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Impact evaluation of the European Circular Bioeconomy Fund

Final report



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Executive summary

Context and methods of the evaluation

The circular bioeconomy is **expanding rapidly**, driven by its potential to address global sustainability challenges such as climate change and resource scarcity. Sectors like bio-based chemicals, plastics, and packaging are experiencing strong growth, while new areas like aquatic biomass and bio-based fertilizers are emerging. In Europe, the bioeconomy sector generates EUR 2.5 trillion in turnover, with bio-based industries contributing 30%. The importance of the circular Bioeconomy sector is also underlined by several policy packages implemented by the EU, including the EU Bioeconomy Strategy as well as the Circular Economy Action plan. Governments around the world are recognizing the potential of the bioeconomy to address critical challenges such as resource sustainability. Countries like the US and China have launched strategic initiatives to boost innovation and competitiveness in bioeconomy sectors. However, this growth comes with challenges, including fragmented regulations, lengthy approval processes for new biotechnologies, and unequal regulatory support for bio-based versus fossil-based products. A 2017 study by the European Investment Bank (EIB) identified a significant **funding gap in bio-based industries and blue economy projects**, particularly during the critical phase of scaling from demonstration projects to first-of-a-kind (FOAK) and industrial-scale plants.

Following an EIB tender, the **European Circular Bioeconomy Fund (ECBF)** was established in 2020 to address this **funding gap** for bio-based innovations in Europe, particularly for growth-stage companies that traditional venture capital (VC) investors often overlook. The fund has raised more than EUR 300m and has invested in 16 circular bioeconomy start-ups as of 30 June 2024. Its current active **portfolio consists of 15 companies** covering 10 countries and multiple sectors such as personal care, farming, packaging and nutrition. The ECBF considers only **late-stage companies** that have demonstrated the underlying technology in a relevant environment (TRL 6 to 9) and that are located in the **EU** or one of the 16 **HORIZON 2020 associated countries**.

This impact study assesses the fund's effects on the European bioeconomy VC market, analyses the impact on bioeconomy start-ups and evaluates its alignment with European sustainability goals. We use a **mixed-methods approach** for the evaluation consisting of

- in-depth desk research of relevant literature;
- analysis of Sustainable Finance Disclosure Regulation (SFDR) documents;
- semi-structured interviews with start-ups, investors and industry experts;
- market analysis of the bioeconomy sector;
- counterfactual analysis using Propensity Score Matching (PSM).

Impact on the Venture Capital landscape

The financing landscape in the bioeconomy **evolved dynamically in recent years**, with increasing interest from the private sector, especially in bio-based chemicals and sustainable agriculture. In the last few years, **VC** and **private equity** investments in bio-based start-ups and companies have surged. Sectors like biotechnology, sustainable agriculture, and bio-based chemicals have been major beneficiaries of this capital inflow. However, recent data points to a decrease of VC investments in the bioeconomy sector after the VC-inflated-valuations years between 2018 and 2021. Therefore, although VC and corporate investments have increased,

VC's role in the bioeconomy financing landscape remains limited notably due to technological, policy, and market risks. Public funding, particularly from the European Union (EU), thus plays a critical role, complemented by national initiatives. Important players include the EIB, national banks as well as Public-Private Partnerships such as the Circular Bio-based Europe Joint Undertaking (CBE JU). In addition, several **impact investment funds**, which focus on generating social and environmental benefits alongside financial returns, have emerged in the field over recent years. Overall, the current financing landscape in the bioeconomy sector is still dominated by public players, with private investments growing in importance.

The ECBF is among the first European VC funds exclusively dedicated to investing in growth-stage (circular-) bioeconomy companies. It has established itself as an **important player** within the European bioeconomy VC landscape, addressing the persistent funding gap for bio-based innovations. In fact, by providing later-stage funding, ECBF not only supports the scalability of bioeconomy ventures but **may also enable more seed-stage investments**. By looking at the most prominent European VC funds that are comparable to the ECBF w.r.t scope and focus, we estimated **an estimated market share of 15%**. The interviews underline that the ECBF is perceived as a **professional organization** with a **very experienced team**.

The ECBF exceeded its fundraising target of EUR 250m, closing at EUR 300m by the beginning of 2022 which was a **significant milestone for the specialized bioeconomy sector**. The fund attracted a diverse mix of public and private investors from ten countries across three continents, with half of commitments (excluding the EIB) stemming from German investors. At the investment stage, ECBF has attracted significant private capital, including institutional and private equity investors despite fluctuations in bioeconomy investments—driven by temporary boosts in 2020 and 2021 followed by declines. The private-to-public capital ratio that measures the share of private investments compared to the public investments (considering cumulative capital raised) stands at 12.3, indicating that **for every euro of public investment, EUR 12.30 of private capital has been leveraged**. However, given the ECBF's relatively short operational period, it is difficult to establish a direct link between the ECBF's activities and increased private investment in the bioeconomy. Thus, the extent of the **crowding-in effect cannot yet be fully assessed**. However, we note that ECBF has been the first designated fund investing in later-stage bioeconomy start-ups in Europe and among the first with a focus on sustainability. This first-mover signal might have caused other funds to follow, and hence support a crowding-in effect.

The ECBF addresses the need for large, patient capital in Europe's bioeconomy but cannot meet the sector's high capital demands alone. A **blended finance approach**, combining debt and equity, might better address these needs. Public-private partnerships, such as co-funded research infrastructures, could help de-risk bioeconomy innovations. The ECBF could play a key role in promoting such collaborative initiatives.

In the medium to long term, with all funds deployed, ECBF investments will likely have an impact on the bioeconomy VC landscape. The fund not only addresses the current funding gap but also sets a precedent for future funds focused on sustainable and circular bioeconomy ventures. As the ECBF matures and its portfolio companies succeed, it **could boost investor confidence** and gradually expand the bioeconomy VC market. ECBF plays a role in advancing the European bioeconomy by investing in innovative companies, reducing risks for investors, and fostering collaboration. However, its long-term impact on significantly expanding the VC market will also depend on broader policy support and market evolution.

Effects on bioeconomy start-ups

Given the circular and bioeconomy scope, the ECBF portfolio **spans several sectors**, including agriculture, nutrition, packaging, basic materials, and personal care. However, while it has a strong presence in more established sectors such as nutrition and agriculture, other critical areas of the circular bioeconomy, like the **blue economy, forestry** and the **chemical sector**, are **so far underrepresented**. The chemical industry, in particular, is essential for transitioning from fossil-based to bio-based production. The limited representation of some sectors suggests that the ECBF may not fully cover the (circular) bioeconomy yet, but we understand that there is an investment in advanced due diligence coming from the bio-based chemical industry.

Qualitatively, ECBF portfolio companies have shown **positive economic development**, partly driven by ECBF's funding. For instance, companies were able to expand into new markets, enter new application sectors, increase their workforce and transition from R&D to product development. However, given that the ECBF is active in the growth-stage and thus, companies had already secured funding before ECBF's involvement, the performance cannot be solely attributed to the ECBF. There is no significant statistical evidence that ECBF portfolio companies outperform comparable bioeconomy start-ups, although there is a **tendency for ECBF-backed companies to experience faster growth**. However, the lack of statistical effects is likely due to the small number of companies in the portfolio, making it difficult to draw robust comparisons.

In addition, the ECBF provides **several advantages beyond just capital**. Portfolio companies benefit from enhanced networks, increased industry knowledge and management advice. Start-ups also highlighted that ECBF's presence on their cap table boosts their credibility, and thus, enhance their reputation for future funding rounds. These non-financial supports are particularly valuable during subsequent funding rounds, helping companies secure additional investment and grow more effectively. Occasional criticisms were raised regarding the reporting requirements and the speed of inquiries, which some young companies find burdensome. However, the majority agree that ECBF's funding processes align with industry standards. Furthermore, the start-ups recognize the value of the ECBF team's thorough and meticulous approach, which contributes to their long-term development.

Interviews indicate that while **funding challenges remain**, new market players and policy measures have helped alleviate some of the risks for innovative business models. Several portfolio companies noted that the ECBF participation was important to keep the investor base in Europe and to attract further investors in the funding rounds. At the same time, there is a general slowdown in the VC and consumer markets. Coupled with the fact that bioeconomy companies are reliant on sustainable sources of financing due to the long development cycles, there is a risk that the financing gap will widen again. Overall, the fund is not large enough to fully address the broader funding gap in the European bioeconomy sector which still requires additional capital from other sources.

In conclusion, while the ECBF **contributes to supporting bioeconomy start-ups**, it does **not entirely cover all sectors** of the circular bioeconomy **nor fully close the funding gap**. However, it offers crucial benefits beyond financing, which contribute to the growth and competitiveness of its portfolio companies.

Sustainability effects

By prioritizing investments in growth-stage companies that contribute to climate change mitigation, circular economy principles, and sustainable resource use, **ECBF's investments align with EU climate and environmental goals**, such as the Green Deal and Bioeconomy Strategy. They also address several UN Sustainable Development Goals (SDGs), including SDG 13



(Climate Action), SDG 12 (Responsible Consumption and Production), and SDG 8 (Decent Work and Economic Growth).

Its **structured ESG approach** integrates comprehensive sustainability criteria into its investment decisions, including a **comprehensive due diligence process** with external verification for greenhouse gas (GHG) emissions across the entire value chain. ECBF-supported innovations enhance sustainable production, job creation, and environmental preservation, with notable achievements like 53% GHG savings compared to conventional products and improved waste management practices in 52% of portfolio companies. However, the fund's publicly available **sustainability reporting lacks detailed absolute impact metrics and industry benchmarking**.

Recommendations for enhancing impact

To continue ECBF's impactful contribution to the bioeconomy sector, there are a few aspects of its operations that should be maintained and strengthened and others that could be added to further increase its impact:

- ECBF should **further broaden its sectoral focus** beyond agriculture and nutrition to include high-potential bioeconomy industries such as chemicals and marine sectors, while ensuring geographic diversity.
- Targeting high-potential start-ups with significant capital needs, particularly those requiring costly infrastructure, is essential. **Blended finance approaches** could complement VC to bridge investment gaps here.
- The ECBF's **personalized guidance should continue** to focus on scaling, market penetration, and navigating regulatory challenges. Facilitating partnerships with established bioeconomy players can also accelerate growth and market access for start-ups.
- **Networking initiatives** like the ECB Forum and deep dives are important to promote the circular bioeconomy as a viable investment area. The ECBF should build on this and further strengthen networking activities to inform other (potential) investors about the bioeconomy and its potential.
- The ECBF's robust ESG assessments should be upheld, ensuring investments align with sustainable and circular economy principles. **Publishing impact reports** and benchmarking portfolio performance against industry standards could enhance transparency and credibility.



1 Introduction

A 2017 study by the European Investment Bank (EIB) identified a significant **funding gap in bio-based industries and blue economy projects**, particularly during the critical phase of scaling from demonstration projects to first-of-a-kind (FOAK) and industrial-scale plants.¹ To address this financing shortfall, the EIB launched a tender to establish a market-oriented European growth fund. ECBF Management GmbH won the tender in 2018, leading to the creation of the **European Circular Bioeconomy Fund (ECBF)** in 2020, backed by a EUR 100m commitment from the EIB.

The **venture capital (VC)** fund was designed to support innovative start-ups driving the transition from a fossil-based to a circular, bio-based economy, aligned with the European Green Deal's target of making Europe climate-neutral by 2050. Key sectors include agrifood, forestry, blue economy, industrial biotechnology, bio-based chemicals, packaging, personal care, construction, and textiles.

This final report presents the findings from the **impact evaluation study of the ECBF** after four years of operation. It assesses the fund's effects on the European bioeconomy VC market, analyses the impact on bioeconomy start-ups and offers recommendations for its future development. Since the fund is still operating, this study is an interim evaluation.

Chapter 2 outlines the methodology used in the evaluation, including the quantitative analysis and data collection approach. Chapter 3 provides an overview of the European circular bioeconomy as well as a description of the ECBF's activities. Chapters 4, 5 and 6 form the main part of this report. In these chapters, the fund's impact on investors and the broader European VC market, on portfolio companies, and on sustainability aspects is evaluated. Chapter 7 reviews the ECBF's investment process. Lastly, Chapter 8 concludes with an assessment of the fund's achievements and recommendations for future action.

2 Evaluation approach and methodology

2.1 Evaluation approach

The “Impact Evaluation of the European Circular Bioeconomy Fund” aims to assess how effectively the ECBF has contributed to strengthening the supply of VC for circular bioeconomy start-ups in European and H2020 associate countries. This analysis makes it possible to better understand the influence of the ECBF on the availability of VC and the development of start-ups in the bioeconomy sector. In particular, the evaluation looks at three dimensions of impact:

The **effects of the ECBF on the supply side of VC**: This section focuses on how the ECBF is positioned as an investor in the European VC market and analyses its effect on other investors. Thereby it is also examined to which extent the ECBF participation leads to additional investments by private investors (crowding-in) in the bioeconomy sector.

The **effects of the ECBF on the portfolio companies of the ECBF**: The aim of the evaluation is also to trace the effects of the ECBF on the direct beneficiaries of the financing, namely the portfolio companies of the fund.

¹ EIB (2017). *Access-to-finance conditions for Investments in Bio-Based Industries and the Blue Economy*.

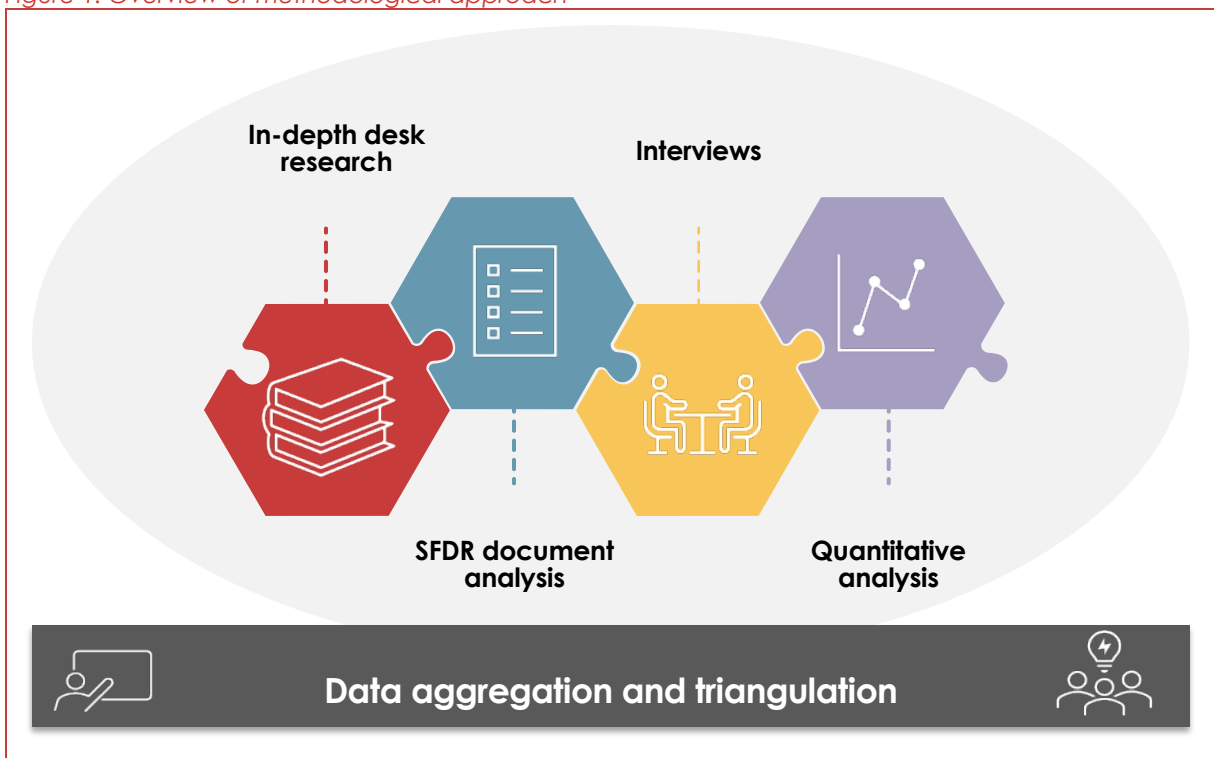
The **effects of the ECBF on sustainability aspects**: This section analyses the extent to which the activities of the ECBF are in line with climate goals. This part also assesses the ECBF's Sustainable Finance Disclosure Regulation (SFDR) in comparison to the SFDRs of other funds.

Finally, we assess the funding efficiency, i.e. the processes and conditions for participating in the ECBF.

2.2 Methodology

For the evaluation of the ECBF, a **methodological mix of qualitative and quantitative data collection instruments** was used to ensure a robust and comprehensive data basis. The data collected in this evaluation was aggregated and triangulated in order to evaluate the effectiveness, impact and efficiency of ECBF activities.

Figure 1: Overview of methodological approach



Own illustration

2.2.1 Literature review and document analysis

The **literature review** encompasses an analysis of relevant studies, publications and grey literature on the activities of the ECBF and other similar funds as well as on the development of the European bioeconomy sector. Sources for this include the Elsevier literature database, but also publications by the EIB, the Bio-based Industries Consortium (BIC) and the Joint Research Centre as well as governmental bioeconomy strategy reports. ECBF-specific documents such as investment reports were also evaluated.

As an extension of the desk research, we conducted an **assessment of the ECBF's Sustainable Finance Disclosure Regulation (SFDR)** reporting with a focus on the Environmental, Social, and Governance (ESG) approach. To perform this, we compared the publicly available SFDR

documents from 20 Article 9 Funds² (A list of these funds is provided in the Appendix A.1). Note that the funds differ in the extent to which they publish documents that are related to the sustainability impact, which limits the comparison. The desk research was validated with a Large Language Model (LLM) tool that has been developed internally by Technopolis, is deployed on local servers and is subject to stringent data protection requirements. This internal natural language processing tool, allows to automate topic detection over large quantities of documents regardless of language, complexity or size, explaining such detection and providing its sources. Moreover, it can answer project-relevant questions about every single document or summarise and synthesise groups of documents solely based on the information contained within the provided documents, which shields against “hallucinations” based on external, web-based text inputs. Thereby, it provides the relevant sources and explaining the reasoning behind each answer, assuring transparency and accountability. The tool was tailored to the context of this evaluation, which involved an iterative process between the data science and qualitative domain experts in the team. Additionally, the results were validated and completed by our sector experts.

2.2.2 Quantitative analysis

The **quantitative analysis** focuses on a data analysis regarding the fund's investments based on an **evaluation dataset** to obtain insights on the **impact of the ECBF** such as the **performance** of the funded start-ups and the **effect of the investments** on other (private) investors.

2.2.2.1 The evaluation dataset

As foundation of the quantitative analysis, we established an **evaluation dataset**, which allows for the examination of investments in bioeconomy-related start-ups. This dataset is comprised of data sourced from the Pitchbook and Crunchbase databases. This data is complemented by the data from the Affinity database provided by the ECBF and provides a comprehensive base to extract quantitative insights.

Since an **identifier indicating whether a firm is a bioeconomy firm** or not does not exist in any of the mentioned datasets, a major challenge of setting up the evaluation dataset is represented by establishing such an identifier. To identify bioeconomy firms within a dataset of 36,839 companies (from which 2,559 were uniquely provided and labelled by the ECBF) at various funding stages (from seed to Series F) in the European Union (EU) as well as the associated countries of the Horizon 2020 (H2020) regulation³, we used firm descriptions from the Crunchbase database to build a machine learning classifier capable of determining whether a firm operates within the bioeconomy sector or not. On the basis of this classifier, we identified **4,262 bioeconomy start-ups** located in the EU and Horizon 2020 associated countries. A more detailed description of how the classifier was built can be found in the Appendix A.2. It should be noted that not all 4,262 bioeconomy companies have values for all variables, such as total funding or number of employees, which is why some of the analyses were carried out with smaller samples.

² Article 9 Funds refer to investment funds that are categorized under the EU's *Sustainable Finance Disclosure Regulation (SFDR)*, which came into force in March 2021. These funds are specifically designed for investments that have sustainability as their core objective.

³ The associated countries of the Horizon 2020 regulation refer to the countries associated with the Horizon 2020 Regulation as of 1 January 2017.

2.2.2.2 Market Analysis

In a first step, the quantitative analysis provides a **market analysis**, delivering an **overview on the identified bioeconomic start-ups** in the evaluation dataset, assessing their geographical and sectoral distribution as well as delivering a brief idea about their funding. Based on the previously detailed identification of start-ups operating in the field of bioeconomy, we mapped the bioeconomy start-ups along their geographical and sectoral distribution. In addition to this static map, we have built an interactive, filterable map based on the OpenStreetMap geographic database, showing each bioeconomy start-up as a separate point on the map on which information on the start-up name, location (city and country), founding year, lead investor and sectoral category can be looked up. The interactive map will be distributed to the ECBF in the form of a local application.

It is important to keep in mind the limitations of this mapping, namely that it cannot show the full picture of all bioeconomy start-ups in the ECBF's geographic scope. This is because the underlying data from Crunchbase only observes large deals, and the start-ups available in their database might be biased by sector or industry. However, despite this limitation, the mapping still provides a valuable overview of the bioeconomy start-up sector in the EU and Horizon 2020 associated countries. By comparing the general distribution of bioeconomy start-ups to the start-ups already supported by the ECBF, we can identify particular geographic and sectoral investment foci of the fund. Additionally, we use the identification of bioeconomy start-ups within the market analysis to **assess the role of the ECBF within the VC market for bioeconomy**.

2.2.2.3 Econometric Analysis

The **econometric analysis** aims to assess the effects of financing through the ECBF on the current performance of portfolio companies. The core of this **counterfactual analysis** is to estimate the effects of an ECBF investment on the development of bioeconomy start-ups. We do this by setting up a control group of start-ups the ECBF has not invested in, which is drawn from the previously identified start-ups engaging in bioeconomic topics. In order to reduce the bias introduced by selection effects in our analysis, we use **Propensity Score Matching (PSM)** to select our control group. This statistical method matches the start-ups in the ECBF's portfolio with the most similar start-ups that have not obtained funding from the ECBF. The aim is to facilitate a comparison of the group of ECBF-financed and non-ECBF-financed companies that are similar in all aspects except whether they received ECBF-financing or not.

Once we selected our control group using PSM, we use the matched companies as a comparison group in our regression models to estimate the effect of ECBF funding on key performance indicators of start-ups, namely (1) the number of successfully completed funding rounds, (2) their success in obtaining funding, and (3) the number of employees, as an indicator for the companies' growth. More detailed descriptions of how the PSM was performed as well as on the model specifications can be found in Appendix A.2.

2.2.2.4 Limitations

While the use of the PSM method aims to better approximate causal relationships between ECBF investment and company performance, the **results should be viewed with caution**. Since the ECBF portfolio contains only 16 companies, the estimates deal with comparably **low statistical power** which leads to a lack in the certainty of the estimates. Furthermore, the marginal effects estimated through PSM are statistical approximations and may not fully capture actual causal impacts due to the presence of **unobservable selection biases**. Therefore, the estimates should be regarded as rough statistical approximations of the true effects.

To implement the framework described above, we chose the Crunchbase dataset. Crunchbase is the leading database for technology companies, entrepreneurs, and investors. This dataset provides a comprehensive and in-depth view of business dynamics with regard to measuring the activities of start-ups and their associated funding rounds. Unlike traditional databases, Crunchbase goes beyond mere financial data, offering a rich collection of information about companies, start-ups, and entrepreneurs. By combining data on funding rounds, detailed information on lead investors and start-up founders, as well as industry trends, Crunchbase provides insights into the intricacies of economic development, innovation, and market trends. However, measuring such deals requires numerous verifications, as not all transactions are publicly disclosed, and there is a significant focus on the U.S. market. We assume that the transactions represented in Crunchbase are the most significant and are comparable with each other. Additionally, there is an above-average representation of fund-of-fund investments in the Crunchbase database. The results are undoubtedly **skewed towards more prominent deals** and tend to **overestimate the average amount of money invested** and raised. Furthermore, the focus on major deals may also affect the availability of data needed to construct various indicators.

2.2.3 Interview programme

The primary data collection is based on interviews. A total of 17 interviews were conducted (in addition to a scoping interview) with the following stakeholders:

- **7 in-depth interviews with start-ups funded by the ECBF** (essentially about half of the ECBF portfolio companies). The companies were selected based on the criteria sector, Technology Readiness Level (TRL), country and revenue to guarantee a high representativeness for the portfolio.
- **2 interviews with circular bioeconomy start-ups not funded by the ECBF** to get an idea of the challenges faced by companies that are not financed by the ECBF.
- **2 interviews with ECBF investors** to assess the effectiveness and efficiency of ECBF and alignment with investor objectives.
- **2 interviews with investors that invest in the bioeconomy sector** to get their perspective on the European VC market and the role of the ECBF. These interviews also aimed at analysing to what extent the ECBF is perceived as an investor with specialized ESG expertise, whose scientific and strategic advice and pioneering can mitigate the risk of investment for other investors.
- **4 interviews with relevant policymakers**, including the European Commission, and experts from **relevant associations in the circular/bioeconomy area** such as the World Bioeconomy Association and the Circular Bio-based Europe Joint Undertaking to assess the contribution of the ECBF to policy objectives and to gain insights on the role of the ECBF for the bioeconomy innovation ecosystem.

For each stakeholder group customised, semi-open interview guides were developed based on the literature review and scoping interviews.

3 European circular bioeconomy sector and ECBF

This chapter provides an overview of the European bioeconomy sector and the activities of the ECBF. While the first part focuses on the sectoral trends in the European bioeconomy, the

following parts describe the financing landscape in the sector as well as the contributions of the ECBF.

3.1 Sectoral trends

- What are the key emerging trends in the European circular bioeconomy, and what challenges does the sector currently face?

The **circular bioeconomy** is rapidly evolving as a critical component of global sustainability efforts, particularly in addressing climate change, resource scarcity, and environmental degradation. Over the past few years, the bioeconomy sphere has expanded into new sectors, has gained significant interest from both public and private stakeholders, and has seen the emergence of innovative technologies and strategies. According to the BIC, the bioeconomy sector in Europe generates a **turnover of EUR 2.5 trillion**⁴, of which approximately 30% is in the bio-based industries, and provides **employment to nearly 18 million people**.⁵ The importance of the circular Bioeconomy sector is also underlined by several policy packages implemented by the EU, including the EU Bioeconomy Strategy launched in 2012 and updated in 2018, as well as the Circular Economy Action Plan, which was first adopted in 2015.

One of the most important trends in the circular bioeconomy is the **diversification and expansion of sectors** involved. Traditionally dominated by the agri-food and forestry sectors, there has been a noticeable shift towards new applications and sectors such as aquatic biomass, packaging, bio-based fertilizers, or cosmetics. This expansion is also reflected in the figures: in 2015, bio-based chemicals grew by +26% and bio-based plastics by +13%, these are indicators for an emerging industry with strong growth potential.⁶

Since 2022, there has also been a **marked increase in interest in the bioeconomy from the public sector**. Governments around the world are recognizing the potential of the bioeconomy to address critical challenges such as resource sustainability. The United States (US) launched, for instance, the National Biotechnology and Biomanufacturing Initiative in 2022, which aimed at boosting innovation and competitiveness in the sector. In the beginning of 2022, China also launched its '14th Five-Year Plan for Bioeconomy Development (2021–2025)', which contains agriculture, biomedicine, bio-manufacturing and biosecurity as strategic priorities. The plan focuses on three pathways to strengthen the bioeconomy, including biotechnological innovation, industrial development and government policies.⁷

While the expansion of the circular bioeconomy sector is promising, it also presents significant challenges. This growth and diversification also create complexities in managing the sector, particularly when it comes to **defining its scope**. There is not one universally agreed upon definition of the circular bioeconomy as every organisation seems to define its scope slightly differently. The inherent complexity of the circular bioeconomy requires a flexible approach to management and policymaking. A rigid definition could hinder innovation and the inclusion of

⁴ This figure is based on the activity of sectors that fully belong to the bioeconomy, including agriculture, forestry, fishing, the manufacturing of food, beverages, tobacco and paper as well as bio-based shares for sectors which only partially belong to the bioeconomy (for further information see Ronzon et al. (2020). *Developments of Economic Growth and Employment in Bioeconomy Sectors across the EU.*)

⁵ BIC (2023). *BIC Trend Report 2023-2024.*

⁶ See also Ronzon and M'Barek (2018). *Socioeconomic Indicators to Monitor the EU's Bioeconomy in Transition.*

⁷ For further information see also Zhang et al. (2022). *The roadmap of bioeconomy in China.*

emerging sectors, while a too-broad definition might dilute the focus and effectiveness of bioeconomy strategies.

Given that the bioeconomy often intersects with various sectors such as agriculture, biotechnology, or waste management, companies face a **fragmented regulatory environment** with different laws and requirements for each sector. Furthermore, **approval processes** for new biotechnologies, such as bio-based chemicals, biofuels, and genetically engineered organisms, can be **lengthy and uncertain**. The European Food Safety Authority (EFSA) and other regulatory bodies often take a cautious approach, which can slow down market entry for innovative products. Regulatory frameworks such as **REACH** (Registration, Evaluation, Authorisation, and Restriction of Chemicals) require start-ups to conduct thorough safety and environmental impact assessments, which can be costly and time-consuming. In addition, the current regulatory framework is criticized for **not providing a level playing field** between the use of renewable resources for energy and industrial biotechnology, as well as in comparison to fossil-based products. While biofuels receive extensive subsidies, bio-based chemicals and materials lack similar regulatory support, hindering their market development in the EU.⁸

Traditionally, a large part of the bioeconomy was focused on substitution, i.e. changing parts of an (industrial) process from petrochemical to bio-based. While this is still an important part of the bioeconomy and the potential impact of the bioeconomy, this has proven difficult, as one-on-one substitution is often not possible and requires additional changes in the process. Additionally, there is a price gap between the proven petrochemical solution and the newer bio-based solution, which makes the uptake of the solutions difficult. In recent years, this has led to an **increase of bioeconomy organisations that are consumer-focused**, producing (partly) bio-based products or bio-based packaging.

Another concern that has gained prominence with the **rise of AI**, particularly in the biotechnology sector, refers to **biosecurity and biosafety**. The US has already published an 18-point policy framework, with a significant focus on biosecurity, reflecting the importance of safeguarding the environment and society from potential biotechnological risks.

Lastly, the circular bioeconomy faces the critical challenge regarding the management of bioresources. The availability of land and other bioresources is a limiting factor, with estimates suggesting a **bioresource gap** of 40-70% by 2050 if current trends continue. This gap highlights the need for a balanced approach to resource extraction and usage, ensuring that bio-based industries do not deplete the very resources they rely on.

3.2 Funding landscape and start-up activity

- What is the current financing landscape of the European bioeconomy sector, and how significant is the role of VC in driving innovation and growth?
- How has the European bioeconomy start-up ecosystem evolved over recent years and what characterises the current ecosystem?

3.2.1 Financing landscape in the European Bioeconomy

According to the expert interviews, the private sector's involvement in financing the bioeconomy is critical to its development. Particularly, the **fossil industry**, mainly the chemical,

⁸ See also Ladu et al. (2017). *Overview of policies, standards and certifications supporting the European bio-based economy*.

agricultural, and energy sectors, is expected to make significant contributions by reallocating investment budgets towards bio-based processes.⁹ One of the experts noted, that large corporations are increasingly investing and partnering with bio-based companies. Firms like Evonik, BASF, and Cargill have made substantial investments in bio-based processes, with a focus on sustainable chemicals and biofuels. However, other interviewees view the financing activities, especially of the chemical industry as still being too small compared to their size.

In the last few years, **VC** and **private equity** investments in bio-based start-ups and companies have surged. Sectors like biotechnology, sustainable agriculture, and bio-based chemicals have been major beneficiaries of this capital inflow. According to a recent WCBEF report¹⁰, particularly the high-tech bioeconomy relies heavily on VC and corporate investments. Also **impact investment funds**, which focus on generating social and environmental benefits alongside financial returns, have increasingly directed their attention to the bioeconomy. Notable examples are the Circular Innovation Fund or Planet A Ventures.

However, recent reports such as the Global AgriFoodtech Investment Report 2024 or the SynBioBeta 2024 Annual Synthetic Biology Investment Report, point to a decrease of VC investments in the bioeconomy sector after the VC-inflated-valuations years between 2018 and 2021.¹¹ In general, the expert interviews reveal that there is increasing interest from the private sector, yet, the VC market still plays a minor role in the financing of the bioeconomy. The VC markets limited engagement in financing the bioeconomy stems from several interrelated challenges, which primarily revolve around technological maturity, policy frameworks, market conditions, entrenched conventional industries, and lack of sectoral understanding according to the expert interviews. **Technological Risks** stem from the fact that bioeconomy companies often rely on emerging technologies, which can be immature or unproven on a commercial scale. This leads to uncertainties in performance, scalability, and return on investment. In addition, the **policy framework** is still fragmented across Europe and slows a fast market adoption of innovative processes. The interviewees also note that approvals for new technologies and new processes take too long. Furthermore, bio-based companies often face **competition from well-established industries**, particularly those reliant on fossil fuels or conventional agricultural practices. These entrenched industries benefit from economies of scale, lower production costs, and existing supply chains, making it difficult for bio-based products to gain market traction. Lastly, there exists a **lack of sectoral understanding** regarding the technologies and processes. These factors create significant financial risks and uncertainties for investors.

Most investors interviewed conclude a **positive development of the European bioeconomy VC market** over the last ten years. Given **increased societal awareness** around topics such as energy, food and materials interest in the sector has grown. The investment hype around meat replacements has brought additional attention to the sector but also created unrealistic expectations and valuations. Covid and vaccines (re-)created similar **excitement around**

⁹ See also Kircher (2019). *Bioeconomy: Markets, implications, and investment opportunities*.

¹⁰ WCBEF (2024). *Financing a Sustainable Global Bioeconomy*

¹¹ Note that value of VC investment raised in Europe increased overall between 2012 and 2022, before decreasing significantly in 2023. In 2023, the value of VC raised amounted to EUR 14.2b (Statista 2024).

pharmaceutical biotechnology where health- and life science focused investors have recently financed several bio-based ventures.

The **public sector**, particularly the EU and national governments, remains the dominant force in shaping the bioeconomy landscape through policy, regulation, and funding. According to the interviewed experts, their involvement is crucial for de-risking projects and attracting private capital. **European Structural and Investment Funds** such as the European Maritime, Fisheries and Aquaculture Fund (EMFF) and the European Agricultural Fund for Rural Development (EAFRD) represent important financing sources for companies in the bioeconomy sector. Other financial instruments by the European Investment Bank Group include the **European Fund for Strategic Investments (EFSI)**, **InnovFin** and the **Natural Capital Financing Facility (NCFF)**. In addition, Horizon Europe, EU's research & innovation framework programme for 2021 to 2027, places significant emphasis on the bioeconomy sector. It supports a wide range of bioeconomy-related activities aimed at advancing the EU's transition to a sustainable, circular economy. Horizon Europe also provides significant funding through **public-private partnerships** such as the **Circular Bio-based Europe Joint Undertaking (CBE JU)**, which promotes research and innovation in sustainable bio-based industries. The EUR 2b partnership between the EU and the BIC is a key instrument for supporting large-scale investments and mobilising private sector involvement in the bioeconomy sector.

EU Member States have implemented a variety of initiatives to support financing and advancing the bioeconomy sector. These initiatives range from research and innovation (R&I) funding schemes to awareness-raising campaigns and platforms for collaboration.¹² While detailed, country-specific figures on bioeconomy investments are not consistently reported, some estimates suggest that EU member states are collectively investing billions in the bioeconomy sector. For instance, France alone has committed over EUR 1.3 billion through its *France Relance* and *France 2030* programs, which aim to boost bio-based products and sustainable agriculture.¹³ Nevertheless, the interviewed experts highlighted regional differences in Europe. While particularly Western European countries like France, the Netherlands or Germany and Scandinavian countries implemented dedicated Bioeconomy Strategies, Eastern European Countries show less developed strategies towards a shift to bio-based processes.

Overall, one of the experts explained that companies in the bioeconomy sector need a combination of funding, including national and EU funding as well as private capital. According to the expert's opinion, the public sector will remain an important pillar for start-ups due to the sector's characteristics, even if private capital increases.

3.2.2 European bioeconomy start-up-ecosystem

While large companies are increasingly shifting to bio-based processes, the interviewed experts note that the importance of SME is also growing in the bioeconomy sector, especially R&D is

¹² See for a brief summary of Member State initiatives European Commission: Directorate-General for Research and Innovation (2022). *European bioeconomy policy: stocktaking and future developments - Report from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions*.

¹³ For more information on the bioeconomy strategy of France see also <https://www.bioeconomyforchange.eu/en/our-ecosystem/the-state/> (Last accessed on 15 October 2024)

largely driven by SME¹⁴. In fact, many bioeconomy start-ups have roots in academic research or close ties with universities and research institutions.

However, it is challenging to identify circular bioeconomy start-ups in the market. Most search platforms and databases do not provide a bioeconomy label, and given the fuzzy definition of the circular bioeconomy (see Chapter 3.1), the identified number of companies may vary. As described in Chapter 2, we built a machine learning classifier to identify relevant start-ups in Crunchbase. In addition, we relied on data provided by the ECBF.

The ECBF identifies bioeconomy start-ups through subscriptions to newsletters, secondary datasets like Pitchbook, active participation in pitching events and trade fairs, web scouting, referrals from fellow investors, and direct outreach from start-ups. The ECBF's data collection process resulted in a database of more than 5,200 bioeconomy companies. The large number of bioeconomy companies identified by the ECBF indicates a **strong deal flow**, using, however, a broader bioeconomy definition compared to our machine learning classifier analysis.

The following analyses will be based on our machine learning classifier dataset of **4,262 identified European (+HH20) bioeconomy start-ups**, given that some variables are not available in the ECBF database. According to this dataset, the start-up ecosystem spans a wide range of sectors, from **biotechnology**, **bioplastics**, and **biofuels** to **agri-tech** and **food-tech**. Most companies are categorized into the sectors Biotechnology (837), Manufacturing (600), Energy (464), Farming (434) and Agriculture (430).¹⁵

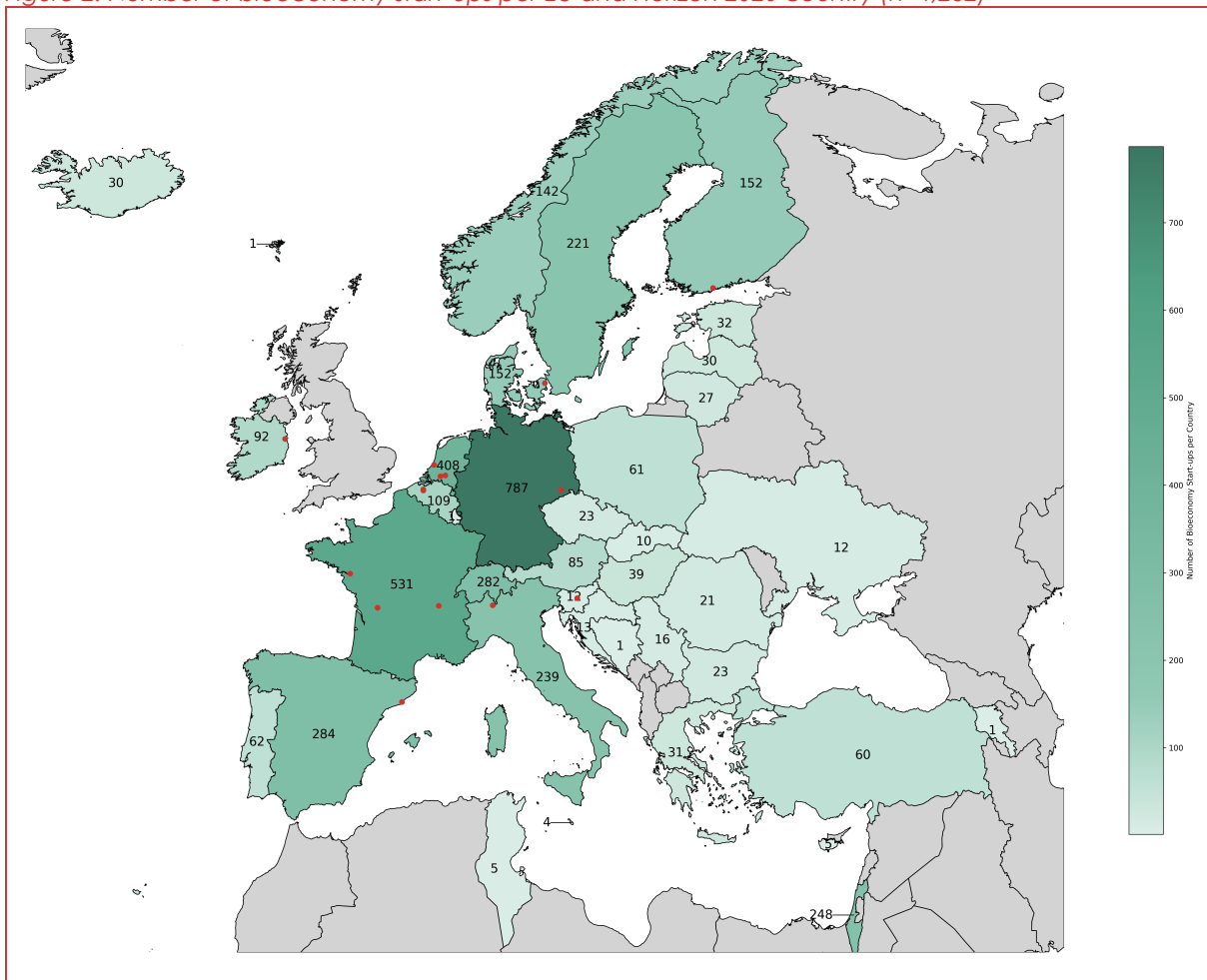
The dataset also reveals significant **regional differences** in the bioeconomy start-up activity. Figure 2 shows the geographical distribution and number of bioeconomy start-ups in the EU and the Horizon 2020 associated countries. Our analysis identified the highest amount of bioeconomy start-ups being located in Germany (787), followed by France (531), the Netherlands (408), Spain (284) and Switzerland (282). The ECBF has invested in start-ups in all of these countries except Israel. Eastern European countries, such as Slovakia, Slovenia and Ukraine, show relatively small numbers and share of bioeconomy start-ups. These findings are in line with the literature which posits an early transitional stage of the bioeconomy for Eastern and Central Europe.¹⁶ From the map it becomes clear that the start-ups supported by the ECBF are concentrated in the northwest of Europe, with most ECBF-financed start-ups located in France, the Netherlands, Germany and Belgium.

¹⁴ According to the Horizon 2020 Interactive Dashboard, the SMEs participation on advanced materials, biotechnology, climate action, and bioeconomy thematic priorities results in 1,620 H2020 signed grants and EUR 1.44 billion of EU Net contribution.

¹⁵ Note, that companies can be listed in multiple categories and that data on sectoral affiliation is not available for 919 of the identified bioeconomy start-ups.

¹⁶ See, for instance, Ronzon et al. (2022). *Has the European Union entered a bioeconomy transition? Combining an output-based approach with a shift-share analysis.*

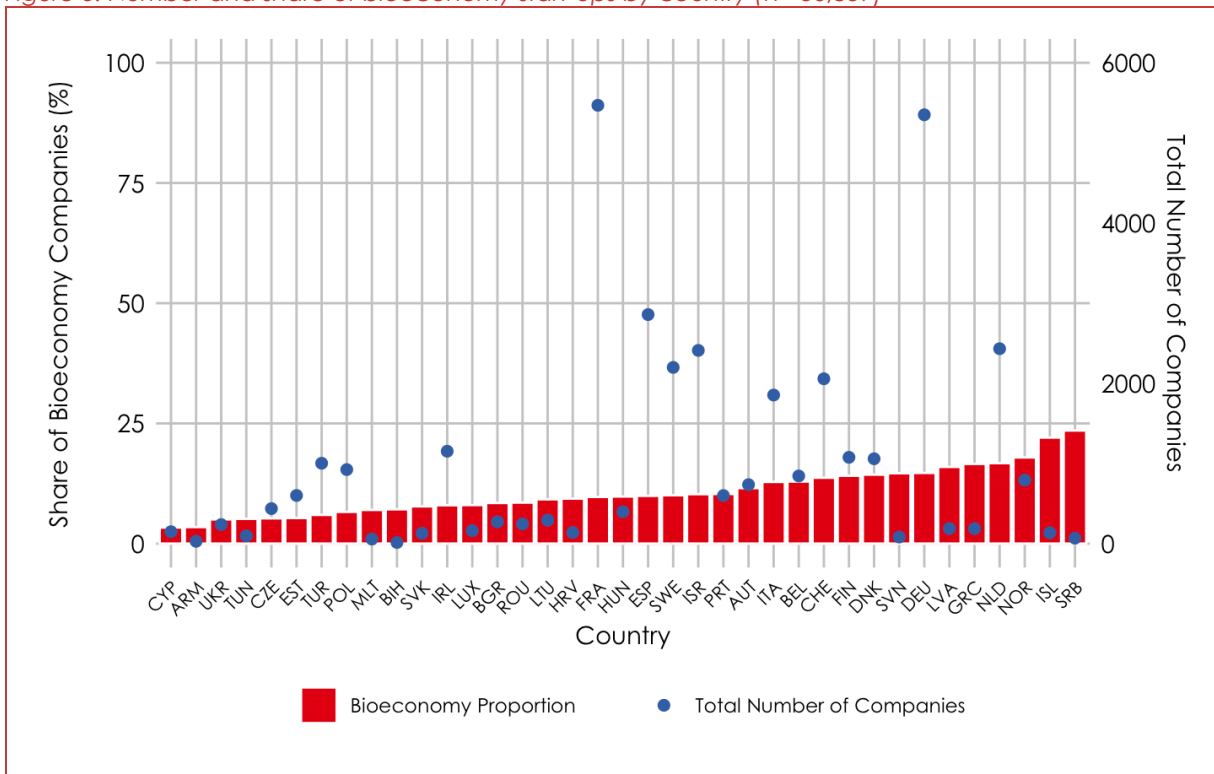
Figure 2: Number of bioeconomy start-ups per EU and Horizon 2020 country (n=4,262)



Own illustration based on own classification of bioeconomy start-ups. The red points represent ECBF-funded start-ups.

Figure 3 shows a relatively small share of bioeconomy start-ups in most Eastern European countries, however, the mean value across all regions is 10.7%. While the blue points represent the total number of companies (bioeconomy and non-bioeconomy) for each country in the dataset, the red bars illustrate the share of bioeconomy companies (in percent) for each country. Note that for some countries such as Bosnia and Herzegovina, Serbia, Slovenia, Armenia or Malta, the database captures only a small amount of companies which is why the share of bioeconomy companies is not representative.

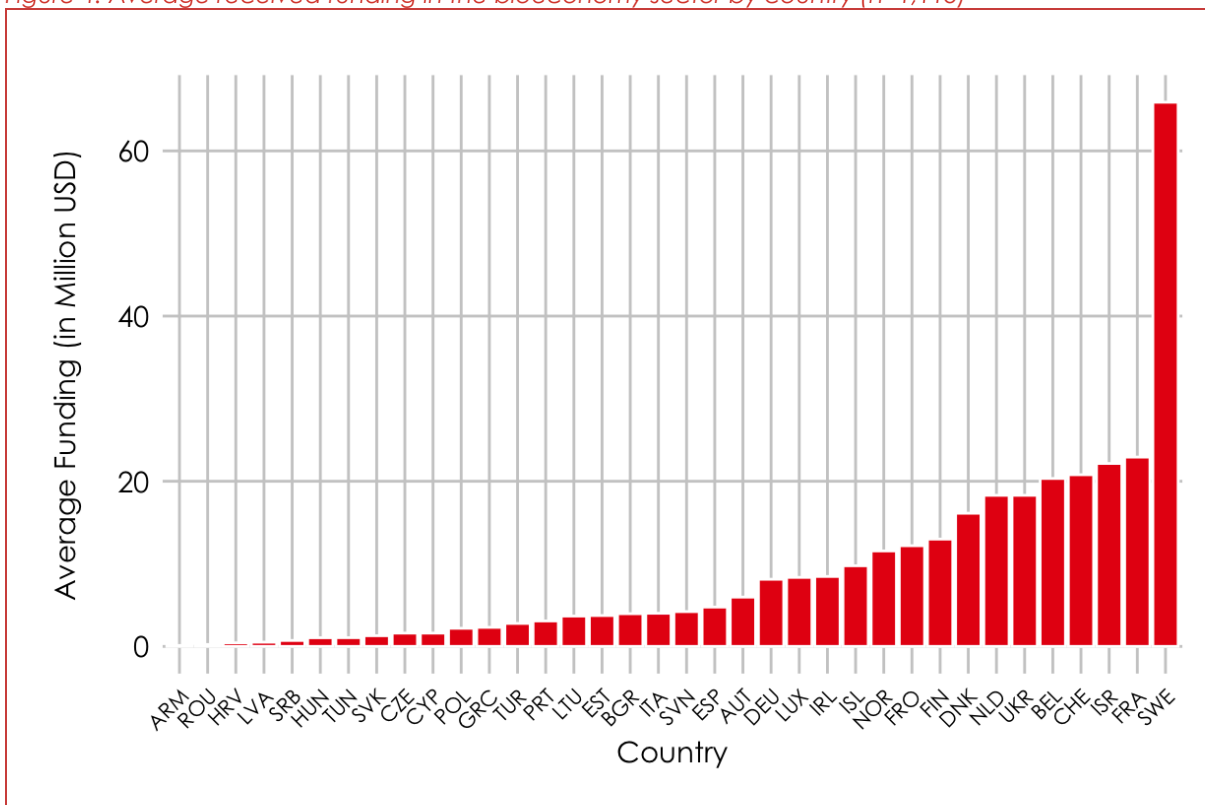
Figure 3: Number and share of bioeconomy start-ups by country (n= 36,839)



Own illustration based on evaluation dataset

Regional differences are also reflected in the amount of money received by bioeconomy start-ups. Figure 4 shows that **Eastern European** countries received the **least amount** of funding in the bioeconomy sector, while the highest average amount of funding for bioeconomy start-ups is observed in Sweden (USD 65.9m), France (USD 22.9m) and Israel (USD 22.2m). Furthermore, different European regions have specialized in specific aspects of the bioeconomy. For instance, the Nordic countries focus heavily on bioenergy and sustainable forestry, while countries like Germany and the Netherlands lead in bio-based chemicals and biotechnology.

Figure 4: Average received funding in the bioeconomy sector by country (n=1,115)



Own illustration based on evaluation dataset. As the total amount of funding is not available for all bioeconomy start-ups, this graph refers to a reduced dataset of 1,115 bioeconomy companies.

Most founding rounds in the dataset of bioeconomy start-ups refer to seed investments with 59%, 29% are pre-seed investments, 10% are Series A investments and less than 2% are Series B or C investments (n=1,130). On average, it took the bioeconomy companies approximately 2.4 years until their first funding round. The companies received on average USD 3,507,450 during the first funding round (n=1,071) and USD 16,505,254 in total (n=1,115).

Despite the bioeconomy's overall turnover increasing from approximately EUR 1.75 trillion in 2014 to over EUR 2.35 trillion in 2021—driven in part by a rise in start-up activity¹⁷—the sector continues to face significant challenges, particularly in scaling technologies from pilot phases to industrial production. Interviews with entrepreneurs in the field highlight that regulatory hurdles, complex supply chains, high capital requirements, and issues related to cost-competitiveness can impede the commercialization of bio-based innovations.

3.3 Activities of the ECBF

- What are the activities of the ECBF and to which extent are they in line with current sectoral trends?

The ECBF is a **private VC fund** that is exclusively dedicated to the **(circular-) bioeconomy**. The fund started as an EU initiative motivated by an EIB study which identified a funding gap for bioeconomy companies in the growth phase. To address this, the EU allocated EUR 100m to

¹⁷ BIC (2024). *European Bioeconomy in Figures 2014-2021*.

create a European Growth Fund. In 2018, the EIB chose ECBF Management GmbH to manage this fund.

The ECBF is a **pan-European** (including H2020 associate countries) **fund investing EUR 300m** in growth-stage companies with high potential for innovation, favourable returns and sustainable impact. Investment size ranges from EUR 2.5m to EUR 10m. ECBF invests in syndicates with private and public investors ranging from equity to mezzanine capital.

The targeted scope includes the following technology fields and industry subsectors:

- Circular economy technologies and new business models including digitalization which for instance enable resource efficiency and supply chain optimization, re-usage, reduction, recycling and valorisation of waste streams as well as carbon capture;
- Biomass/feedstock production, e.g. increase of output and/or decrease footprint of agriculture, farming, forestry and the blue economy;
- Technologies to enable biomass/feedstock processing, e.g. biorefineries, process and conversion technologies;
- Bio-based chemicals & materials, e.g. solvents, intermediates, monomeric building blocks, polymers, fibres and composites;
- Performance biologicals, e.g. specialties with applications in nutrition, personal care and other industry verticals.

The ECBF considers only **late-stage companies** that have demonstrated the underlying technology in a relevant environment (TRL 6 to 9) and that are located in the **EU** or one of the **16 HORIZON 2020 associated countries**.

The current active **portfolio of 15 companies** covers 10 countries and multiple sectors such as personal care, farming, packaging and nutrition. Another company filed for insolvency in 2023.

The ECBF has raised EUR 300m to finance growth companies in the bioeconomy and bio-based circular economy. In total, the group of investors now includes 26 shareholders (including EIB) from 10 countries.

4 ECBF's role and impact on the European bioeconomy VC market

This chapter focuses on the role and impact of ECBF on the European bioeconomy VC market. The first section aims to assess the relative share and importance of ECBF in the market while the second section tries to quantify the impact ECBF had so far on increasing the supply of VC within the bioeconomy sector.

4.1 Role of the ECBF in the European bioeconomy VC market

- Which role does the ECBF play in the European bioeconomy VC landscape?

The ECBF is among the first European VC funds exclusively dedicated to investing in growth-stage (circular-) bioeconomy companies. As outlined in the previous chapter, the VC market still plays a minor role in the financing of the bioeconomy, mainly due to technological risks of bioeconomy technologies that can be immature or unproven on a commercial scale, leading

to uncertainties in performance, scalability and notably return on investment. This systemic challenge is even exacerbated for investments in later company growth stages.

Against this background, ECBF targets a naturally small funding segment of the bioeconomy sector. This in itself constitutes a contribution to the bioeconomy VC funding “value-chain”: By providing later-stage funding, ECBF not only supports the scalability of bioeconomy ventures but **may also enable more seed-stage investments**. The success of growth-stage funding might signal maturity and viability within a sector, attracting more early-stage investors who feel reassured about potential future funding opportunities and exit options.¹⁸

With around EUR 300m in size, ECBF is a notable player in the overall European bioeconomy growth VC market. Since the bioeconomy sectoral delineation makes it difficult to identify the specific bioeconomy share in later-stage, it is not possible to pinpoint ECBF market share in the later-stage Bioeconomy VC market. But even outside the bioeconomy, there are few deep-tech later-stage funds in Europe.

There does not exist a comprehensive overview of VC funds investing in European growth-stage companies in the bioeconomy. But according to our own desk research and interviews, the most relevant VC funds compared to ECBF’s focus are the following:

- Health-focused Forbion Capital recently launched in 2024 its **Forbion BioEconomy Fund 1** with a focus on biotech companies across Food, agriculture, materials and environmental technologies. They aim to raise EUR 150m and build a portfolio of 10-12 investments in Europe and North America. Investors include KfW Capital, Novo Holdings and Rentenbank.¹⁹
- The **Sofinnova Industrial Biotech 2 fund** by Sofinnova partners focuses on start-ups working on renewable raw materials (like agricultural waste or CO₂) and renewable end-products such as bio-plastics and other bio-sourced materials and has raised EUR 150m with a primary focus on Europe.
- **Astanor Ventures** has closed its second agrifood fund on EUR 360m in 2023 and includes bio-based applications in their focus on food, blue economy and agriculture.
- **Synthesis Capital** from the UK focuses on novel food proteins, such as Beyond Meat. They closed their first fund with EUR 270m targeting around 15 investments with an average ticket size of EUR 14m.
- Capricorn Venture Partners launched in 2022 the Article 9 Fund **Capricorn Industrial Biotech Fund**, which focuses on early-stage investments in the industrial biotech sector in Northwestern Europe. The final closing will be at a maximum of EUR 25m.
- In 2021, Pymwymic launched its second fund that focuses on sustainable agriculture, food systems, and ecosystem regeneration. **Pymwymic Healthy Ecosystem Impact Fund II** aims to invest EUR 60m in up to 14 companies which is twice the amount invested in Pymwymic’s Healthy Ecosystems Impact Fund I.
- Anterra Capital invests in Agri-food technology companies reaching from the incubation stage to Series D with a focus on Europe and North America. Its second **Global Food and Agriculture Technology Fund closed** on USD 260m in 2022.

¹⁸ See also, Janeway, Nanda and Rhodes-Kropf (2021). *Venture capital booms and start-up financing*. Annual Review of Financial Economics: p.9

¹⁹

<https://forbion.com/en/news/forbion-announces-first-close-of-its-new-bioeconomy-fund-i-backing-biotech-enabled-companies-aiming-to-impact-the-future-of-our> (30.08.2024)

- **Aqua-Spark** is an investment fund based in the Netherlands which is fully dedicated to investing in sustainable aquaculture. The fund has approximately EUR 500m in assets under management and focuses on later-stage companies around the world.
- The **MLS Capital Fund II** focuses on innovations in agriculture, food, industrial biotech, and life sciences at all stages of development. In 2015, the fund closed at USD 150m.

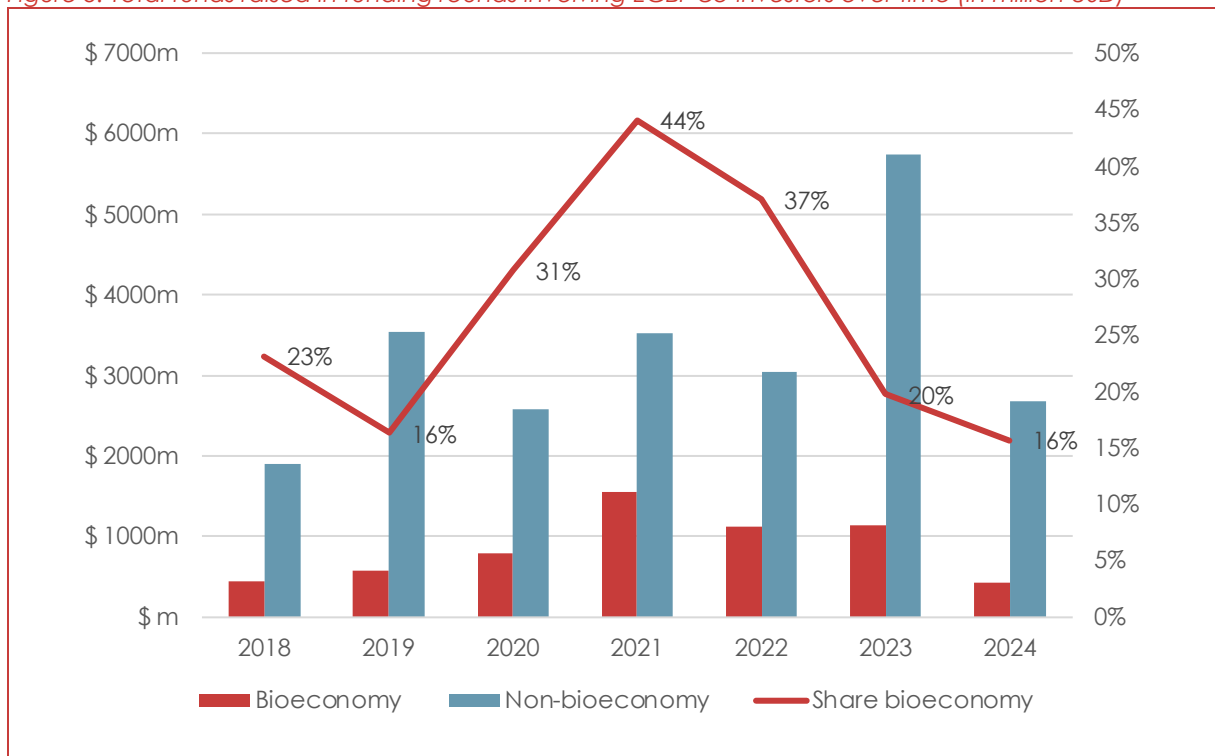
All of these funds, together with ECBF, constitute an available funding potential for growth-stage bioeconomy start-ups in Europe of at least EUR 1.93b.

Although this total sum is a rough estimate, given the differing strategies and investment periods of the funds, it provides an estimate of the ECBF market share. Given this total sum, ECBF accounts for more than 15% of the total. This rough estimate still highlights the prominent role of ECBF in its sub-market.

In addition to funds specifically focused on bio-based applications, a range of later-stage “impact” funds focusing on sustainability and climate change are also investing in the bioeconomy area. Relevant funds include the Circular Innovation Fund, a USD 160m growth-stage VC focusing on circular innovation, including new materials, circular packaging, recycling and waste innovations, logistics and distribution, clean tech and eco-efficient processes and business models. Other important impact funds focusing on climate technologies include Planet A Ventures (EUR 160m) and World Fund (EUR 300m).

Given the larger ticket sizes of later-stage Bioeconomy investments, ECBF usually invests together with other investors. Figure 5 displays the total amounts raised in funding rounds where ECBF's co-investors took part. This provides an approximate measure of the level of investment that ECBF's co-investors commit to bioeconomy start-ups (note: data might be incomplete since not all transactions from co-investors might be reported in Crunchbase and only 34 out of 39 ECBF co-investors are included in Crunchbase).

Figure 5: Total funds raised in funding rounds involving ECBF co-investors over time (in million USD)



Own illustration based on Crunchbase data for 34 co-investors of the ECBF

In 2023, for instance, total raised amount in funding rounds involving ECBF's 34 co-investors amounted to close to EUR 6.9 bn, out of which about 20% went to bioeconomy companies. In 2021, that share amounted to more than 40%.

As mentioned above ECBF invested overall in the portfolio companies with 39 co-investors including public investments banks (e.g. BPI France), sector specific investors (e.g. Unigrains or Aquaspark), impact investors (e.g. Pymwymic) and multinational corporations from outside of Europe (e.g. Kubota). Demeter, Pymwymic, Sofinnova and PMV appear multiple times as investors. According to the Crunchbase dataset, the majority of these investors are predominantly involved in non-bioeconomy funding rounds. Besides the ECBF, only four investors were involved in more bioeconomy than in non-bioeconomy funding rounds since 2020.

The descriptive analysis of ECBF's role in the EU bioeconomy growth VC market shows, that ECBF is part of a leading batch of around 10 privately initiated funds that focus either entirely or with a significant share of their investments on the bioeconomy sector.

In our interview programme, we discussed ECBF's impact on the bioeconomy growth VC market. While interviewees generally confirm the assessment of the descriptive analysis (that ECBF is indeed part of a group of leading bioeconomy-focused investors), they also underline that ECBF's mark on the sector is still work in progress since VC and bioeconomy especially represent a "long term game". One interviewee notes, that even though other fund managers such as Forbion also target the bioeconomy, ECBF is almost unique in the fact that they target only later-stage rounds and therefore represent a true "growth specialist" fund.

One interviewee highlights the strong increase in start-up valuations that has coincided with ECBF's start of operations. This makes it difficult to find suitable investment objects. In addition, the bioeconomy VC sector has attracted some non-specialist funds and hedge funds from the US, who have contributed to the increase in valuations.

With its clear sectoral focus and later-stage strategy, ECBF answers to the need in Europe for big and patient capital but cannot make a difference alone. In addition, the bioeconomy market is very CapEx (capital expenditures) intensive, further increasing the demand for capital as well as the investment risk. One interviewee raises the question, if later-stage VC in itself can meet this capital demand, or if a blended finance approach, such as a mix of debt and equity financing could be more suitable in the bioeconomy sector. Here, public-private partnerships, such as central research infrastructures co-funded by governments and industry could play a role to contribute to a de-risking of bioeconomy innovations. In the opinion of the interviewee, ECBF could play a role in advancing such initiatives.

Interviewees underline the ECBF teams' experience, although compared to other fund managers that have been in the market for more time, they of course have not yet achieved an exit. This will be a challenge, given that a 3x return on the investment (so EUR 900m in total on a EUR 300m fund) in ECBF would require exits totalling EUR 4 to 5bn, assuming an average share in companies of about 20%. Therefore, ECBF needs to keep investing to the end and look at significant growth investment outside their portfolio today and not only use the remaining funds to defend the current portfolio.

To conclude this section, ECBF meets the requirement of the EIB commitment to display additionality with other VC funds. As the Terms of Reference mandates, ECBF "needs to be 'additional' to other sources of funding from the market or from other EU instruments. Given the small market volume in later-stage/growth VC for bio-based applications in Europe and the small competition in later-stage bioeconomy investments, this additionality appears to be the case.

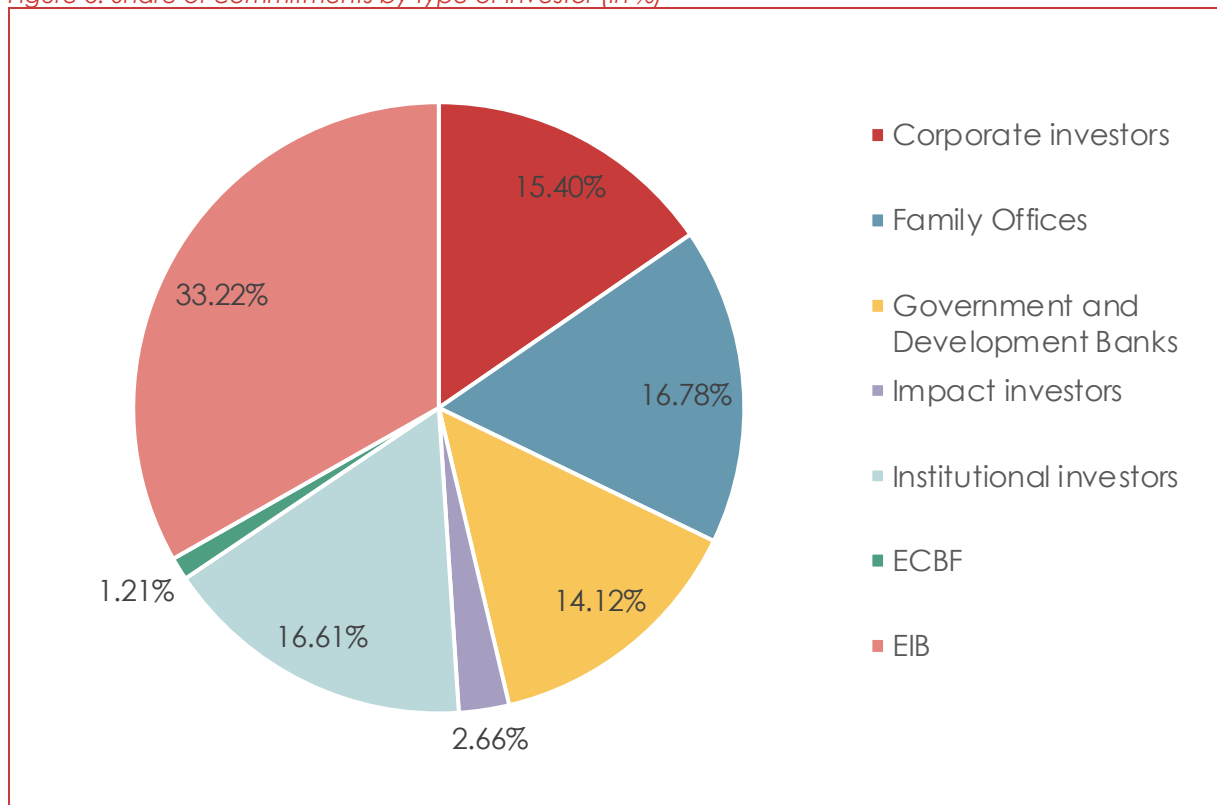
4.2 ECBF's impact on other investors

- Has the ECBF facilitated the entry of new players (private or public) into the bioeconomy and is there evidence of a crowding-in effect of private capital?
- To what extent does the ECBF contribute to reducing risk for innovative technologies, processes, or business models within the bioeconomy?
- What are the medium- to long-term effects of ECBF investments on the venture capital landscape within the bioeconomy sector, particularly regarding the supply of capital?

4.2.1 Leverage on private capital

During its fundraising stages, being launched in 2020, the ECBF has targeted a fund size of EUR 250m, but due to strong investor interest, it closed above its original target. By the end of 2021, the ECBF had successfully closed its final round of fundraising, reaching a total of EUR 300m. This can be considered a milestone, especially considering the specialized nature of the bioeconomy sector. The ECBF attracted a mix of public and private investors, including institutional investors, family offices, and industrial partners from ten different countries and three continents. Figure 6 shows the share of commitments by type of investor. Approximately 50% of the commitments by investors (excluding the EIB) stem from German investors, highlighting an existing path dependency given ECBF's headquarters and German Managing Partners.

Figure 6: Share of commitments by type of investor (in %)



Own illustration based on ECBF data

The EIB as an anchor investor underlines the strong role of the public sector in ECBF. The capacity of the ECBF to bind private capital to the ECBF's purposes can be analysed on two levels: the ECBF's fundraising stage and the ECBF's investment stage.

During the fundraising stage, the share of private capital that has been bound to the ECBF's investment purposes can be considered a success since it leverages public investments through private capital. The ratio of funding raised between public and private capital is approximately one to three. Thereby, the ECBF generated additional funding available for the bioeconomy, positively affecting the mid- and long-term supply of capital to bioeconomy firms.

Table 1: Private/ Public capital ratio of ECBF investments

Name	Initial Investment	Invested (Status: 30.09.2024)	Entry Round Size	Cumulative Capital Raised
Total	EUR 70.761.983	EUR 96.290.587	EUR 238.877.431	EUR 394.033.539
thereof EIB	EUR 23.508.964	EUR 31.990.228		
Private/Public capital ratio			10,2	12,3

Own illustration based on ECBF data

Table 1 provides an overview of the private/public capital ratio at the investment stage. These investment figures for the ECBF show the additional private investments that had been taken in the ECBF's portfolio companies.

The table shows that the total initial investment by the ECBF amounts to EUR 70.76m, which has grown to EUR 96.29m invested to date. This indicates that the fund has allocated an additional EUR 25.53m beyond its initial commitments. Regarding the Entry Round Size, the total stands at EUR 238m. This figure represents the combined capital involved in the initial funding round for the companies within the ECBF's portfolio. The cumulative capital raised by these companies had reached EUR 394.03m, suggesting that they have secured significant additional funding after the initial rounds.

The EIB has played a notable role in the fund's capital structure and thus, in the ECBF's investments. Initially investing EUR 23.51m, the EIB's total investment has increased to EUR 32.99m until September 2024 out of the total commitment of around EUR 100m (see Table 1). Most importantly, the private-to-public capital ratio indicates the share of private investments compared to the public investments and provides a notion of private capital that has invested in line with the ECBF's investment strategy. For the Entry Round Size, this ratio is 10.2, indicating that for every euro of public investment, EUR 10.20 of private capital has been leveraged. This ratio increases to 12.3 when considering the cumulative capital raised, indicating a higher proportion of private investment over time relative to public funding. Yet, this does not necessarily imply that the ECBF's investments have triggered these private investments. To shed further light on this, the next part is dedicated to the counterfactual analysis, assessing the ECBF's impact on attracting further private investments.

4.2.2 Counterfactual analysis: ECBF's impact on attracting further private investments

In the following, we analyse the extent to which the ECBF's financing of investment funds has contributed to **attracting private investments** using a **statistical counterfactual analysis**. The

counterfactual control group consists of start-ups that received investments from investors other than the ECBF.

The assumption we want to test here is whether a company that has received ECBF funding has been able to acquire more VC capital than companies that have not received such funding. Implicitly, we therefore address the question of whether ECBF investments lead to a "crowding-in" of VC capital. In the analysis, we assess crowding-in on the basis of two indicators: the total amount of VC capital raised and the total number of financing rounds.

It will also be analysed whether an ECBF participation has had a positive influence on the future development of a company in that it has been able to grow faster and now has more employees than companies in which the ECBF did not have an indirect funding participation.

We check the comparability of the ECBF portfolio start-ups and the comparison group using various indicators that were available in the evaluation dataset, which are summarised in Table 2. The identification of the companies to include in the control group is based on a Propensity Score Matching (PSM) in order to further increase the comparability of the treatment and control group using statistical techniques. This approach aims at reducing potential selection effects as the ECBF deliberately invests in promising companies that are likely to be successful. However, despite this statistical intervention, it is impossible to ensure that the ECBF-financed companies and the companies included in the counterfactual group have exactly the same a priori attributes, i.e. attributes that are measured before or are assumed to be independent of their source of financing. This is because not all observable attributes of companies are actually observed in the database available to us as well as the existence of unobservable attributes that may contribute to a start-up's success but cannot be measured quantitatively.

Table 2: Attribute overview of ECBF portfolio companies and control group companies

	Portfolio companies	Control companies
Number	15	75
Dominant Sectors	Biotechnology, AgTech, Sustainability	Biotechnology, Science and Engineering, Sustainability
Geographical coverage	10 EU countries	20 countries (2 outside of EU)
Mean company age	9 years	10 years
Mean length of time until initial funding acquisition	3 years	4 years
Mean age of lead investor	19 years	20 years

Own illustration based on sample of 90 start-ups after PSM

Furthermore, the small number of active ECBF-financed companies (15) hardly allows for statistically valid conclusion as it is difficult for statistical models to detect generalisable trends over such a small population size. Therefore, the estimated results must be understood as proxies of the actual effect and interpreted with caution.

Nevertheless, the empirical analysis based on the comparability of ECBF-financed and non-ECBF-financed start-ups allows to detect important trends in the number of financing rounds of the companies and in the total investment volume that the companies were able to acquire.

4.2.2.1 Effects of an ECBF investment on the number of financing rounds

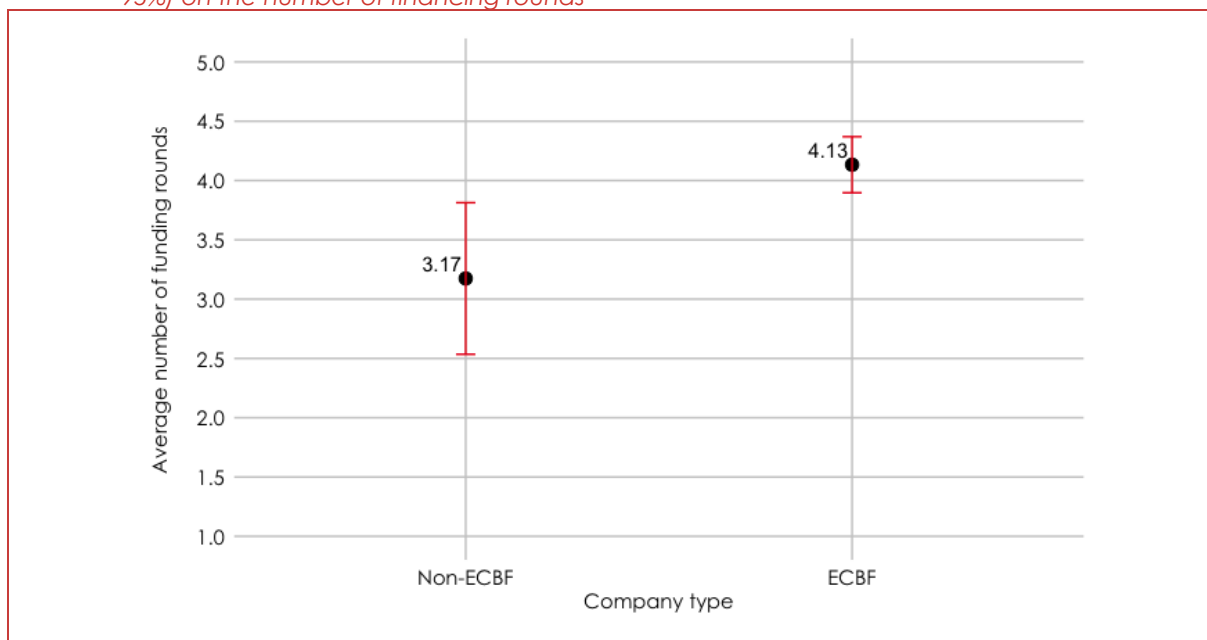
In the following, we analyse the financing rounds that were successfully completed by bioeconomy companies. We pay particular attention to the differences in the financing rounds between bioeconomy companies that were supported by ECBF funds and those that did not receive ECBF financing.

The aim of the statistical analysis is to work out whether investments by the ECBF have led to a higher number of further financing rounds than investments in which the ECBF was not involved. This analysis helps to establish an understanding of the extent to which ECBF investments promote the successful development of a start-up.

For this purpose, we use a statistical model, whose specifications are explained in detail in Appendix A.2, model 1. The model estimates the impact of an ECBF investment on the ability of companies to carry out further financing rounds. Figure 7 shows the results of the statistical analysis. While the horizontal axis differentiates between company types, "ECBF-financed companies" and "non-ECBF-financed companies", the vertical axis shows the average number of VC financing rounds conducted (as of 2024).

We observe a weak but positive effect related to the companies that were financed by the ECBF. On average, a non-ECBF-funded start-up receives 3.2 rounds of funding, while an ECBF-funded start-up raises slightly more than 4.1 rounds of funding on average. The effect size of 0.9 means that, when controlling for the control variables, **ECBF-financed companies go through approximately one financing round more on average** than the comparison group of non-ECBF-financed companies. This indicates that ECBF-financed companies appear to be in a better position to carry out follow-up financing rounds, which can be interpreted as an indicator of success for these companies or start-ups.

Figure 7: Average effect of non-ECBF financing compared to ECBF financing (confidence intervals at 95%) on the number of financing rounds



Graph shows average predictions based on Model 1 in the Appendix A.2. 95%-confidence intervals in red, based on robust standard errors.

4.2.2.2 Effects of ECBF financing on total capital raised by a company

In this section, we analyse the total investments that the bioeconomy companies were able to raise in all previous financing rounds and look at whether ECBF financing is associated with higher total investments.

Apart from the ability to maintain a flow of funding, the total volume of investment is a key indicator of success for start-ups. Table 3 shows the average and median total investment volume of the start-ups. The median value shows that 50% of the start-ups financed by the ECBF were able to raise a total investment volume of at least USD 18.6m. Due to very high upward outliers, the average value is above the median value and indicates that ECBF portfolio companies were able to acquire on average approximately USD 54.3m. In contrast, the first column of Table 3 shows that companies that have never received financing from the ECBF have significantly lower total investment volumes. The median value for these companies is around USD 2.4m and the average value is USD 16.0m. This indicates that companies in which the ECBF is involved tends to be accompanied by further investments by other investors. This finding can be seen as an initial indication but in no way as clear evidence of a crowding-in effect of an ECBF investment. This is due to the fact that this analysis is purely descriptive, and we do not yet control for characteristics such as the age of the company up to the current observation period (2024), the length of time until initial funding is acquired, and the sector in which the start-up is active. However, these factors could be crucial for successful investment acquisition. To integrate these controls, we turn to statistical modelling analysis in the next section.

Table 3: Overview of capital invested into bioeconomy start-ups in the Horizon 2020 countries compared to the ECBF portfolio companies

	Non-ECBF-financed bioeconomy start-ups (n=1,100)	Total investments in ECBF-financed bioeconomy start-ups (n=15) ²⁰	ECBF investments in ECBF-financed bioeconomy start-ups (n=16) ²¹
Average funding (in USD)	USD 15,989,800	USD 54,305,253	USD 6,048,088
Median funding (in USD)	USD 2,439,621	USD 18,558,992	USD 6,031,145

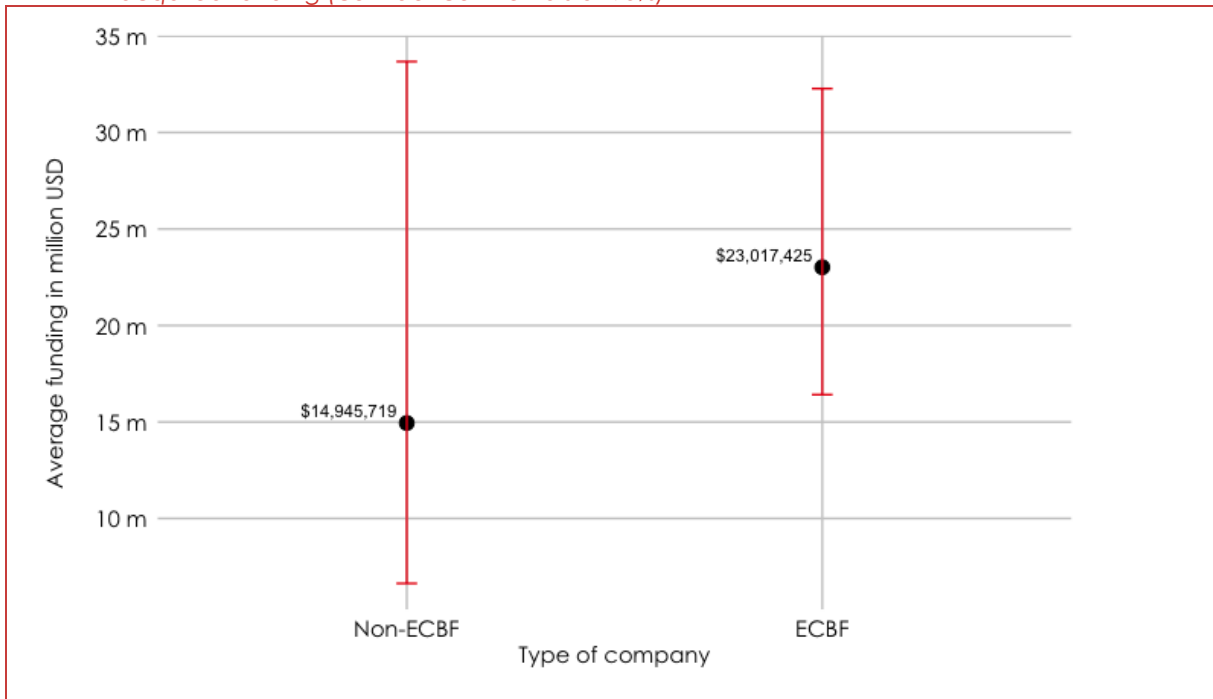
Own calculations based on evaluation dataset (columns 1 and 2) and ECBF data (column 3)

The statistical modelling analysis used to assess the effects of an investment with ECBF participation is presented in further detail in Appendix A.2, model 3. Figure 8 presents the results of the statistical estimation, which aims to analyse whether ECBF-financed companies were able to acquire higher investment sums than non-ECBF-financed companies.

²⁰ Only 15 of the 16 ECBF-financed start-ups are included in this statistic because one ECBF-financed start-up has since gone bankrupt and there is no funding data available for it in Crunchbase.

²¹ Values converted from EUR to USD based on average exchange rate in 2023 provided by European Central Bank

Figure 8: Average amount of total investment for non-ECBF-financed vs. ECBF- financed average acquired funding (confidence intervals at 95%)²²



Graph shows average predictions based on Model 3 in the Appendix A.2. 95%-confidence intervals in red, based on robust standard errors.

Contrary to our descriptive statistics, we do not observe a significant effect of ECBF-financing in terms of the total amount of investment acquired by a company. When controlling for the effects of time to initial funding, lead investor age, company age, and the sectoral focus of the start-ups, the model predicts around USD 8m higher total acquired investments on average for ECBF portfolio companies. However, this effect is not statistically significant, which is why we conclude that there is no significant effect of ECBF-financing on the amount of capital raised by a start-up. This means that ECBF involvement in the financing of a start-up is found to be **neither an advantage nor a disadvantage** for private investor engagement. We, therefore, find no statistical evidence for a crowding-in effect on the basis of the amount of financing acquired by ECBF vs. non-ECBF-financed start-ups.

5 ECBF’s effect on portfolio start-ups

This chapter focuses on the role and impact of the ECBF on its portfolio start-ups. The first part provides a descriptive overview of the ECBF portfolio. The following parts analyse the fund’s effect on the economic development of its portfolio companies as well as on the funding gap in the bioeconomy sector.

²² Note that the log-transformed predicted values were exponentiated back to the original scale for this graph.

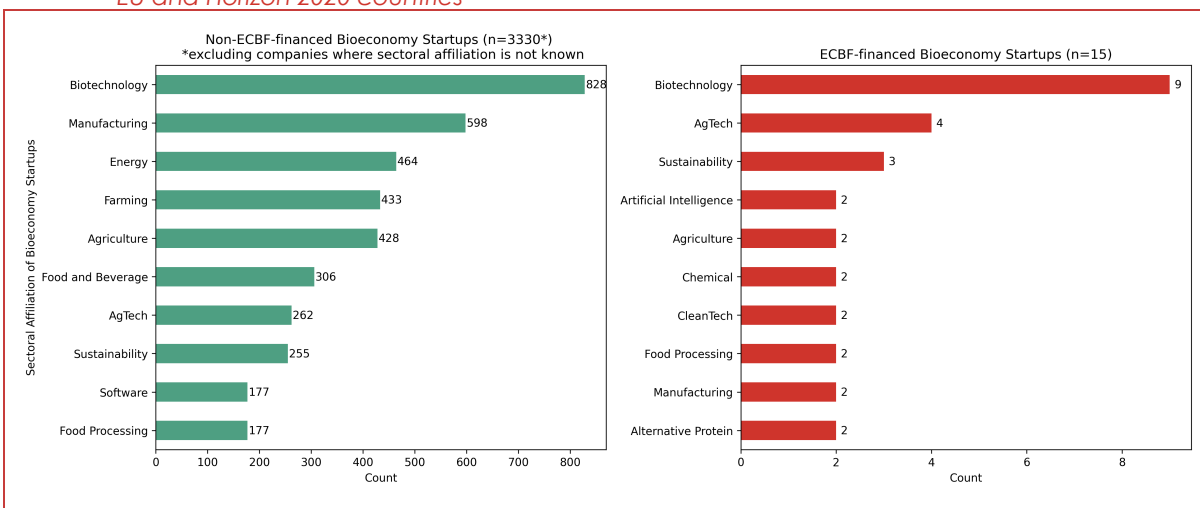
5.1 Overview of the ECBF portfolio

• Does the ECBF portfolio cover sufficiently the circular bioeconomy?

Since 2020, the ECBF invested in **16 companies** from ten different European countries. The portfolio covers the sectors packaging, personal care, agriculture, basic materials, and nutrition with applications in the agricultural (6 out of 16) and nutrition (5 out of 16) sectors accounting for the largest share. The interviewed experts also highlighted ECBF's very strong focus on the novel nutrition sector. In contrast, **forestry and aquatic sectors are not represented** in the portfolio.

To get a better idea of the business focus of the ECBF-financed start-ups in comparison to the rest of the bioeconomy sector, we compared the sectoral affiliation of the ECBF-financed bioeconomy start-ups to the rest of the identified bioeconomy start-ups shown in Figure 9. This figure reveals that both groups primarily support start-ups in the **Biotechnology** sector. Also in line with the overall trend in the field, the ECBF exhibits a focus on funding start-ups in the **AgTech** sector. While the agricultural and manufacturing sectors do appear in the top ten of sectors of the start-ups funded by the ECBF, the relative importance of these sectors seem to be higher among the non-ECBF-financed bioeconomy start-ups than in the ECBF portfolio. Conversely, the **Sustainability** sector appears relatively more frequently in the ECBF portfolio than in the rest of the bioeconomy field. While the sectors "Food and Beverage", "Farming", "Software" and "Energy" are in the top ten sectoral affiliations of non-ECBF-financed bioeconomy start-ups, these sectors do not appear frequently in the ECBF portfolio. On the other hand, the sectors "Clean Tech", "Chemical", "Alternative Protein" and "Artificial Intelligence" are found with some frequency among the ECBF portfolio companies, but do not appear at frequently in the remaining European (+H2020) bioeconomy field.

Figure 9: Sectoral distribution (Top 10) of non-ECBF-financed vs- ECBF-financed bioeconomy start-ups in EU and Horizon 2020 countries

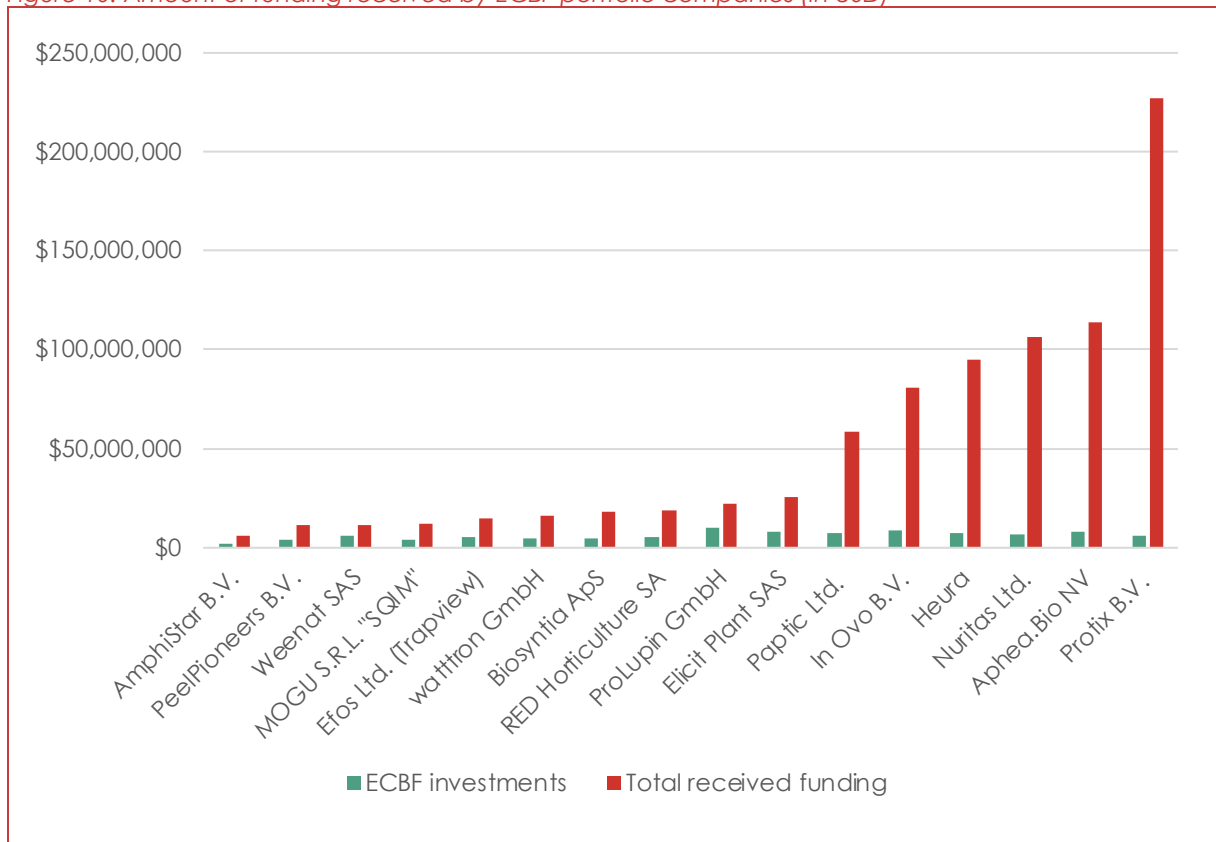


Own illustration based on evaluation dataset

One company of the portfolio is not in existence anymore. The company Prolupin, a producer of lupine-based products, **filed for insolvency** in June 2023 and has been dissolved. Any remaining assets were acquired by the Australian publicly listed company Wide Open Agriculture. Reasons included the consumer spending decrease for dairy alternatives, increased costs for energy and due to a higher price for lupin seeds and difficulties to find new investors.

From the operating portfolio companies (based on data provided by the ECBF), six portfolio companies have a revenue of EUR 0-1m, five companies reach an annual revenue of EUR 1-5m and four companies earn higher revenues. With seven companies, the majority of the portfolio has between 51 and 100 employees, two companies have between 1 and 10 employees and six companies have between 11 and 50 employees. Thus, portfolio companies are on average larger than bioeconomy start-ups in the evaluation dataset, in which 56% of the start-ups have between 1-10 employees. On average, it took the companies three years until the first funding round (which is similar to bioeconomy start-ups in the evaluation dataset), five companies received their first funding within the first year after founding. The earliest raised amount varies between USD 138,850 and USD 18,786,239 according to the evaluation dataset. The average received funding (including Prolupin) amounts to USD 52,271,174.

Figure 10: Amount of funding received by ECBF portfolio companies (in USD)



Own illustration based on evaluation dataset (for total received funding) and ECBF data (for ECBF investments)

5.2 Effect on competitiveness and economic development

- Have the portfolio companies of the ECBF performed above average with regard to other bioeconomy start-ups?
- Has the ECBF contributed to a strengthened competitiveness of European start-ups in the bioeconomy sector?

The following chapter will focus on the economic effects of an ECBF participation on the portfolio companies. For this purpose, we leverage statements from the interviews with portfolio companies as well as analyse the effects on the company size using the counterfactual

analysis described in the chapter before. Thereby, the number of employees serves as an indicator to analyse the economic growth of the company.

Based on the interviews, three portfolio companies stated that they **expanded to new markets** after the participation of the ECBF, further two companies plan to expand in the following years. One company, e.g., indicated that they established five subsidiaries abroad which would not have been possible without the funding. Particularly the US seems to be in the focus of the portfolio companies. Another company positioned their products in **new market sectors** with the help of the funding and one is planning to do so.

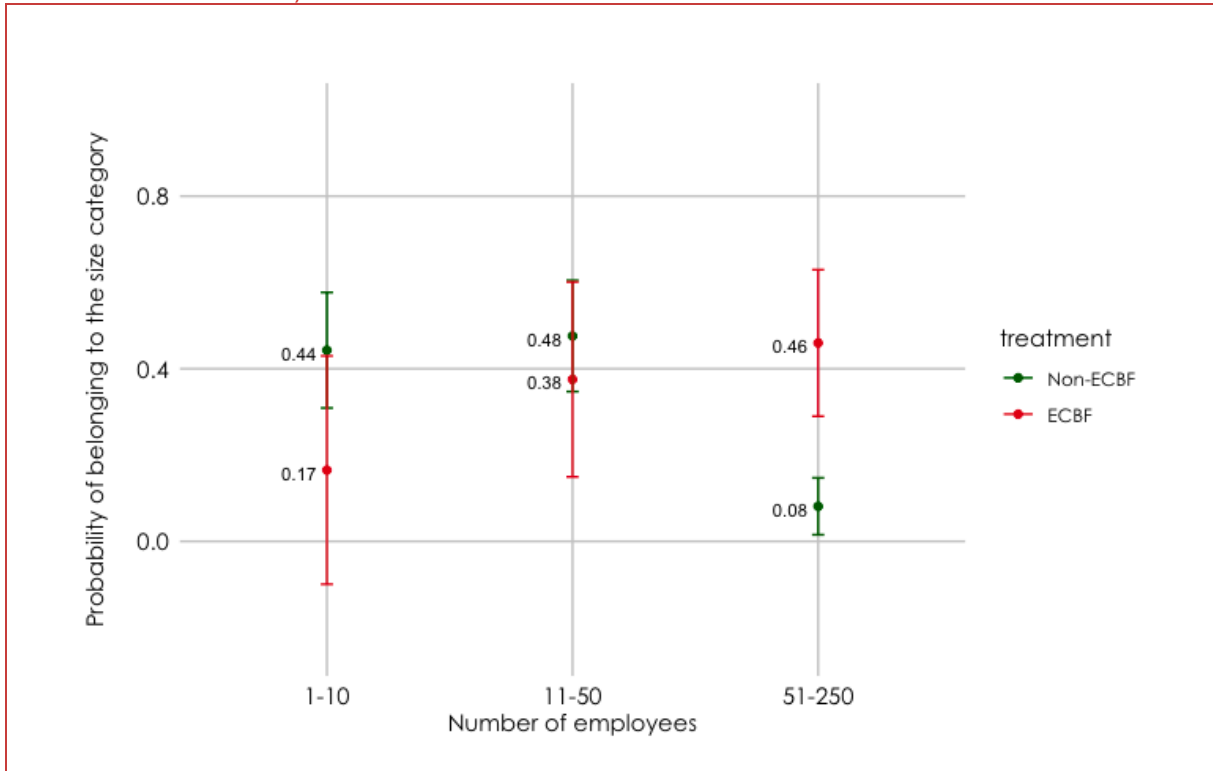
Four of the interviewed portfolio companies were able to **increase the size of employees**, only one interviewed portfolio company mentioned a decrease in the headcount. One company mentioned a large increase in turnover during the funding period, while three companies explained that they are still pre-revenue. Three companies mentioned that the ECBF helped to **professionalise the processes** and to **transition from R&D to product development**. Three companies explained that their operations would be considerably smaller in terms of FTEs and production capacities without the ECBF funding.

The positive economic development is also reflected in the descriptive statistics. The comparison of employee numbers between ECBF portfolio companies and the control group suggests that ECBF-financed companies are less likely to have a very low number of employees and more likely to have a very high number of employees than non-ECBF-financed companies. While 47% of ECBF portfolio companies have more than 50 employees, only 13% of non-ECBF-financed companies achieve such high employment figures.

The statistical model (see Appendix A.2) which has the advantage that we can control for various characteristics of the companies, such as the age of the companies, the VC investment period and the sector, confirms the trend observed in the descriptive statistics.

The results are shown in Figure 11. The horizontal axis shows the employment sizes of the companies divided into four categories. The vertical axis shows the probability of ECBF- and non-ECBF-financed companies falling into one of the specific employment categories.

Figure 11: Average effect on company size: Non-ECBF financing vs. ECBF financing (confidence intervals at 95%)



Graph shows average predictions based on Model 2 in the Appendix A.2. 95%-confidence intervals in red, based on robust standard errors.

The econometric results show that the growth of firms is only affected by an ECBF investment in large firm sizes. The estimated average marginal treatment effects show that an ECBF-financed company is more likely to reach a very large company size (51-250 employees) than companies that have not received financing from the ECBF. For small (1-10 employees) and medium-small (11-50 employees) company sizes, the differences between companies with and without having received ECBF financing are not statistically significant. These results indicate that ECBF involvement in the financing of a start-up is associated with a higher probability of the start-up achieving a large company size, but that there is no effect of ECBF-financing on its potential to grow apart from that.

5.3 Effect on the funding gap

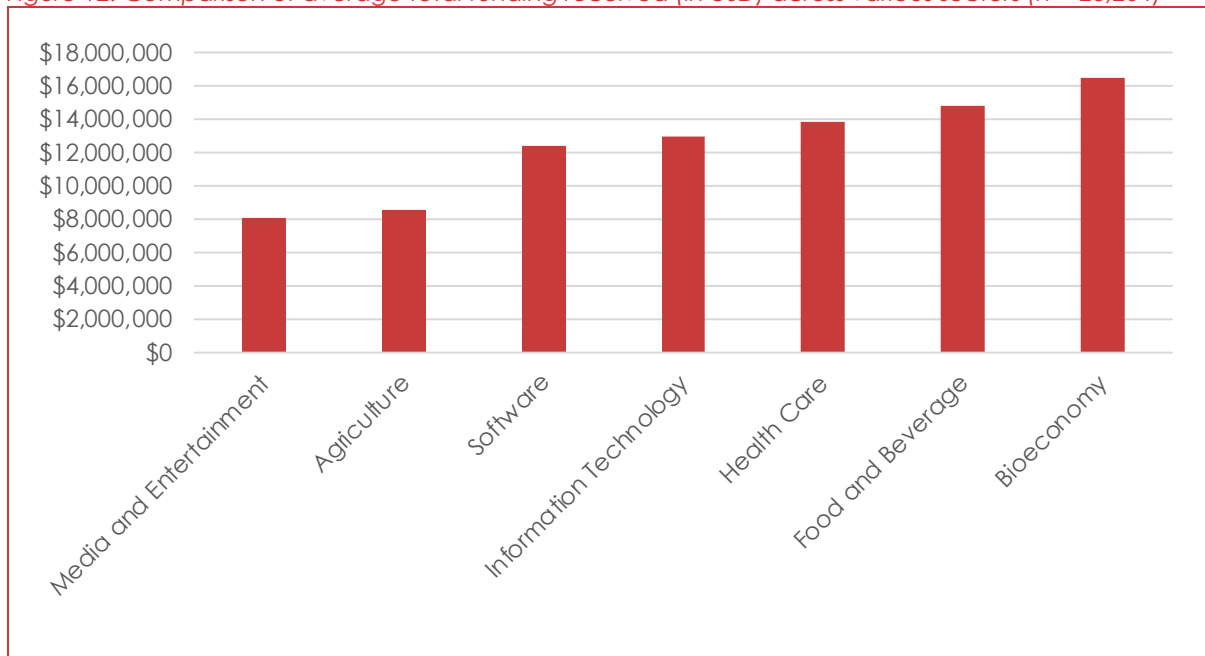
- Does the ECBF fill a funding gap for circular bioeconomy start-ups in Europe?

The bioeconomy sector has faced persistent **funding challenges**, particularly when companies attempt to scale by building first-of-its-kind plants, which are highly capital-intensive. This aligns with existing studies²³ and was confirmed by nearly all the interviewed portfolio companies. The higher capital needs are also reflected in the evaluation dataset. Start-ups classified as bioeconomy received significantly higher funding than start-ups from other sectors. Under the assumption, that the total amount of received funding reflects the capital needs of the companies, these results underline the financing challenges faced by the bioeconomy sector.

²³ EIB (2017). *Access-to-finance conditions for Investments in Bio-Based Industries and the Blue Economy*.

These companies often struggle to secure the necessary funding for physical infrastructure, which contrasts sharply with software applications, where VC investors are more active due to the potential for faster returns.

Figure 12: Comparison of average total funding received (in USD) across various sectors (n= 25,204)



Own illustration based on evaluation dataset

Many of the companies we interviewed started with crowdfunding, bootstrapping, or local public funding, demonstrating that early-stage financing tends to come from sources other than VC funds. In most cases, larger private investors participated only in subsequent funding rounds. At the growth stage, where the ECBF operates, six portfolio companies indicated that **alternative VC funds would have been available** as an option to the ECBF. However, all companies stated that looking for a new fund is a challenge, and that they are not interested in an alternative. Several start-ups also noted that, from a financial perspective, the US VC market is significantly more attractive than the European VC market. One company mentioned that the ECBF was quite important to **keep the investor base in Europe**, otherwise they would have talked also to Chinese corporates that were very interested. In fact, two companies were thinking about building the production plant outside of Europe for regulatory and financial reasons but decided against it, mainly because of the employees and the familiarity with the European market. Another company mentioned that the ECBF's leadership in their investment round was crucial in **attracting other investors**. Additionally, one company found the ECBF more trustworthy compared to investors from Asia and the Middle East, who were seen as more aggressive in their approach.

The experiences of these companies highlight the funding challenge in the bioeconomy sector, particularly for capital-intensive projects like building plants. VC funds, while crucial, often shy away from such projects, preferring sectors with quicker returns. The role of dedicated funds like the ECBF becomes essential in bridging this gap, providing not only the necessary capital but also maintaining regional investment within Europe and fostering trust among other investors. At the same time, it seems that promising start-ups have several sources of funding to rely on, which points to an improvement regarding the financing of bioeconomy companies over the last years. At the same time, there is a general slowdown in the VC and consumer

markets. Coupled with the fact that bioeconomy companies are reliant on sustainable sources of financing due to the long development cycles, there is a risk that the financing gap will widen again.

5.4 Further advantages of ECBF participation

- Are there advantages - beyond the pure capital offer - of an ECBF participation?

In the interviews, the portfolio companies were asked about advantages of an ECBF participation that go beyond the pure capital offer. The responses can be classified in four non-financial benefits that result from being an ECBF portfolio company.

Firstly, several interviewed start-ups highlight the importance of the ECBF's **network** as a crucial factor. This network helped companies to establish connections with other entrepreneurs and investors within the sector.

Secondly, several start-ups remarked an **extensive industry knowledge** of the ECBF team, particularly compared to other VC. According to the interviewees, this depth of sectoral understanding is essential for a productive cooperation given the technological complexity and long-term nature of the bioeconomy sector.

Thirdly, several interviewed start-ups reported gaining significant insights into **business operations and management** from their interactions with the ECBF team. This was particularly evident among start-ups that originated as academic spin-offs, highlighting the value of ECBF's expertise in transitioning from research to commercial ventures.

Lastly, a few start-ups emphasized that having ECBF on their cap table serves as a strong endorsement for future funding rounds. They noted that the association with ECBF enhances their **credibility** and provides a **positive reputational effect**, which facilitates subsequent financing efforts.

6 Sustainability impact of the ECBF

This chapter aims at assessing the ECBF's ESG approach in comparison to other Article 9 Funds. In addition, it looks at the alignment of the ECBF with broader sustainability policy goals and tries to analyse its sustainable impact.

6.1 SFDR disclosure and sustainable investment criteria

- Does the ESG reporting by ECBF set standards in the industry?

Through extensive desk research, we compared the publicly available SFDR documents from 20 Article 9 Funds with ECBF's SFDR Level I disclosure regarding the **sustainable investment objectives**, the **investment strategy** and the **ESG approach**. The results were validated and completed by using our internal LLM tool (for further methodological details see chapter 2). The goal of this analysis is to highlight best practices, and areas for enhancement in the ECBF's ESG reporting practices.

6.1.1 Sustainable investment objective and investment strategy

The **sustainable investment objectives** of the ECBF focus **on climate change mitigation** by investing in growth-stage companies in the bioeconomy and circular bioeconomy. This includes innovations that replace fossil resources with renewable materials and improve biomass production and feedstock conversion. At least 80% of its capital commitments are

invested in companies that contribute to climate change mitigation and adhere to good governance practices. Other funds share common goals of climate change mitigation and sustainability but differ in their specific focus areas and methodologies. While the ECBF documentation has a strong focus on measurable greenhouse gas (GHG) emissions (including scope 3 of the entire value chain), other funds, for instance, focus on reducing resource exploitation and biodiversity loss.

The ECBF demonstrates a good level of transparency in disclosing the process and outcomes of its sustainable investments. ECBF only makes its Level I disclosure publicly available. ECBF's Level II (often called the Regulatory Technical Standards) disclosures, which are much more detailed, are therefore not considered in the comparison. Only a few Article 9 Funds offer more details on the sustainability criteria of their investment strategies in their publicly available documents. 2150 provides a comprehensive overview of its sustainable investment process, including a paragraph on data sources and processing as well as data and methodological limitations. AENU categorizes investment focus into six clusters and describes the technologies applied to achieve sustainable objectives, ensuring a comprehensive understanding of their process. Furthermore, 4impact outlines its vision and objectives, emphasizing impact investing aligned with the UN's Sustainable Development Goals (SDGs), and details the Theory of Change and impact KPIs. The ECBF also provides information on how its portfolio companies align with specific SDGs. However, it has intentionally chosen not to use the SDGs as its primary framework for measuring impact. This decision stems from the fact that the SDGs were originally designed to set objectives for broad societal and economic advancement, and many associated KPIs are challenging to quantify and measure, particularly in the context of scaling start-ups within the EU and Horizon 2020 countries.

While the ECBF investments adhere to the definition of sustainable investments as outlined in Article 2(17) of the SFDR, these investments are **not assessed against** the criteria set out in the **EU Taxonomy**, since many of the ECBF's investees NACE²⁴ codes cannot be found in the Taxonomy. The ESG Due Diligence framework is based on the Taxonomy though. Planet A is the only considered fund that is Taxonomy aligned²⁵.

Overall, the investment strategy of the ECBF is **distinct in its specific focus on growth-stage companies within the European circular bioeconomy**. While the ECBF provides substantial information on its sustainable investment process and outcomes for the public, **a few other funds offer more detailed public sustainable finance reports**.

6.1.2 ESG and impact approach and methodology

The ECBF has a formalized ESG approach that integrates binding sustainability criteria into its investment decision process. This includes assessing ESG factors when building a portfolio and actively improving the ESG performance of investees.

The **due diligence process** of the ECBF is structured into **three distinct levels**, starting with an initial screening, followed by a preliminary due diligence and finally a confirmatory due diligence process. The first screening involves evaluating each potential investment for its positive contribution to environmental sustainability, including an initial assessment of GHG emissions. The fund also applies strict exclusion criteria, rejecting any activities deemed harmful. The fund uses tools like the EIB Project Carbon Footprint Methodologies and the FAO Ex-ante

²⁴ Nomenclature of Economic Activities (NACE) is a classification of economic activities developed by the European Union.

²⁵ Note, that Planet A uses a different coding framework for EU Taxonomy eligibility.

Carbon Balance Tool for thorough environmental assessments. In the preliminary due diligence phase, ECBF ensures that investment targets provide evidence of positive environmental contributions and validates key assumptions on ESG materiality. The fund conducts a "Do No Significant Harm" (DNSH) analysis, assesses Principal Adverse Impacts (PAIs) based on regulatory requirements, and evaluates governance and social practices alongside environmental impacts. Performance is compared against quantitative thresholds from industry benchmarks, and if significant negative impacts are identified, the due diligence process is discontinued. However, for some investments exceeding or falling below thresholds (depending on the PAI) of certain qualitative and quantitative mandatory PAIs may not be indicative of adverse impact and the due diligence process is still continued. This may be the case specifically for young companies with low revenue, few employees or limited access to renewable energy. Confirmatory Due Diligence further assesses ESG risks and opportunities, focusing on material sustainability indicators.

Only a few Article 9 Funds describe similarly comprehensive due diligence processes. Rubio outlines a comprehensive due diligence process consisting of eight steps including among other things qualitative review of impact risk (the risk that the causality between the proposed Theory of Change and associated impact indicators does not hold), the risk of negative externalities (the unintended negative consequences of the business model) and the risk of misalignment (the risk that the business and its impact are misaligned). The due diligence process by AENU consists of four distinct phases, focusing on various aspects of the investment. It begins with "Screening," assessing impact alignment and investment focus, followed by "Meet the Founders," which involves deeper analysis. The "Pre-Diligence" phase covers impact unit economics and market analysis, and the final "Due Diligence" phase includes legal and sustainability assessments. Other funds, include a Life Cycle Assessment with emphases other than GHG emissions, i.e., an assessment of climate and other environmental impacts associated with all stages of a product's life (e.g. Planet A) or an Impact Assessment Framework that requires an impact thesis to be drafted and reviewed (e.g. 4impact).

Within the due diligence process, the ECBF stands out with a **very structured and comprehensive PAI approach**, including additional PAIs such as 'non-recycled waste ratio' and 'non-renewable energy share. In addition, the ECBF identifies **specific sustainability risks** that may not be highlighted by other Article 9 Funds. Notably, it emphasizes Market Value Risks, such as physical and transition risks linked to climate change, reputational damage, sanctions, or shifts in consumer behaviour leading to reduced demand, as well as operational Risks, including losses due to environmental disasters, socially induced aspects related to employees or third parties, and failures in corporate governance. Furthermore, the fund provides a detailed description of the instruments that are considered in the Sustainability Risk assessment which is lacking in other SFDRs.

As part of its investment process, ECBF **collaborates with external technical experts** to evaluate the environmental performance of production processes, focusing on key PAI indicators such as GHG emissions and energy consumption. The second due diligence level, for instance, also includes an external verification of the GHG emissions (including **Scopes 1, 2 and 3 emissions and GHG savings**) **resulting in a report** provided by the nova-Institute, which is specialized in environmental innovation research. Hence, the fund has third party expert reports on the GHG emissions of the entire value chain of each portfolio company. Similarly, other funds do incorporate third-party audits or assessments to verify their sustainability claims, however, not all funds mention third-party involvement or not as extensively.

In summary, while methodologies vary, all Article 9 Funds share a commitment to contribute to a social or environmental objective, to comply with minimum social safeguards, and adhering

to comprehensive due diligence (including a DNSH analysis) and monitoring practices. Yet, the ECBF stands out with a very structured due diligence process including an extensive PAI assessment that includes external verification for GHG emissions.

6.2 ECBF's impact on carbon footprint

- Do the activities of ECBF contribute to the EU priorities on environment and climate?
- Do activities of ECBF promote circular paradigms in the bioeconomy?

The ECBF contributes to **the EU's sustainability goals** by supporting innovations that promote circular economy principles, reduce greenhouse gas (GHG) emissions, and foster sustainable resource use. The ECBF is thereby aligned with the **EU's Bioeconomy Strategy**, which is in turn crucial to the implementation of the **Green Deal**. Additionally, ECBF promotes compliance with EU environmental regulations and integrates ESG factors, ensuring that portfolio companies contribute positively to the EU's climate and sustainability objectives.

The ECBF also **contributes to multiple SDGs** through its investment strategy. It directly supports SDG 13 (Climate Action) by reducing greenhouse gas emissions. Additionally, the fund promotes disruptive innovations that foster sustainable production (SDG 12), economic growth, and job creation in value-added sectors (SDGs 8 and 9). The diverse business models of bio-industries supported by ECBF also align with various SDGs. For example, food tech innovations can enhance food security and nutrition (SDGs 2 and 3), while other companies work to mitigate environmental impacts on water, air and land (SDGs 14 and 15). The focus on circular technologies and resource efficiency strengthens sustainable consumption and production patterns (SDG 12) and contributes to building resilient and sustainable communities (SDG 11).

The publicly available **ECBF Impact Insights 2023** state that approx. 53% of GHG emissions were saved compared with conventional products. However, the report does not provide information on the absolute savings. Furthermore, approx. 45% of the portfolio companies' energy supply is renewable, 52% of the companies optimised their waste management and 27% of companies optimised their sourcing of raw materials. The impact results are **not contextualized** against broader industry benchmarks.

7 Funding efficiency and processes

- Are the ECBF's processes efficient and in line with industry standards?

In the interviews, we asked the portfolio start-ups to rate ECBF's funding processes and requirements.

Almost all portfolio start-ups rate the **competence** of ECBF managers as **very high**, and positively emphasize the personal relationship with their own investment manager.

Four companies stated that the **documentation requirements** by the ECBF are **fairly standard** and do not significantly differ from other funds. The same number of companies stated that the **documentation is a burden**, particularly **for young companies** that have limited personnel resources. However, companies also see the purpose of comprehensive documentation and to some extent it is also seen as a strength, as it helps them to improve their own processes. One company said the documentation is substantially higher compared to other funds. In particular, the documentation requirements are criticized for being partly not relevant for start-ups that do not even have a product in the market. Another company stated that the reporting became leaner and more pragmatic over time.

Criticism was occasionally voiced regarding the speed with which inquiries were processed, and the duration of the **participation process** as a whole was considered to be rather **lengthy**. Nevertheless, all portfolio companies have indicated that they **would recommend** the ECBF as an investor to other companies.

Overall, the statements by the portfolio companies confirm that the ECBF's funding requirements are in line with industry standards. However, it is also evident that the documentation standards represent a burden, especially for young companies. Although processes and conditions may take longer and be more demanding compared to some other investors, start-ups can benefit from the extensive experience of the ECBF managers.

8 Conclusions and recommendations

8.1 Conclusions

Impact on supply side

- Which role does the ECBF play in the European bioeconomy VC landscape?
- Has the ECBF facilitated the entry of new players (private or public) into the bioeconomy and is there evidence of a crowding-in effect of private capital?
- To what extent does the ECBF contribute to reducing risk for innovative technologies, processes, or business models within the bioeconomy?
- What are the medium- to long-term effects of ECBF investments on the venture capital landscape within the bioeconomy sector, particularly regarding the supply of capital?

As one of the few growth VC funds in Europe dedicated to the bioeconomy, the ECBF contributes to **addressing the funding gap** for bio-based innovations. By providing growth-stage financing, it has supported companies that receive too little support from VC investors due to the bioeconomy's capital-intensive nature and long development cycles.

Despite **growing interest from both public and private sectors**, the **bioeconomy VC market in Europe remains relatively small**, especially compared to the US. The sector experienced a boost during 2020 and 2021, particularly in biotech and food-tech, but has recently decreased in volume. Initially supported by EIB funding, the ECBF has since positioned itself as a **significant player within the bioeconomy VC space**. The fund's size is comparable to other VC funds in the sector, and interviews reveal that it enjoys a strong reputation. Estimating the available funding potential for growth-stage bioeconomy start-ups in Europe at around EUR 2bn, ECBF makes up roughly 15% of this sum, highlighting its relevant role in the bioeconomy growth market.

The private-to-public capital ratio that measures the share of private investments compared to the public investments (considering cumulative capital raised) stands at 12.3, indicating that **for every euro of public investment, EUR 12.30 of private capital has been leveraged**. However, given the ECBF's relatively short operational period, it is difficult to establish a direct link between the ECBF's activities and increased private investment in the bioeconomy. Thus, the extent of the **crowding-in effect cannot yet be fully assessed**. While the ECBF has successfully raised private capital, including from institutional and private equity investors from several countries, the majority of commitments stem from German investors.

The bioeconomy growth investment landscape is marked by collaboration rather than competition, with private investors often pooling resources to finance high-risk, capital-intensive projects. Bioeconomy growth funds compete in the fundraising rather than in the investment

space. In this context, the ECBF acts as a **mediator**, facilitating funding rounds by co-investing alongside other private investors. Given the small market volume in later-stage/growth VC for bio-based applications in Europe and the small competition in later-stage bioeconomy investments, ECBF appears to **fulfil the criterion of additionality**.

In the medium to long term, with all funds deployed, ECBF investments will likely have an impact on the bioeconomy VC landscape. The fund not only addresses the current funding gap but also sets a precedent for future funds focused on sustainable and circular bioeconomy ventures. As the ECBF matures and its portfolio companies succeed, it **could boost investor confidence** and gradually expand the bioeconomy VC market. Public incentives and regulatory changes, such as policies promoting green investment and carbon neutrality, will be crucial in further expanding this market.

In conclusion, the ECBF plays a role in advancing the European bioeconomy by investing in innovative companies, reducing risks for investors, and fostering collaboration. However, its long-term impact on significantly expanding the VC market will depend on broader policy support and market evolution.

Impact on demand side

- Does the ECBF portfolio cover sufficiently the circular bioeconomy?
- Have the portfolio companies of the ECBF performed above average with regard to other bioeconomy start-ups?
- Has the ECBF contributed to a strengthened competitiveness of European start-ups in the bioeconomy sector?
- Does the ECBF fill a funding gap for circular bioeconomy start-ups in Europe?
- Are there advantages - beyond the pure capital offer - of an ECBF participation?

Given the circular and bioeconomy scope, ECBF portfolio **spans several sectors**, including agriculture, nutrition, packaging, basic materials, and personal care. However, while it has a strong presence in more established sectors such as nutrition and agriculture, other critical areas of the circular bioeconomy, like the **blue economy, forestry** and the **chemical sector**, are **so far underrepresented**. The chemical industry, in particular, is essential for transitioning from fossil-based to bio-based production. The limited representation of some sectors suggests that the ECBF may not fully cover the (circular) bioeconomy yet, however, we understand that there is an investment in advanced due diligence coming from the bio-based chemical industry

Qualitatively, ECBF portfolio companies have shown **positive economic development**, partly driven by ECBF's funding. However, many of these companies had already secured funding before ECBF's involvement, suggesting their performance cannot be solely attributed to the fund. Quantitatively, there is no significant statistical evidence that ECBF portfolio companies outperform comparable bioeconomy start-ups, although there is a **tendency for ECBF-backed companies to experience faster growth**. However, the lack of statistical effects is likely due to the small number of companies in the portfolio, making it difficult to draw robust comparisons.

In addition, the ECBF provides **several advantages beyond just capital**. Portfolio companies benefit from enhanced networks, increased industry knowledge, management advice, and greater credibility. These non-financial supports are particularly valuable during subsequent funding rounds, helping companies secure additional investment and grow more effectively.

Interviews indicate that while **funding challenges remain**, new market players and policy measures have helped alleviate some of the risks for innovative business models. Although the ECBF is a valuable source of financing for its portfolio companies, its size limits its ability to substantially strengthen the competitiveness of the entire European bioeconomy sector on its own. This is especially so because of the high capital expenditures required for starting industrial production in some of the start-ups. Overall, the fund is not large enough to fully address the broader funding gap in the European bioeconomy sector which still requires additional capital from other sources.

In conclusion, while the ECBF **contributes to supporting bioeconomy start-ups**, it does **not entirely cover all sectors** of the circular bioeconomy **nor fully close the funding gap**. However, it offers crucial benefits beyond financing, which contribute to the growth and competitiveness of its portfolio companies.

Impact on sustainability

- Does the ESG reporting by ECBF set standards in the industry? Do the activities of ECBF contribute to the EU priorities on environment and climate?
- Do activities of ECBF promote circular paradigms in the Bioeconomy?

The ECBF follows a **unique investment strategy** with its focus on the circular bioeconomy and is thereby **aligned with broader sustainability goals**, including the Green Deal and SDGs, yet the fund is not taxonomy aligned. While other funds consider broader sustainability aspects in their reporting, the ECBF has a strong focus on the reduction of GHG emissions.

While the ECBF impact Insights report provides important information on the sustainable impact of the fund and its activities, it provides only limited information on the applied methods and **does not compare results with other funds**.

Overall, the fund stands out with a **very structured and comprehensive ESG approach** including an extensive PAI assessment. However, the interviews did not lead to any conclusions that other investors follow this approach.

8.2 Recommendations

To continue ECBF's impactful contribution to the bioeconomy sector, there are a few aspects of its operations that should be maintained and strengthened and others that could be added to further increase its impact.

1. To broaden its impact, ECBF should **further expand its sectoral focus** beyond the agriculture and nutrition sectors to areas with a stronger decarbonisation potential such as the chemical industry. The marine and aquatic sectors similarly offer immense potential for sustainable growth and circular economy, that could be further explored by the ECBF. Furthermore, a geographic expansion of the portfolio offers the potential to harvest regional bioeconomy potentials, such as in southern or eastern Europe.
2. There is a need to better **support high-potential start-ups in the bioeconomy sector that face significant funding gaps**, particularly those with large capital needs for scaling. The fund should continue to actively target this underserved group, in order to fill a critical gap in the bioeconomy's innovation pipeline. There might also be a limit for VC to close the investment gap in bioeconomy companies and a need to **apply blended finance approaches** involving debt finance and grants/subsidies, especially with regard to funding large capital expenditures such as fermenters or plants.

3. ECBF provides more than just financial support to the start-ups. It offers hands-on support to its portfolio companies, enhancing their strategic growth and operational capacity. This **personalized engagement** is crucial for the development of young, innovative bioeconomy firms. The ECBF should continue to **offer tailored guidance**, e.g., on scaling, market penetration, and navigating regulatory hurdles, to ensure that the portfolio companies can maximize their growth potential. In addition, by connecting the start-ups with established players in the bioeconomy, the ECBF can help its portfolio companies accelerate partnerships, collaborations, and access to new markets.
4. While the ECBF has gained recognition within the bioeconomy sector, it should work further towards **increasing its visibility and positioning itself as a key player in the broader European VC ecosystem**. For instance, it could leverage more press opportunities and show stronger presence at traditional VC events to promote the (circular) bioeconomy as an attractive and viable investment area. In this context, the ECBF has successfully organized events such as the ECB Forum as well as deep dives for Limited Partners. The ECBF should build on this and strengthen networking activities to inform other (potential) investors about the bioeconomy and its potential.
5. The fund's commitment to extensive ESG assessments ensures that investments are made with a long-term, sustainable perspective. This practice not only enhances the fund's credibility but also drives the industry towards more responsible and ethical standards. The ECBF should **maintain its high standards in assessing the environmental and social impact** of prospective companies, ensuring that only those aligned with circular economy principles receive support. However, detailed **impact reports published** by the ECBF could further enhance transparency and set standards for the industry. In addition, to provide greater insight into the ECBF's sustainability outcomes, its impact results should be contextualized against broader industry benchmarks. A comparative framework to assess how ECBF's portfolio companies perform in terms of sustainability and circular economy contributions relative to other funds, both within and outside the bioeconomy, could also be an important asset for the portfolio companies.

Appendix

A.1 List of Article 9 Funds

Article 9 Funds
2150 Urban Tech Sustainability Fund II
4impact Fund II Coöperaef U.A. (4impact)
AENU Fund SCA SICAV-RAIF
Ananda Impact Ventures Fund III
Astanor GHVI-S2 SCSp
Extantia Climate Flagship II
Future Energy Ventures Fund I
Green Code Ventures
Meaningful Impact High Yield (Norselab)
Mustard Seed Maze
Next Technology Ventures II (Axon)
NLC Health Impact Fund
NVC Fund 2 (Norrskén)
Pale Blue Dot I AB
Planet A. Ventures
Rubio Impact Fund II Coöperatie U.A.
Seaya Andromeda Sustainable Tech Fund
Tilia Impact Ventures Fund II
Circular Economy Transition fund (una terra)
WF World Fund I

A.2 Quantitative Analysis

A.2.1 Building a Bioeconomy Classifier

To identify bioeconomy firms within a dataset of 36,839 companies at various funding stages (from seed to Series F) in the EU as well as the associated countries of the H2020 regulation, we utilized firm descriptions from the Crunchbase database. These firm descriptions served as the primary textual input for building a machine learning classifier capable of determining whether a firm operates within the bioeconomy sector.

The first step involved the creation of a so-called **golden dataset**, which consisted of 2,000 firms, which were initially classified based on a few-shot model on whether the respective firm engages in the bioeconomy sector. As feed-in texts, we used the firms' descriptions provided via the Crunchbase database. Based on this initial classification, our experts assessed each classification manually and if necessary, rendered the label to whether the firm belongs to the bioeconomy or not. This manually curated dataset became the ground truth for training the classifier. Next, we pre-processed the firm descriptions using natural language processing (NLP) techniques. This preprocessing included steps such as tokenization, lowercasing, and the removal of stop words. More advanced techniques, such as sentence segmentation, were also applied to ensure consistent input to the classification model. We then developed a classifier

based on the BERT (Bidirectional Encoder Representations from Transformers) model, which was fine-tuned specifically for this text classification task. BERT, a pre-trained transformer model known for its contextual understanding of language, was chosen due to its ability to capture nuanced meanings within firm descriptions—an essential feature for differentiating bioeconomy firms from others. On top of the **BERT model**, we employed a **neural network** to handle the actual classification task. The classifier was trained on the manually labelled golden dataset, which was divided into training and validation sets. Using categorical cross-entropy loss, the model learned to distinguish between bioeconomy and non-bioeconomy firms. After training, the model was evaluated using accuracy as the primary performance metric. The classifier achieved an **accuracy of 96%**, demonstrating a high level of precision in identifying bioeconomy firms.

A.2.2 Econometric Analysis

The **econometric analysis** aims to assess the effects of financing through the ECBF on the current performance of portfolio companies. The core of this **control group analysis** is to compare the effects of different types of investors, including the ECBF, on the development of German bioeconomy start-ups. We do this by setting up a control group of start-ups the ECBF has not invested in, which is drawn from the previously identified start-ups engaging in bioeconomic topics. The process of identifying which start-ups to include in the control group is important for the reliability of the estimates obtained from the regressions conducted as part of the control group analysis. This is because the causal relationship these statistical estimates measure is complicated by **selection effects**. These effects arise from the specific criteria companies must meet to qualify for ECBF investments, as well as the decision criteria used by the ECBF. Since these decisions are not randomized, the condition of a company can influence whether it receives ECBF funds, making it challenging to estimate causal effects through simple regressions.

A.2.2.1 Propensity Score Matching

To address the challenge of estimating causal effects, we use **Propensity Score Matching (PSM)** to select our control group. This statistical method matches the start-ups in the ECBF's portfolio with the most similar start-ups that have not obtained funding from the ECBF. The aim is to facilitate a comparison of the group of ECBF-financed and non-ECBF-financed companies that are similar in all aspects except whether they received ECBF-financing or not. The PSM matching is based on a vast set of different attributes of the start-ups to assure the robustness of the comparison. These attributes include the key sectors the start-ups operate in, the age of the start-up, the length of time until the start-ups acquired their first funding, and how established their lead investor was at the time of investment. This method minimizes selection effects, but it is limited by the Conditional Independence Assumption (CIA). CIA requires that all covariates influencing the likelihood of receiving ECBF financing are measurable and included in the analysis. However, factors like the quality of a business idea or the founder's personality, which likely influence ECBF's decisions, are not quantifiable. Therefore, we can only control for observable variables, leaving some selection effects unaddressed, which limits the causal interpretation of the results.

A.2.2.2 Control Group Analysis

Once we selected our control group using PSM, we use the matched companies as a comparison group in our regression models to estimate the effect of ECBF funding on key performance indicators of start-ups, such as the number of employees, as an indicator for the companies' growth, or their success in obtaining funding.



The following models are used to estimate:

The current number of funding rounds (Model 1),

The final portfolio company size (Model 2),

The current total amount of VC funds raised (in USD) (Model 3),

The dependent variables (company performance indicators) used in these three models are measured as of "today" or the most recent entry for the company in Crunchbase or in the ECBF database. The following equations were used for models 1-3, using "t" for the current period:

Model 1:

$$\text{Number_of_funding_rounds}_i = \beta_0 + \beta_1 \cdot \text{ECBF_funded}_i + \beta_2 \cdot \text{Green_indicator}_i + \beta_3 \cdot \text{Employee_count}_i + \beta_4 \cdot \text{Time_until_first_investment}_i + \beta_5 \cdot \text{Company_age}_i + \beta_6 \cdot \text{Leading_investor_age}_i + \beta_7 \cdot \text{Category_Biotechnology}_i + \beta_8 \cdot \text{Category_Agriculture}_i + \beta_9 \cdot \text{Category_Sustainability}_i + (\beta_{10} \cdot \beta_{11} \cdot \text{ECBF_funded}_i \cdot X_i) + \varepsilon_i$$

The first Generalized Linear Model (GLM) is estimating the relationship between the number of funding rounds a start-up has received and a set of explanatory variables, with a special focus on how the **treatment "ECBF funded"** (whether a start-up received ECBF funding) interacts with several other factors. The model controls for a green indicator (green orientation is classified as "green" or "non-green" using company descriptions), the number of employees, the time that has passed until first investment in the company, the age of the company and the leading investor as well as for the categories biotechnology, agriculture and sustainability. Additionally the term $\beta_{10} \cdot \beta_{11} \cdot \text{ECBF_funded}_i \cdot X_i$ represents the interaction term between treatment and each of the control variables.

Model 2:

$$\text{Company_size}_i = \beta_0 + \beta_1 \cdot \text{ECBF_funded}_i + \beta_2 \cdot \text{Green_indicator}_i + \beta_3 \cdot \text{Time_until_first_investment}_i + \beta_4 \cdot \text{Company_age}_i + \beta_5 \cdot \text{Leading_investor_age}_i + \beta_6 \cdot \text{Category_Biotechnology}_i + \beta_7 \cdot \text{Category_Agriculture}_i + \beta_8 \cdot \text{Category_Sustainability}_i + (\beta_{10} \cdot \beta_{11} \cdot \text{ECBF_funded}_i \cdot X_i) + \varepsilon_i$$

The second GLM is estimating the relationship between the company size (measured by the number of employees) and a set of explanatory variables, with a special focus on how the **treatment "ECBF funded"** (whether a start-up received ECBF funding) interacts with several other factors. The model controls for a green indicator, the time that has passed until first investment in the company, the age of the company and the leading investor as well as for the categories biotechnology, agriculture and sustainability. Additionally the term $\beta_{10} \cdot \beta_{11} \cdot \text{ECBF_funded}_i \cdot X_i$ represents the interaction term between treatment and each of the control variables.

Model 3:

$$\text{Log}(\text{Total_funding}_i) = \beta_0 + \beta_1 \cdot \text{ECBF_funded}_i + \beta_2 \cdot \text{Green_indicator}_i + \beta_3 \cdot \text{Time_until_first_investment}_i + \beta_4 \cdot \text{Company_age}_i + \beta_5 \cdot \text{Leading_investor_age}_i + \beta_6 \cdot \text{Category_Biotechnology}_i + \beta_7 \cdot \text{Category_Agriculture}_i + \beta_8 \cdot \text{Category_Sustainability}_i + (\beta_{10} \cdot \beta_{11} \cdot \text{ECBF_funded}_i \cdot X_i) + \varepsilon_i$$

The third GLM is estimating the relationship between the (log) total received funding in USD and a set of explanatory variables, with a special focus on how the **treatment "ECBF funded"** (whether a start-up received ECBF funding) interacts with several other factors. The model controls for a green indicator, the time that has passed until first investment in the company, the age of the company and the leading investor as well as for the categories biotechnology, agriculture and sustainability. Additionally the term $\beta_{10} \cdot \beta_{11} \cdot \text{ECBF_funded}_i \cdot X_i$ represents the interaction term between treatment and each of the control variables.



These models are used to estimate the average predicted number of funding rounds, company size and total funding for start-ups that received the ECBF funding versus start-ups that received no ECBF funding.

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