SCALING UP EUROPE'S BIO-BASED INDUSTRIES

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European Investment Bank | Advisory

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EXECUTIVE SUMMARY

The bioeconomy is central to the European Union's commitment to transitioning towards a more sustainable, carbon-neutral future. The bioeconomy refers to the use of biological resources to produce food, materials and energy. Valued at €2.3 trillion and representing 8.0% of the workforce, the bioeconomy is integral to achieving Europe's climate and environmental goals, including the Sustainable Development Goals (SDGs) and its commitments under the Paris Agreement. The bioeconomy offers significant potential for job creation, particularly in rural and coastal regions, while driving carbon reduction across industries and supporting nature restoration. The European Union's political framework for the bioeconomy is built around three core priorities: sustainability, economic growth and climate action.

The bioeconomy plays a crucial role in addressing key challenges such as food security, sustainable (biogenic) resource management and reducing dependence on non-renewable materials – helping to build strengthen the autonomy of the European Union. In addition, the bioeconomy is instrumental in driving competitiveness and fostering innovation and is deeply rooted in rural economies. A strong and resilient bioeconomy underpins both the green transition and long-term environmental sustainability.

This study examines the EU bio-based industry, a key driver of the bioeconomy. It provides an overview of the barriers facing European companies operating within this sector and builds on the European Investment Bank (EIB)'s 2017 publication on access to finance for the bioeconomy. The study is complemented by another EIB study published in 2025, *Investment gaps to achieve sustainable targets in the bioeconomy*, which specifically explores investment gaps within the broader bioeconomy sectors.

The study focuses on three product classes within the bio-based industry that demonstrate significant potential for scaling up: (i) bio-based materials and chemicals, (ii) innovative food and feed ingredients and (iii) bio-based soil nutrients and enhancers. Primary agriculture and the blue economy (economic activities related to oceans, seas and coasts) are beyond the scope of this study.

As a general principle, scalability, profitability and market demand for the output products are key factors determining investor interest in new bio-based technologies. However, it can be difficult to assess demand, especially for new bio-based products and drop-in substitutes of existing fossil-based products.

Figure 1 divides the relevant bio-based industry into four main segments based on two factors: how new the products are (existing products vs. new products) and production volumes/margins (lower volumes/higher margins vs. higher volumes/lower margins). This structure is used to highlight key trends in the bio-based industry.

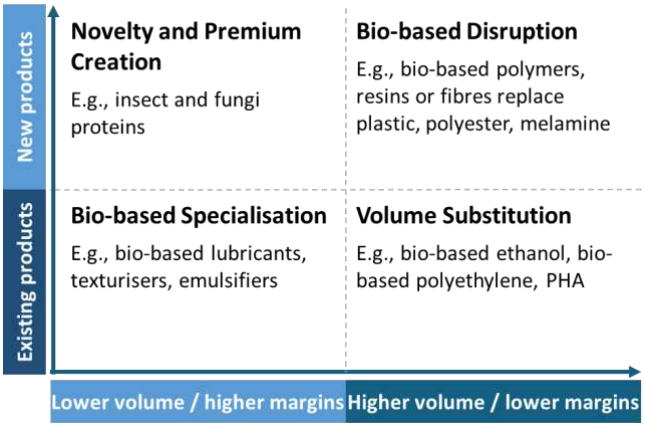

Figure 1: Bioeconomy segments used throughout this study (Source: Roland Berger)

The bio-based industry was studied through questionnaires and interviews with investors, project partners and industry leaders who were all carefully selected.

A regional analysis was also conducted to identify the best financial instruments and practices for scaling up bio-based industry projects. Four regions were selected for detailed case studies using a two-step process.

Different types of investors are needed to fund bio-based industry projects from inception to commercialisation: early-stage capital is provided by venture capital and public funds, while growth financing typically comes from loans, venture debt and similar options. Established companies often help by offering technical expertise, market access and operational support.

The market consultation showed how Europe has what it takes to lead in the bio-based industry, including strong research and development (R&D) capabilities, skilled workers, feedstock availability and high socioeconomic acceptance. However, unfocused regulations, fragmented markets and slow regulatory approval processes compared to places like the United States put European projects and companies at a disadvantage in attracting global investment.

In some of the industry segments analysed in this study, bio-based products can compete with fossil-based ones. But they are often more expensive, and people are not always willing to pay more for green products. This makes securing offtake contracts particularly challenging, and without these contracts, investors and lenders are reluctant to provide financing.

The two main challenges slowing down the growth of European bio-based industries are:

1. Insufficient early-stage capital, particularly for pilots and demonstration plants. While EU mechanisms exist to cover this gap, they have not yet provided enough national or regional funding to make a significant impact.
2. Lack of market competitiveness, as bio-based products often cost more than their fossil-based equivalents, limiting demand and investor interest.

Figure 2 shows the funding gaps across the four segments:

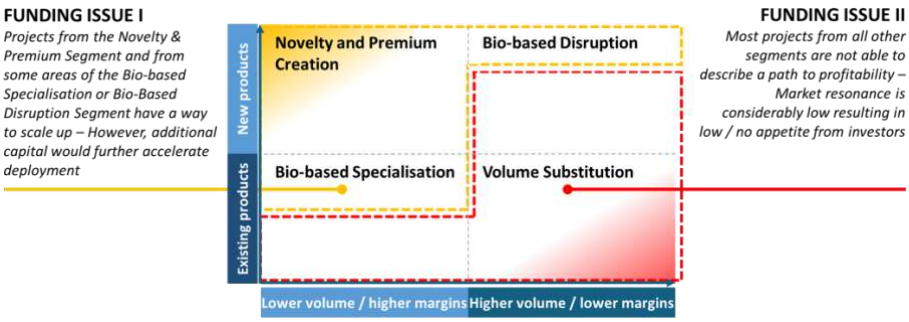

Figure 2: Funding issues in the European bioeconomy (Source: Roland Berger)

These findings are consistent with the EIB study from 2017. The analysis identifies two specific funding gaps: from pilot to demonstration plants and from demonstration plants to first-of-a-kind industrial facilities. These transition points are particularly difficult to finance because innovative bio-based products cost more to produce, which raises concerns about competitiveness in terms of market demand and profitability of biobased industry projects especially in the early productions phases.

The study also looked closely at selected regions and identified five key success factors for regional bioeconomy ecosystems (Figure 3): strong agri-forestry primary production, industrial partners, a robust academic R&D environment, good public infrastructure and corporate investors.

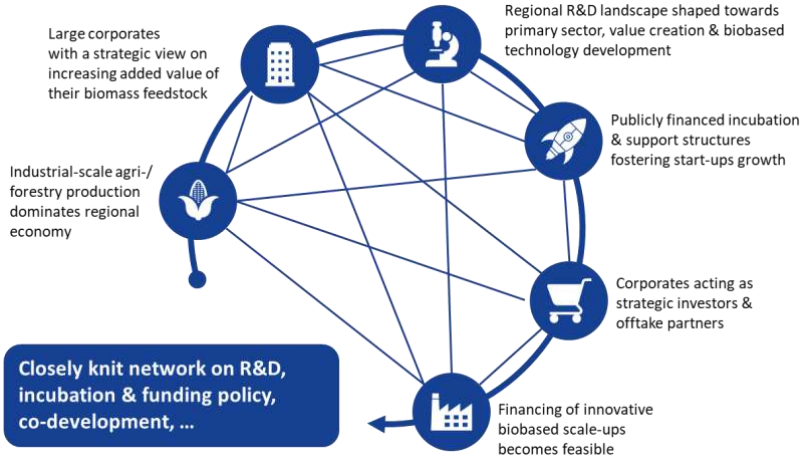

Figure 3: Key success factors for bioeconomy regions (Source: Roland Berger)

Based on these findings, the study offers eight actionable recommendations for developing financing instruments and provide policy support, which are summarized below:

- Recommendation #1 - Establish a Deployment Group, as a Working Group on Finance and Investments in the bioeconomy.
- Recommendation #2 - Develop a European bioeconomy booster programme.
- Recommendation #3 - Leverage Circular Bio-based Europe Joint Undertaking (CBE JU) flagship grant applications to build a pipeline of promising projects.
- Recommendation #4 - Enable the EIB to support bioeconomy projects/ventures with venture debt investments under InvestEU.
- Recommendation #5 - Expand the European Circular Bioeconomy Fund (ECBF) model to enable high-risk investment in early-stage bio-based ventures.
- Recommendation #6 - Support the access of bio-based projects to multipurpose demo and pilot plants.
- Recommendation #7 - Educate on bioeconomy opportunities within the boundaries of the EU taxonomy.
- Recommendation #8 - Create an eligibility checker for bioeconomy and circular economy projects.

Such recommendations may also provide insights to help shape existing initiatives. The EIB has recently launched the TechEU programme, which will be instrumental in accelerating innovation across Europe and unlock finance for innovative companies in key sectors. The European bio-based industry sector is highly innovative and will therefore benefit strongly from the resources provided by TechEU.

1 CONTEXT

1.1 Project partners

This study was commissioned and supported by the European Commission, which considers the bio-based industry as a key driver to boost innovation and strengthen the European bioeconomy as part of the European Green Deal. The main sponsor department was the Directorate General for Research and Innovation (DG RTD).

Other important players supporting the European bio-based industry include: the Bio-based Industries Consortium (BIC) and the Circular Bio-based Europe Joint Undertaking (CBE JU).

The BIC is a non-profit organisation that represents the private sector in a public-private partnership with the European Commission and works to strengthen Europe's bio-based industry sector.

The CBE JU is a partnership between the European Commission and the BIC that funds projects to grow competitive circular bio-based industries in Europe and follows Horizon Europe rules (the European Union's research and innovation framework programme). The CBE JU is the successor of the Bio-Based Industries Joint Undertaking (BBI JU) and aims to set up a group focused on finance and investments (DEG F&I) to boost growth and speed up technological deployment in Europe's bio-based industry sector.

The European Investment Bank (EIB) acts as an advisor to the European Commission, providing advice and expertise for the development and implementation of investment projects. This report builds on a 2017 EIB study that identified funding gaps in Europe's bioeconomy.

1.2 Background and objectives of this study

The bioeconomy is broadly defined as the use of renewable biological resources to produce food, materials and energy. It promotes a sustainable and circular economic model. It covers all sectors and systems that use biological resources (animals, plants, microorganisms and derived biomass, including organic waste and biogenic CO_2), their functions and principles, encompassing all primary production sectors that use and produce biological resources (agriculture, forestry, fisheries and aquaculture), and all economic and industrial sectors that use or could use biological resources and processes to produce food, feed, bio-based products, energy and services. Biorefineries play a crucial role in the bioeconomy by transforming biomass into value-added products and energy in a sustainable way.[1]

In 2022 the EU bioeconomy produced an estimated added value of €812 billion, accounting for around 5.0% of the EU's GDP and employing around 17.2 million people in biomass-producing and -converting sectors,

[1] Circular Bio-based Europe Joint Undertaking (CBE JU). (2022). Strategic Research and Innovation Agenda. https://www.cbe.europa.eu/system/files/2022-06/cbejusria.pdf

corresponding to around 8.0% of total employment.[2] However, the bioeconomy has the potential to do far more in reducing carbon emissions and creating jobs.

Since its introduction in 2012, the European Union (EU) Bioeconomy Strategy[3] has successfully mobilised research, innovation, investment and value chain development. A 2018 review reiterated its importance while emphasising the need to align it with the Circular Economy Action Plan, the Clean Energy for All Europeans package[4], and the renewed Industrial Policy[5]. This would maximise its impact on sustainability and economic growth. As announced by President Ursula von der Leyen, the European Commission is now working on an updated EU Bioeconomy Strategy, expected by the end of 2025.

The European Union's bioeconomy and circular economy are closely linked. They promote efficient use of resources, reduce waste and support sustainable business and consumption models, especially in agriculture, forestry and bio-based industries. Advances in biotechnology and biomanufacturing are key to replacing fossil-based materials across sectors, supporting the European Union's Industrial Policy and recently introduced initiatives like its Clean Industrial Deal. However, transitioning to a full bioeconomy requires systemic change, significant investment and greater cooperation among EU members and regions. Financial instruments will be essential in fostering research and innovation, scaling bio-based solutions, supporting regional development and strengthening the European Union's global leadership in sustainability.

The European Investment Bank (EIB) Advisory's 2017 study *Access-to-finance conditions for Investments in Bio-Based Industries and the Blue Economy*[6] (referred to as the "EIB's 2017 bioeconomy study" in this report) identified a funding gap for scaling up bioeconomy projects. This was largely due to low demand and a limited market for bio-based products, often caused by regulatory uncertainty, which made investment cases less appealing and limited funding opportunities. The study recommended introducing specialised financing instruments to support more advanced projects closer to commercial deployment.

The European Circular Bioeconomy Fund (ECBF) was created to invest in bioeconomy projects, especially in agriculture and food, with support from the European Commission. The Bio-Based Industries Joint Undertaking (BBI JU, 2014-2021) funded 142 projects, including 13 flagship industrial-scale biorefineries, with investments totalling around €820 million. For every euro the BBI JU invested, nearly three euros were attracted from private sources. Its successor, the Circular Bio-Based Europe Joint Undertaking (CBE JU), is backed by €1 billion in EU funding and an equal amount from the Bio-based Industries Consortium (BIC), to further scale up Europe's bio-based industries.

As part of its work to support the European bioeconomy and address the challenges of scaling up and replicating bio-based projects, the CBE JU plans to set up a CBE JU Deployment Group on Finance & Investments. The group has the following objectives:

- Help companies and project promoters in the European bioeconomy to access funding.
- Reduce the risks of financing and investing in the bio-based sector.
- Conduct activities/actions that help financial institutions and private investors fund CBE JU companies.
- Identify, optimise and develop existing and new financial instruments and approaches to support bio-based solutions. This includes scaling up and replicating successful bio-based technologies and solutions.

This new study updates the EIB's 2017 bioeconomy analysis, focusing on barriers and opportunities for scaling up bioeconomy projects. The study looks at the bio-based industrial sector and examines specific industry

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2 DataM - Bioeconomy generated €812 billion in 2022 (5.0% of EU's GDP) and created 17.2 million jobs - European Commission
3 https://environment.ec.europa.eu/strategy/bioeconomy-strategy_en
4 https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52016DC0860
5 https://www.consilium.europa.eu/en/policies/eu-industrial-policy/#strategy
6 European Investment Bank. (2017). Study on Access-to-finance conditions for Investments in Bio-Based Industries and the Blue Economy. https://www.eib.org/files/pj/access_to_finance_study_on_bioeconomy_en.pdf

segments within the bioeconomy. It focuses on areas with considerable innovation potential and where industrial scaleup could significantly contribute to a low-carbon economy. These segments are (i) bio-based materials and chemicals, (ii) bio-based food and feed ingredients and (iii) bio-based soil nutrients and enhancers. This study does not cover primary agriculture or the blue economy. To develop targeted and effective recommendations and identify common trends, products from the covered industry segments are organised into four categories. These categories are divided into high-margin and low-margin products, as well as those that replace existing products (i.e. drop-ins) and those that introduce new ones.

Within the analysed bio-based industry segments, the study highlights the investment barriers, as well as their strengths and weaknesses, and suggests potential solutions to bridge the funding gaps. It investigates the underlying causes of the funding gaps and examines financial tools to address them. The main focus is on the challenges of scaling up bio-based technologies. This includes financing the move from demonstration and pilot-level projects to commercial-scale operations. However, the study does not cover the potential environmental impacts arising from mobilising large amounts of biomass feedstock for producing bio-based products in the quantities required to replace a significant share of traditional fossil-based products with bio-based alternatives.

This study is complemented by another EIB study published in 2025, *Investment gaps to achieve sustainable targets in the bioeconomy*.[7]

[7] https://www.eib.org/attachments/lucalli/20250089-150925-investments-gaps-to-achieve-sustainable-targets-in-the-bioeconomy-en.pdf

2 METHODOLOGY

2.1 Finding candidates for profiles and interviews

The state of the bio-based industry in Europe was evaluated by speaking with investors, financial actors and industry leaders. A three-step process was followed to select the people to interview.

Figure 4 shows the selection process for investors and financial actors. First, a list of 55 potential candidates was created with input from all project partners. In the next step, the list was narrowed down to the 30 most relevant investors and financial actors. The main criteria for this selection included feedback from internal project partners and the need to represent a variety of investor types. The decisions were made based on research and discussions with finance and bioeconomy experts. To ensure a wide representation, the selected investors came from various sectors of the bioeconomy, various countries, and included different types of investors. After that, a detailed profile was created for each of the 30 candidates. In the third step, these profiles were used to select candidates for the expert interviews. The selections were based on the potential insights they could provide, aiming for a diverse and comprehensive overview. The expected insights were evaluated using the detailed profiles, considering factors such as their involvement in the bioeconomy, interest in the sector, total assets under management, available financial resources and regional focus. Ultimately, this step identified 19 investors and financial actors for the expert interviews.

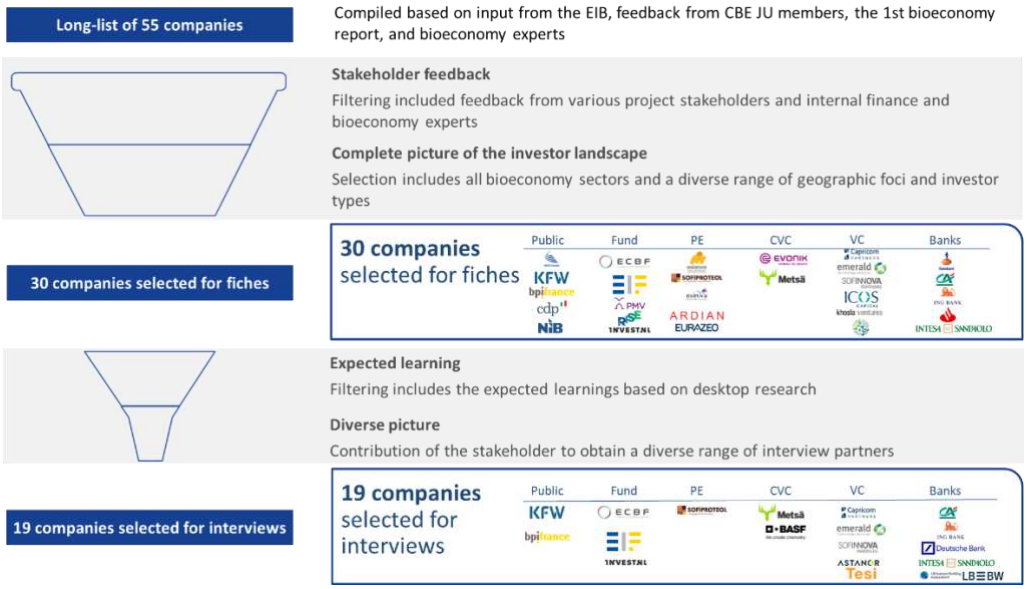


Figure 4: Selection process for investors and financial actors (Source: Roland Berger)

Figure 5 shows a similar pattern for the selection of industry leaders as the one used for selecting investors and financial actors. A list of 50 companies was created with input from all project partners. This list was then narrowed down to 30 companies based on feedback from internal project partners and to ensure it was representative of the entire bioeconomy field. The selection process relied on initial research and feedback from finance and bioeconomy experts. To ensure comprehensive coverage, we selected companies of different sizes from various geographic regions and all sectors of the bioeconomy. We created detailed profiles of these 30 companies, which were then used in another round of filtering. The selection criteria for this process were based on the potential insights to be gained and the aim of achieving a wide and thorough overview. The expected insights considered factors such as how much a company participates in the bioeconomy, its business model and

role in the industry, its strategic interest in the bioeconomy, examples of bioeconomy-related projects, and where the company operates geographically. Based on the company profiles, 11 industry leaders were selected for the expert interviews.

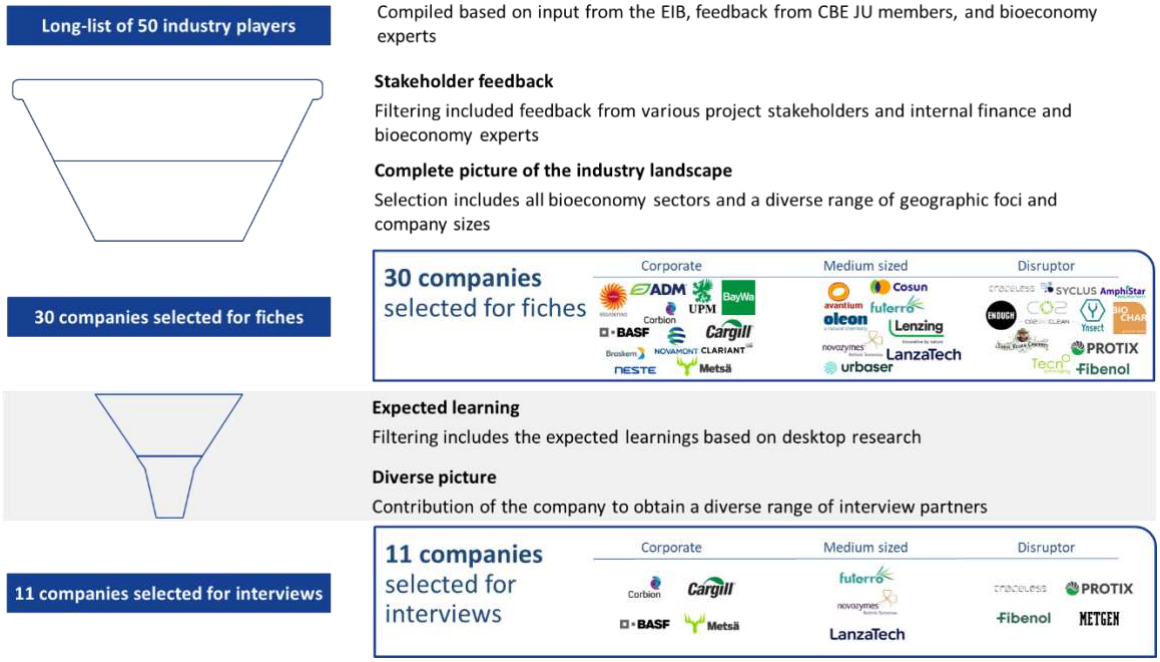


Figure 5: Selection process of the industry leaders (Source: Roland Berger)

The profile sheets used to select candidates for interview were created together by the EIB, BIC, the European Commission (specifically the Directorate-General for Research and Innovation) and the CBE JU. These sheets included a detailed overview of each company, their importance to this study, their suitability as potential members of the CBE JU Deployment Group on Finance & Investments, and their recent and future financing activities.

The interviews with the experts included a questionnaire with both open-ended and closed-ended questions. The closed-ended questions investigated the main reasons behind the current status of the European bio-based industry sector and the funding opportunities available. The questions were the same for all the questionnaires, which made it possible to analyse the interview results using statistical analysis. The open-ended questions encouraged discussion and invited feedback about the EU bio-based industry sector and the specific challenges that companies and investors face when trying to raise funds and find good opportunities.

2.2 Selecting the top regions for bio-based innovation

To find the best financial tools for helping the bioeconomy grow through bio-based innovations, we compared successful regions in Europe and beyond. We looked at the best ways to finance the bioeconomy in different regions, examining how they fund bio-based industry projects and what actions governments take to support them. This study included a comprehensive analysis of specific financing programmes, the overall financial situation, other factors driving bioeconomy growth and the general progress of the bio-based industry.

Figure 6 shows the selection process for the regions. Initially, a list of 13 relevant regions was created with input from all project partners. We then narrowed down these regions by using advice from our bioeconomy experts, looking at potential insights from our early research, and aiming to include a variety of sectors and geographical locations. We created detailed profile sheets for the eight regions. These sheets included a summary of the financial situation, examples of financing programmes, and information about the level of development of the

bio-based industry is in each area. These profiles also identified key success factors, such as infrastructure availability. Four out of the eight regions were selected for detailed case studies by looking at their profiles, the choice was based on the relevance of the regional context and bioeconomy initiatives to the study objectives, including the possibility to gain insight and know-how on effective ways to support the biobased industry sector.

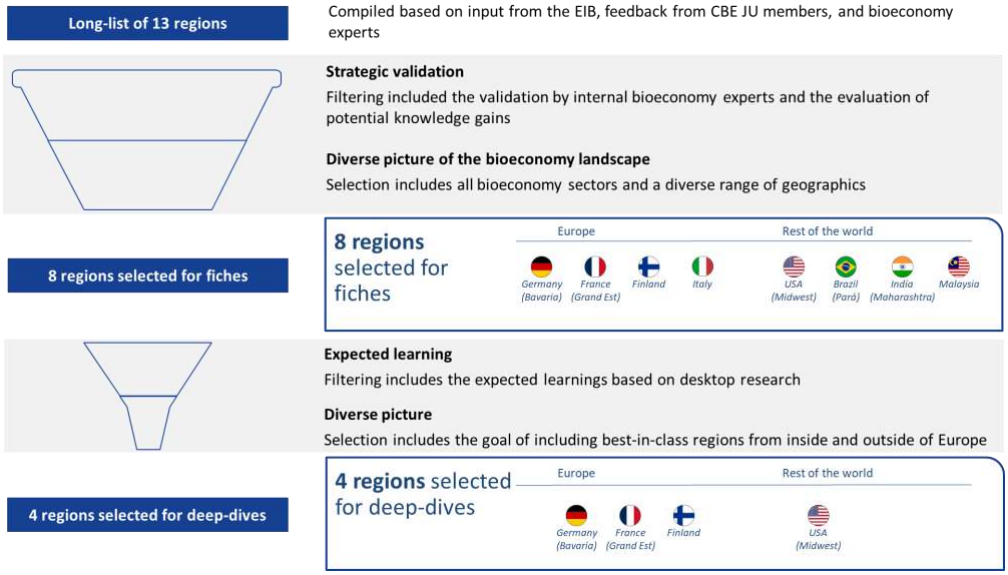


Figure 6: Selection process for the top regions (Source: Roland Berger)

2.3 Defining relevant bio-based industries for this study

The EIB's 2017 bioeconomy study provided a comprehensive overview of the European bioeconomy, but did not focus on the specifics of individual sectors. In contrast, this study focuses on bio-based industries and examines various product types, innovation trends and the challenges of moving technologies from the pilot/demo stage to commercial deployment.

All study partners agreed on the importance of the bio-based product categories included in this study, in terms of innovation potential. The focus is primarily on three sectors: materials & chemicals, food & feed ingredients and soil nutrients & enhancers (see Figure 7).

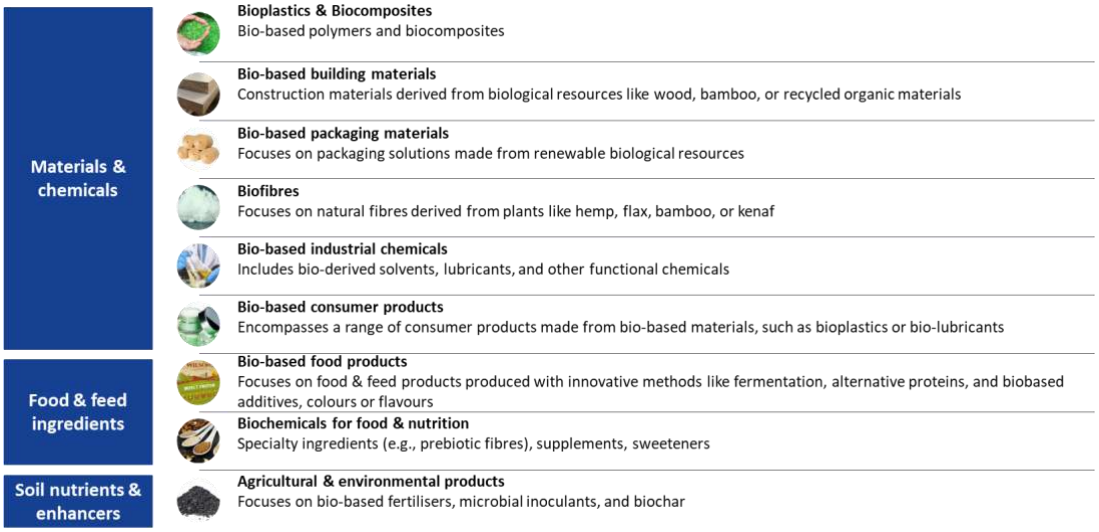


Figure 7: Relevant bioeconomy sectors for this project (Source: Roland Berger)

At the beginning of the study, it was agreed that biofuels, bioenergy, biopharmaceuticals/medical devices, and basic food and feed products directly tied to primary agriculture would not be covered.

2.4 Limitations of this study

This study examines the challenges of scaling up bio-based industry projects, with a primary focus on financing issues. However, it is important to note that other significant factors exist. These include the complexity of sustainably sourcing biomass feedstock for large-scale bio-based production. These concerns are critical for companies and investors planning investments in large-scale bio-based industry projects. For example, manufacturing bio-based plastics in amounts comparable to traditional fossil-based plastics would require a huge quantity of biomass feedstock. The environmental impacts and market effects of feedstock mobilisation on such scale are difficult to predict. Understanding these implications is vital to ensure that bio-based industry projects achieve their expected economic, environmental and social benefits, aligning with EU policy goals while avoiding negative externalities. However, assessing these factors falls outside the scope of this study.

Another limitation of this study is the confidentiality surrounding investment plans of companies and investors. This confidentiality restricts the information which could be obtained by interviewing market participants. Most respondents were hesitant to share detailed estimates about financing needs or to provide specific details about their investments. Consequently, a detailed estimation of the investment gap was not possible, and this study aims to identify the reasons behind the investment gap, explain funding challenges and recommend actions to overcome these issues. Another EIB study, the 2025 *Investment gaps to achieve sustainable targets in the bioeconomy* is dedicated specifically to providing estimates of the funding shortfalls in the bioeconomy in Europe.

3 MARKET ANALYSIS AND FINDINGS

3.1 Snapshot of the European bio-based industry in 2024

Bio-based investors and financing partners

In the European bio-based industry sector, there are three types of capital providers that cater to different investment stages, each offering various financing options:

- *Venture capital and corporate venture capital:* These investors focus mainly on early-stage companies, providing funding mainly through equity. In later stages, they may also offer debt or mezzanine financing (a combination of debt and equity). They are interested in innovative startups with high growth potential. A strong business plan that demonstrates market demand is essential for attracting significant investment. For corporate venture capitalists, alignment with their existing business operations is often a prerequisite, while traditional venture capitalists usually prioritise potential financial returns.
- *Development banks:* These institutions are important in helping established bio-based industry companies access finance. They provide financial assistance and resources to help these companies grow and succeed in the European bioeconomy. Development banks typically invest through debt instruments in later stages to scale up proven technologies and products with lower market risk, but they also support early-stage companies. For example, KfW (a German state-owned investment and development bank) uses a fund-of-funds instrument to invest in funds with exposure to the bio-based industry sector.
- *Private equity funds:* These funds invest in late-stage bio-based companies. They look for mature companies with a proven business model and a track record of success, which can be scaled up with additional capital.

All three types of investors were considered in this study, and the analysis yielded the following key findings:

1. Relatively few investors focus only on bioeconomy startups as defined in this study. We looked at 30 investors. Only two specialise in the bio-based industry: the European Circular Bioeconomy Fund (ECBF) and Metsä Spring. Most investors have a wider focus that includes other parts of the bioeconomy and other industries.
2. A few venture capital and corporate venture capital investors are active in bio-based projects, but they also look at other sectors. These investors usually target high-value markets where there is no fossil-based alternative. They want profitable and scalable niches, not necessarily areas with the greatest potential for reducing carbon emissions. Overall, venture capital investors see the European bio-based industry as political and risky, with unclear regulations.
3. Development banks have remarkably low exposure to the bio-based industry segments addressed in this study. Green funding is available through green bonds, but many biobased industry projects are not eligible because they are seen as risky and the regulations are unclear. The bioeconomy and bio-based industries are often not well covered by the EU taxonomy for sustainable activities.
4. The investor network for bio-based industry projects is stronger in some countries (for example, France, Belgium and Germany) than in others. Some countries with abundant capital, such as Finland, Sweden and Italy, still have fewer activities in this area.

Bio-based industry segmentation and innovation routes

To better understand the needs and challenges of growing the European bio-based industry, this study divides it into four distinct segments. These segments are based on two main factors: the novelty of the product and the

product's market type. Product novelty is further divided into "new product" and "replacement of an existing product." Market type is either "high margin/low volume" or "low margin/high volume." Combining these creates four specific segments, as shown in Figure 8.

Figure 8: Bioeconomy segments used in this project with examples (non-exhaustive) (Source: Roland Berger)

1. **Novelty and premium creation** – This segment includes companies that create new markets with innovative bio-based products and technologies, often focusing on few specific applications. Examples include insect- and fungi-based proteins for food and feed, and CO_2-based chemicals.

2. **Bio-based disruption** – This segment focuses on materials that aim to replace fossil-based products with bio-based ones of similar or better quality (for example, being biodegradable or recyclable). Economically, it creates value-added products from primary biomass (e.g., starchy and sugar crops) and biobased streams like forestry or agricultural residues, or underused process streams (e.g., lignin). These new biobased materials can also compete with high-volume fossil-based products in some specific applications, replacing products like polypropylene, polyester, phenol or polyethylene. Examples include cellulose-based textile fibres, resins from algae, biopolymers from primary and residue biomass (for example, polyhydroxyalkanoates and polylactic acid), as well as biobased-composites and building materials.

3. **Bio-based specialisation** – Products in this segment are replace existing high-margin fossil-based specialty items. Examples include performance-enhancing additives, lubricants, coolants, thickeners and emulsifiers replaced by bio-based products.

4. **Volume substitution** – Products in this segment replace basic and intermediate chemicals produced in large amounts that are key to many value chains. For example, bioethanol can be used to manufacture many bio-based products such as bio-polyethylene (bio-PE), bio-polypropylene (bio-PP) and bio-ethylene glycols.

This structure simplifies the complex bio-based industry, where, in reality, some products may overlap different industry segments. But it helps identify the common trends within each segment, making recommendations more accurate, broadly applicable and useful. These recommendations come from analysing market failures, main trends, risks and obstacles faced by companies operating in each segment.

Innovation methods, market strategies and company types vary across the four segments. Here is a summary of the key aspects for each segment:

1. In the **novelty and premium creation** segment, innovation is mainly driven by startups and scaleups, which commercialise their biobased technology/products independently. These companies usually focus on one or few specific products, for which they have developed and upscaled the production technology to commercial readiness. Initially, the technology development is financed by raising funds from venture capital or public sources. In later stages, they may also look for debt financing for further expansion. As their products often do not compete directly with fossil-based ones and present high profit margins, these companies are able to obtain funding, either equity or debt, providing they can show market traction for their products, for example, through binding offtake agreements.

2. In the **bio-based disruption** segment, startups also drive the development of innovative technologies and products. However, as biobased products in this segment compete with medium to high-volume, established, fossil-based products in a business-to-business (B2B) market context, economies of scale are key. In fact, B2B markets are highly price sensitive, therefore achieving a large production scale and full plant utilisation is essential to optimise production costs and achieve sufficient margins. Scaling up new products and technologies often involves partnering with established companies that can provide access to large volumes of feedstock, capital and/or market, as well as technical expertise in biomass feedstock processing and/or in the implementation of complex projects. For large corporations, these partnerships offer a chance to diversify, get more value out of their biobased feedstock and enter new markets, often with products that provide higher margins than their existing businesses. There are two main scaleup models in this segment:
    - Linear scaleup: gradually increasing the scale of the bio-based production technology and, along with it, the capital needed to support the investments to fuel the company growth.
    - Exponential scaleup: making a large early investment to build a big plant to achieve high volumes quickly. This is often the case for technologies which produce lower margin bio-based products that require high volumes to be profitable.

Corporations active in this segment usually have large amounts of feedstock available and are looking to maximise the value they can extract from it. They are already established in the market, with an established sales network and customer base. Startups often team up with these corporations to grow, as the partner can provide access to the required amounts of feedstock and/or ensure product offtake.

3. In the **bio-based specialisation** segment, the innovation mechanisms resemble the ones in the bio-based disruption segment, with innovation often driven by startups, which then partner with established companies to scale up. Given the technical specialisation in niche markets, these partners bring engineering expertise, technical platforms and market access through their established brands and/or customer networks. Because the products in the bio-based specialisation segment compete directly with established fossil-based ones, investors and companies are cautious and typically focus on profitable cases where customers are willing to pay more for a sustainable biobased alternative. In a way, this market segment acts like a testing ground for large companies to learn about new production technologies and processes, and expand their product portfolio. Therefore, large companies are attracted to this segment as investing in startups offers them profitable opportunities with only limited risks.

4. In the **volume substitution** segment, bio-based products compete with established large-scale/low-margin fossil-based products made and marketed by petrochemical companies. These companies rely on vertical integration, controlling the entire fossil value chain, often from oil/gas extraction downstream to intermediate chemicals, and keeping their production plants running at high capacity allows them to minimise production costs. Petrochemical companies are less interested in developing and producing bio-based alternatives because it exposes them to business risks. In fact, petrochemical companies have less experience and engineering expertise in biomass processing and do not have an integrated supply chain for bio-based feedstock. Therefore, they risk losing the advantage of vertical integration further up the fossil-based supply

chain. Investing in new biorefineries to produce drop ins competing with their existing fossil-based products may also lower the utilisation rates of their existing plants and the revenues coming from these products. Startups or other young companies often drive technological innovation in this segment, but the significant capital expenditure needed for scaling up to industrial levels (the only ongoing biorefinery investment project in Europe will cost an estimated €1.3 billion[8]) means a partnership with an established larger company is the default option. This partnership can take many forms. For example, it can be a strategic investment or a joint venture, with a licence and/or offtake agreement.

Large-scale replacement of fossil commodities with bio-based products requires high operational efficiency, including a high utilisation of production capacities and supply chain management to minimise production costs. This is key to achieving sufficient operational margins and maintaining the viability of production operations. The market for the products in this segment is usually B2B, which offers limited potential for a green premium. A typical partnership often consists of four main roles: (1) feedstock provider, (2) technology/intellectual property supplier (licensor), (3) engineering and operations, and (4) market access. While technology/intellectual property is often the key competency of the startup or growth company, the large company can assume more than one role in the partnership (e.g. feedstock supplier and market access). This segment has the highest transformational impact due to the size of the markets it addresses (large-volume commodities). Bio-based products from this segment could benefit from established value chains and distribution networks, as they are typically bio-based drop-in alternatives to established fossil-based products. However, the high price sensitivity of these commodity markets, the direct competition of established and often cheaper fossil-based incumbents, and a lack of sufficient regulatory or market support for bio-based products, makes it hard to build a viable business case in this segment. As a result, petrochemical companies and other large companies that might have the means and capability to invest in the upscaling of these technologies are cautious in their approach.

Overall, innovation in the bio-based industry is mostly driven by a mix of small startups and small to medium-sized enterprises (SMEs) across all segments. At the same time, larger, established companies can be instrumental in bringing these innovations to market. This is often the case for petrochemical companies producing fossil-based products which can be replaced with bio-based alternatives, and/or large companies with access to biomass feedstock and with biomass processing expertise, for example large players in the food and paper sectors. To fully understand the European bio-based industry, it is essential to consider all the types of companies involved. Figure 9 highlights the different stages of the upscaling process and companies' typical approaches to scaling up.

[8] https://www.upmbiochemicals.com/about-upm-biochemicals/biorefinery-leuna/

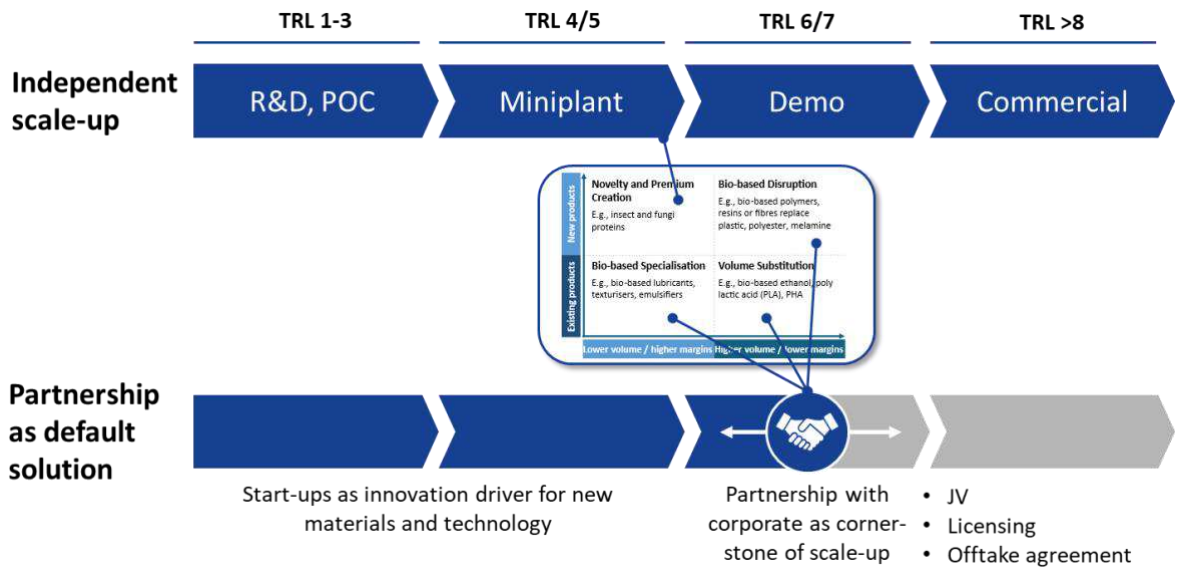


Figure 9: Predominant scaleup models in the European bio-based industry (Source: Roland Berger)

3.2 Findings from the market consultation

Findings from the market consultation

- **Europe has what it takes to be a leader in the bioeconomy as it is already a leader in R&D, is equipped with skilled workers, has sufficient feedstock and considerable local demand for bio-based products. In the survey, 75% of investors and 50% of industry leaders agreed with this statement.**
- **However, the same proportion of investors and industry leaders also believe that the European market is fragmented, which negatively affects business prospects. They also believe that Europe is missing an overarching clear transformative agenda mandating the use of bio-based or circular products.**
- **In the absence of clear regulatory incentives, demand for green products remains insufficient, making it difficult for these products to find a market. As a result, producers often struggle to secure offtake agreements. Respondents shared varying perspectives on this issue, depending on the type of bio-based product in question. However, 66% of investors and 80% of industry leaders identified securing offtake agreements as the biggest challenge for bio-based industry projects to achieve financial viability, thereby making them bankable.**
- **The issues above mean also that EU bio-based industries struggle to attract capital. Debt providers, such as development and commercial banks, that could play a pivotal role in scaleup financing, are particularly hesitant to finance these projects. Over 70% of investors and industry leaders surveyed stated that funding is not sufficiently available, especially during scaleup.**
- **The implications differ slightly for the four bioeconomy segments:**
  - **In the new and premium product creation segment, several projects/products already have potential to be technologically and economically viable at scale. Therefore, further developing this segment would help accelerate the deployment of innovative and profitable scaleups.**

- **The bio-based specialisation segment suffers from a lack of corporate interest beyond R&D, hindering investment to bring bio-based products to market. Regulatory intervention is needed to create a market for bio-based products.**
- **Similarly, the lack of regulatory pressure limits investor interest in bio-based disruptors.**
- **The absence of regulatory support and feedstock concerns hinders commercial developments in the volume substitution segment.**

- **So far, banks have shown limited interest in the bio-based industry as they consider it lacks profitable projects. However, even for projects that could become profitable, there is no structured network of capital providers willing to finance and structure them. Such a network could greatly boost the development of the bio-based industry in Europe.**

Two main points in the technology development pathway are hindering the upscaling and deployment of new technologies in the bio-based industry segments investigated: the first is the transition from pilot to demo plant, and the second is the transition from demo to first-of-a-kind facility.

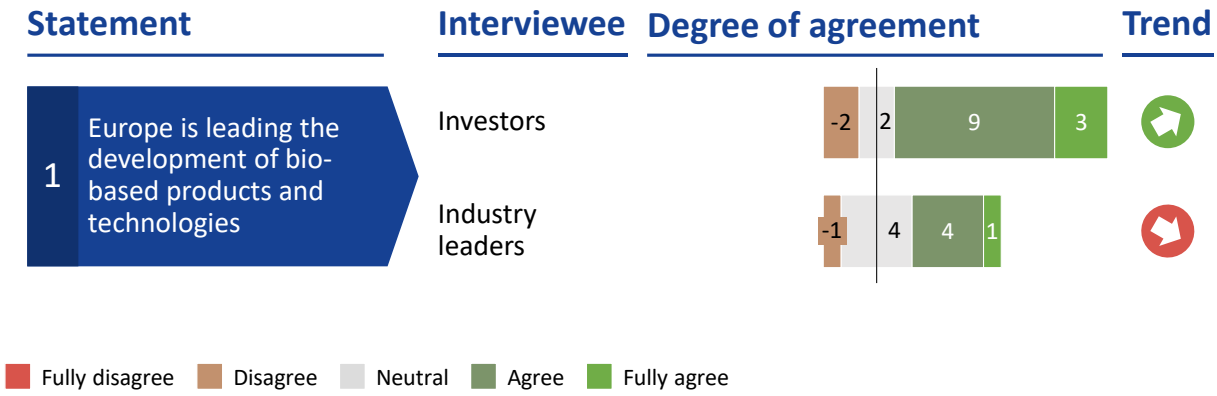
This section presents the results of the interviews conducted with investors, financial actors and industry leaders. The interviews are evaluated statistically, with remarks on the major subjects based on quotes from the people interviewed included for context.

Besides the direct insights into the European bio-based industry, the interviews highlighted the low priority of the bioeconomy for investors. Within banks, it was often difficult to find people to provide input on the bioeconomy and bio-based industries due to a lack of activities in this area. Furthermore, the interviews revealed that there is currently no structured network of capital providers working in the bioeconomy sector. One exception is InvestNL, which is part of an investor group focusing on the circular economy. This group could serve as a blueprint for developing a joint working group on bio-based industry financing. Further information regarding the development of a working/investing group (a deployment group) can be found in the recommendations in section 5 of this report.

3.2.1 Europe has what it takes to be a leader in the bioeconomy

Europe is at the forefront in developing innovative bio-based processes and technologies

Around 75% of the investors and half of the industry leaders interviewed agree that Europe is currently leading the development of bio-based products and technologies. Europe is home to major academic institutions involved in bioeconomy-related developments. This is crucial as most startups in the bio-based industry are spin-offs from research centres/academia. Furthermore, several highly innovative startups developing bio-based technologies are based in Europe. The interviews indicated that larger companies also pursue research in bio-based technologies and are “ready to go” from a technology/product readiness perspective. However, they remain cautious and are waiting for the right moment, hinting that the conditions for successful upscaling of their bio-based technologies are not yet in place.



"Europe was leading for a long time in R&D, but the US and Asia are catching up quickly. We are losing our technological advantage."

- Startup founder, active in the bioeconomy

"There is a lot of innovation and technology development in Europe, but companies look to the US and Asia for scaling up."

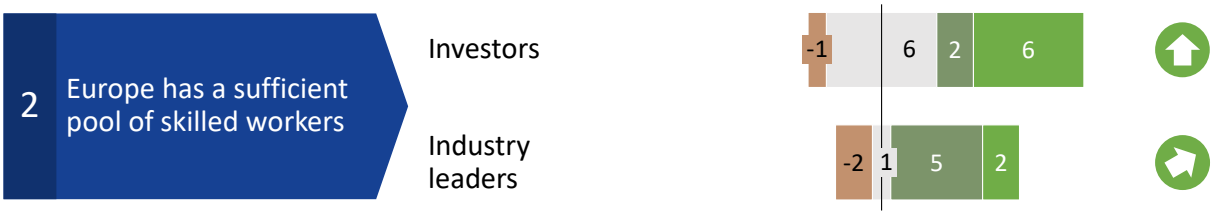
- Investor, active in the bioeconomy

Respondents also stated that the United States and Asia are catching up rapidly and that Europe's technological lead is shrinking. All industry leaders agree that Europe's lead in research and development has deteriorated over the last five years.

While the market situation is comparable between the United States and Europe, China has recently introduced ambitious regulations concerning plastics and will bring in a ban on the use of low-end plastics (for example, for packaging) with the aim of providing a market pull for industrial-scale production of circular and bio-based alternatives.

Europe has a sufficient pool of skilled workers

For the availability of skilled workers, 60% of the respondents agree that there are adequate resources in Europe. However, respondents mentioned that Europe lacks experienced entrepreneurs with a strong track record that would provide the required confidence to investors. Overall, the availability of skilled workers and talent is not an obstacle to the deployment of large-scale bio-based industry projects.



"There is a plentiful supply of engineers and manual workers in Europe, but not many genuine, driven entrepreneurs."

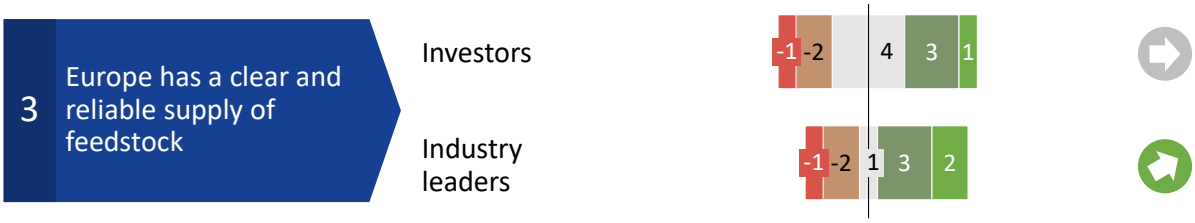
- Investor, active in the bioeconomy

"People are actively looking for upskilling opportunities. We had no difficulties finding the right people for our project."

- Startup founder, active in the bioeconomy

The feedstock situation is complex

Market consultation and additional research paint a complex and sometimes contradictory picture in relation to feedstock availability and uses. Europe has large production volumes of primary feedstock, but the use of first-generation feedstock (that is, feedstock that can be used as food and feed), has attracted criticism in the past, even though this feedstock makes up most of the biomass used for biofuels.[9] While the use of first-generation feedstock for the production of biochemicals and biomaterials is not prohibited in the European Union, access to financing for new first-generation feedstock-based projects is severely limited as most major lenders exclude such projects in their technical due diligence criteria due to environmental, social and governance (ESG) concerns. Respondents from major banks cited the paramount importance of avoiding "headline risk" and past NGO criticism as key reasons for their reluctance to consider investing in bio-based industry projects. In response to the initial controversy around first-generation feedstock, banks established internal ESG guidelines (before the EU taxonomy was published). This means two sets of criteria are in use: the voluntary ESG criteria used by most banks and investors and the, somewhat more permissive, criteria of the EU taxonomy (established to guide investment decisions towards sustainability).



"Europe is fragmented, and regulation varies widely across countries. However, this is not an issue for the current, somewhat niche applications."

- Investor, active in the bioeconomy

Industry leaders highlighted that second-generation feedstock (biomass that does not compete directly with food and feed, such as waste, agricultural residues and side streams of forestry value chains) is widely available. However, challenges in logistics (collection, transport and storage) and local implementation of regulations often make it difficult to mobilise such resources. Furthermore, additional processing steps to release and purify the desired molecules (for example, sugars from wood residues) can increase the technological complexity, risks and costs of the production processes, thereby limiting their techno-economic viability. Several respondents emphasised that while feedstock availability is not a problem per se, availability at the required quality and price is a significant challenge. This was repeatedly cited by investors as a reason not to invest in industrial-scale bio-based projects in Europe.

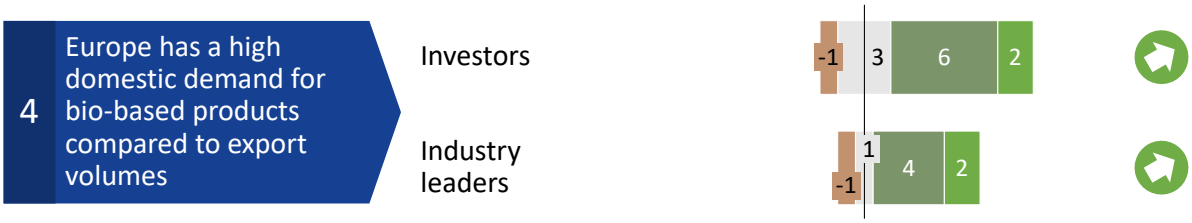
The difficulty in financing projects that rely on first-generation feedstock potentially reduces the economic viability of new bio-based technologies during scaleup, and poses a challenge for bio-based sector companies looking for funding in Europe. While the availability of feedstock has not changed over the past five years according to market participants, the need to use second-generation feedstock may result in higher costs (e.g. operational costs) compared with the cheapest available feedstock on global commodity markets. This reduces

[9] OECD/FAO (2024). *OECD-FAO Agricultural Outlook 2024-2033*, Paris and Rome, https://doi.org/10.1787/4c5d2cfb-en.

the ability to compete with fossil-based alternatives and identical bio-based products from regions with no restrictions or fewer restrictions on biomass feedstock use.

Domestic demand for bio-based products is relatively high in Europe

The research showed that all the bio-based companies investigated are producing solely for the European market. Exporting European-made bio-based products is commercially unattractive because energy, labour, feedstock and other cost drivers are cheaper in other large offtake markets, especially the United States. This severely limits the export opportunities for European-made bio-based products. Production abroad with subsequent import of bio-based products or feedstock to Europe is currently seen as controversial, as it could create dependencies on other countries and could pose questions about sustainability, considering that EU standards are often tighter. However, if implemented at scale in a smart way, production abroad could still offer a more sustainable alternative compared with the import of fossil-based feedstock. For example, sourcing bio-based products or feedstock from multiple countries would prevent over-reliance on any one country and lower the risk compared with imports of fossil-based feedstock, that usually comes from a restricted number of sources. However, while this may provide a solution to enhance the offering and affordability of bio-based products in the European Union, it would certainly not encourage building EU capacity in the bio-based industry. This is because it could lead to more competition and the risk of a non-level playing field (e.g. imports from jurisdictions with lower environmental and social standards, cheaper labour costs, etc.).



70% of respondents state that domestic demand would be high in Europe if competitive prices can be achieved. A significant increase in demand over the last five years was also mentioned while industry leaders highlighted the difficulty of competing internationally.

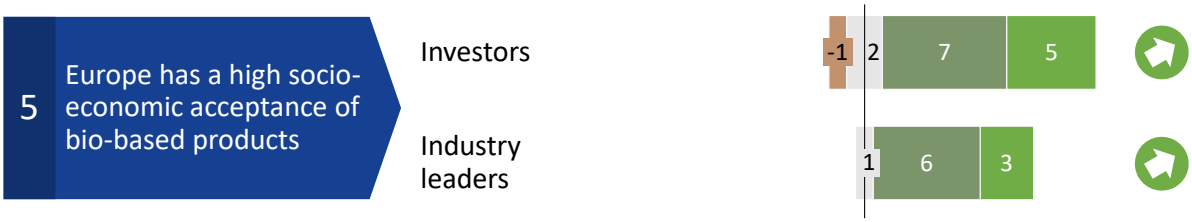
"There is a high demand for bio-based and sustainable products in Europe. However, this only holds true if prices are competitive."

- Investor, active in the bioeconomy

"Europe faces challenges in exporting bio-based products as production costs are significantly lower in other regions."

- Startup founder, active in the bioeconomy

Europeans show a high socioeconomic acceptance



"There is a high demand for sustainable products, mainly from consumers. Not many businesses care but their input is essential."

- Investor, active in the bioeconomy

Socioeconomic acceptance of bio-based and circular products in Europe is high, as confirmed by 64% of respondents. A positive trend was observed by industry leaders and investors over the last five years.

3.2.2 Europe has no clear regulatory agenda to drive the bioeconomy transformation and is seen as a fragmented market

The market for bio-based products in Europe is perceived as fragmented

Bio-based and recyclable products must in many cases receive approval before being placed on the European markets, such approval has to be in accordance with both national and European regulations. The study shows that it takes a great deal of effort to obtain regulatory approvals in Europe and there are huge differences in procedures depending on the specific product application domain and/or country. Furthermore, rather than being uniform or coordinated, European and national regulations for bio-based products vary and can even contradict each other. This lack of harmonisation and the complexity in regulations results in very long approval processes. In turn, this delays time to market and further reduces the attractiveness of investing in bio-based industrial projects in Europe.

"Approval times are way too long in Europe. It takes three to four years, while in the United States it takes only one to two years. The corresponding costs are very high, and these delays are being priced in by investors. If we want to regain competitiveness in Europe, we urgently need to reduce regulatory complexity."

- Investor, active in the bioeconomy

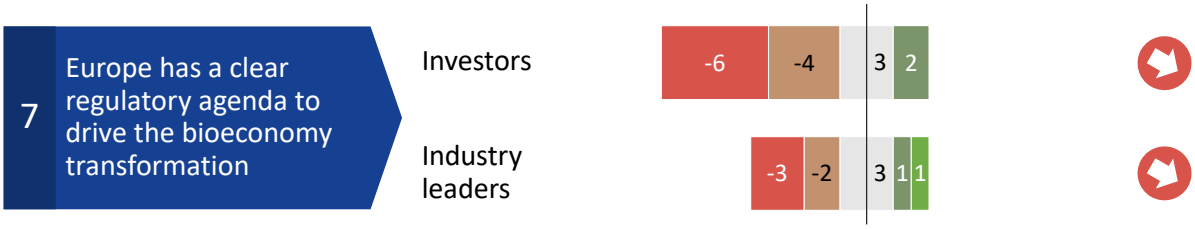
"We are invested in a startup in new foods. It was approved in the United States within four months, whereas it still has no reliable feedback in Europe after 36 months. This is absolutely unacceptable and small companies cannot cope with this."

- Investor, active in the bioeconomy

64% of the respondents do not see Europe as a harmonised market for bio-based and circular economy products. It was stated several times that national and European approaches are often contradictory. As explained above and confirmed in the interviews, such inconsistencies increase the bureaucratic effort and cost required to enter the market and scale up production in Europe. This represents an intrinsic disadvantage for European bio-based industry projects as competing countries such as the United States are described as being fully harmonised and easily accessible. This disadvantage, in turn, adversely affects financing conditions, making EU bio-based companies and projects less attractive to investors. According to the respondents, harmonisation seems to have neither improved nor deteriorated over the last five years.

Europe does not have a clear regulatory agenda driving the bioeconomy

Technically, bio-based materials and chemicals in Europe have reached a high degree of maturity in many cases, but the products often do not have sufficient market demand. In similar situations, in other domains, the EU has intervened with regulatory measures, such as introducing a sustainable aviation fuel mandate. While this EU-wide mandate only became active in 2025 and the effectiveness of the regulatory mechanisms have yet to be confirmed, the legislation has already resulted in significant developments in the sustainable aviation fuel field, as the perceived market risk, in terms of product demand, has been reduced sufficiently to attract private investment. Similar instruments could be effective in the bio-based industry but are currently underutilised.



"We very often receive interesting business plans and the products in scope could have a huge impact in terms of CO_2 avoidance. However, they almost always cost two to three times what current fossil-based products cost because of the high prices of primary feedstock. There is no regulation in place to enforce the use of more sustainable products. Therefore, these great products do not have a market and are not a suitable investment. The key lever to accelerate the European bioeconomy is to create a market first. Everything else will follow. This needs a long-term regulatory strategy."

- Investor, active in the bioeconomy

"Regulations keep changing which makes investments more risky. We cannot do business if regulations keep changing."

- Investor, active in the bioeconomy

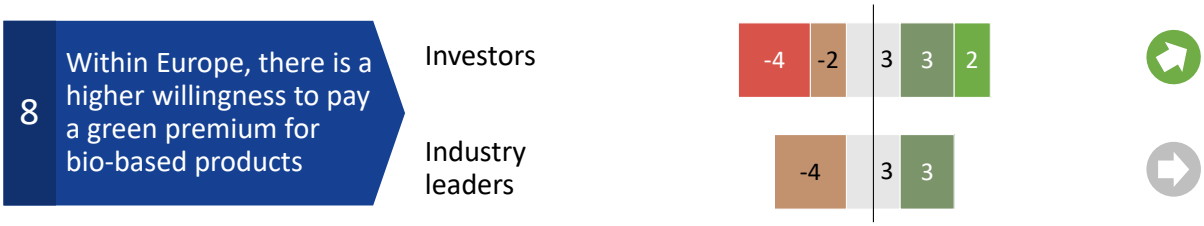
Most respondents do not see a clear and supportive European regulatory agenda to advance the shift to a bioeconomy. Rather, market participants stated that this unclear regulatory environment is a key reason for the slow growth trajectory of the bioeconomy and its low financing volumes. Without supporting regulatory measures such as quotas for green and sustainable products, bio-based industry projects face considerable hurdles in disrupting established fossil-based value chains, including in terms of prices, production networks and logistics. As product characteristics usually differ only minimally (from fossil-based incumbents), price is often the main factor behind purchasing decisions. This tends to disadvantage green alternatives compared with fossil-based products. Respondents agree that the notable exception here is the novelty and premium segment, where there are no fossil-based alternatives. All respondents stated that the regulatory environment has deteriorated significantly over the last five years. This refers mostly to the increased focus on ESG criteria for feedstock, and the reluctance to support the use of first-generation feedstock.

3.2.3 Willingness to pay a green premium is limited, with many products not finding offtakers

Paying a green premium may be acceptable, but only at 5-10%

The research showed that most successful European startups in the bio-based industry operate in profitable niche markets where there is no competition with legacy products. For markets where there is competition from

cheaper legacy products, customers willingness to pay a small green premium of 5-10% seems realistic, but this level cannot be reached by many innovative biobased products.



"There is a higher willingness among end consumers to pay a green premium of between 5% and 10% – but this is not enough."

- Investor, active in the bioeconomy space

"There is a higher willingness to pay in the B2C business but, currently, Europe's companies are very price driven."

- Startup manager, active in the bioeconomy

Respondents offered mixed views on the willingness to pay extra for green products in Europe. For some respondents, customers are open to paying a premium but this is usually limited to 5% to 10% above the cost of fossil-based alternatives. There is wider agreement that this willingness is mostly seen among private consumers, with companies showing less interest. In many cases, the similar characteristics of bio-based and fossil-based products mean price is the main factor influencing market success. Respondents stressed that bio-based products need to be cost-competitive to gain a foothold. Investors and industry leaders noted a trend of targeting niche, higher value-added markets such as personal care, even though the technology has the potential for much larger-scale applications.

Innovators cannot obtain offtake agreements

Despite a lengthy search, only a few large-scale offtake agreements were found within the scope of this study, confirming the difficulties that European bio-based industry startups have in securing such agreements.

"For a project to be suitable for investment, offtake agreements need to be in place. 90% of projects fail because they have no such agreements. What many investors don't understand is that it takes 5 to 7 years to go from the planning stage to running an industrial-scale plant. Nobody is signing a binding offtake agreement for 7 years in the future."

- Investor, active in the bioeconomy

"Potential offtakers are very selective and only enter into talks if funding is pretty much secured. It's a vicious circle."

- Startup manager, active in the bioeconomy

Almost all respondents identified the signing of offtake agreements as a major challenge for scaleups. According to the investors surveyed, the risk profile of many projects without signed offtake agreements is too high. In addition to inherent project implementation and technology risks, a high market risk must be accepted and is priced in to deal conditions, if a deal is even feasible. Some respondents suggested that the difficulty in obtaining offtake agreements lies in the lack of clear regulations enforcing the use of green and sustainable products in Europe, resulting in potential buyers being unwilling to make binding long-term commitments. The respondents mentioned that introducing contracts for difference could be one possible approach to promote the offtake of more expensive green products. See the Recommendations in section 5 of this report for more details.

3.2.4 Capital for the bioeconomy industrial transformation is limited, with a lack of funding to bridge the gap to industrialisation

The European bio-based industry does not have access to the capital it needs

Most funding for scaling up bio-based industry projects needs to come from debt or mezzanine financing rather than venture capital equity because typical bio-based technology scaleup projects do not generate the returns that venture capitalists expect. Furthermore, a potential exit would often require substantially longer timeframes than those sought by venture capitalists. However, obtaining debt financing for bio-based scaleup projects is often challenging for project developers due to the significant technical and supply chain risks involved in scaling up. Unlike incremental improvements to existing value chains, most bio-based technologies require entirely new supply chains and production processes. Even after a successful pilot or demonstration plant, questions about the scalability of the technology and the feedstock supply often remain unresolved.

This risk profile is generally incompatible with non-recourse debt financing, where lenders rely solely on project revenues for repayment. Research shows that few commercial or development banks are actively involved in financing bio-based industry projects, likely due to the perceived high level of risk. Although other sources of capital, such as pension funds, may be available in Europe, such investors typically find that the risk profile of bio-based industry projects exceeds their tolerance.

"Venture capitalists do not invest in bricks and steel; this is not our business. And those who could make these investments cannot take this sort of risk. They have many other green options with a better risk profile."

- Investor, active in the bioeconomy

The respondents paint a mixed picture. Capital is available in some niche areas, but only if these areas are highly profitable with clear business cases and a low risk profile. In most other areas of the bio-based industry where it is not possible to demonstrate a profitable business case at an early stage, there appears to be a corresponding lack of capital, especially for further upscaling.

Even when a business could be profitable after scaling up, the higher perceived risk for most bio-based industry projects means that debt financing is not accessible. Moreover, venture capital funding is also unavailable because venture capital firms do not usually invest in the construction of production sites. To increase funding,

respondents suggested a regulatory push for investors and banks, stating that without incentives for investors, the bio-based industry would continue to struggle and the amount of available capital would remain inadequate for large-scale projects. The efforts of Circular Bio-based Europe Joint Undertaking (CBE JU) were recognised, but the respondents highlighted the limited amount of funding at its disposal and therefore the continuing difficulty of financing scaleup projects.

Funding is not available throughout all stages, especially during scaleup

70% of the respondents agreed that funding is not available at every stage of development. In Europe, capital is often available in the early phases (R&D, small-scale pilot production stage) but is lacking for more costly scaleup projects (for example, flagship first-of-a-kind commercial plants and large-scale demonstrators). The main reason cited is the disproportionately high market risk (as previously described) combined with long lead times and potentially low returns due to low margins. According to one startup, there is a lack of mid-sized investors to fund their scaleup to technology readiness level (TRL) 6[10]. Its business was too big for small investors, but too small for big investors. In addition, multiple respondents stated that the funding required for scaleup to TRL 8 and higher is too large for the investors currently active in the bio-based industry in Europe. In general, the respondents indicated that the financing situation for scaling up has improved over the last five years but is still in a very poor state.

"The scaleup of these projects does not yield the returns a venture capitalist is expecting. Most of the bio-based products have considerably low margins. There is very little scope for a venture capitalist to make the returns it needs. And for us as a commercial bank, these projects are too risky. There is the technology upscaling risk, the high feedstock supply risk and the market risk. The only way we would finance such a project is if a cost-plus based offtake agreement is in place, meaning that feedstock price fluctuations, energy costs and debt repayment and interest are fully covered. And even then, we need an interest rate of >6% to cover the risk. That rarely works for these low-margin products."

- Banker, not active in the bioeconomy

Challenges for bioeconomy scaleups

In the survey, investors and entrepreneurs were asked for their opinions on the challenges of raising funds. Figure 10 provides an overview of the findings.

[10] https://euraxess.ec.europa.eu/career-development/researchers/manual-scientific-entrepreneurship/major-steps/trl

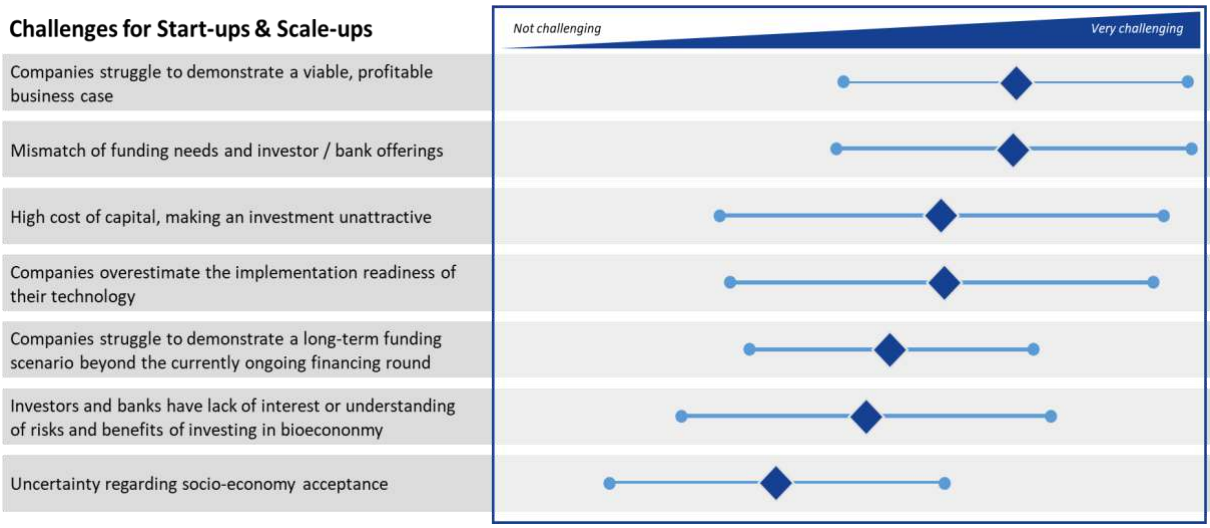


Figure 10: Challenges experienced during funding rounds (Source: Roland Berger)

The biggest challenge cited is demonstrating a viable, profitable business case. This aligns with the findings from the root-cause analysis in section 3.2.3, where the possibility to obtain offtake agreements and the ability to sell products with a green premium were described as very difficult.

The second biggest challenge was the mismatch of funding needs and investor/bank offerings. This is aligned with the overall limited availability of capital for the bioeconomy, and particularly, the absence of capital for later development stages, i.e. construction of a demonstration or industrial-scale plant. The experts interviewed agreed that the construction of these plants is too expensive and takes too long for venture capitalists. It is also too risky for traditional large-scale lenders such as banks.

While the analysis above focuses on the EU bio-based industry in general and outlines the funding gaps across the board, the following section provides a detailed description of the four segments in terms of their respective strengths, weaknesses and implications, which will provide input for the Recommendations in section 5 of this report.

3.3 Segment analysis

The four segments describe different product categories. In Figure 11, product examples for each segment are listed. While the product categories are segment-specific, bioeconomy companies can operate in multiple segments at the same time. For example, if they produce several products belonging to different segments (e.g., bio-based texturisers and bio-based lactic acid).

Figure 11: Product examples for each segment (Source: Roland Berger)

3.3.1 The novelty and premium creation segment offers scalable opportunities, it can grow stronger (with the right incentives)

3.3.1.1 Description

The novelty and premium creation segment includes new products with high margins and lower volumes, often with a proximity to customers or business-to-consumer (B2C) business models. High margins are possible due to the absence of fossil-based like-for-like alternatives. Products include insect proteins, biochar, CO_2-based chemicals and fungi proteins. Companies active in this segment include The Vegan Cowboys, Enough, Protix, AmphiStar and Biochar.

3.3.1.2 Strengths

New products in new markets command higher margins and while their scaleup is expensive, it is more linear and can already yield small revenues and profits even at lower production scale. In this segment, all funding types (e.g. grants, venture capital, debt etc.) are present in the different stages of the scaleup chain.

3.3.1.3 Weaknesses

The selective filtering process by early-stage investors eliminates some promising disruptors prematurely due to the limited number of active investors in the field. There is often a mismatch between the typical venture capital investor timeline (for an exit) and the time required until the startup can reach a commercial scale and profitable operations with a new type of technology/product. In general, the time required to bring the new product/technology to market is too long for venture capital investors, especially considering that substantial market and technology risks can still exist.

3.3.1.4 Implications

While the European Circular Bioeconomy Fund (ECBF) already provides capital for early-stage investments, increasing its size or establishing a fund with similar features but on a larger scale could allow investments in

more early-stage companies in the bio-based industry that are promising. Moreover, these early-stage companies would benefit from a long-term, venture capital-like player such as an "ECBF 2." The involvement of an ECBF-like investor may also help in attracting further funding by bringing in other investors.

Access to multipurpose pilot and demo plants would enable disruptors to mitigate market and technology risks and help them attract the large investments they need to scale up their production. Furthermore, access to dedicated pilot and demo facilities could greatly accelerate technology and product development, also shortening the time required for achieving commercial-scale operations.

3.3.2 The lack of regulatory pressure limits the appeal of bio-based disruptors

3.3.2.1 Description

The bio-based disruptors segment comprises high-volume products that possess similar functionalities and improved qualities (for example, being biodegradable) compared with fossil-based products. Products in this segment include bio-based specialty fibres, specialty paperboards, wood pulp-based chemicals and wood pulp composites. Companies active in this segment include Cosun, Metsä, UPM and Lenzing.

3.3.2.2 Strengths

Because companies that own large volumes of feedstock are naturally incentivised to look for technologies to extract more value from their resources, they are more receptive to approaching startups in this segment. In addition, profitable niche markets and linear scaling models allow a staged approach to achieve high-volume production and there are linear and lower-tech business models suitable for investment in the segment.

3.3.2.3 Weaknesses

The segment is suffering from a fragmented regulatory landscape, which includes lengthy product approval processes and industry standards that are skewed towards fossil-based legacy products. There are also ESG concerns as the segment suffers from an image problem originating from the biofuel debate, linked to the use of first-generation feedstock for applications other than food and feed, and low investor visibility. Ultimately, high-volume production will be needed to achieve profitability and competitive prices per unit. This in turn demands large investments.

3.3.2.4 Implications

Harmonisation of product approval processes and industry standards could strengthen the competitiveness of the bio-based industry and drive innovation and resilience in key transformational industries. Investor interest could be increased by providing market studies (identify disruptable markets, mature technologies and linear scaleup cases) and offering fund-matching for EIB investments. This could be achieved through a deployment group focused on finance and investments. In addition, targeted bans on fossil-based products could create a demand base (market pull) for bio-based substitutes and thus drive investment in large production facilities. Such bans could target low-value or potentially harmful, high-volume products like packaging materials, plastics in agricultural production or mineral wool.

From a transformational perspective, this segment holds a lot of potential, considering that it addresses high-volume markets currently dominated by fossil-based products. This segment attracts interest from large players in industries linked to biomass processing, such as pulp, paper and food. Their interest in this segment comes from the option to strategically capture additional value from their operations by transforming industrial side streams into products of commercial interest. On the other hand, for traditional players in the same markets, such as petrochemical companies, this transformation would mean venturing into totally new markets (e.g. biomass feedstock), losing revenues from the (fossil-based) products they already market, and, at the same time, shifting from the existing fully established fossil-based value chain to new ones. On the other hand, for these

traditional players, disrupting the fossil-based markets with bio-based solutions could potentially provide a route to sustainable and long-term growth.

3.3.3 The bio-based specialisation segment suffers from a lack of interest from companies to go beyond R&D

3.3.3.1 Description

The bio-based specialisation segment consists of substitutes for low-volume, fossil-based products in sectors that are willing to pay relatively high prices and/or green premiums, such as personal care products. Products include bio-based lubricants, texturisers, emulsifiers, as well as enzymes and microorganisms. Leading companies in this segment are BayWa, Cargill, Oleon and ADM.

3.3.3.2 Strengths

Companies are willing to invest in the development of knowledge and capabilities and use this segment as a testing ground. In this segment, all funding types are present in their respective stages of the scaleup chain.

3.3.3.3 Weaknesses

The two-tier filtering process (venture capital for initial technology development, companies for investment decisions) is very selective, thereby eliminating promising disruptors prematurely due to the limited number of early-stage investors active in the field and uncertainty surrounding the go-to-market model. Furthermore, access to niche markets is often tightly controlled by very few producers.

3.3.3.4 Implications

An important lever for increasing the number of projects that succeed in the filtering process is improving the return on investment. This is a key investment criterion for companies and, considering bio-based industry projects compete for investment with projects from other sectors, their investment returns should be comparable or higher to attract capital. This improvement could be achieved by providing advantageous financing conditions or other incentives for capital expenditure and associated costs for innovative and low-carbon projects through enhanced (that is, low interest rate) loans, accelerated depreciation (increasing project cash-flows by reducing tax burdens) and by simplifying access to high-quality, low-price primary and secondary feedstocks.

3.3.4 Absence of regulatory support and feedstock concerns impede the volume substitution segment

3.3.4.1 Description

The volume substitution segment includes like-for-like replacements of basic and intermediate chemicals that are produced in high volumes and form the basis of many value chains. Products include bio-based chemicals, resins and biodegradable polymers. Companies active in this segment include Clariant, Braskem, BASF, Avantium and Neste.

3.3.4.2 Strengths

When produced at scale, many volume substitution products are broadly competitive and can be used as like-for-like drop-in substitutes.

3.3.4.3 Weaknesses

Producing biobased products at scale requires petrochemical companies to enter into complex collaboration models and potentially lose value from vertical integration in the fossil value chain. Another major challenge in Europe is the high prices of high-quality biomass feedstock. As a result, this segment is in a vicious circle: competitive prices are only achievable with very large investments, investment decisions need reliable market demand and market demand needs competitive prices.

3.3.4.4 Implications

The large investments needed to achieve profitable operations require reliable demand at competitive prices. This can be achieved through (1) a regulatory push via targeted bans and blending quotas for fossil-based products with feasible bio-based alternatives. This would lead to a reliable and predictable demand base allowing for investment in large-volume production facilities and (2) contracts for difference, which could mitigate price risks and provide confidence to enter binding offtake agreements for drop-in bio-based chemicals. Contracts for difference could be financed via targeted taxation of fossil-based alternatives.

Another issue is the supply of feedstock: large-volume plants require a reliable supply of feedstock at competitive prices. Increasing the flexibility of using first-generation biomass for bio-based materials production in the mid-term and redirecting the use of biofuel feedstocks to material use in the long-term are potential solutions.

3.4 Bio-based industries funding gap – Concept and structural challenges

Establishing the scale of the funding gap is not part of this study but is within the remit of a dedicated EIB study published in 2025, Investment gaps to achieve sustainable targets in the bioeconomy. However, there are some key concepts and structural challenges related to the funding gap in the bio-based industry that are relevant to this study.

The concept of the funding gap refers to the shortage of financing required by companies or projects/technologies at specific stages of their development. The concept is used particularly in connection with the scaling of innovative technologies.

The funding gap is obtained by comparing the required capital (demand side) and the capital available for investment (supply side). If there is more demand than required supply, there is a funding gap which can be closed by soft capital (Figure 12).

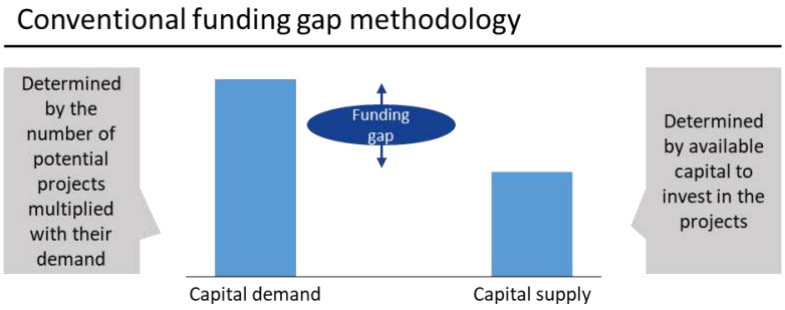


Figure 12: Conventional funding gap calculation methodology (Source: Roland Berger)

In the context of the European bio-based industry, the main underlying causes of the funding gap are:

- Technology-related risks
- Lack of offtake agreements and other market-associated risks

- Feedstock supply risks
- Regulatory risks and long lead times for approvals thereby delaying market access
- Low return on investment compared to other sectors. Investors active in the bio-based industry are not specialised but multipurpose (thus potentially allocating their capital to sectors with better risk-reward ratios).

For more details on these issues, please refer to the Market consultation in section 3 of this report.

The funding gap in the wider scaleup ecosystem has been analysed in the following studies:

- *The scale-up gap: Financial market constraints holding back innovative firms in the European Union* (European Investment Bank, 2024)[11]
- *The scale-up finance gap in the EU: Causes, consequences, and policy solutions* (Quas et al., 2022)[12]
- *EIF Venture Capital Survey 2021: Market sentiment* (Botsari et al., 2021)[13]
- *EIB Investment gaps to achieve sustainable targets in the bioeconomy*.

Their findings point to:

- **Shortage of capital for scaleup**: While Europe has sufficient funds for early-stage financing, there is a lack of financing for innovative firms to scale up. This particularly refers to a lack of venture capital, which is the typical form of financing for most innovative technologies, especially deep technology. Europe has a relatively small and declining number of venture capital funds that focus on later stages, and few with sufficiently deep pockets.
- **Low involvement of institutional investors:** Institutional investors such as pension funds do not typically fund high-risk projects and technologies in Europe. According to the European Investment Fund, pension funds increased their investments in venture capital funds by 3.5 times between 2015 and 2021.[14] However, the current level of investment remains 30 times lower than investments in lower-risk private equity funds.
- **High involvement of public funding but a fragmented landscape:** European governments have been instrumental in fostering the venture capital market, particularly through public funding and supportive regulations. However, these efforts have generated a fragmented landscape of smaller funding sources across Member States and at European level that do not have the required financial firepower to fund projects through the capital-intensive upscaling process. A lack of large, pan-European funds remains a challenge and hinders the scaling of innovative companies. The European Union has implemented various initiatives to address the scaleup funding gap. The European Innovation Council (EIC) provides early-stage funding (recently increased to equity injections of up to €30 million), while InvestEU offers support to growth-stage companies through financial instruments like debt and equity. Additionally, the ESCALAR programme attracts private investment to scale up companies.
- **Complex regulation:** Regulatory requirements, which often vary from country to country, are described as a major hurdle for projects (e.g. different requirements for the same product in different EU countries) and increase the perceived risk of projects, thereby reducing investor appetite and the availability of capital.

The only recent study that has analysed the funding gap **specifically in relation to bio-based industries** is the EIB's 2017 bioeconomy study which highlights funding gaps at the following stages:

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[11] European Investment Bank. (2024). The scale-up gap: Financial market constraints holding back innovative firms in the European Union. https://www.eib.org/en/publications/online/all/the-scale-up-gap

[12] Quas, A., Mason, C., Compano, R., Testa, G. & Gavigan, J. (2002). The scale-up finance gap in the EU: Causes, consequences, and policy solutions. *European Management Journal*, 40 (5), 645-652. JRC Publications Repository – The scale-up finance gap in the EU: Causes, consequences, and policy solutions

[13] Botsari, A., Kiefer, K., Lang, F., & Legnani, D. (2021). EIF Venture Capital Survey 2021: Market sentiment. Luxembourg: European Investment Fund. https://www.eif.org/files/records/eif_working_paper_2021_74.pdf

[14] Arundale, K. (2020). Venture capital performance – A comparative study of investment practices in Europe and the USA. Abingdon, Oxon: Routledge.

- **Funding gap 1:** Scaling up from pilot to demonstration projects
  - Grant funding is available but is often restricted to the R&D phase and has complex and lengthy application procedures.
  - Private investors are not well-equipped for the high technological risks associated with this phase, resulting in expensive funding with risk-minimising conditions that many promoters cannot meet.
  - This funding gap is filled by own funds from innovative companies, and equity from strategic industrial partners and a few specialist investors.
- **Funding gap 2:** moving from demonstration to flagship first-of-a-kind production and industrial-scale projects
  - The projects surveyed rely heavily on grants, but also on equity capital from private sources.
  - Issues accessing private funding due to a lack of interest in investing from private financial market participants.

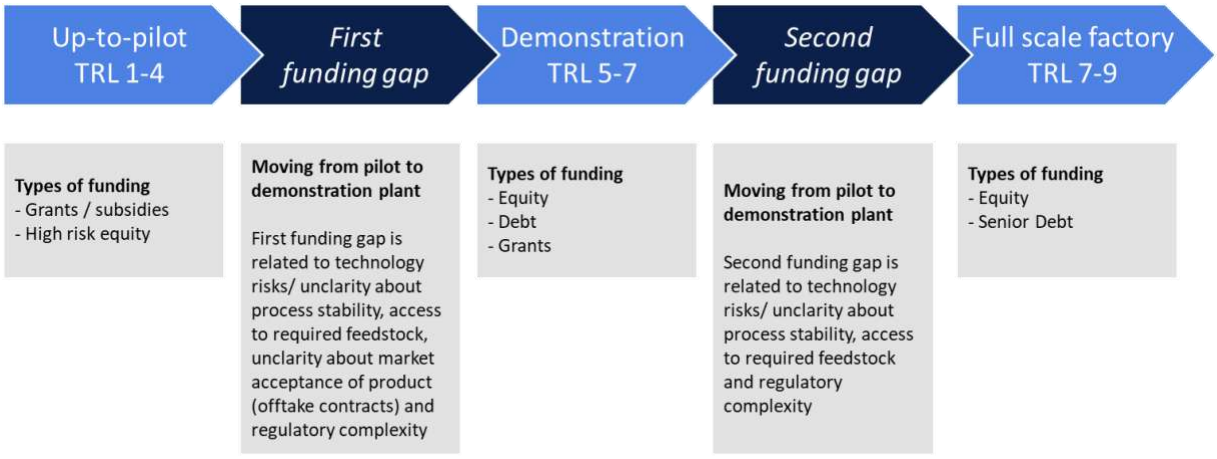


Figure 12: Funding gaps along the scaleup path for bioeconomy projects (Source: Roland Berger)

3.5 Bio-based industry projects – insights from project partners, available literature and public information

3.5.1 Capital expenditure requirements: Results from earlier studies and publicly available information

The EIB's 2017 bioeconomy study serves as a benchmark. The study evaluated the capital expenditure of 27 bio-based projects. To extrapolate the data to the present study and conclusions, we excluded projects that do not belong to the bio-based industry subsectors considered in the current study.

The remaining projects had an average capital expenditure requirement of €30 million (technology readiness level (TRL) 5 to 7) and €177 million (TRL 8 to 9). There is a very high variance in the reported capital expenditure, especially for TRL 8 to 9, with €500 million being the highest reported value and €4 million being the lowest.

To compare these figures, development expenses must be included and the figures must be adjusted for inflation. To this end, development costs were considered to be 25% of capital expenditure, which is a reasonable average figure in the industry. The cumulative inflation between 2017 and 2024 was 32%, so this adjustment was applied to the figures. This yields an adjusted average capital requirement of €50 million at the first transition point and €310 million at the second transition point. These are just average estimates and may vary greatly depending on the specificities of the bio-based technology in question, as well as other factors.

Some information on capital expenditure for biobased industry projects may also be obtained from press releases on company investments or sector publications. However, the reliability of such figures is unclear. As most companies, including most of the ones interviewed in this study, are unwilling to share precise estimates about capital requirements for the investments they are planning.

Public information has been found for two projects relevant to this study:

- Fibenol, a producer of wood-based materials, announced an investment of €600-700 million for their commercial-scale biorefinery.
- Similarly, Futerro, a producer of specialised bioplastic solutions from glucose, announced an investment of €500 million to build their industrial facility.

Both projects represent large investments in their bio-based industry segments, but overall they seem aligned with findings from earlier studies and interviews with market participants carried out during this study.

3.5.2 Results from interviews with market participants

To explore the funding gap in the bio-based industry and the underlying root causes, we use the same segmentation framework previously introduced, with the four bio-based industry segments. Using this framework, two funding-related issues have been identified and need to be treated separately, as shown in the following figure.

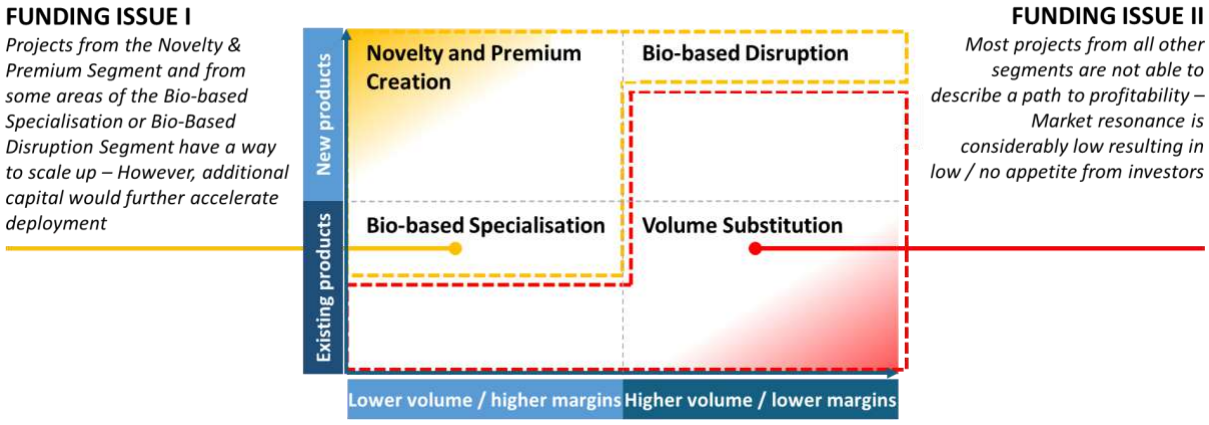


Figure 13: Funding issues by segment (Source: Roland Berger)

The first funding issue describes projects from the novelty and premium creation segment and selected areas of the bio-based specialisation and bio-based disruption segments. Projects in these segments address high margins bio-based products and do not usually have direct competition from fossil-based products.

Successful projects often rely on offtake agreements to reduce market risks, making them more attractive to equity and debt investors. However, in the bio-based industry, investors are often wary due to the perceived high risk (e.g., technology, feedstock supply). This skepticism results in a strict selection process, where only the most promising and lower-risk projects secure funding. Consequently, many projects which could become viable with further development face challenges during the upscaling phase and struggle to progress. Introducing additional soft capital funding that is flexible and focused on supporting bio-based industry projects during upscaling could address this issue by helping projects mature and lower their risk profile, thereby making them more appealing to investors in the sector. In turn, this would also improve the chances of raising the necessary funds by reducing the overall capital needs. In addition, providing extra soft capital may encourage the involvement of more private investors, thereby mobilising greater financial support for these initiatives.

This study finds two scaleup-related funding gaps at the transition points (i) from pilot to demonstration plants and (ii) from demonstration plants to industrial facilities. This is in line with the findings from the EIB's 2017 bioeconomy study.

The first funding gap is primarily characterised by technological risks, feedstock supply uncertainties and market risks associated with securing offtake agreements and navigating complex regulatory hurdles.

The second funding gap is influenced by technological challenges related to pathways for scaling up to industrial levels, securing sufficient feedstock supplies and navigating complex regulatory environments, particularly when entering new markets.

The second funding issue refers to the segment volume substitution, and a large share of the bio-based disruption and bio-based specialisation segments. These segments face unique funding challenges, often characterised by lower profit margins and competition from established fossil-based products. Some of the products in these segments are commodities or products produced at a significant volume and with high demand elasticity, thereby limiting the willingness of buyers to pay more for a bio-based, green product.

Scaling production in these segments is only possible if long-term offtake agreements are established to lower market risks. Without a secured offtake, obtaining financing – especially debt financing – is almost impossible. Given the high price sensitivity in these market segments, bio-based products will likely need to be competitively priced compared to incumbents, which are often fossil-based products, to secure large-volume offtake agreements. However, in these high-volume markets, a large share of the products in the three bio-based industry segments mentioned cannot compete on price with the commercially available ones. This creates a vicious circle that hampers the development of bio-based technologies in these segments as such investments are commercially unviable. The picture is somewhat brighter for niche applications with higher price premiums, for example, ingredients for personal care products. These specific domains can support the market penetration of bio-based technologies and products, even though the volumes are usually lower compared to mainstream applications.

The current lack of commercial viability in the upscaling of bio-based technologies and products in the three bio-based industry segments mentioned makes it impossible in most cases to mobilise the required private investment in the current market and regulatory environment. For this reason, a meaningful funding gap for these segments cannot be determined. Currently, the market conditions needed for the successful scaling of these projects do not exist, and this picture is unlikely to change in the near future. Since new financing tools alone cannot address the lack of market demand and/or commercial viability, the concept of a funding gap remains largely theoretical for now. With improved market conditions and a sustainable business model, helped by a supportive regulatory framework, financing would likely become more accessible, shifting the context for evaluating any funding gaps, as well as solution to filling them.

"For many projects that we have screened, it is very hard to see how they could ever become profitable... it certainly makes sense to have these sustainable and green products from a sustainability point of view, but from an investor perspective, most of them will not earn any money. In fact, they will cost money. So, from a funding perspective, you would have to put money in first to finance a plant, and then you would need significant subsidies to make the product competitive. "

- Investor, active in the bioeconomy

4 FINDINGS FROM REGIONAL CASE STUDIES

Main research findings

Regions with a long tradition in agriculture or forestry production, aiming to find new applications to maximise value from feedstock production, have been successful in scaling up bio-based innovations. France's Grand Est is a prime example.

In addition to innovators and R&D capabilities, large corporate partners are instrumental in driving the industrialisation of bio-based industry projects. The absence of such partnerships at the regional level is a major hurdle to scaling up bio-based technologies, as evidenced in Bavaria.

Bio-based industry investments should concentrate on regions with abundant biomass feedstock availability (such as biomass from forestry, agriculture or aquaculture) and large established companies or networks of companies interested in finding new applications to increase the value of this biomass feedstock. These regions also tend to have well-developed networks of private or publicly funded research institutions with strong connections to industry players.

Even well-funded bioeconomy support initiatives that are targeting bio-based industries struggle in regions which do not meet the basic conditions for a market-driven bioeconomy.

4.1 High-level analysis of regions (profiles)

Main research findings

- **Four strong bioeconomy regions have been identified in Europe: Grand Est in France, Bavaria in Germany, Finland with a focus on wood processing, and Italy with a focus on agriculture.**
- **Beyond Europe, the US Midwest has seen rapid increases in large bio-based industry projects that use a number of different supporting instruments.**
- **There is a significant disparity in the development and investment opportunities for the bio-based industry across the countries/regions investigated.**

Feedstock availability, R&D capabilities at nearby universities and the ability to mitigate market risk by securing binding offtake agreements are key drivers for bio-based industry development.

The map in Figure 15 shows an overview of the regions selected for high-level analysis and why they were selected.

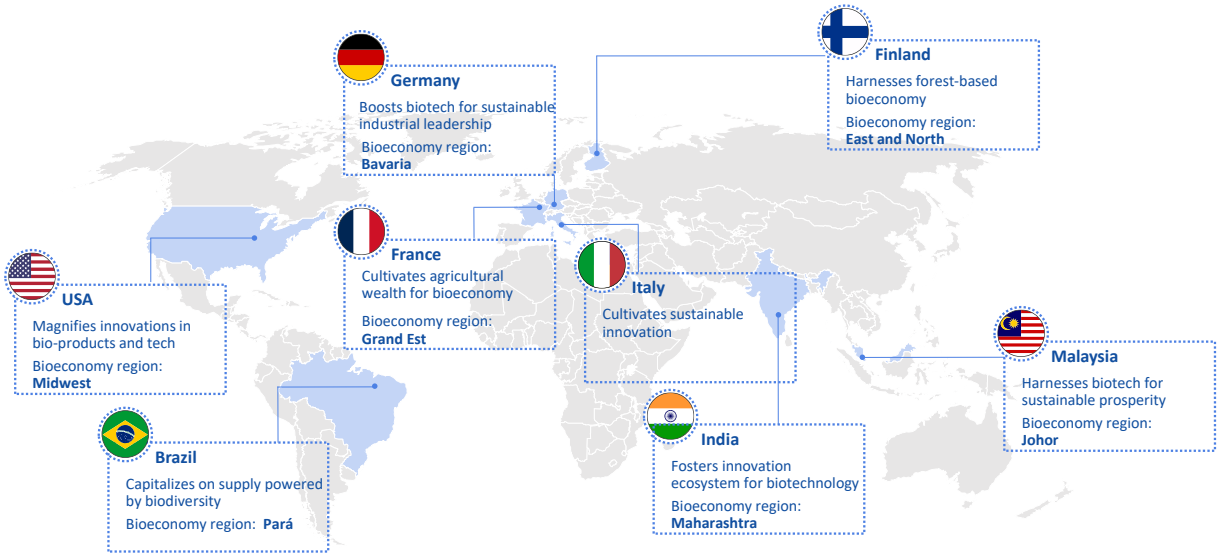


Figure 14: Overview of regions selected for high-level analysis (Source: Roland Berger)

The main findings for each region are as follows:

- **Grand Est** (France) has a developed an advanced bio-based industry sector. This region benefits from a complete bioeconomy value chain, including biomass resources and leading bioeconomy clusters, with a strong R&D and industrial ecosystem with established champions in fossil-based industries and leading agribusinesses. Additionally, in 2022, the French government introduced France 2030, an initiative to support the reindustrialisation of France, which provides multiple funding instruments for scaling up new technologies to industrial level. Although this initiative is not specific to bio-based industries, it is driving the industrialisation of bio-based products in France.
- **Bavaria** (Germany) introduced a dedicated bioeconomy strategy in 2020 that includes a broad range of initiatives. The strategy supports a vibrant innovation ecosystem with numerous funding opportunities for startups and small and medium-sized enterprises. However, a potential gap exists in relation to funding for large companies and scaleup initiatives, unlike the comprehensive approach in Grand Est. To tackle this funding gap, Bavaria established the BayBioeconomy Scale-Up initiative[15] which supports TRL 8-9 projects.
- **Italy's bio-based industry** (as defined by this study) appears less developed despite abundant feedstock availability. The national and regional financing ecosystems remain immature, relying heavily on European programmes to support key projects. Italy has a national bioeconomy strategy but it focuses on the traditional bioeconomy sectors such as food and feed production.
- **Nordic and Eastern European countries**, despite feedstock availability, show limited activity in the scaleup of bio-based industry projects. **Finland**, for example, primarily supports research programmes rather than commercial, large-scale endeavours. Despite this, some market-driven activities (mostly from large forest-based industry companies) stand out. The bioeconomy sector in Finland is focused on increasing the value extracted from its forestry output by using biomass residues for higher value products such as bio-based composites, bio-based fibres for textiles and bio-based building materials. The scaleup of startups and small and medium-sized enterprises is driven through collaborations with large companies.

[15] PowerPoint Presentation

- The region of **Pará** in Brazil lacks dedicated bioeconomy financing mechanisms, relying on more general programmes. Consequently, bioeconomy initiatives are primarily driven by larger companies due to limited government support. Brazil has ample feedstock availability and knowledge of agriculture and forestry businesses, but the bio-based industry is still in the early stages of development.
- **India** prioritises biopharmaceuticals in its investments, with other sectors like materials and chemicals receiving less attention and limited funding. Therefore, investigating India's financing instruments may be less relevant for the specific bio-based industry subsectors included in this study.
- **Malaysia's** bioeconomy is supply driven, with a recent government shift towards reduced public involvement and greater reliance on private participation. While various financing programmes exist, their impact appears limited.
- The **US Midwest** region has a diverse biomass supply, which combined with a mix of government programmes and a long-standing agglomeration of major agribusiness companies, creates a potential bio-based industry powerhouse.

Based on these initial findings, four regions – Grand Est (France), Bavaria (Germany), Finland and the US Midwest – were selected for further investigation through interviews and detailed case studies.

4.2 In-depth analysis of selected regions

4.2.1 Grand Est (France)

Key findings from the Grand Est region

- **The region has a large availability of agricultural feedstock.**
- **Driven by agricultural companies which aim to increase the value they can extract from their feedstock, R&D platforms such as ARD (Agro Industrie Recherches et Développements) have developed over decades.**
- **R&D institutions have strong networks with innovators and corporate partners and offer multi-functional shared pilot/demo facilities for industry players to progress and derisk their bio-based technologies and products before investing in their own industrial plants.**

This network leverages public support instruments such as France's Première Usine programme which supports the industrialisation phase of new innovations.

Innovation structure

Grand Est has a strong R&D network with several universities including the Université de Strasbourg and the Université de Lorraine that have established an incubator to help their spin-out startups to scale up their businesses. Moreover, there are several bioeconomy-specific research institutions and R&D companies that develop innovations for scaleup and industrial companies, while also conducting commissioned R&D projects. In general, France has a strong startup ecosystem with 2 300 startups accounting for more than 40% of French Tech fundraising in the first half of 2023[16] which also include bioeconomy startups.

[16] Reindustrialising France by Bpifrance (https://www.bpifrance.com/2024/06/13/reindustrializing-france-an-ambitious-project-supported-by-bpifrance/)

Conditions for industrialisation

The regional economy is shaped by agriculture and forestry. About 50% of the Grand Est area is given over to agriculture with around 50 000 farms, while one-third is covered in forest.[17] In addition, the region offers a highly diverse market with an established chemical industry including cosmetics, paints and detergents, and strong industries in bioresources and bioenergy, including biogas.[18] The existing infrastructure of general industrial production plants and the technological competencies (Figure 16) which have grown over centuries provide considerable potential for further scaling up the bio-based industry.[19]

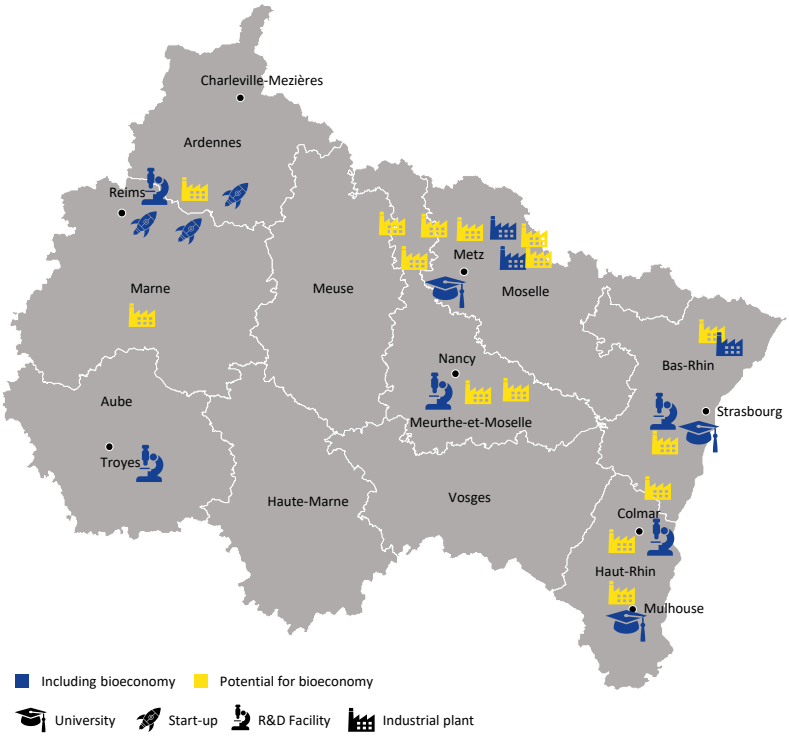


Figure 15: Map of Grand Est showing the network of R&D facilities and industrial production plants (non-exhaustive) (Source: Roland Berger)

Scaleup funding environment

Two initiatives support the scaleup of the bioeconomy in Grand Est through funding and advice:

1. On a regional basis, La Région Grand Est partnered with Bioeconomy for Change (B4C) to drive Grand Est's bioeconomy. The region's Bioeconomy Strategy 2019-2022 provided €500 million in support between 2019 and 2024. B4C is a bioeconomy competitiveness cluster based in France with over 500 project partners. It provides support and funding to bioeconomy companies when starting and scaling up their businesses and has so far financed over 450 projects in France with a total budget of €3.5 billion[20]. B4C supports La Région Grand Est in the operational implementation of its bioeconomy strategy. The partnership puts out tenders for projects which they then support with either a grant or a repayable advance payment. The projects cover all bioeconomy sectors from bioenergy and bio-based industries to bioresources.

[17] Grand Est bioeconomy commitments (https://www.bioeconomie-grandest.fr/en/the-regions-commitments/)
[18] Grand Est bioeconomy markets (https://www.bioeconomie-grandest.fr/en/the-bioeconomy/markets/)
[19] Industry explorer France (https://industrie.usinenouvelle.com/)
[20] Bioeconomy for Change (https://www.bioeconomyforchange.eu/nos-services/innovate/)

2. France 2030 is a national programme aimed at stimulating employment, boosting productivity and increasing the competitiveness of French businesses. With a budget of €54 billion, the programme focuses on strategic industrial sectors – traditional and new ones – that foster investment, innovation and reindustrialisation. The programme budget is split equally to support early-stage growth companies and decarbonisation actions. Although not specific to the bio-based industry, the programme benefits bioeconomy businesses.

France 2030 supports industry with multiple initiatives (Figure 17) from R&D to industrial-scale activities, including grants, loans and guarantees, equity, a fund-of-funds and general guidance. To scale up emerging bio-based industry businesses beyond technology readiness level (TRL) 6, the SPI fund (Sociétés de Projets Industriels 2), the New Industry Loan (Prêt Nouvelle Industrie) and the Première Usine programme are especially useful.

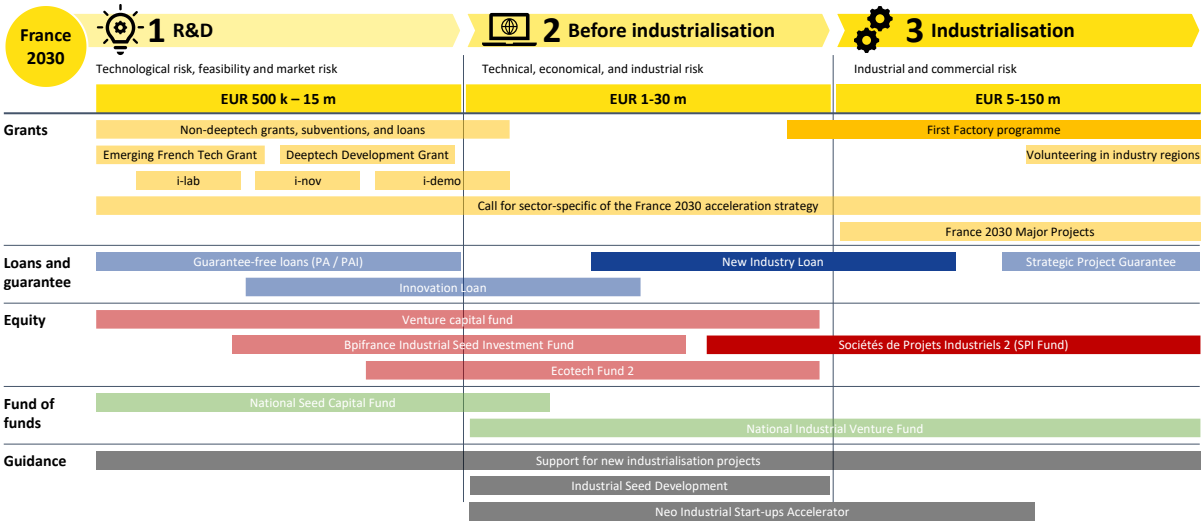


Figure 16: Overview of France 2030 initiatives (Source: Bpifrance, translated by Roland Berger)

The SPI[21] fund supplements traditional investment tools such as venture and growth capital by focusing on the industrialisation phase of a technology. It targets relatively mature technologies with TRL >6. With €800 million under management, and investments between €10 million and €160 million, the SPI fund provides equity alongside other investors. It is managed by Bpifrance[22], Noovista, YPOSKESI, Evertree and Vallourec and supported by PIA[23] and the EIB. An example of a project supported by SPI is the construction of AFYREN's first-of-its-kind biorefinery, AFYREN NEOXY.[24]

One of BPI's products, the "New Industry Loan" (Prêt Nouvelle Industrie), provides loan funding with or without a guarantee. It targets projects with TRL >5 by providing financing for material and intangible expenses, increases in working capital related to industrial demonstrator projects and pilot plants, and the creation of new production plants. Loans range from €3 million to €15 million and are directed at small, medium and intermediate-sized companies. SPI has set aside €150 million for this instrument.

21 SPI fund - Bpifrance.com
22 Homepage - Bpifrance.com
23 Le Programme d'investissements d'avenir | info.gouv.fr
24 AFYREN NEOXY (https://www.businesswire.com/news/home/20220928005741/en/AFYREN-Inaugurates-Its-First-Factory-AFYREN-NEOXY-a-First-of-its-kind-Biorefinery)

Comparison of the Première Usine programme and CBE JU initiatives

Disclaimer: The Première Usine programme is a national initiative supporting industrialisation aimed at small and medium-sized enterprises in France. While the format of the programme can be used for guidance, there are legal limitations to what can be implemented by EU programmes such as CBE JU.

The Première Usine programme supports the construction of industrial facilities including pilot and industrial plants with a TRL >5. So far, the programme has funded 51 projects, resulting in over €1 billion in productive investments using only €240 million of public money. The programme, which has a total budget of €550 million and is managed by Bpifrance, provides a combination of grants (60%) and repayable advances (40%) and matches the respective company's equity, thereby investing into companies which already had market success in attracting equity, leveraging investor's market intelligence. Projects must have a total expenditure rate of > €5 million to be eligible for the programme. The programme exclusively funds capital expenditures. It operates within the framework of the EU Block Exemption Regulations (part of competition law). Therefore, it has an intervention rate of between 20% and 30% on expenses presented by the project leader and is subject to compliance with various aid schemes.

Compared with CBE JU initiatives, the Première Usine programme is a national initiative and benefits from less strict legislation, thus providing more flexibility in terms of the beneficiaries, prerequisites and project topics. Two enhancements could further strengthen CBE JU support for the industrialisation of bioeconomy projects: (1) relaxing project member requirements to allow for one-company funding or smaller consortia, and (2) building a funding ecosystem with partners to allow for a combination of funding tools (for example, CBE JU provides a grant while the partner provides a loan).

4.2.2 Bavaria (Germany)

Findings from the Bavaria region

- **Bavaria demonstrates that challenges exist, even for well-funded initiatives when it comes to build a strong bio-based sector, if the basic conditions for a successful and market-driven bio-based industry are not in place.**
- **The region lacks a structured network of R&D institutions and companies focused on primary sector (feedstock), bio-based value chains, respective technologies and markets.**
- **For bio-based technology scaleups, there is a lack of large companies in the agriculture or chemical industries that can act as partners to bio-based startups, by providing offtakes and/or market access, and that could be the clients for R&D and technology development institutions.**

Although Bavaria has a strong funding environment for startups, bio-based companies are failing to reach industrial scale because of a lack of scaleup partners.

Innovation structure

Research institutions in Bavaria are among the best in Germany and Europe, with two universities leading the field in Germany and ranking among the top 20 in Europe[25]. Numerous startups are emerging from this strong R&D base, especially spin-offs from the nurturing environment of top universities such as the Technical University

of Munich (TUM). These early-stage startups are supported through an established funding ecosystem, including multiple incubators and governmental programmes specifically designed to support the spin-off process and prepare young companies for their first funding rounds.

Despite the generous funding ecosystem, competition from innovative startups in other sectors poses a challenge for bio-based industry startups, which must compete with these other disruptors for attention and funding from private investors. Bio-based sector companies have a natural disadvantage as other startups have easier business models with lower capital expenditure requirements, lower technological risks, a more straightforward scaleup logic and, often, a shorter time to market.

Bavaria developed a dedicated bioeconomy strategy in 2020 known as Future.Bioeconomy.Bavaria, which comprises 50 initiatives for developing and strengthening the region's bioeconomy. The state's progress on the initiatives is regularly reviewed by an expert council known as Sachverständigenrat Bioökonomie Bayern. Figure 18 shows a non-exhaustive overview of the support initiatives for young bioeconomy companies. The initiatives coupled with public funding are mainly focused on early-stage startups (up to TRL 5) and are often dedicated to specific regions or institutions, so there is a certain redundancy at state level. Furthermore, these early-stage initiatives tend to push startups through the development stages rather than supporting market pull (and revenue generation), leading to the funding of ideas and technologies that do not have a market and which later fail due to the lack of a viable business case for investors.

This push to market and the absence of market intelligence in early-stage funding limits the effectiveness of the initiatives.

Biocubator/BioCampus Straubing is an incubator based near the TUM Campus Straubing that is bringing together disruptors, companies, investors and research institutions. BioCampus is also building one of the few multipurpose demo plants in Europe for the development, scaling, testing and optimisation of bio-based products, with other examples being in Leuna (Germany) and Ghent (Belgium). In addition, they host a competition called Plan B for bio-based startups. However, despite numerous efforts to create a thriving bioeconomy environment, they have only managed to attract six bioeconomy startups to Bavaria. One reason for this struggle may be the lack of large companies with a strategic interest in developing solutions jointly, which can provide resources, expertise and/or market access.

[25] QS University Ranking (https://www.topuniversities.com/europe-university-rankings?page=0)

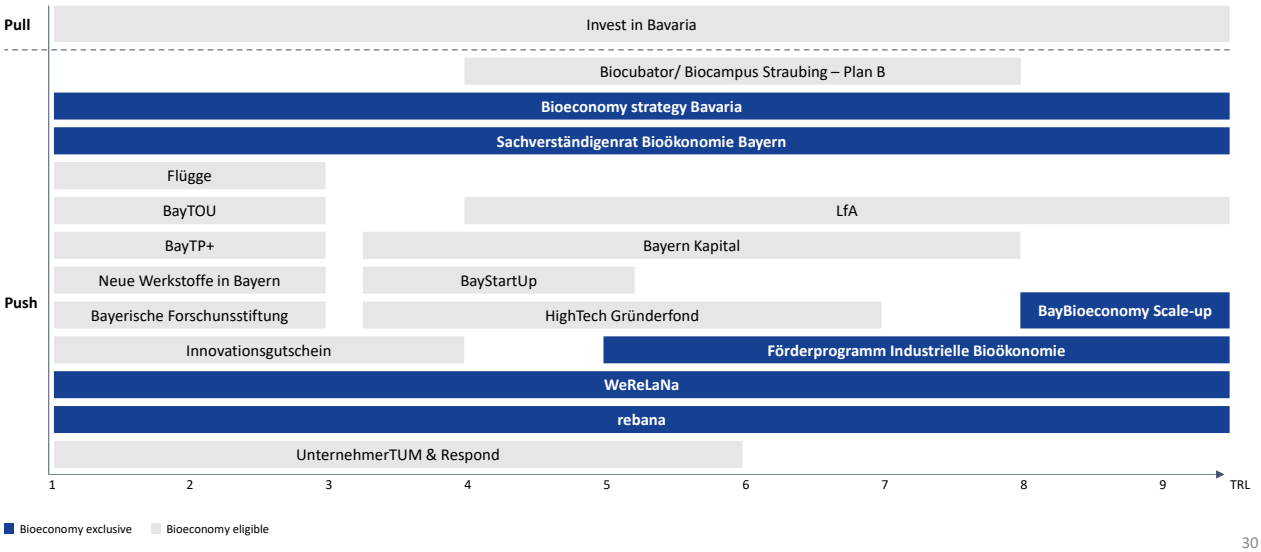


Figure 17: Non-exhaustive overview of supportive initiatives in Bavaria (Source: Roland Berger)

Conditions for industrialisation

Although there is a strong agricultural tradition in Bavaria, its primary sector is dominated by small businesses. The industrial use of large amounts of biomass feedstock is not a common practice. As a result, Bavaria has a shortage of large companies with local R&D departments that can function as partners for bio-based startups in R&D, process development and engineering, or for the operation of commercial plants. This also means that there are no large companies that can act as offtaker partners or provide market access. Large German companies interested in the bioeconomy, such as Südzucker and Nordzucker in the agrisector and BASF, Covestro and Evonik in the (petro)chemical industry, are concentrated in other regions.

Bavaria is a powerhouse for the German and European economy, contributing approximately 19% (around €720 billion) to Germany's gross domestic product (GDP)[26], but the agriculture sector accounts for only around 1% of this. Bavaria does have extensive and leading manufacturing, with presence of high-tech industries,[27] including the corporate headquarters of BMW, Audi, Siemens and many more. However, the traditional industrial sectors most relevant for this study (for example, rubber, plastics and chemical processing), which could support the development of bio-based industries, only account for around 10% of the industrial base in the region, which is dominated by the automotive sector.

The lack of industrial partners for scaleup in the region is exemplified by the company Biofibre. Founded in Bavaria, Biofibre developed its products and two pilot plants in the region but later entered a joint venture with a French company and built their first commercial-scale factory in the Grand Est region of France.

Feedstock availability is not a major issue at the current scale (with no major projects in a late development stage). Bavaria is conducting a study about feedstock availability for the bioeconomy and is looking to increase the use of its forests as a future source of feedstock for bio-based industries.[28]

[26] Statistics website for the country and the federal states of Germany (https://www.statistikportal.de/de/vgrdl/ergebnisse-laenderebene/bruttoinlandsprodukt-bruttowertschoepfung/bip)

[27] Invest in Bavaria (https://www.invest-in-bavaria.com/en/blog/post/bavaria-home-of-many-innovative-companies-in-the-manufacturing-sector)

[28] Announcement of Bavaria's biomass strategy (https://www.bayern.de/bayerischen-biomasse-ressourcen-strategie/)

Scaleup funding environment

The BayBioeconomy Scale-Up initiative[29] is part of the Bavarian bioeconomy strategy and is managed by the Bavarian Ministry of Economics. Aimed at bio-based companies that are scaling up mature innovative technologies (>TRL 8), the initiative provides up to 20% of the scaleup costs for production facilities for small companies and up to 10% of the costs for mid-caps, while for large companies, up to 40% of project's costs are covered, with specific eligibility conditions. This approach leverages market intelligence as at least 80-90% of the funds must come from private investors. Despite addressing the "valley of death" of the scaleup phase (that is, the period where a startup has begun operating but is not yet generating revenue), the initiative had to be revised due to a lack of applications in the first round. This suggests that (1) despite a nurturing innovation ecosystem and generous early-stage funding, there are not many bio-based scaleups in Bavaria, and that (2) funding instruments, to be effective, must be aligned to industry needs in the targeted development phase. For bio-based technology scaleup, this may mean covering a larger share of the full project costs. Often, the innovative and riskier part of a bio-based scaleup project is a relatively small share of the overall cost, as a substantial share of the capital requirements is set aside to develop the infrastructure for the demo and/or flagship plants. The investments to build infrastructure, while substantial, are in principle less risky compared to the innovative technology scaleup part. Therefore, a strategy to support innovative bio-based industry scaleup could potentially be to develop financing instruments targeting infrastructure costs. These investments would still greatly support the scaleup of innovative bio-based technologies but would entail a lower risk.

To summarise, although Bavaria provides considerable support for early-stage bio-based startups, only one instrument to help scale up more advanced projects (TRL >8) was identified in this study. This shows a lack of focus on supporting commercial deployment of new bio-based technologies (e.g. large-scale demonstrators or first-of-a-kind-commercial facilities). As such, it may not represent a successful framework to support the commercial scaleup of bio-based technologies.

[29] * BayBioeconomy-Scale-Up: Secure Investments for Bioeconomy in Bavaria!

4.2.3 Finland

Findings from Finland

- **Finland has an ample supply of wood-based feedstock. It has an annual logging volume of around 60-75 million cubic metres, the wood residues from these forest harvesting activities could be used as feedstock for bio-based products such as packaging, fibres and textiles, chemicals and biofuels.**
- **Growth of the bioeconomy in Finland is driven by a long history of dedicated, applied R&D and large regionally anchored forest-based industry players that are looking for to maximise value creation from the available biomass resources.**
- **Although Finland is viewed as a European success story in the bio-based industry, market participants in the country perceive the funding gap in the sector as substantial, potentially as much as ten times the available capital.**

This funding gap is associated with a lack of market pull, arising from a lack of regulatory clarity and support.

Innovation structure

Finland has a very strong R&D environment with several universities and VTT, a government-funded applied sciences R&D platform that has been driving bioeconomy research for 30 years. The country also has an active startup scene with multiple market-driven initiatives and general financial support from Business Finland, a government-funded organisation. Due to increasing market demand, large companies are driving the scaleup of the Finnish bioeconomy by taking up R&D and cooperating with startups.

Government support in Finland is limited. Finland's Bioeconomy Strategy 2022-2035, which aims to double the value of the Finnish bioeconomy by 2035, has produced limited tangible results since its introduction. In addition, the strategy covers all bioeconomy sectors without an explicit focus on bio-based materials and chemicals.

There are some non-bioeconomy-specific government initiatives that support the development of startups. For instance, Business Finland supports Finnish companies with guidance and funding, especially for early startups and small and medium-sized enterprises in the developing stage of their businesses by offering grants through multiple financial support programmes:

1. Young Innovative Company funding is intended for promising startups that have been operating for less than five years. Grants can be for up to €1 million and are divided into three phases: phases one and two are worth €250 000 each, and phase three is worth €500 000. The grants target the growth of startups' international businesses, their teams, the development of business models and growth strategies, and access to new markets. Based on the focus of the programme and the size of the grants, support is most suitable for companies in TRLs 2-6.
2. Tempo funding is also intended for startups that are less than five years old. It aims to prepare businesses for international growth by obtaining feedback on their products and mapping their demand and functionality in the international market. The maximum funding amount is €60 000 and covers up to 75% of a project's costs. The funding is intended for projects in TRLs 2-4.
3. The Funding for R&D programme is intended as a basis for product development work and pilot projects, and targets projects with TRLs between 1 and 4. The programme was recently expanded to provide more incentives for business research projects, with large companies now able to receive a grant of 40% of the total project cost, rising to 50% for projects with purely industrial research. A large company must spend at

least 40% of the total project costs on acquiring services from small and medium-sized enterprises and/or research organisations. Small and medium-sized companies can receive grants covering 50% of the total eligible R&D project costs and 60% for purely industrial research. For mid-cap companies, these grants cover 40% of eligible R&D costs and 50% of industrial research costs.

Furthermore, Finland's General Government Fiscal Plan 2025-2028 includes €1.75 billion for general R&D and foresees tax credits for large industrial investments aimed at transitioning to a net-zero economy.[30]

Aside from public support, the startup scene in Finland is largely market-driven. The community is driving cooperation between startups, R&D companies, corporations and investors through initiatives such as Slush. Slush is a global startup event, bringing together around 13 000 startups and investors such as venture capitalists annually in Finland and helping startups raise private money by actively facilitating meetings. The Finnish Startup Community promotes a growth environment for all Finnish startups by communicating with Finnish and European decision-makers. Comprising 275 Finnish growth companies at various stages, from early-stage startups to the ten largest growth companies in Finland, the community is not focused on a specific industry, but bioeconomy companies can still benefit. The privately financed Startup Foundation provides grants to individuals and projects that support the Finnish startup ecosystem. For instance, they have supported Slush.

The bioeconomy in Finland is also supported by VTT, which has 700 bioeconomy researchers developing bioeconomy know-how alongside universities, with several startups being spun off to commercialise their ideas. The economic benefit and environmental necessity of the bioeconomy has resulted in leading corporations massively increasing their commitments and budgets for R&D and innovation. VTT partners with private companies to develop new bio-based technologies. For example, Stora Enso and VTT developed a barrier film for packaging from microfibrillated cellulose, with VTT providing the material recipes, technologies and measurement devices that demonstrated viability, while Stora Enso supplied funding for the pilot plant.

Conditions for industrialisation

In Finland, the bio-based industry has traditionally been among the top industries, with the strong presence of the pulp and paper, and forest-based industry sector, shaping public policy and the economy. Research and Innovation in bio-based technologies is therefore a key topic in the country. This began with VTT's application-oriented research in bio-based technologies but has since been taken up by industry, generating a strong network of technology and business-minded experts including scientists focused on practical uses and corporations with large production plants. Finland's financial support for startups is comparable to other countries, but so far there hasn't been any specific scaleup support instrument for the bio-based industry, particularly for projects that need to scale up and are close to commercial deployment. There are several corporate players and startups that drive the bioeconomy, and scaleup relies almost exclusively on the market. However, even with the market pull in Finland, a significant funding gap exists, especially for more mature projects (TRL >6).

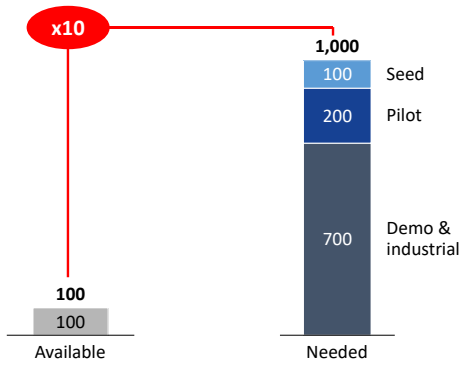
[30] New fiscal plan – Business Finland (https://www.businessfinland.com/news/2024/new-fiscal-plan-makes-finland-a-hotbed-for-investors/)

Information obtained during the interviews indicated that the value extraction per tree, and therefore from forestry assets, is considered as fully optimised and the potential for further improvements is rather marginal. As a result, leading corporations are turning to new bio-based technologies to extract additional value from side streams in their operations, previously underutilised. In addition to partnering with VTT, Finnish corporations use different approaches to increase their capabilities in the development of bio-based technologies:

1. Some corporations, including Metsä, focus on venture collaborations with startups and minimise their own R&D.
2. UPM and Neste conduct R&D internally and through joint ventures.
3. Companies such as Stora Enso focus on internal R&D.

Overall, Finland has a well-integrated ecosystem of research institutions, corporations and startups focused on generating value from primary sector resources, which fosters the development of bio-based technologies and provides growth opportunities for the bio-based industry.

Scaleup funding environment



No dedicated government scaleup support programmes for the bio-based industry were identified, especially for late-stage technologies (TRL >6).

From the interview information, the funding gap for the bioeconomy sector was estimated to be around €900 million, ten times the amount of available capital (Figure 19). The €100 million currently available for funding bioeconomy projects only covers their seed phase or 14.3% of the demo and industrial phase.

Figure 18: Finland's estimated funding gap [EUR m] (Source: Roland Berger)

4.2.4 Midwest (United States)

Findings from the US Midwest region

- **The Midwest has the same overall structure as Grand Est and Finland with the resources required to develop into a bioeconomy powerhouse.**
- **The region has a near unlimited and unrestricted supply of feedstock, an unrivalled presence of major agro-industrial and petrochemical companies and deep capital markets.**
- **However, the region and the US government are currently focusing on other green priorities such as biofuels and there is no strategic interest in scaling up the bio-based materials and chemicals sector.**

In scaling up the biofuels market, the United States has developed some noteworthy funding mechanisms.

Innovation structure

The region has a strong traditional focus on exploiting primary feedstock. A good mix of public institutions (primarily the state university system) and private research facilities has led to the development of a research environment concentrating on agriculture and related technologies (including biotechnology, genetically modified organisms and digital farming). There is also a vibrant agri-tech startup ecosystem, which creates a strong and nurturing environment and generates considerable attention for the agricultural sector. Furthermore, there are several incubators for spin-offs and startups in the region, offering office spaces, shared laboratory facilities, contact with investor networks and direct funding, as well as partnerships with biomass producers. However, the public funding schemes for early-stage startups in the United States are not as developed as in Europe.

The Midwest's focus on agriculture means the bioeconomy is an important topic in the region, as evidenced by the conferences held (for example, Bio Innovations Midwest) and the vocal industry associations (for example, Plant Based Products Council, Ag Bioeconomy Coalition). These associations are lobbying for improvements to the regulatory environment for the bioeconomy, including bio-based industries, and promoting existing government initiatives that facilitate the development and expansion of bioeconomy markets and infrastructure. The associations include large corporations such as ADM, Cargill, Neste and Braskem, as well as startups and mid-sized companies.

Conditions for industrialisation

The significant presence of agro-industrial corporations – including all the major global agri-industrial conglomerates, many of which are headquartered in the Midwest or have substantial R&D facilities there – and petrochemical companies concentrated along the Mississippi River and the Great Lakes region, creates a unique industrial network. This network provides connections to R&D, process innovation, engineering expertise, potential offtake partners and feedstock suppliers.

US capital markets, including access to venture capital, have historically been much deeper than those in the European Union. However, the United States has a relatively weaker incubation system for early-stage startups, resulting in higher selection pressure for companies at earlier stages of development, compared with their European counterparts.

The Midwest benefits from an abundant and unrestricted supply of feedstock, unaffected by "food vs. material/energy" debates. Approximately one-third of the nation's farmland – an estimated 100 million acres –

is in this region. This feedstock abundance simplifies the scaling of businesses compared to Europe, where ensuring a consistent and reliable supply of high-quality feedstock often poses significant challenges.

The US market for bio-based products is huge and fully harmonised. Approval processes (for products) and permit application processes (for building plants) were cited by several interview partners as being considerably faster in the United States compared with those in Europe, providing a shorter time to market and faster return on investment, which are key aspects to trigger investment decisions.

Scaleup funding environment

The United States has three public funding schemes or programmes dedicated to or including the bioeconomy. The expert interviews indicate that these schemes are not very effective at stimulating the bioeconomy. However, the approaches employed in these funding schemes differ from those used in the European Union, warranting discussion. The three US programmes are:

1. The Inflation Reduction Act (IRA). The IRA provides $394 billion of funding. However, this funding mostly targets the scaleup of renewable energy including biofuels and does not focus on the bio-based industry, as defined in this study. The support for biofuel projects could lay the foundation for a future next step in creating more value from biomass through material use, although feedstock set aside for biofuels is potentially unavailable for use in bio-based materials and chemicals production. The support is mainly paid through tax incentives (66%), grants (21%) and loans (10%). The future of this programme under the Trump administration is uncertain[31].
2. The BioPreferred programme[32]. Operating for more than 20 years, with the goal to increase the purchase and use of bio-based products. This differs from current European initiatives, as it attempts to create a market pull rather than pushing technologies into the market. The programme consists of two separate initiatives:
    a) A mandatory purchasing requirement for federal agencies and their contractors. In this initiative, a catalogue with bio-based products is provided alongside acquisition tools and training resources. If a bio-based product (or partly bio-based product) with similar qualities is available and is within price range, then agencies are required to purchase the bio-based alternative. Food, animal feed and fuel are excluded from the programme. In 2017, the government purchased more than $453 million of bio-based products, which is less than 0.1% of annual purchased products and services. These figures align with the view of experts on this topic, who deem the initiative useful but not implemented strictly enough as there are currently no sanctions for not complying with the mandatory purchasing requirement.
    b) A voluntary labelling initiative. This includes 139 categories and more than 14 000 products with a specific minimum amount of bio-based content, creating visibility and credibility for bio-based products. The experts interviewed judged this initiative as more effective in promoting bio-based products than the purchasing programme in its current form.
3. Biden's Executive Order on Advancing Biotechnology and Biomanufacturing Innovation for a Sustainable, Safe, and Secure American Bioeconomy, also called the Biotechnology and Biomanufacturing Initiative. In 2022, the Biden-Harris administration introduced this executive order to support the development of a bioeconomy ecosystem, including improving the infrastructure, fostering access to quality federal data, training a diverse skilled workforce and streamlining regulations for biotechnology products. The overarching goal of the initiative is to reduce America's dependency on foreign materials and bioproduction in critical industries and re-shore supply chains. Implementation of the initiative is managed by the United States

[31] https://www.thomsonreuters.com/en-us/posts/corporates/ira-uncertain-future/
[32] BioPreferred|About

Department of Agriculture (USDA), which invested more than $750 million in the bioeconomy (including biofuels) in 2023 for this initiative[33]. These investments included grants and loans to enhance the production capability of biomass and biofuels, loan guarantees for the construction of biorefineries, and grants to expand fuelling stations and other infrastructure for biofuels. However, experts from the United States suggest that the Biotechnology and Biomanufacturing Initiative is focused on enhancing the effectiveness of existing initiatives (like the purchasing programme described above) and linking various efforts rather than introducing new and innovative measures. This initiative has been recently terminated by an executive order of the Trump administration.[34]

Overall, development of a strong bio-based and circular economy in the United States must overcome the same challenges as in the European Union, notably, price competitiveness with legacy fossil-based solutions. However, given a viable position in the market, scaleups benefit from faster approval and permit application processes and the opportunity of accessing very large markets and deep capital pools. However, and especially when compared to other areas of strategic interest, the bioeconomy is currently not a priority for the US government.

Clean energy, which is adjacent to the bioeconomy, was a strategic priority for the United States under the Biden administration (January 2021 to January 2025) and therefore a sector in which the country invested large amounts of public money. Analysis of this adjacent area for financing approaches that could provide strategies for bio-based technologies identified two funding mechanisms within the Department of Energy. Both mechanisms focus on commercial scaleup of projects and could serve as a blueprint for respective European initiatives.

- The Office of Clean Energy Demonstrations (OCED) was founded in 2021 and is mainly funded by the Infrastructure Investment and Jobs Act (also known as the Bipartisan Infrastructure Law). The OCED is focused on scaling technologies and developing hubs to tackle climate challenges and to address current barriers to achieve such objectives. The mechanism provides funding on a large scale, with a budget totalling more than $25 billion. By seeking first- or early-of-a-kind production, the mechanism has a broad approach and can enable multiple companies to scale up during a comparably early development stage. Funding works through grants, contracts and cooperative agreements, with the latter being similar to grants but involving substantial input from federal agency staff, which gives the agencies a better view of all the genuine risks of a project. The share of public funding is always capped at 50%, forming a public-private partnership. This approach means the funding integrates a natural market intelligence, as a substantial share of private capital must be committed. The total funding volume is invested in nine different areas, with examples including $8 billion to support the development of six to ten hydrogen hubs and $6.3 billion to establish commercial-scale demonstration projects for technologies to reduce greenhouse gas emissions in energy-intensive industries. These large ticket sizes (e.g., up to $1.3 billion of public support each of the hydrogen hub) are vital for the scaleup of capital-intensive projects, allowing the implementation and testing of critical technologies at industrial scale. This initiative has been recently terminated by an executive order of the Trump administration[35].

4. The Loan Programs Office (LPO) focuses on projects with TRL 8+ and is based on the Infrastructure Investment and Jobs Act (also known as the Bipartisan Infrastructure Law) and the Inflation Reduction Act. Providing a bridge to bankability for emerging technologies deployed on a commercial scale, the LPO has a total remaining loan capacity of around $220 billion. Figure 20 shows the sectors the LPO supports and the split of the remaining loan authority. The support mechanisms include loans and loan guarantees, which are both offered at favourable conditions compared to the market. This offer is possible due to a thorough due

[33] USDA Bioeconomy Accomplishments, 2023 (https://www.usda.gov/sites/default/files/documents/bioeconomy-2023-accomplishments-fact-sheet.pdf)
[34] President Trump Revokes 2022 EO on Advancing Biotechnology and Biomanufacturing - Bergeson & Campbell, P.C.
[35] https://www.theguardian.com/us-news/2025/oct/04/trump-clean-energy-cuts-democrat-states

diligence process conducted by in-house technical experts, allowing the LPO to assess and understand the true risks of the project better than most private investors or banks.

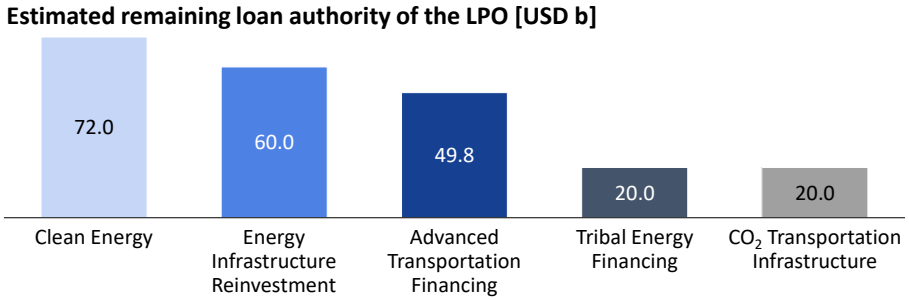


Figure 19: Estimated remaining loan authority of the LPO [$ bn] (Source: LPO (https://www.energy.gov/lpo/overview))

To summarise, bioeconomy innovators in the US Midwest suffer from the same key challenge as those in the European Union. For example, the market is not willing to pay a significant premium for large volumes of B2B products just because they are bio-based. For this reason, there is no opportunity to raise the massive investments required to build large production facilities, which may be in the region of $1 billion per plant. Regulatory market pressure in the United States is as absent as in the European Union – there is not even a carbon pricing mechanism – and big corporations show less strategic willingness to pay a sustainability premium compared with their European counterparts. On the other hand, regulatory approvals and the permitting processes are faster than in the EU.

The US government has been focusing on other green priorities rather than the bioeconomy and is not addressing the key issues with effective measures. Nonetheless, the adjacent topic of clean energy provides useful insight funding mechanisms for large scaleup projects. A new administration took office in the United States in January 2025, with different priorities, which had implications for some of the schemes and funding mechanisms described in this study, including pausing or termination for some of them.

5 RECOMMENDATIONS

Key findings

- **Recommendation #1 - Establish a Deployment Group, as a Working Group on Finance and Investments in the bioeconomy.**

  This Deployment **Group should be a permanent working group that facilitates** the **financing of larger** bioeconomy **investments and creates a strong network between project promoters and potential investors and lenders.**

- **Recommendation #2 - Develop a European bioeconomy booster programme.**

  The **Breakthrough Energy Catalyst programme** has **successfully** mobilised **funding for large energy projects** and could serve as a model for **a comparable programme for the European bioeconomy.**

- **Recommendation #3 - Leverage Circular Bio-based Europe Joint Undertaking (CBE JU) flagship grant applications to build a pipeline of promising projects.**

  The objective would be to spot high-quality, innovative and sufficiently mature bioeconomy projects, and to try and facilitate financing through the Deployment Group.

- **Recommendation #4 - Enable the EIB to support bioeconomy projects/ventures with venture debt investments under InvestEU.**

  A top-up in funding for the bioeconomy under InvestEU's thematic product (Green Transition) would allow the EIB to extend venture debt to high-risk and high-impact bioeconomy projects.

- **Recommendation #5 - Expand the European Circular Bioeconomy Fund (ECBF) model to enable high-risk investment in early-stage bio-based ventures.**

  The successful model of the ECBF should be expanded to establish a fund that can invest in more bioeconomy **projects, especially projects that promise substitution of fossil-based materials.**

- **Recommendation #6 - Support the access of bio-based projects to multipurpose demo and pilot plants.**

  Multipurpose demo and pilot plants are seen as crucial in the technology de-risking of bioeconomy **ventures. Financing access to such facilities is challenging, especially for early-stage companies, which are developing new bio-based technologies and have low revenues or are still at pre-revenue stage. We encourage developing appropriate co-funding mechanisms to enable easier access** to finance.

- **Recommendation #7 - Educate on bioeconomy opportunities within the boundaries of the EU taxonomy.**

  There is a widely shared assumption among financial actors that most bioeconomy **projects are ineligible for financing under the EU taxonomy, while there is in fact a range of activities that are compliant. We recommend developing practical guidance** to educate **financial actors on this.**

- **Recommendation #8 - Create an eligibility checker for bioeconomy and circular economy projects.**

  The EIB eligibility checker is a powerful tool to check eligibility for certain funding products. The tool should be expanded to cover all aspects of bioeconomy **projects.**

Figure 20: Overview of recommendations (Source: Roland Berger)

Recommendation #1: Establish a deployment group as a working group on finance and investments in the bioeconomy

A key finding from the interviews was that financing large-scale bioeconomy projects would benefit from a permanent working group that facilitates discussion. The main objective would be to build financing consortia for 10-20 large-scale projects over the next ten years, taking an average a capital requirement of around €500 million, such a group could mobilise a total financial capacity of up to €5-10 billion of investment.

The working group should:

- Include different types of bioeconomy investors, with an emphasis on potential big-ticket investors such as strategic investors, development and commercial banks, private equity funds, insurers and infrastructure investors.
- Ensure a steady flow of quality investment opportunities to keep investors engaged. Engagement can be further enhanced through proactive efforts to identify and shape interesting topics, regular studies, updates and market insights

The Circular Bio-based Europe Joint Undertaking (CBE JU) Deployment Group on Finance and Investments could be the starting point for this working group, potentially adding members over time.

The following key aspects should be covered by the working group:

- To improve deal flow and support projects in accessing private funding, the working group should provide coaching to promising projects to help them address the key issues and gain bankability and investor appeal as proposed in Recommendation #2.
- Identify and shape interesting topics for the bio-based industry sector, provide market insights and facilitate technical discussions. This will help improve the understanding of financial and operational risk mitigation, contract design and financial product structuring for the bio-based industry sector, which will be invaluable in attracting and retaining investors.

Snapshot: The Innovation Fund

The Innovation Fund is one of the largest grant schemes worldwide and supports projects with the potential to reduce CO_2 emissions. The focus is on realising first-of-a-kind solutions with high capital expenditure requirements that have a well-defined path towards commercial scaling once the pilot project is funded. The programme is designed to push close-to-market technologies into large-scale commercialisation.

Selection criteria for funding are geared towards achieving the most greenhouse gas avoidance per euro spent, both in terms of absolute avoidance (cost per tCO_2e in the supported project) and relative avoidance (savings of the project compared with the status quo).

The Innovation Fund is a beacon in the funding landscape for several reasons:

- Willingness to invest in projects with technical uncertainty (often an obstacle in discussions with other investors).
- Option to deploy funds early in the project (before and directly after final investment decision).
- Focus on late-stage innovation on the brink of commercial scaling, rather than early R&D.
- Long funding period of up to 10-15 years, in line with the lifetime of technically ambitious projects.

The list of projects funded is testament to this approach and features many promising technologies and capable project promoters, but there is a dominance of projects in areas with clear offtake markets, including:

- Hydrogen and electrolysers.
- Construction materials, cement and lime.
- Photovoltaic (PV) and wind projects, energy storage and trading.

The few bio-based projects that have been funded are all concentrated on the energy sector (bio-methane, bioenergy with carbon capture and storage, biofuels). The apparent focus of the Innovation Fund on the energy sector or solutions that can markedly reduce emissions in energy- and resource-intensive industries might make it difficult for bioeconomy projects focused on resource sustainability to succeed in Innovation Fund calls. Specific challenges for bioeconomy project applications are:

- Strict requirements to prove there are no potential land-use conflicts make it hard to show scaling potential and a large-scale deployment in Europe.
- The lack of demand at viable prices (offtake) in most markets makes it hard to show a positive business plan for the scaleup, which is generally a key requirement for a successful application.
- The evaluation for a concrete project with its greenhouse gas avoidance requires equipment manufacturers to team up with project owners and apply for a specific project that runs for 7-10 years. The lack of scale and doubts about the long-term business outlook make this difficult to achieve the same for bio-based industry projects.

Additional Innovation Fund challenges include the considerable effort required to put together an application and the highly selective evaluation process. Preparation of a high-quality application can easily absorb 15 to 20+ man-months plus costs for external support, and out of several hundred applications, only a small number receive funding.

Bio-based industry projects involving the substitution of materials or specialty chemicals could potentially succeed in Innovation Fund calls. However, securing feedstock supply at viable prices, creating a sustainable offtake market and avoiding competition in arable land use appear to be prerequisites for successful

participation in the Innovation Fund and not all bio-based industry projects may be able to overcome these hurdles.

Recommendation #2: Develop a European bioeconomy booster programme

The study identified two very successful scaleup programmes:

1. The EU-Catalyst Partnership consisting of the European Commission, the EIB and Breakthrough Energy Catalyst (see the snapshot below).
2. The French Première Usine programme (part of France 2030) that is managed by Bpifrance, mentioned in section 4.2.1.

Snapshot: Breakthrough Energy Catalyst

Breakthrough Energy Catalyst (BEC) is a private fund initiated by Bill Gates to accelerate the development and commercial deployment of innovative clean technology solutions that reduce greenhouse gas emissions.

The EU-Catalyst Partnership was founded in 2021 at COP26 and brings together the European Commission, the EIB and BEC. The partnership, which will mobilise up to €820 million between 2022 and 2027, focuses on five priority areas: green hydrogen, long-duration energy storage, sustainable aviation fuel, direct CO_2 air capture, and advanced manufacturing processes for cement, steel and plastics. Funded projects typically fall within TRLs 5 to 7 for demonstration projects (€30-€100 million) or TRLs 6 to 9 for more mature projects (about €100 million to €1 billion). The partnership aims to fill financing gaps for these technologies, which struggle to access private capital due to their high costs and risks, thus reducing the green premium associated with cleaner alternatives.

Horizon Europe has committed €200 million to the partnership and €220 million will come from the Innovation Fund. Each euro of public funding is expected to leverage €3 in private funds.

Funding products include venture debt from the EIB as implementing partner, and capital expenditure grants from BEC for demonstration projects, while large first-of-a-kind projects can receive equity from BEC combined with quasi-equity from the EIB. In cases where the green premium is significant, grants for operating expenses may be considered.

We recommend developing a European programme for the bio-based industry that replicates the successful approach of these two programmes. Several key questions need to be answered in the development process, including:

- How could the flexible approach of the Première Usine programme be replicated in the context of a EU-wide initiative?
- Could or should national promotional banks play a role? If so, what should their contribution be?
- Under which framework and/or entity could the programme be realised (for example, R&D initiative of the European Commission or funding instrument of the EIB) and what mandates and funds would be needed?

The first step would be to define a clear programme and success factors for implementation that will then indicate the best organisation or framework to provide a mandate, a budget and implementation resources.

Taking the two successful programmes as a blueprint, a new European scaleup fund should be established, focusing on seven aspects:

1. Focus on projects with a TRL >6 to reduce funding gaps between TRL 6 to 7 and TRL 8 to 9.
2. Cover circular and bioeconomy projects at large (that is, a bottom-up approach with no specific tendering for selected themes).
3. Fund first-of-a-kind production facilities for companies investing in the European Union to allow upscaling of new bio-based technologies, technology transfer to the European Union and to foster investment by foreign bio-based companies in the European Union.
4. Provide different types of funding such as loans, grants and quasi-equity to cover various funding needs.
5. Provide funding targeted to support installations and infrastructure (capital expenditure) required to upscale bio-based technologies, rather than focussing only on funding innovation, thereby covering most of the necessary investments for new production plants.
6. Consider grants for operating expenses for projects with a significant green premium.
7. Require matching of a significant amount of funding (equity, loans).

A possible funding structure is detailed in Figure 22.

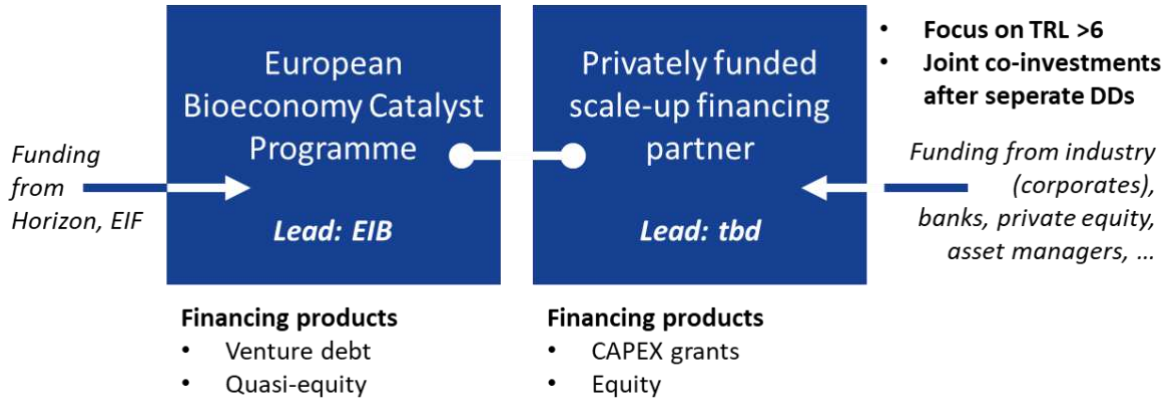


Figure 21: Possible funding structure for a European Bioeconomy Catalyst Programme (Source: Roland Berger)

The GDP of the European Union is 5.6 times greater than that of France. To create a comparable European "First Factory" programme along the lines of France's "Première Usine" one, the initiative would therefore require around €616 million in investment per annum (Figure 23).[36]

A potential avenue to explore for the development of such a programme would be to engage with the internal consulting unit of Bpifrance that was involved in designing the Première Usine programme and tapping into the experience of Bpifrance experts interviewed during this study.

[36] France's GDP was around €3.03 trillion in 2023 (Source: Statista), while the Première Usine programme utilises €550 million over five years. This translates into €110 million per annum, which is 0.0038% of France's GDP in 2023. In the European Union, GDP was around €16.97 trillion in 2023 (Source: Statista). Thus, the European Union's GDP was 5.6 times higher than France's GDP. On that basis, a European programme would need 5.6 times the amount of funding as the Première Usine, i.e. €616 million per annum.

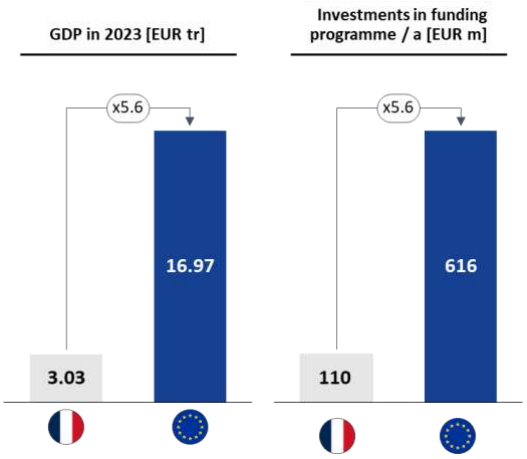


Figure 22: Possible funding amount/annum of a European "First Factory Programme" (Source: Roland Berger)

Recommendation #3: Leverage Circular Bio-Based Europe Joint Undertaking (CBE JU) flagship grant applications to build a pipeline of promising projects

The Circular Bio-Based Europe Joint Undertaking (CBE JU) regularly organises calls for proposals for flagship grants. The applications received include mature projects ready for industrial scaleup in Europe. One aspect raised multiple times during the interviews is the limited capital available to CBE JU which restricts the number of applications that receive funding under the calls and results in promising applications not being financed. After a failed application, many projects are discontinued. One respondent engaged with the CBE JU gave three reasons for this, which were echoed in other interviews:

1. Due to the enormous work involved in preparing the CBE JU application, many applicants get disheartened.
2. There is a lack of knowledge about the next steps, including which financial institutions to address to secure funding and how to prepare for such applications, as they often require more focus on a profitable business plan and financial model. During the interviews, not being able to prove a viable business case was perceived to be the biggest challenge for startups/scaleups when applying for funding.
3. Investors have limited experience with the bio-based industry and are often skeptical about innovative projects that are at proof-of-concept, pilot or even demonstration stage. Similarly, many respondents cited a lack of understanding about the risks surrounding bioeconomy projects as a turn-off for investors.

To increase the prospects of promising applications obtaining funding from private investors, there is potential in leveraging the work done by the consortia involved in CBE JU flagship calls. This approach could:

a) create a deal flow for the working group recommended above (Recommendation #1); and

b) support access of the consortia and their projects to private capital markets.

Three main cases with related funding needs can be identified:

- Flagship projects that are successful for CBE JU grants and need complimentary funding.
- Promising applications that are unsuccessful due to limited CBE JU budget availability (seal of excellence) and should be supported in looking for private investments.
- Successfully finalised flagship projects that need private capital to replicate or further expand their industrial plants.

For these projects, it would be beneficial to offer a range of supporting actions, including:

- Technical support to improve commercial business plans, financial models, clarity and comprehensiveness of application documents, and feasibility studies.
- Third-party opinions on the technical maturity and/or the market environment for future offtake to address and mitigate investor concerns about project risk.
- Financial support in finding the appropriate funding strategy and capital structure, and optimising investor documents (for example, presentations, due diligence reports, etc.).
- An established roundtable with potential investors, where curated projects with a seal of excellence from the CBE JU can pitch their project to investors that are looking to invest in bio-based industry projects.
- Access to external advisors that specialise in finding partners and financing for innovative projects, with a strong network of corporate partners/investors and venture capital resources.

Recommendation #4: Enable the EIB to support bioeconomy projects/ventures with venture debt investments under InvestEU

InvestEU, which is an EU programme for boosting investment, innovation and job creation in Europe from 2021-27, could further boost the EIB's lending and risk-taking capacity to support higher risk innovative bio-based industry projects with the aim of mobilising private capital and allowing disruptive solutions to emerge.

The EIB, with its venture debt product deployed under the InvestEU Green Transition window, offers a strong financing complement to venture capital in supporting innovative bioeconomy projects/ventures and bridging an identified market financing gap. This product is already successful, enabling the EIB to work with companies in early stages of demonstration, commercialisation or scaling up, and is designed to address high-risk investments that require long-term capital and to fuel high-risk, high-growth companies.

The product conditions are seen as attractive and less dilutive than the alternative of equity financing, while investors value the EIB's long-term commitment and stamp of approval. Venture debt is a particularly good fit for bio-based industry projects as it often provides the first financial leverage for scaleup projects, whereas other forms of low-risk debt are generally not yet available. As such, the venture debt product can provide substantial financial resources for scaleup projects (e.g. building a first-of-a-kind facility). Beyond demonstration and early-stage commercialisation, EIB venture debt can also be instrumental in growth stages and could be seen as complementary, providing follow-on capital to early-stage investors, including EU initiatives such as the European Circular Bioeconomy Fund (ECBF) and the European Innovation Council (EIC).

There is continued demand for EIB venture debt from several sectors of the bioeconomy, including bio-based materials and packaging solutions, as well as sustainable agriculture. Venture debt financing under InvestEU's Green Transition window can address market gaps as well as technological and regulatory risk, in key fields. For example in the displacement of less sustainable materials by bio-based alternatives or support the emergence of new markets, for example, insect farming.

InvestEU support for bio-based industry projects could be enhanced through dedicated resources for the bioeconomy or its subsectors, for example via an InvestEU top-up, as the InvestEU products have a limited capacity to support numerous strategic policy areas in parallel. Demand for InvestEU resources to support policy objectives on sustainability initiatives and investments exceeds the funding available, as confirmed in the Interim Evaluation of the InvestEU Programme. Blending through top-ups to InvestEU is the tool for increasing the programme's resources in support of specific strategic priorities such as the bioeconomy. Further support for the specific policy areas and subsectors of the bioeconomy is only possible with a top-up from an EU sector-specific programme. The EIB Group is already making use of such InvestEU top-ups in several key policy areas.

As referred to in the report *Strategic Dialogue on the Future of EU Agriculture*,[37] the use of venture debt, possibly under InvestEU, may be useful for leveraging resources from the Common Agriculture Policy for technology companies along the agricultural value chain.

Recommendation #5: Expand the European Circular Bioeconomy Fund (ECBF) model to enable high-risk investments in early-stage bio-based ventures

To support early-stage funding for bio-based industry projects, including academic spin-offs, a dedicated early-stage investment fund is required. The European Circular Bioeconomy Fund (ECBF), which was established based on the findings in the EIB's 2017 bioeconomy study, targets precisely this challenge. Many of the investors and startup managers interviewed highlighted the successful work of the ECBF, as shown in the following quote:

"The ECBF is a game-changer for the European bioeconomy. By providing targeted funding and support to innovative bio-based businesses, the fund is paving the way for the development of sustainable and scalable solutions that address pressing global challenges. While the ECBF has managed to attract private capital from prominent investors, it still has only made 15 investments, and all in early stages. From my point of view, the concept is a great fit – but it also requires growth capital, ideally enough to guide the startups for several years throughout the most challenging growth and scaleup phases!"

- Investor, active in the bioeconomy space

As mentioned by the above respondent, the ECBF has so far made 15 investments – of these, ten projects fit the biobased industry sectors addressed in this study (the other five projects are in enabling technologies, such as lighting technology for greenhouses or AI-based agritech). These ten investments mostly belong to the novelty and premium creation segment or the bio-based specialisation segment.

Overall, the ECBF is already a key contributor and is targeting suitable projects. However, even though the current financial firepower of the ECBF is unknown, according to market experts, the traction could be substantially increased with additional capital. An initial injection of public money may provide a catalyst effect to boost mobilisation of further private capital.

To increase support for the other segments of the bio-based industry addressed in this study, beyond the two mentioned above, regular technology scouting assessments should be carried out to determine whether there are any breakthroughs which make bio-based product types/technologies in the volume substitution and bio-based disruption segments economically viable. Furthermore, investment criteria for spin-offs from larger corporations or joint ventures between startups and corporations should be revised to make it easier to invest in the bio-based disruption segment.

Expanding the ECBF model with fresh capital could help innovative players, thereby bringing to the market new bio-based products and technologies. However, an expanded ECBF-like fund should look beyond the novelty and premium creation segment (compare Figure 2) and aspire to identify scalable businesses in the other industry segments to make the funds available in areas that can provide the biggest impact on CO_2 reduction.

[37] Strategic Dialogue on the Future of EU Agriculture: A shared prospect for farming and food in Europe (September 2024). https://agriculture.ec.europa.eu/document/download/171329ff-0f50-4fa5-946f-aea11032172e_en?filename=strategic-dialogue-report-2024_en.pdf

Recommendation #6: Support the access of bio-based projects to multipurpose demo and pilot plants

Financing the scaling up of complex production systems to advance from TRL 5 to TRL 7 is challenging, especially when the technology is not yet proven, offtake contracts are not (yet) in place and investors are waiting for both. There is a solution to this challenge, as summarised by one respondent:

"The problem during scaleup: These projects are not venture capital cases; the returns can only work for a bank. But a bank requires a fully de-risked project – that means supply, technology and offtake in particular. Most projects cannot yet prove their technological viability, and cannot find offtake, and therefore never become bankable. One way out of this dilemma is shared demo plants. These enable early-stage projects to prove their technology and produce the product volumes they need to convince offtakers. Therefore, the use of such a demo site would be an additional de-risking step, before building your own plant."

- Investor, active in the bioeconomy

Key obstacles for investors mentioned consistently by all respondents are high technology risks as scaleup potential remains unproven, and a high market risk as products have not been placed in the market in any representative volumes.

Several respondents highlighted shared multipurpose demo and pilot plants that scaleups could use for technology development as a potential solution. These plants allow bio-based companies to prove the feasibility and scalability of their process/product. Multipurpose demo and pilot plants would also provide a route to test market acceptance, by allowing for the production of volumes of bio-based products to seed the market, and be tested/validated by potential customers for their specific applications, without the need for large capital expenditure investments. Furthermore, the support from experienced and qualified staff within multipurpose demo and pilot plant facilities, to help with technology upscaling and improvement, could substantially reduce the company's time to market, which increases the attractiveness of the project for investors and improves the overall prospects of a successful scaleup.

Commercial examples of multipurpose demo plants include BioDémo from ARD in France. ARD offers services throughout the lifecycle development of bio-based technologies. For example, it provides facilities and equipment to scale up from laboratory trials to pilot production and is a key driver of the bioeconomy in the Grand Est region. The BioDémo plant can be used as a blueprint for successful concept development and offers services such as validation of process reliability and consistency, determination of industrial mass, energy, water balances and cost of goods models, quality testing of the end products, and fine tuning of standard operating procedures. The demo plant is partially financed by ARD itself and co-financed by the Grand Est region, the department of Marne and the European Regional Development Fund.

Shared multipurpose demo plants are available throughout Europe. To make it easier to find a matching demo plant for the respective product, CBE JU's COPILOT project is creating a comprehensive database of open access pilot and demo bioeconomy infrastructure.

The financing of demo/pilot-runs is a challenge for some companies. Multipurpose demo and pilot plants are usually financed by regional funds, and the financial support for using them is linked to those regional funds – cross-regional and cross-border access to those funds is not planned – despite the high degree of specialisation of these plants and the need to optimise their utilisation across Europe.

Exploring a co-funding concept that can be implemented on a European or regional level to finance demo/pilot-runs for scaleups or to make grants available for existing plants across regions and borders is recommended. Such harmonisation and flexibility across Europe would be beneficial.

In addition, conducting a demand study and identifying gaps in terms of technologies, feedstocks and regions is suggested. The study should also cover possible investors – including large corporations with a possible interest in supporting scaleup infrastructure in their adjacent region – and key product categories.

Recommendation #7: Educate on bioeconomy opportunities within the boundaries of the EU taxonomy

Many bioeconomy project partners assume that the EU taxonomy does not classify most bio-based technologies as "green" activities as defined in its Article 9. In fact, the limitations on the use of food/feed crops as industrial feedstocks enforced by most major banks in their respective due diligence guidelines are often attributed to the EU taxonomy.

The feedback from the interviews conducted with industry leaders and investors was that they consider the European Union to be an unfriendly environment for scaling up bioeconomy innovations and businesses. Extensive and complicated rules and regulations were often cited as reasons, as well as a complex framework for obtaining financing (grants from public bodies and equity/debt from banks). Some of the respondents also mentioned that NGOs making accusations about greenwashing might be playing a role in this perception.

The requirements for bio-based feedstock to be used in industrial processes can differ between commercial banks, the EIB and the European Commission in their grant programmes, and this can be perceived as complex. The differences in the requirements seem to be linked to the varying focus of the initiatives. For example, the EU taxonomy and the key regulations referred to in the directive establish rules to avoid further intensification of land use at the expense of sensitive (high carbon, high biodiversity) areas and to establish good practice laws and rules to preserve soil health and soil carbon content. In this context, the EU taxonomy does not include biofuels for transport or bioliquids if they are produced with food/feed feedstock as a raw material (i.e., they are not considered green activities). On the other hand, bio-based materials (bioplastics, organic basic chemicals) from food/feed feedstock are included (i.e., considered as green activities), if a sustainable sourcing of the feedstock can be proven and lifecycle greenhouse gas emissions are lower than those calculated with comparable fossil-based raw materials.

Against this background, we recommend three actions:

1. Inform investors and financing actors about potential bio-based industry projects that would qualify as green under Article 9 requirements. While many activities are not yet covered, several activities in the circular economy space and some bio-based activities are already included. Producing information sheets, websites and interactive webinars is suggested, with the objectives of providing information about the framework and opportunities that it can provide for the bioeconomy, and building a network of investors that are confident and willing to pursue significant bioeconomy investments under the green funding schemes available.
2. Prepare a hands-on guidebook for investors and companies on how to build and pitch their projects to demonstrate that they have the required credentials to qualify as green under the existing EU Taxonomy framework. Possible avenues are (a) the EU-mandated certification logic established in Commission Delegated Regulation 2019/807, which ensures that food/feed feedstock is sourced sustainably and has a low risk of resulting in direct or indirect land use change, and (b) the demonstration of compliance with other leading ESG frameworks that are more focused on bio-based activities (without being weaker standards). One example is the global Climate Bonds Initiative. While this instrument may not be fully aligned with the criteria of some European lenders, it has been key to securing financing for recent industrial-size biobased industry projects by European banks.
3. Prepare similar guidelines for project developers/applicants on how to demonstrate sustainable land use and/or feedstock sourcing for EIB funding and the most relevant EU grant programmes (for example, the

Innovation Fund). The guidelines should use concrete examples on what is considered acceptable and what is not.

A recently published report by six EU Member States (*Bioeconomy – next steps in the EU, dated November 2024*) suggests developing a common definition of bioeconomy across all Member States to include biotechnology and biomanufacturing. It would certainly help to also reflect this in the different frameworks that effectively govern the bankability of bioeconomy projects.

Recommendation #8: Create an eligibility checker for bioeconomy and circular economy projects

Being eligible under the EU taxonomy is a key enabler for corporate and project finance and applies to any bioeconomy project or company. Confirming eligibility and proving it to potential investors and lenders is generally more challenging for bio-based companies and projects, than for projects in other areas, owing to the bioeconomy being at the intersection of many policy areas.

The EIB has developed a very useful EIB Group Green Checker as a digital, web-based tool[38] to support financial intermediaries and other financial actors in assessing the environmental impact and green eligibility of potential investment projects. The tool allows users to quickly and easily check whether a project meets the EIB's green eligibility criteria, which are aligned with the EU taxonomy, thereby lowering investment hurdles and serving as a green quality standard.

For bio-based industry projects and companies, it would be beneficial to expand the eligibility checker to cover all the relevant activities of bioeconomy. If done properly, the expanded tool could enable startups and investors to gain clarity on their green eligibility and use the result to engage other financiers that might not perceive a certain bio-based industry project as eligible.

5.1 Considerations on EU policy

Establishing the bioeconomy as a green asset class

Two recent reports have emphasised the importance of deepening European capital markets. Enrico Letta's report on the Single Market (April 2024) and Mario Draghi's report on European competitiveness (September 2024) both underline the need for enhanced mechanisms to support scaleup investment. They also stress the importance of aligning rules and their implementation across Member States, as well as identifying opportunities to reduce bureaucratic burdens for small and medium-sized enterprises. Both reports relate to the results of this study. Currently, there is no deep capital market for bioeconomy scaleups, as biomass-related investments are considered a potential reputational risk, and often qualified as too technical. Investors interviewed for this study perceived the European Union as being a difficult territory for bioeconomy scaleup financing, based on complicated rules for green funds (EU taxonomy) and even stricter due diligence criteria around biomass use enacted by leading banks.

Another recently published report by six EU members (Estonia, Finland, Latvia, Lithuania, Portugal and Sweden), *Bioeconomy – next steps in the EU* (published on 11 November 2024), proposes developing a European Biotech Act to promote bioeconomy applications across policy areas, simplify regulation, speed up permit application and improve market access. This proposal resonates with the findings of this study.

[38] The Green Eligibility Checker

Given that the EU taxonomy is the benchmark definition for green investments and works like a positive list (if an activity is not on the list, it is not considered as 'green') and it is a key tool to facilitate (not hamper) the green transition, the following questions should be considered by policymakers:

- How can additional bioeconomy activities be introduced into the respective chapters of the EU taxonomy as quickly as possible to broaden the basis for financing bioeconomy projects, including bio-based industry ones, within the given framework?
- Given the huge potential for value and job creation through the utilisation of biomass resources, including first-generation biomass, in the production of bio-based chemicals and materials, should there be a separate set of ESG criteria specifically tailored for this purpose? Such criteria could replace the auxiliary standards currently established for biofuels, which are often also used for projects addressing bio-based materials and chemicals, in the relevant directives and regulations. Alternatively, should an internal hierarchy be introduced that distinguishes between the use of biomass for producing materials (and chemicals) and its use for biofuels? This would help differentiate between the use biomass in the bio-based industry, without allowing further use of first-generation biomass for biofuels production.
- How can the EU taxonomy be revised to better reflect innovative solutions that do not fit neatly into either the circular or carbon-neutral evaluation and selection criteria?
- Given that (a) the EIB acts as a beacon for major lenders in the European Union regarding ESG due diligence criteria for bio-based industry projects, its due diligence criteria should be aligned as much as possible with the EU taxonomy ones. Furthermore, such criteria should be harmonised across leading European financial institutions. This would enable European bio-based industry players to better understand the criteria that projects must fulfil to be considered green (i.e., taxonomy-aligned) and structure them accordingly. It would also allow investors to easily identify whether a project they are considering supporting is taxonomy-aligned or not.

Activating the market for bio-based products

Currently, the European market does not provide the robust pull needed for financing the scaleup or industrial-scale production of innovative bio-based solutions. The bio-based and circular economies mostly play out in B2B markets driven by price, meaning that new technologies and players struggle to compete with established fossil-based industrial processes, carried out in fully amortised facilities with large economies of scale. While the situation is comparable in the US market, China is implementing a more ambitious strategy to establish economically viable, high-volume bio-based production by banning selected fossil-based plastics for certain uses.

If the regulatory framework is regarded as settled, policymakers could consider various options to address the price gap between bio-based and circular vs. fossil-based products:

- Contracts for difference are an established tool for bridging price gaps. The key mechanism is the setting of a (competitive) price to which the market price is then adjusted. Contracts for difference suits basic products in large-volume/commodity markets. In addition, they would de-risk investments in scaleup and industrial production, thus enabling their financing by capital markets.
- Quotas for bio-based and circular products would guarantee market offtake and thus support the business cases required to establish financing. An example of the successful implementation of quotas is sustainable aviation fuel. Industry-specific quotas could be designed to target specific products (for example, basic ingredients for bioplastics) or work across the board (compared to car fleet emission standards), allowing companies to locate the most economic market niches and technologies best suited for achieving an overall target quota of bio-based and circular products.

The previously mentioned *Bioeconomy – next steps in the EU* paper proposes establishing a Sustainable European Bio-based Products Alliance that promotes industrial activities and the circular economy, enhancing the

legitimacy of different bio-based products as alternatives to fossil-based products. Such an alliance combined with strong backing by EU members would significantly benefit the market for bio-based products.

Strategic considerations regarding access to feedstock

Competition for available biomass and land to produce it is becoming an increasingly important and somewhat controversial discussion topic. Interviews conducted in this study confirm that investors are keenly aware of the uncertainty affecting the feedstock supply security of their investments. Besides food and animal feed production, there is a growing number of potentially overlapping and/or conflicting current and prospective uses of biomass feedstock to achieve different policy goals, including:

- Bioenergy/biofuels: use of biomass feedstock as direct fuel for heating or, after processing into biofuels, in various combustion engines (cars, shipping, aviation).
- Biobased materials and chemicals production, including in the bio-based industry segments addressed in this study.
- Reduced use to improve soil health and restore nature.
- Non-use for conservation/biodiversity purposes or as a carbon sink.

The resulting biomass gap was described in detail in the European Environment Agency report 8/2023 *The European Biomass Puzzle*. Other aspects to consider can be found in the Strategic Dialogue on the Future of EU Agriculture report,[39] including changing dietary habits that can potentially free up land used for animal feed production.

From the perspective of improving access to financing for capital-intensive European bio-based industry projects, key questions on feedstock are:

- How do policymakers prioritise the various potential biomass uses and what are the key criteria (for example, value/job creation potential per tonne of biomass, climate mitigation potential) for predicting feedstock-related policy and thus reliability of feedstock supply over a longer timeframe (decades)?
- Is there willingness to allow scaleup and first-of-a-kind projects to establish a competitive position in the market by using first-generation feedstock if a further upscaling of the technology could be achievable, at a later stage, with second- or third-generation feedstock?
- Can policymakers guarantee readily available biomass volumes for materials (and chemicals) production, for example, by overhauling policies and reallocate biomass as and when technical progress and/or societal change frees it up from other uses (for example, lowering use in biofuels production as battery electric vehicles penetrate the market or from a reduction in livestock populations)?
- Is there a potential win-win solution for soil health, carbon sequestration, biodiversity enhancement and non-edible biomass availability for the bio-based industry in the emerging and evolving discussions around increased diversity in crop rotation and intercrops/cover crops (under various, not yet clearly defined terms like regenerative/conservation/carbon farming)? Further exploration of this area could potentially provide a solution to prevent that certain biomass uses are pitched against others, which are equally justified.

These questions need to be considered at several levels, globally in the overall context of land use, but also for the different biomass classes (for example, wood, agricultural, maritime sources, and first vs. second generation). In the context of bio-based technologies, this subject is often debated, especially for sugars as a key feedstock

[39] Strategic Dialogue on the Future of EU Agriculture: A shared prospect for farming and food in Europe (September 2024). https://agriculture.ec.europa.eu/document/download/171329ff-0f50-4fa5-946f-aea11032172e_en?filename=strategic-dialogue-report-2024_en.pdf

for fermentation processes. The origin of such sugars (e.g., first vs. second generation) has important implications for technology upscaling risk, costs and business case scalability.

Land use and agricultural production are affecting and affected by numerous EU policies: economic, environmental and climate-related. This subject also raises cultural issues and strong opinions are often voiced during Member States' political discussions, so it is an area for further consideration by all stakeholders involved in shaping these policies.

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