="list-style-type: none"> • universities • advisory services providers • vocational schools • chambers/coops 		P2 (AKIS/KT), Erasmus+, LIFE
		Deploy digital registry and benchmarking tools with TA support, integrated with CAP monitoring	2028-2030	<ul style="list-style-type: none"> • Ministry of agriculture • paying agency • research institutions in agriculture 		TA CAP, DEP, HE

				<ul style="list-style-type: none"> • advisory networks 		
		Scale up: $\geq 4,000$ credentials issued and $\geq 6,000$ farms using diagnostics with $\geq 70\%$ uptake rate by 2030	2028-2034	<ul style="list-style-type: none"> • Ministry of agriculture • agriculture modernisation units • research institutions in agriculture • advisory services providers 		P2 (AKIS/KT), LIFE, HE
63	Result-based eco-scheme: certified compostable agri inputs & plastic-residue reduction	Develop national eligibility list of EN-certified compostable agri inputs (mulch films, trays, clips) and digital reporting templates.	2026-2027	<ul style="list-style-type: none"> • Ministry of agriculture • research institutions in agriculture • standardisation bodies • advisory services providers 	Research, Innovation & Digitalisation	HE, LIFE, SMP
		Pilot digital collection/delivery note system with authorised composters (chain-of-custody verification)	2026-2027	<ul style="list-style-type: none"> • agriculture modernisation units • composting facilities • producer groups • IT providers 		DEP, HE, LIFE
		Launch eco-scheme payments based on Plastic-Residue Avoidance Index (area \times % certified collection \times field cleanliness score)	2027-2028	<ul style="list-style-type: none"> • agriculture modernisation units • Ministry of agriculture • farmer advisory services providers 		P1 (Eco-schemes), LIFE, National Funds
		Scale enrolment to $\geq 45k$ ha by 2027, ensuring $\geq 80\%$ of certified inputs collected with composting certificates	2027-2030	<ul style="list-style-type: none"> • farmers • coops • agriculture modernisation units • composters 		P1 (Eco-schemes), LIFE, DEP
		Expand to $\geq 110k$ ha by 2030, reaching $\geq 92\%$ certified	2028-2034	<ul style="list-style-type: none"> • Ministry of agriculture 		P1 (Eco-schemes), LIFE, HE



		collection and field cleanliness pass rate.		<ul style="list-style-type: none"> • agriculture modernisation units • farmers • advisory bodies 		
64	Regional collection & composting hubs for agri plastics (material-first, eow)	Develop national conformity guidance for certified compostable agri plastics (EoW thresholds, QA, digital certificate templates).	2026-2027	<ul style="list-style-type: none"> • Ministry of agriculture • Ministry of climate & environment • research institutions in agriculture • standardisation bodies • inspectorates 	Sustainable Agriculture, Food & Forestry Value Chains	HE, LIFE, SMP
		Launch innovation operational groups under EIP pilots for regional hubs (collection, QA, sorting, composting logistics) with municipality-coop-SME partnerships	2026-2027	<ul style="list-style-type: none"> • EIP consortia (municipalities, coops, SMEs, composters, labs) • universities/advisory 		EIP-OG (P2), Interreg, HE
		Open CAP Pillar II calls for CAPEX investments (composting lines, QA labs, traceability IT) with performance-based contracts	2027-2028	<ul style="list-style-type: none"> • agriculture modernisation units • Ministry of agriculture • regional governments 		P2 (Investments), ERDF, CF, National Funds
		Integrate certified compost return into nutrient planning tools and eco-scheme linkages (soil-return contracts)	2028-2030	<ul style="list-style-type: none"> • research institutions in agriculture • farmer advisory services providers • farmers • composting operators 		P1 (Eco-schemes), AECM (P2), LIFE



		Scale up to ≥22 regional hubs processing ≥14 kt/year by 2030 with ≥75% compost returned to farms	2028-2034	<ul style="list-style-type: none"> • Ministry of agriculture • agriculture modernisation units • municipalities • coops • composting operators 		P2 (Monitoring), LIFE, DEP
65	National protocols, label & AKIS micro-credentials for compostables (DPP-ready)	Draft and validate national test protocols for compostable agri inputs (EN-aligned, performance, compostability incl. home) and develop conformity assessment templates	2026-2027	<ul style="list-style-type: none"> • Ministry of agriculture • Ministry of climate & environment • standardisation bodies • universities/labs • research institutions in agriculture 	Climate Environmental Sustainability &	HE, LIFE, SMP
		Design and launch a national compostables label and open registry/API with DPP-ready data fields, linked to CAP monitoring tools	2027-2028	<ul style="list-style-type: none"> • Ministry of agriculture • agriculture modernisation units • registry owner (agency/authority) • IT/standards bodies 		DEP, HE, LIFE
		Roll out AKIS training and stackable modular skill certificates for farmers, advisors and municipal staff on certified product use, QA/MRV and end-of-life	2027-2029	<ul style="list-style-type: none"> • farmer advisory services providers • universities • chambers/co-ops • municipalities 		P2 (AKIS/KT), Erasmus+, LIFE
		Develop and disseminate buyer/procurement toolkits to support public and private	2028-2030	<ul style="list-style-type: none"> • Ministry of agriculture • public procurement office • advisory bodies • producer groups 		SMP, LIFE, National Funds

		tenders specifying compostable criteria				
		Scale-up: ≥30 protocols validated, ≥380 certified product lines, ≥3,500 modular skill certificates issued, ≥350 tenders specifying the label by 2030	2028-2034	<ul style="list-style-type: none"> • Ministry of agriculture • agriculture modernisation units • registry/label owner • advisory bodies • procurement authorities 		P2 (AKIS/KT), HE, LIFE
66	Result-based eco-scheme: certified algae inputs & precision dosing	Establish national eligibility and soil/nutrient plan requirements for parcels using certified algae biostimulants/biofertilisers (product certificates, toxin limits)	2026-2027 (pre-rollout)	<ul style="list-style-type: none"> • Ministry of agriculture • research institutions in agriculture • farmer advisory services providers • certification bodies 	Governance & AKIS	HE, LIFE, CBE-JU
		Pilot precision dosing tools and digital logging with early adopter farms; validate Substitution & Soil Benefit Index (nutrient reduction + soil proxy)	2026-2027	<ul style="list-style-type: none"> • innovation operational groups under EIP consortia (farmers, IT/advisory, universities) 		DEP, HE, LIFE
		Launch eco-scheme payments under CAP Pillar I, including onboarding top-up for baseline tests/logs	2027-2028	<ul style="list-style-type: none"> • agriculture modernisation units • Ministry of agriculture 		P1 (Eco-schemes), LIFE, National Funds
		Monitor nutrient substitution and soil benefits using LPIS/IACS data, invoices, certificates and field spot checks	2027-2030	<ul style="list-style-type: none"> • agriculture modernisation units • research institutions in agriculture • advisory bodies 		P1 (Eco-schemes), DEP, LIFE



		Scale-up to $\geq 240k$ ha enrolled by 2030 with average $\geq 18\%$ mineral nutrient reduction and verified soil proxy improvements	2028-2034	<ul style="list-style-type: none"> Ministry of agriculture agriculture modernisation units advisory services providers farmers 		P1 (Eco-schemes), HE, LIFE
67	Wastewater /digestate - algae circular nutrient hubs (material-first, end-of-waste)	Develop national End-of-Waste conformity protocols for algae from digestate/WWTP effluents, including toxin/species monitoring and safe-use thresholds	2026-2027 (pre-rollout)	<ul style="list-style-type: none"> Ministry of agriculture Ministry of climate & environment research institutions in agriculture inspectories certification bodies 	Research, Innovation & Digitalisation	HE, LIFE, CBE-JU
		Launch innovation operational groups under EIP pilots linking AD operators/WWTPs with farms and SMEs to test cultivation, harvesting, QA methods and packaging	2026-2027	<ul style="list-style-type: none"> EIP consortia (farmers, WWTP/AD plants, SMEs, universities, municipalities) 		EIP-OG (P2), Interreg, HE
		Deploy investment grants scheme for algae hubs under CAP Pillar II (cultivation ponds, harvesting, QA labs, logistics)	2027-2028	<ul style="list-style-type: none"> agriculture modernisation units Ministry of agriculture regional governments 		P2 (Investments), ERDF, CF, National Funds
		Integrate certified algae biomass into CAP nutrient/soil plans and eco-schemes (biofertilisers, biostimulants)	2028-2030	<ul style="list-style-type: none"> research institutions in agriculture farmer advisory bodies farmers 		P1 (Eco-schemes), AECM (P2), LIFE
		Scale-up to ≥ 18 regional hubs producing ≥ 15 kt/year certified	2028-2034	<ul style="list-style-type: none"> Ministry of agriculture 		P2 (Monitoring), LIFE, DEP



		algae biomass with verified farm delivery and QA pass rates		<ul style="list-style-type: none"> • agriculture modernisation units • operators • farmers 		
68	National algae protocols, certification & AKIS micro-credentials	Draft national guidelines & thresholds for algae on waste streams (species lists, toxin/contaminant limits, lab methods) and circulate for consultation	2026-2027 (pre-rollout)	<ul style="list-style-type: none"> • Ministry of agriculture • Ministry of climate & environment • research institutions in agriculture • universities/labs • inspectorates 	Sustainable Agriculture, Food & Forestry Value Chains	HE, LIFE, CBE-JU
		Establish a national certification & open registry/API of approved algae products, templates for conformity assessment, and conformity with End-of-Waste rules	2027-2028	<ul style="list-style-type: none"> • Ministry of agriculture • agriculture modernisation units • research institutions in agriculture • certification bodies • IT/standards agency 		DEP, HE, LIFE
		Roll out AKIS training & stackable modular skill certificates for advisors, farmers, AD/WWTP operators and municipalities on algae basics, QA/MRV, agronomic use, and procurement claims	2027-2029	<ul style="list-style-type: none"> • research institutions in agriculture • farmer advisory services providers • universities • chambers/co-ops 		P2 (AKIS/KT), Erasmus+, LIFE
		Annual outreach campaigns and policy briefs to counter misinformation and promote	2027-2034	<ul style="list-style-type: none"> • Ministry of agriculture • advisory networks • NGOs • producer groups 		TA CAP, HE, LIFE



		uptake of certified algae-based products				
		Scale-up & monitoring: ≥25 validated protocols, ≥3,000 credentials issued, ≥70% utilisation rate across advisors/farms/municipal operators	2028-2034	<ul style="list-style-type: none"> • Ministry of agriculture • agriculture modernisation units • research institutions in agriculture • advisory services providers 		P2 (AKIS/KT), HE, LIFE
69	Result-based eco-scheme: regenerative & precision bundle (arable/grasses)	Develop Soil & Input Efficiency Index (cover %, infiltration, no/low-till status, ΔSOC proxy) and prepare CAP eco-scheme contract templates	2026-2027 (pre-rollout)	<ul style="list-style-type: none"> • Ministry of agriculture • research institutions in agriculture • agriculture modernisation units • universities/advisory boards 	Rural Communities & Regional Bioeconomy Hubs	HE, LIFE, TA CAP
		Pilot test digital logs & field diagnostics (cover/infiltration) with representative farms in erosion-/drought-prone catchments	2026-2027	<ul style="list-style-type: none"> • research institutions in agriculture • farmer advisory bodies • farmer groups • innovation operational groups under EIP pilots 		P1 (Eco-schemes), LIFE, National Funds
		Launch national eco-scheme call with result-based payment tiers (€80-180/ha) and onboarding top-up for baselines/logging	2027-2028	<ul style="list-style-type: none"> • agriculture modernisation units • Ministry of agriculture • regional governments 		P1 (Eco-schemes), DEP, HE
		Integrate eco-scheme data with LPIS/IACS and monitoring	2027-2029	<ul style="list-style-type: none"> • agriculture modernisation units 		P1 (Eco-schemes), CAP, LIFE



		systems (RS/field spot checks; digital log verification)		<ul style="list-style-type: none"> • research institutions in agriculture • inspectorates 		
		Scale-up and monitor uptake: ≥180k ha enrolled by 2027, ≥380k ha by 2030, with ≥55% parcels reaching tier-2+	2028-2034	<ul style="list-style-type: none"> • Ministry of agriculture • agriculture modernisation units • research institutions in agriculture • farmers 		P1 (Eco-schemes), (Monitoring), DEP P2
70	Shared precision & smart irrigation pools (cooperation + investments)	Design national support scheme and procurement guidelines for shared precision & irrigation pools (vendor-neutral, data ownership rules, LFAs priority)	2026-2027 (pre-rollout)	<ul style="list-style-type: none"> • Ministry of agriculture • agriculture modernisation units • research institutions in agriculture • advisory bodies 	Climate Environmental Sustainability &	HE, LIFE, TA CAP
		Launch pilot innovation operational groups under EIP clusters testing shared GNSS/variable-rate kits and smart irrigation in dry catchments; develop data protocols	2026-2027	<ul style="list-style-type: none"> • farmer coops • EIP consortia (advisory, SMEs, universities) 		EIP-OG (P2), Interreg, HE
		Roll out CAPEX calls under Pillar II Investments with performance top-ups linked to precision-covered area and water-productivity proxies	2027-2028	<ul style="list-style-type: none"> • agriculture modernisation units • regional governments • producer groups 		P2 (Investments), ERDF, CF, National Funds
		Integrate pool service logs and device data with CAP	2028-2029	<ul style="list-style-type: none"> • research institutions in agriculture 		P1 (Eco-schemes), LIFE, DEP



		<p>monitoring (LPIS/IACS; eco-scheme alignment with M1)</p>		<ul style="list-style-type: none"> • agriculture modernisation units • advisory services providers 		
		<p>Scale-up to ≥260 clusters and ≥320k ha with precision/irrigation pools by 2030; monitor ≥15% water-productivity improvement in targeted crops</p>	2028-2034	<ul style="list-style-type: none"> • Ministry of agriculture • agriculture modernisation units • coops/producers • SMEs 		P2 (Monitoring), LIFE, DEP
71	<p>Biomethane upgrades & digestate circularity (investments + cooperation)</p>	<p>Map existing farm-scale and industrial AD plants; assess upgrade potential and digestate handling gaps; prepare sustainability/QA guidelines.</p>	2026-2027 (pre-rollout)	<ul style="list-style-type: none"> • Ministry of agriculture • national environmental and water management fund • research institutions in agriculture • regional energy/waste agencies 	Governance & AKIS	HE, LIFE, TA CAP
		<p>Launch pilot innovation operational groups under EIP consortia for AD upgrades with nutrient-management plans and short-haul logistics; test CO₂ capture readiness</p>	2026-2027	<ul style="list-style-type: none"> • AD operators • farmer clusters • universities/advisory bodies • SMEs 		EIP-OG (P2), Interreg, HE
		<p>Roll out CAPEX calls for biomethane upgrading, CHP/grid injection and digestate processing; include performance top-ups linked to verified biomethane output and digestate use on fields</p>	2027-2028	<ul style="list-style-type: none"> • agriculture modernisation units • Ministry of agriculture • regional governments 		P2 (Investments), ERDF, CF, National Funds



		Integrate plant meters, grid/CHP records and nutrient logs with CAP monitoring; align with eco-scheme soil/nutrient outcomes	2028-2029	<ul style="list-style-type: none"> • research institutions in agriculture • agriculture modernisation units • advisory services providers 		P1 (Eco-schemes), AECM (P2), LIFE
		Scale to ≥25 upgraded plants delivering ≥1.0 TWh/yr biomethane and ≥70% digestate under field plans by 2030	2028-2034	<ul style="list-style-type: none"> • Ministry of agriculture • AD operators • farmer groups • energy regulators 		P2 (Monitoring), LIFE, DEP
72	Side-Stream biohubs & modular biorefining (material-first, energy-second)	Map fruit/vegetable side-streams and identify high-potential regions (processing clusters, PO catchments); draft cascading & soil-organic-matter safeguards	2026-2027	<ul style="list-style-type: none"> • Ministry of agriculture • research institutions in agriculture • universities/labs • producer organisations (POs) 	Research, Innovation & Digitalisation	HE, LIFE, CBE-JU
		Launch pilot hubs with modular pre-processing (drying/chilling) and first extraction lines (bioactives, fibres); test End-of-Waste templates	2027-2028	<ul style="list-style-type: none"> • POs/co-ops • SMEs • municipalities • advisory services providers 		EIP-OG (P2), Interreg, HE
		Develop QA/safety analytics and packaging pilots; sign long-term contracts with processors/farms; set up digital dockets for logistics	2028-2029	<ul style="list-style-type: none"> • SMEs • universities • food processors • local authorities 		P2 (Investments), ERDF, CF, National Funds
		Scale regional hubs with certified product lines and material-first cascading	2029-2030	<ul style="list-style-type: none"> • Ministry of agriculture 		HE, LIFE, CBE-JU



		protocols; monitor soil-C balance impacts and logistics efficiency		<ul style="list-style-type: none"> • regional agencies • agriculture modernisation units • advisory networks 		
		Achieve ≥18 hubs with ≥25 kt/yr residues stabilised and ≥120 certified SKUs by 2030; integrate with CAP monitoring and procurement schemes	2030+	<ul style="list-style-type: none"> • Ministry of agriculture • research institutions in agriculture • producer groups • market regulators 		P2 (Monitoring), DEP, LIFE
73	Result-based eco-scheme: material-grade residue mobilisation & on-farm stabilisation	Define eligible residues (fruit/veg side-streams, vine prunings) and design the Residue Quality Index + SOM-cap thresholds; prepare eco-scheme guidelines	2026-2027	<ul style="list-style-type: none"> • Ministry of agriculture • research institutions in agriculture • agriculture modernisation units • universities/labs 	Sustainable Agriculture, Food & Forestry Value Chains	HE, LIFE, TA CAP
		Launch pilots with selected orchards/vineyards; introduce digital delivery notes (e-dockets) and storage/stabilisation protocols (covered storage, drying/chilling)	2027-2028	<ul style="list-style-type: none"> • producer groups/co-ops • advisory services providers • biohub operators 		P1 (Eco-schemes), EIP-OG (P2), HE
		Roll out payment tiers per t/ha delivered meeting quality spec; monitor SOM-cap compliance and QA pass rates at hubs	2028-2029	<ul style="list-style-type: none"> • agriculture modernisation units • Ministry of agriculture • Hub QA labs • advisory services providers 		P1 (Eco-schemes), DEP, LIFE
		Scale-up nationally with ≥8,000 farms by 2030; integrate	2029-2030	<ul style="list-style-type: none"> • Ministry of agriculture 		P1 (Eco-schemes), P2 (Monitoring), LIFE



		residue mobilisation data with Side-Stream Biohubs (Measure 29.1) for cascading monitoring		<ul style="list-style-type: none"> • agriculture modernisation units • producer organisations • regional agencies 		
74	Sectoral (fruit & vegetables po): circular packaging & by-product certification + AKIS micro-credentials	Integrate circular packaging, by-product certification, and training actions into recognised Fruit & Vegetable POs' operational programmes; draft protocols and open criteria	2026-2027	<ul style="list-style-type: none"> • Ministry of agriculture • agriculture modernisation units • recognised POs • research institutions in agriculture • universities/labs • standardisation bodies 	Rural Communities & Regional Bioeconomy Hubs	CMO Fruit & Veg, HE, LIFE
		Launch pilots with POs and SMEs: set up fibre-based packaging lines, validate protocols for residue-derived ingredients, test DPP-ready templates, and roll out first micro-credential modules	2027-2028	<ul style="list-style-type: none"> • producer organisations • SMEs • universities/advisors bodies • registry owner (monitoring agency/agency) 		EIP-OG (P2), Interreg, HE
		Scale up certification and labelling system; expand registry/API for DPP-ready data; onboard more POs and processors into procurement-ready schemes	2028-2029	<ul style="list-style-type: none"> • monitoring agency/paying agency • agriculture modernisation units • POs • advisory networks 		HE, LIFE, CBE-JU
		By 2030 achieve ≥280 certified lines, ≥25 validated protocols, and ≥3,000 modular skill certificates; embed green	2029-2030	<ul style="list-style-type: none"> • Ministry of agriculture • agriculture modernisation units • POs 		CMO Fruit & Veg, DEP, LIFE



		procurement and circular packaging criteria in PO programmes nationwide		<ul style="list-style-type: none"> regional authorities procurement agencies 		
75	Biomethane pilots & digestate circularity (investments + cooperation)	Develop legal/regulatory framework for biomethane (grid injection rules, guarantees of origin, RENenergy regulatory office digestate classification, permitting & QA guidance)	2026-2027 (pre-CAP rollout)	<ul style="list-style-type: none"> Ministry of agriculture Ministry of climate and environment energy regulatory office research institutions in agriculture agriculture support centre environment protection public bodies 	Knowledge & Skills for Farmers and Advisors	HE, LIFE, Innovation Fund
		Launch 2-3 demonstration biomethane pilots from existing large biogas plants (CAPEX calls + TA support); include digestate QA & nutrient plans	2027-2028	<ul style="list-style-type: none"> Agriculture modernisation units Ministry of agriculture regional governments pilot operators 		P2 (Investments), TA, CAP, National Funds
		Establish short-haul logistics models and farmer/processor cooperation protocols (innovation operational groups under EIP consortia, contracts for feedstock & digestate use)	2027-2029	<ul style="list-style-type: none"> innovation operational groups under EIP consortia (farmers, municipalities, processors) farmers advisory bodies universities, institutes 		EIP-OG (P2), Interreg, HE
		Scale up biomethane capacity with investment grants under Pillar II; embed digestate nutrient planning in CAP advisory/eco-schemes	2028-2030	<ul style="list-style-type: none"> agriculture modernisation units Ministry of agriculture advisory services providers farmers 		P2 (Investments), ERDF, CF, National Funds

		Monitoring & verification system operational: biomethane metering, digestate application logs, RENenergy regulatory office compliance	2028-2034	<ul style="list-style-type: none"> • Ministry of agriculture • agriculture modernisation units • research institutions in agriculture • operators 		P2 (Monitoring), LIFE, DEP
76	Result-based eco-scheme: verified renenergy regulatory office & precision nutrient substitution	Develop national RENenergy regulatory office conformity criteria (QA thresholds for heavy metals, pathogens; compliance templates for farms) and design result-based eco-scheme payment logic (Nutrient Substitution Index)	2026-2027 (pre-CAP rollout)	<ul style="list-style-type: none"> • Ministry of agriculture • research institutions in agriculture • environment protection public bodies • agriculture modernisation units • certification bodies 	Governance & AKIS	HE, LIFE, TA CAP
		Pilot precision RENenergy regulatory office use with innovation operational groups under EIP consortia (farms, AD operators, advisors, universities) to validate digital logging tools and soil-water proxies	2026-2027	<ul style="list-style-type: none"> • innovation operational groups under EIP consortia • farmer advisory bodies • universities • research institutions in agriculture 		EIP-OG (P2), Interreg, HE
		Launch eco-scheme call for RENenergy regulatory office substitution under CAP Pillar I, including onboarding support (baseline sampling/logging)	2027-2028	<ul style="list-style-type: none"> • agriculture modernisation units (paying agency) • Ministry of agriculture • regional governments 		P1 (Eco-schemes), DEP, LIFE
		Integrate RENenergy regulatory office into national nutrient planning/digital advisory tools	2028-2030	<ul style="list-style-type: none"> • research institutions in agriculture • farmer advisory bodies 		P2 (AKIS/KT), Erasmus+, HE



		and train advisors/farmers in precision dosing protocols		<ul style="list-style-type: none"> • chambers/coops • SMEs 		
		Scale up implementation and monitor substitution outcomes (≥260k ha by 2030; ≥18% average mineral N reduction; % parcels with digital logs)	2028-2034	<ul style="list-style-type: none"> • Ministry of agriculture • agriculture modernisation units • farm operators • certification/ verifier bodies 		P1 (Eco-schemes), (Monitoring), LIFE
77	Side-Stream registry & cascading valorisation pilots (cooperation + AKIS + investments)	Establish a national side-stream registry (digital platform + API) and draft QA/EoW conformity templates for food-industry residues	2026-2027 (pre-CAP rollout)	<ul style="list-style-type: none"> • Ministry of agriculture • national R&D funding agency • research institutions in agriculture • environment protection public bodies • agriculture modernisation units • certification bodies 	Climate Environmental Sustainability &	HE, LIFE, CBE-JU
		Launch innovation operational groups under EIP pilots for bioactive extraction, enzymatic fermentation, and fibre-based packaging; integrate cascading protocols (materials-first, residuals to AD)	2026-2027	<ul style="list-style-type: none"> • innovation operational groups under EIP consortia (PO/co-ops, processors, SMEs, universities, municipalities) 		EIP-OG (P2), Interreg, HE
		Roll out targeted investment grants for pilot lines (QA labs, modular extraction, drying/logistics) with performance-based top-ups linked to certified product lines	2027-2028	<ul style="list-style-type: none"> • agriculture modernisation units • regional governments • Ministry of agriculture 		P2 (Investments), ERDF, CF, National Funds



		Develop AKIS-linked training and stackable modular skill certificates for advisors, SMEs, and municipal staff (QA/MRV, cascading protocols, procurement)	2028-2030	<ul style="list-style-type: none"> • research institutions in agriculture • farmer advisory bodies • universities • chambers/co-ops • SMEs 		P2 (AKIS/KT), Erasmus+, HE
		Scale-up registry coverage and cascading pilots (≥450 processors onboarded; ≥150 certified product lines; >70% non-material fractions to AD)	2028-2034	<ul style="list-style-type: none"> • Ministry of agriculture • agriculture modernisation units • registry operator • processors • biohub operators 		P2 (Monitoring), DEP, LIFE
78	Hardwood mobilisation corridors & pre-processing hubs (material-first cascades)	Establish national guidance and pilot mapping of low-grade hardwood supply (beech/under-used species) with GIS and owner-group clustering	2026-2027 (pre-CAP rollout)	<ul style="list-style-type: none"> • State Forests • Ministry of agriculture • IBL • environment protection inspectorate • regional authorities 	Sustainable Agriculture, Food & Forestry Value Chains	HE, LIFE, CBE-JU
		Launch innovation operational groups under EIP pilots and regional cooperation schemes for owner groups, SMEs and municipalities to design mobilisation corridors and contracts	2026-2027	<ul style="list-style-type: none"> • forest-owner co-ops • SMEs • municipalities • universities/RTOs 		EIP-OG (P2), Interreg, HE
		Deploy investment grants for pre-processing hubs (drying, chipping, scanning/QA, covered	2027-2028	<ul style="list-style-type: none"> • agriculture modernisation unit • Ministry of agriculture 		P2 (Investments), ERDF, CF, National Funds



		storage, shared logistics) with performance top-ups per tonne of material-grade feedstock delivered		<ul style="list-style-type: none"> regional governments 		
		Integrate QA protocols and EUDR due diligence into national registry; roll out traceability tools and training for SMEs and owner groups	2028-2030	<ul style="list-style-type: none"> IBL research institutions in agriculture advisory services providers chambers/co-ops 		P2 (AKIS/KT), Erasmus+, HE
		Scale-up to ≥22 hubs and ≥260 kt/yr material-grade hardwoods mobilised for domestic processors, with ≥75% QA pass and reduced export share	2028-2034	<ul style="list-style-type: none"> Ministry of agriculture agriculture modernisation units hub operators processors owner groups 		P2 (Monitoring), DEP, LIFE
79	National wood traceability & owner cooperation (eudr-ready)	Develop national registry architecture for wood flows, aligned with EUDR due diligence, incl. open APIs and procurement templates	2026-2027 (pre-CAP rollout)	<ul style="list-style-type: none"> Ministry of agriculture Ministry of climate and environment State Forests IBL GovTech 	Research, Innovation & Digitalisation	HE, LIFE, DEP
		Pilot innovation operational groups under EIP cooperation projects for owner associations, SMEs and processors to test digital traceability tools, templates and contracts	2026-2027	<ul style="list-style-type: none"> forest-owner groups SMEs universities advisory services providers 		EIP-OG (P2), Interreg, HE



		Roll out national onboarding programme for holdings and processors; integrate advisory/AKIS trainings and due diligence toolkits	2027-2028	<ul style="list-style-type: none"> • agriculture modernisation units • farmer advisory bodies • agriculture chambers/co-ops 		TA CAP, P2 (AKIS/KT), LIFE
		Scale procurement uptake: embed traceability criteria in public tenders and ensure ≥55% harvest volume tracked	2028-2030	<ul style="list-style-type: none"> • Public Procurement Office • Ministry of agriculture • regional governments • buyers 		DEP, LIFE, National Funds
		Full deployment: ≥15,000 holdings onboarded, ≥80% harvest volume tracked, ≥300 API users (buyers/authorities)	2028-2034	<ul style="list-style-type: none"> • Ministry of agriculture • agriculture modernisation units • registry operator • owner associations, processors 		DEP, HE, LIFE
80	Engineered wood & biorefinery pilots with chp+biochar return	Identify candidate SMEs/processors, owner groups and municipalities for pilot engineered wood/biorefinery lines, map low-grade hardwood supply, and prepare feasibility studies	2026-2027 (pre-CAP rollout)	<ul style="list-style-type: none"> • Ministry of agriculture • Ministry of climate and environment protection • State Forests • IBL • municipalities • clusters/SMEs 	Rural Communities & Regional Bioeconomy Hubs	HE, LIFE, CBE-JU
		Launch experimental programmes (LVL/CLT incl. beech, wood modification, modular biorefinery/extractives) integrated with CHP+biochar units, including QA/testing labs	2027-2028	<ul style="list-style-type: none"> • SMEs/processors • municipalities • IBL/universities • agriculture modernisation units (as managing authority) 		P2 (Investments), ERDF, CF, National Funds



		Develop national QA/certification protocols for engineered wood products and biochar (soil-safety thresholds, conformity testing) with innovation operational groups under EIP pilots	2027-2029	<ul style="list-style-type: none"> • IBL • research institutions in agriculture • accredited labs • certification bodies 		EIP-OG (P2), HE, LIFE
		Train operators/advisors under AKIS (modular skill certificates, procurement/standardisation playbooks) to scale adoption and ensure compliance with EU standards	2028-2030	<ul style="list-style-type: none"> • farmer advisory bodies • universities • chambers/co-ops • Ministry of agriculture (AKIS coordination) 		P2 (AKIS/KT), Erasmus+, HE
		Scale-up to ≥7 lines with integrated CHP+biochar return, ensuring ≥100k m ³ /yr capacity and ≥6 kt certified biochar applied to farms under nutrient/soil plans	2028-2034	<ul style="list-style-type: none"> • Ministry of agriculture • Agriculture modernisation units • SMEs/operators • farmers' groups • municipalities 		HE, LIFE, CBE-JU
81	Circular investment blending facility for bioeconomy smes	Design facility pooling CAP Pillar II, ERDF, and EIB loan instruments; consult with national banks and stakeholders	2026-2027 (design phase)	<ul style="list-style-type: none"> • Ministry of agriculture • public financing provider • EIB • national R&D funding agency • Ministry of finance 	Climate Environmental Sustainability &	CAP P2 (Investment ERDF, CF)
		Pilot blended finance calls targeting circular bioeconomy SMEs (waste valorisation, biomaterials, renewable energy)	2027-2028	<ul style="list-style-type: none"> • bank (public financing provider) • Ministry of agriculture • agriculture modernisation units 		EIB, InvestEU, National Funds

				<ul style="list-style-type: none"> selected SMEs 		
		Establish risk-sharing mechanisms and monitoring KPIs for supported SMEs	2028-2029	<ul style="list-style-type: none"> bank (public financing provider) EIB Ministry of agriculture national R&D funding agency 		HE, LIFE, CBE-JU
		Scale facility to national coverage, include guarantee schemes and regional investment branches	2029-2034	<ul style="list-style-type: none"> Ministry of agriculture bank (public financing provider) regional banks voivodeships 		ERDF, CF, National Funds, EIB
82	Eco-scheme for on-farm food waste prevention	Develop MRV indicators (kg waste avoided, % redistributed) and design payment logic	2026-2027	<ul style="list-style-type: none"> Ministry of agriculture research institutions in agriculture NGOs 	Sustainable Agriculture, Food & Forestry Value Chains	HE, LIFE, TA CAP
		Pilot eco-scheme in fruit/vegetable farms with monitoring of avoided waste and redistribution via food banks	2027-2028	<ul style="list-style-type: none"> Ministry of agriculture food banks producer groups 		P1 (Eco-schemes), OG (P2), HE
		Roll out scheme nationally with digital logging and verified redistribution chains	2028-2029	<ul style="list-style-type: none"> agriculture modernisation units Ministry of agriculture NGOs 		P1 (Eco-schemes), LIFE
		Scale adoption to cover main horticultural areas; integrate with EU waste reduction targets	2029-2034	<ul style="list-style-type: none"> Ministry of agriculture research institutions in agriculture 		P1 (Eco-schemes), LIFE, National Funds



				<ul style="list-style-type: none"> • NGOs • advisory services providers 		
83	Rural bioeconomy leader labs	Create local innovation funds under LEADER for local action groups to pilot circular services (repair hubs, reuse centres, short supply chains)	2026-2027	<ul style="list-style-type: none"> • Ministry of agriculture • local action groups • NGOs 	Research, Innovation & Digitalisation	LEADER/CLLD (P2), Interreg, National Funds
		Support 10-15 pilot LEADER Labs testing circular services in rural areas.	2027-2028	<ul style="list-style-type: none"> • Ministry of agriculture • local action groups • municipalities 		LEADER/CLLD (P2), HE, LIFE
		Evaluate pilots, develop scaling guidelines and funding mechanisms for wider rollout	2028-2029	<ul style="list-style-type: none"> • Ministry of agriculture • farmers advisory units • regional authorities 		HE, LIFE, TA CAP
		Expand network of LEADER Labs to 50+ across Poland; integrate results into CAP reporting	2029-2034	<ul style="list-style-type: none"> • Ministry of agriculture • local action groups • NGOs 		LEADER/CLLD (P2), ERDF, National Funds
84	Eco-scheme for hedgerows & buffer strips with carbon/water co-benefits	Define indicators (SOC, erosion control, biodiversity species counts) and draft eco-scheme contracts	2026-2027	<ul style="list-style-type: none"> • Ministry of agriculture • research institutions in agriculture • State Forests 	Knowledge & Skills for Farmers and Advisors	HE, LIFE, TA CAP
		Pilot result-based contracts in 3-4 regions with high erosion and biodiversity priority	2027-2028	<ul style="list-style-type: none"> • agriculture modernisation units • Ministry of agriculture • farmer advisory units • farmers' groups 		P1 (Eco-schemes), EIP-OG (P2), HE



		Develop CRCF-compliant templates for hedgerows as carbon removals	2028-2029	<ul style="list-style-type: none"> • research institutions in agriculture • Ministry of agriculture • NGOs 		HE, LIFE, CRCF
		Roll out scheme nationally with monitoring and audits	2029-2034	<ul style="list-style-type: none"> • Ministry of agriculture • agriculture modernisation units • advisory services providers 		P1 (Eco-schemes), P2 (Monitoring), LIFE
85	Carbon literacy campaign for farmers	Design training modules on carbon farming, soil carbon, and GHG mitigation tailored for a country's conditions	2026-2027	<ul style="list-style-type: none"> • Ministry of agriculture • research institutions in agriculture, NGOs 	Governance & AKIS	HE, LIFE, Erasmus+
		Roll out training via ODR and universities; combine workshops with online materials	2027-2028	<ul style="list-style-type: none"> • Ministry of agriculture • farmers advisory units • media partners 		P2 (AKIS/KT), National Funds
		Launch national media campaign with farmer stories, TV/radio spots, and social media presence	2028-2029	<ul style="list-style-type: none"> • Ministry of agriculture • NGOs • agricultural press 		LIFE, National Funds
		Maintain continuous outreach and update training modules with new CAP developments	2029-2034	<ul style="list-style-type: none"> • Ministry of agriculture • advisory services providers • universities 		P2 (AKIS/KT), TA CAP, LIFE
86	Green public procurement accelerator	Pilot procurement of biobased products (food packaging, cleaning agents, insulation) in selected rural schools and hospitals	2026-2027	<ul style="list-style-type: none"> • Ministry of agriculture • local authorities • NGOs 	Climate Environmental Sustainability &	HE, LIFE, CBE-JU



	for rural schools/hospitals	Develop national green procurement criteria and toolkits for rural public institutions	2027-2028	<ul style="list-style-type: none"> Ministry of agriculture Public Procurement Office NGOs 		DEP, LIFE, National Funds
		Train procurement officers and local suppliers on criteria and certification	2028-2029	<ul style="list-style-type: none"> Ministry of agriculture farmers advisory units universities 		Erasmus+, P2 (AKIS/KT), LIFE
		Scale adoption across all voivodeships, monitor uptake and market impact	2029-2034	<ul style="list-style-type: none"> Ministry of Agriculture local governments NGOs 		ERDF, CF, National Funds
87	Regional carbon farming living labs	Select 4-5 priority regions (different soil/climate types) for Carbon Farming Living Labs	2026-2027	<ul style="list-style-type: none"> Ministry of agriculture research institutions in agriculture regional authorities 	Sustainable Agriculture, Food & Forestry Value Chains	HE, LIFE, CBE-JU
		Co-design practices with farmers, SMEs, advisors, and researchers in pilot labs	2027-2028	<ul style="list-style-type: none"> research institutions in agriculture universities farmer groups 		EIP-OG (P2), Interreg, HE
		Integrate monitoring (soil C, biodiversity, water retention) and economic analysis into lab activities	2028-2029	<ul style="list-style-type: none"> research institutions in agriculture Ministry of agriculture NGOs 		P2 (AKIS/KT), Erasmus+, LIFE
		Maintain operational labs as permanent innovation and advisory centres	2029-2034	<ul style="list-style-type: none"> Ministry of agriculture research institutions in agriculture regional hubs 		P2 (Monitoring), TA CAP, National Funds



88	Eco-scheme for circular grazing & mixed farming	Pilot result-based eco-scheme for livestock-crop nutrient recycling (rotations, manure return, fodder self-sufficiency)	2026-2027	<ul style="list-style-type: none"> Ministry of agriculture farmer advisory bodies cooperatives 	Research, Innovation & Digitalisation	HE, LIFE, TA CAP
		Develop monitoring framework (NPK balances, forage productivity, soil cover)	2027-2028	<ul style="list-style-type: none"> research institutions in agriculture Ministry of agriculture NGOs 		P1 (Eco-schemes), EIP-OG (P2), HE
		Expand scheme to mixed farms nationwide with region-specific payment tiers	2028-2029	<ul style="list-style-type: none"> agriculture modernisation units Ministry of agriculture producer groups 		P1 (Eco-schemes), LIFE, National Funds
		Scale adoption to >200k ha with verified circularity benefits	2029-2034	<ul style="list-style-type: none"> Ministry of agriculture agriculture modernisation units farmer advisory bodies 		P1 (Eco-schemes), P2 (Monitoring), LIFE
89	Digital farmer wallet for eco-scheme tracking	Develop app linked to IACS/LPIS that issues digital eco-credits for eco-scheme practices.	2026-2027	<ul style="list-style-type: none"> Ministry of agriculture agriculture modernisation units IT providers 	Rural Communities & Regional Bioeconomy Hubs	DEP, HE, LIFE
		Pilot in 2-3 voivodeships with farmers receiving digital credits.	2027-2028	<ul style="list-style-type: none"> agriculture modernisation units NGOs farmer groups 		P1 (Eco-schemes), EIP-OG (P2), HE



		Integrate with carbon market platforms and cooperative schemes.	2028-2029	<ul style="list-style-type: none"> • Ministry of agriculture • bank (public financing provider) • advisory 		LIFE, Innovation Fund, National Funds
		Scale nationwide, enabling transparent farmer reporting and credit trading.	2029-2034	<ul style="list-style-type: none"> • Ministry of agriculture • agriculture modernisation units • IT sector 		DEP, TA CAP, P2 (Monitoring)
90	Knowledge vouchers for bioeconomy start-ups	Design voucher scheme for start-ups to buy advisory/university services (IPR, testing, business models)	2026-2027	<ul style="list-style-type: none"> • Ministry of agriculture • national R&D funding agency • entrepreneurship support agency 	Governance & AKIS	HE, LIFE, Erasmus+
		Pilot with 50-100 start-ups in agri-food bioeconomy value chains	2027-2028	<ul style="list-style-type: none"> • national R&D funding agency • Ministry of agriculture • incubators 		Interreg, EIT KICs, National Funds
		Evaluate impact and refine eligibility criteria, expand to regional clusters	2028-2029	<ul style="list-style-type: none"> • Ministry of agriculture • bank public financing provider • clusters 		HE, CBE-JU, National Funds
		Scale to national programme with >500 vouchers per year	2029-2034	<ul style="list-style-type: none"> • Ministry of agriculture • national R&D funding agency • regional agencies 		ERDF, CF, National Funds
91	Regional composting & soil hub network	Map regional bio-waste streams (farm, municipal, food industry) and identify priority catchments	2026-2027	<ul style="list-style-type: none"> • Ministry of agriculture • municipalities • research institutions in agriculture 	Climate Environmental & Sustainability	HE, LIFE, CBE-JU

		Pilot 2-3 compost hubs integrating farmers, municipalities, and SMEs	2027-2028	<ul style="list-style-type: none"> • local governments • cooperatives • agriculture modernisation units 		EIP-OG (P2), Interreg, HE
		Develop QA protocols for compost use in soils (nutrient value, heavy metals, microplastics)	2027-2029	<ul style="list-style-type: none"> • research institutions in agriculture • accredited labs • certification bodies 		P2 (Investments), ERDF, CF, National Funds
		Integrate compost hubs into CAP AECM and eco-schemes (soil C, erosion, nutrient substitution)	2028-2029	<ul style="list-style-type: none"> • Ministry of agriculture • agriculture modernisation units 		P1 (Eco-schemes), AECM (P2), LIFE
		Scale hubs across all voivodeships with >150k t/year certified compost flow	2029-2034	<ul style="list-style-type: none"> • Ministry of agriculture • municipalities • local action groups 		P2 (Monitoring), LIFE, DEP
92	Eco-scheme for agrotourism ecosystem services	Design payment logic for agrotourism services linked to landscape/ecosystem maintenance	2026-2027	<ul style="list-style-type: none"> • Ministry of agriculture • Tourism Board • NGOs 	Sustainable Agriculture, Food & Forestry Value Chains	HE, LIFE, Erasmus+
		Pilot scheme in Natura 2000 and rural heritage landscapes	2027-2028	<ul style="list-style-type: none"> • local authorities • local action groups • farmer groups 		P1 (Eco-schemes), LEADER/CLLD (P2), HE
		Develop monitoring framework (visitor satisfaction, biodiversity proxies, cultural services)	2027-2029	<ul style="list-style-type: none"> • universities • research institutions in agriculture • NGOs 		LIFE, Interreg, National Funds
		Train advisors and local action groups on scheme administration and farmer onboarding	2028-2029	<ul style="list-style-type: none"> • Ministry of agriculture • farmers advisory units • advisory bodies 		P2 (AKIS/KT), LEADER/CLLD (P2), TA CAP



		Scale to 5,000+ farms offering ecosystem-based tourism services	2029-2034	<ul style="list-style-type: none"> Ministry of agriculture Tourism Board agriculture modernisation units 		P1 (Eco-schemes), P2 (Monitoring), National Funds
93	National fund for on-farm renewable energy self-sufficiency	Design investment grants scheme for PV, heat pumps, and small wind dedicated to farms	2026-2027	<ul style="list-style-type: none"> Ministry of agriculture national environmental and water management fund public financing provider 	Knowledge & Skills for Farmers and Advisors	HE, LIFE, Innovation Fund
		Pilot installations in mixed farms (livestock, horticulture, arable)	2027-2028	<ul style="list-style-type: none"> agriculture modernisation units local authorities 		P2 (Investments), ERDF, CF, National Funds
		Develop advisory toolkits for energy audits and integration with CAP climate objectives	2027-2029	<ul style="list-style-type: none"> farmers advisory units advisory bodies NGOs 		P2 (AKIS/KT), LIFE, National Funds
		Integrate monitoring (energy self-sufficiency %, GHG cuts) into CAP reporting	2028-2029	<ul style="list-style-type: none"> Ministry of agriculture research institutions in agriculture 		P2 (Monitoring), LIFE, DEP
		Scale to >20,000 farms nationwide with verified self-sufficiency gains	2029-2034	<ul style="list-style-type: none"> Ministry of agriculture national environmental and water management fund agriculture modernisation units 		Innovation Fund, National Funds
94	Carbon smart labels for farmers	Pilot certification system for verified soil organic carbon gains on farms	2026-2027	<ul style="list-style-type: none"> Ministry of agriculture NGOs research institutions in agriculture 	Governance & AKIS	HE, LIFE, CBE-JU

		Develop consumer-facing logo/label for farm products with verified climate benefits	2027-2028	<ul style="list-style-type: none"> • Ministry of agriculture • NGOs • retailers 		EIP-OG (P2), Interreg, F
		Set certification rules, verification protocols, and monitoring indicators (SOC, biodiversity)	2027-2029	<ul style="list-style-type: none"> • research institutions in agriculture • certification bodies 		LIFE, CBE-JU, National Funds
		Integrate smart label into CAP AKIS knowledge sharing and eco-scheme reporting	2028-2029	<ul style="list-style-type: none"> • Ministry of agriculture • advisory services providers 		P2 (AKIS/KT), TA CAP, LIFE
		Scale adoption across retailers and processors, covering >20% of labelled agri-food products	2029-2034	<ul style="list-style-type: none"> • Ministry of agriculture • retailers • producer groups 		DEP, LIFE, H
95	Bioeconomy fellowships for young farmers	Design fellowship programme linking universities with circular farms/SMEs	2026-2027	<ul style="list-style-type: none"> • Ministry of agriculture • Ministry of education • universities 	Knowledge & Skills for Farmers and Advisors	HE, LIFE, Erasmus+
		Launch first cohort of 200 fellows in 3-4 thematic areas (bioenergy, biomaterials, carbon farming, digital)	2027-2028	<ul style="list-style-type: none"> • universities • research institutions in agriculture • farmer groups 		P2 (AKIS/KT), Interreg, HE
		Provide structured placements (6-12 months) with evaluation of skills uptake	2027-2029	<ul style="list-style-type: none"> • Ministry of agriculture • agriculture modernisation units • chambers 		Erasmus+, HE, National Funds



		Expand programme to include international mobility (Erasmus-style) and start-up incubation	2028-2029	<ul style="list-style-type: none"> • Ministry of agriculture • national R&D funding agency • NGOs 		Erasmus+, HEI Alliances, LIFE
		Scale to 2,000 fellows by 2034 with verified employment/start-up outcomes	2029-2034	<ul style="list-style-type: none"> • Ministry of agriculture • Ministry of education • universities • incubators 		HE, Erasmus+, National Funds
96	Soil health bonds (green finance)	Design pilot bond instrument with Ministry of agriculture & public financing provider, earmarking proceeds for soil-health AECMs	2026-2027	<ul style="list-style-type: none"> • Ministry of agriculture • public financing provider • Ministry of finance • national R&D funding agency 	Climate Environmental Sustainability &	HE, LIFE, InvestEU
		Develop monitoring indicators (SOC increase, erosion control, nutrient balance) linked to bond payouts	2026-2027	<ul style="list-style-type: none"> • research institutions in agriculture • universities • certification bodies 		National Funds, EIB, public financing provider
		Issue first Soil Health Bonds with partial EU/EIB guarantee	2027-2028	<ul style="list-style-type: none"> • public financing provider • EIB • Ministry of agriculture 		EIB, InvestEU, Innovation Fund
		Allocate bond proceeds to CAP AECM eco-schemes and nutrient management pilots	2028-2029	<ul style="list-style-type: none"> • Ministry of agriculture • agriculture modernisation units 		P1 (Eco-schemes), AECM (P2), LIFE
		Scale bond issuance to multi-voivodeship coverage, targeting >€500M by 2034	2029-2034	<ul style="list-style-type: none"> • public financing provider • Ministry of agriculture • Ministry of finance 		ERDF, CF, National Funds



97	Eco-scheme for crop diversification & local protein sources	Define monitoring indicators (protein crops share, rotation diversity index)	2026-2027	<ul style="list-style-type: none"> Ministry of agriculture research institutions in agriculture universities 	Rural Communities & Regional Bioeconomy Hubs	HE, LIFE, TA CAP
		Pilot eco-scheme contracts with 500 farms in 3 regions	2027-2028	<ul style="list-style-type: none"> agriculture modernisation units advisory services providers producer groups 		P1 (Eco-schemes), EIP-OG (P2), HE
		Develop digital log templates and field-verifier protocols	2027-2028	<ul style="list-style-type: none"> Ministry of agriculture agriculture modernisation units IT providers 		DEP, LIFE, HE
		Integrate scheme with national protein strategy and CAP eco-scheme menu	2028-2029	<ul style="list-style-type: none"> Ministry of agriculture agriculture modernisation units 		P1 (Eco-schemes), National Funds
		Scale to >300k ha with ≥20% average mineral protein substitution by 2034	2029-2034	<ul style="list-style-type: none"> Ministry of agriculture producer groups agriculture modernisation units 		P1 (Eco-schemes), P2 (Monitoring), LIFE
98	Circular manure exchange platform	Develop national digital platform for surplus-deficit matching (GIS-based)	2026-2027	<ul style="list-style-type: none"> Ministry of agriculture research institutions in agriculture IT partners 	Sustainable Agriculture, Food & Forestry Value Chains	DEP, HE, LIFE
		Pilot in 3 voivodeships with high livestock densities	2027-2028	<ul style="list-style-type: none"> Agriculture modernisation units advisory bodies municipalities 		EIP-OG (P2), Interreg, HE



		Integrate with CAP nutrient planning tools (eco-schemes/AECM)	2028-2029	<ul style="list-style-type: none"> Ministry of agriculture agriculture modernisation units 		P1 (Eco-schemes), AECM (P2), LIFE
		Develop logistics and quality-assurance protocols (storage, odour, hygiene)	2028-2029	<ul style="list-style-type: none"> research institutions in agriculture inspectories 		P2 (Investments), ERDF, CF, National Funds
		Scale nationwide with >10Mt nutrient flows annually matched digitally	2029-2034	<ul style="list-style-type: none"> Ministry of agriculture agriculture modernisation units IT operators 		P2 (Monitoring), DEP, LIFE
99	Eco-scheme for orchard carbon & biodiversity services	Design orchard SOC and biodiversity indicators (soil cover, pollinator habitat, pruning residues)	2026-2027	<ul style="list-style-type: none"> Ministry of agriculture research institutions in agriculture fruit producer groups 	Research, Innovation & Digitalisation	HE, LIFE, TA CAP
		Pilot contracts in 2-3 fruit clusters (apples, berries)	2027-2028	<ul style="list-style-type: none"> agriculture modernisation units advisory services providers fruit organisations 		P1 (Eco-schemes), EIP-OG (P2), HE
		Develop monitoring protocols (soil tests, biodiversity transects, e-dockets for residues)	2027-2029	<ul style="list-style-type: none"> universities NGOs advisory services providers 		P2 (Monitoring), LIFE, DEP
		Integrate results with CRCF-ready frameworks for carbon credits	2028-2030	<ul style="list-style-type: none"> Ministry of agriculture certification bodies 		HE, LIFE, CRCF



		Scale to ≥50k ha orchards under SOC/biodiversity eco-schemes by 2034	2029-2034	<ul style="list-style-type: none"> Ministry of agriculture fruit producer groups agriculture modernisation units 		P1 (Eco-schemes), National Funds
100	Regional bio-based construction pilots	Identify candidate municipalities and local SMEs for straw/wood-based construction pilots	2026-2027	<ul style="list-style-type: none"> Ministry of agriculture national R&D funding agency local authorities 	Governance & AKIS	HE, LIFE, CBE-JU
		Support experimental programmes in public buildings (schools, kindergartens, rural admin)	2027-2028	<ul style="list-style-type: none"> local governments SMEs agriculture modernisation units 		Interreg, ERDF, National Funds
		Develop QA protocols for insulation/panels (fire safety, compostability, thermal)	2027-2029	<ul style="list-style-type: none"> IBL research institutions in agriculture universities 		HE, LIFE, CBE-JU
		Develop procurement criteria/playbooks for municipalities & housing co-ops	2028-2029	<ul style="list-style-type: none"> Ministry of agriculture NGOs certification bodies 		DEP, LIFE, TA CAP
		Scale to 200+ public/rural housing buildings using bio-based materials	2029-2034	<ul style="list-style-type: none"> Ministry of agriculture municipalities national R&D funding agency public financing provider 		ERDF, CF, National Funds