

Fraunhofer Group for Resource Technologies and Bioeconomy
Fraunhofer Strategic Research Field Bioeconomy

Invest in Innovation: Secure Europe's Bio-Based Future

Considering the EU's ambitious climate, energy, and competitiveness goals – as well as current geopolitical and economic challenges – a strengthened, innovation-driven bioeconomy is more important than ever. As Europe risks falling behind in this strategically vital and fast-growing sector, Fraunhofer Institutes strongly support the initiative to develop a new bioeconomy strategy by the end of 2025. It is imperative that the EU urgently addresses the following key issues:

Create a Stable Investment Climate for the European Bioeconomy

Regulatory unpredictability remains a significant barrier to investment. Reconsideration of previously approved bio-based materials and chemicals, such as the recent evaluation of ethanol reclassification¹, sends conflicting signals to investors and industry. Similarly, the legislative process of the Packaging and Packaging Waste Regulation (PPWR) has created prolonged uncertainty around the future of bioplastics. These disruptions delay the commercial deployment of market-ready technologies, weaken investor confidence, and risk stalling Europe's bio-based industrial transformation. Additionally, current legal requirements often lag behind state-of-the-art practices and are inconsistently applied. To reverse this trend, the EU must establish a stable, evidence-based regulatory framework that reflects the characteristics of bio-based materials and processes. Research-driven predictability, clarity, and long-term coherence are essential to de-risk investments and enable scaling of sustainable solutions.

In parallel, the EU must introduce strong demand-side measures, including:

- EU-wide defossilization targets for fossil carbon content in materials,
- Minimum bio-based content in consumer products, and
- Material quotas that incentivize uptake of circular bio-based alternatives.

These actions will increase market security, unlock private capital, and reinforce Europe's strategic autonomy. Additional steps encompass:

- Clear framework conditions for market entry and phasing out subsidies for non-sustainable alternatives,
- Innovation-linked financial tools and pilot and demonstration access for start-ups and SMEs, closely linked to the Startup and Scaleup Strategy,

¹ [VCI-eDokument](#)

- Regulatory alignment with modern sustainability assessments, and
- Empowering research organizations to deliver market-ready solutions.

Strengthening modular and scalable infrastructure is vital. Public-private investment in pilot plants, demonstration facilities, and digitally enabled production platforms need to be designed for rapid cross-sectoral and -regional adaptation to reduce operational risk and speed up deployment and production efficiency. Data availability and interoperability are foundational enablers of a competitive and scalable European bioeconomy that supports faster innovation cycles and more informed investment. The EU should support open-data platforms and interoperable European bioeconomy data spaces, integrated with initiatives like Gaia-X, alongside tools such as digital twins and advanced process control systems to improve traceability, resource efficiency, and system resilience.

To sustain this transformation, the EU must invest in its workforce. Cross-sector education programs (combining life sciences, engineering, and digital skills) and re-skilling in rural and industrial regions are essential to prepare for emerging bio-based industries and ensure a just and inclusive transition.

Increase Resource-Efficient and Circular Use of Biological Resources

The EU must redefine waste (biological and water alike) as a valuable feedstock, not just a disposal issue, to unlock innovation. This requires revising legal definitions of “waste”, ensuring safety and consumer acceptance, and creating viable markets. Harmonized regulations must support innovative, circular applications for local and cascaded uses, including waste-to-product pathways, like nutrient recovery from wastewater; high-value compounds from food residues; and protein extraction from slop. Biotechnological techniques for sustainable waste management, such as using straw as fertilizer rather than classifying it as industrial waste or the safe use of bio-waste as insect feed, should be recognized and facilitated through updated legal frameworks.

The bioeconomy and water economy are deeply interconnected. Water is essential for biomass processing, yet linear, centralized, and disrupted local water systems and regulatory inertia impede circularity, efficiency, and resilience. The EU must promote decentralized purification, wastewater reuse, and blue-green infrastructure in rural and urban areas. Resource-efficient innovation calls for:

- Regulatory frameworks must allow for local reuse while ensuring consumer safety,
- Clear sustainability standards and transparent product design criteria must be defined early in the value chain,
- End-of-life options – recyclability, biodegradability, or water reintegration – must be embedded from the start,

- Subsidies for non-sustainable alternatives must be phased out, and
- Raw material use must be aligned with circular economy principles (“R” strategies).

Standardized metrics and product labeling will empower both businesses and consumers to make informed, comparable decisions, help to build a European market for circular and water-efficient solutions. This requires the definition of clear, consistent criteria for evaluating sustainability performance and supporting companies in transparently documenting and communicating their social and environmental responsibilities.

Bio-based products and materials, and water-intensive processes must be integrated into efficient (existing) recycling and reuse systems to close the carbon and water loops. Bio-based carbon and water circularity needs targeted incentives, awareness campaigns, and dedicated research funding to drive market penetration of bio-based and water-efficient solutions. Where recycling is not feasible, biodegradability must be recognized as viable end-of-life strategy. Carbon captured from combustion or agricultural wastewater can serve as green feedstock for chemical production and new products. The EU should revise carbon labeling to reflect this circular and innovation potential.

Diversify Biomass Supply for a Resilient and Sustainable Bioeconomy

To reduce dependency on limited or imported resources and strengthen regional economies and supply security, the EU must diversify its biomass supply and integrate underutilized biomass sources (such as agricultural residues, industrial by-products, and secondary raw materials) into sustainable value chains. Water, too, must be treated as a strategic resource. Its role in processing, purification and biomass transformation is essential, yet current systems treat water as a linear input-output utility, rather than as a circular, recoverable, and locally renewable resource. The EU must expand its definition of resource diversification to include treated wastewater reuse and integration of decentralized water systems into industrial processes. This requires investments in:

- Adaptive purification and pre-processing technologies,
- Circular logistics infrastructure, and
- Cross-sector collaboration and permitting frameworks for water reuse and recovery.

Robust, science-based certification systems must guarantee traceable and sustainable sourcing of biomass and water. Harmonizing sustainability criteria across Member States will create a level playing field and foster investor and consumer trust. Such actions are particularly important in rural and structurally weak regions, where improved logistics and regional infrastructure can lower

operational costs, reinforce supply chain, water and drought resilience and improve the economic viability of bio-based manufacturing.

Accelerate Innovation to Strengthen Global Bioeconomy Leadership

The EU must adopt a coordinated, innovation-driven strategy to compete globally. Fragmented national engagement and inconsistent Member State support undermine the scale and speed of innovation deployment.

IBISBA (Integrated Biotechnological Infrastructure for Sustainable Bioproducts), for instance, now on the path to becoming a European Research Infrastructure Consortium (ERIC) and designed to accelerate lab-to-market development in industrial biotechnology, remains underutilized due to scattered backing by member states. The EU and member states must provide coherent political and financial support for shared infrastructures and designate them as cornerstones of industrial transformation. This applies equally to interdisciplinary water system innovation, which is often hampered by outdated infrastructure, fragmented responsibilities, and regulatory uncertainty. To unlock the full potential of circular innovation, the EU should:

- Embed water system transformation into the bioeconomy R&I agenda,
- Fund lighthouse projects focused on nutrient recovery, bio-based and water-smart production, and climate adaptation, and
- Expand public-private partnerships and public procurement to bridge the innovation-commercialization gap.

The EU must play a proactive role in global standard-setting bodies. By leading the development of international criteria for water reuse, circular manufacturing and sustainable products, Europe can shape global markets and ensure its innovations set the benchmark for the world.

Climate neutrality, resource resilience, and economic competitiveness require a bold, coordinated, and innovation-driven bioeconomy strategy. By aligning regulations, investments, infrastructures and innovations with science-based sustainability principles, **Europe will lead the global transition toward a circular, regenerative, and competitive future.**

[Fraunhofer Roadmap for the Future Development of the Circular Bioeconomy](#)

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