European Commission

Partnership Evaluation Report: **Circular Bio-Based Europe Joint Undertaking**

Horizon Europe and the Green Transition Interim evaluation support study

Independent Expert Report

Research and Innovation

Partnership Evaluation Report: Circular Bio-Based Europe Joint Undertaking

European Commission
Directorate-General for Research and Innovation
Directorate C — Clean Planet
Unit C.1 — Strategy, policy coordination & urban transitions
Contact Thomas Schubert (DG RTD), Veera Natunen (DG RTD)
Email Thomas.SCHUBERT@ec.europa.eu
RTD-G2-SUPPORT@ec.europa.eu
RTD-PUBLICATIONS@ec.europa.eu
European Commission
B-1049 Brussels

Manuscript completed in June 2024

This document has been prepared for the European Commission, however it reflects the views only of the authors, and the European Commission shall not be liable for any consequence stemming from the reuse.

PDF	ISBN 978-92-68-19827-8	doi:10.2777/636121	KI-02-24-844-EN-N

Luxembourg: Publications Office of the European Union, 2024

© European Union, 2024

The reuse policy of European Commission documents is implemented by Commission Decision 2011/833/EU of 12 December 2011 on the reuse of Commission documents (OJ L 330, 14.12.2011, p. 39). Unless otherwise noted, the reuse of this document is authorised under a Creative Commons Attribution 4.0 International (CC BY 4.0) licence (https://creativecommons.org/licenses/by/4.0/). This means that reuse is allowed provided appropriate credit is given and any changes are indicated.

For any use or reproduction of elements that are not owned by the European Union, permission may need to be sought directly from the respective rightholders. The European Union does not own the copyright in relation to the following elements:
Image credits for cover page and throughout: © ivector #235536634 #249868181 #251163013 #266009682, #273480523 #362422833 #241215668 #244690530 #245719946 #251163053 #252508849, 2020. Source: Stock.Adobe.com.

EUROPEAN COMMISSION

Partnership Evaluation Report: **Circular Bio-Based Europe Joint Undertaking**

Horizon Europe and the Green Transition Interim evaluation support study

Fraunhofer Institute for Systems and Innovation Research ISI

2024 Directorate-General for Research and Innovation EN

Table of contents

PARTNERSHIP EVALUATION REPORT: CIRCULAR BIO-BASED EUROPE JOINT UNDERTAKING 3

1. Executive Summary 3

2. Key definitions, acronyms and glossary 4

3. Introduction 6

3.1. Purpose and Scope 6

3.2. Methodology 6

3.3. Background of BBI JU / CBE JU 7

3.4. Governance of CBE JU 8

3.5. Transition from the BBI JU to the CBE JU 10

3.6. Intervention Logic 12

4. Implementation state of play 14

4.1. Thematic structure of R&I activities 14

4.2. Project portfolios: Horizon 2020 & Horizon Europe 16

4.3. Project type and geographical distribution 19

4.4. Other activities 22

5. Findings 23

5.1. Relevance 23

5.2. Coherence 24

5.3. Efficiency 25

5.4. Effectiveness 27

5.5. EU added value 29

5.6. Additionality 31

5.7. Directionality 32

5.8. International positioning and visibility 33

5.9. Transparency & Openness 34

5.10. Phasing out preparedness 37

6. Conclusions 38

7. Lessons Learned and Recommendations 40

8. Annex 43

A8.1 Supplementary evidence: Results 43

A8.2 Sources 50

PARTNERSHIP EVALUATION REPORT: CIRCULAR BIO-BASED EUROPE JOINT UNDERTAKING

FH-ISI: Fraunhofer Institute for Systems and Innovation Research, Version No 2

1. Executive Summary

This report analyses the Partnership Circular Bio-Based Europe Joint Undertaking (CBE JU) and its predecessor “Bio-Based Industries Joint Undertaking (BBI JU)” under the criteria of relevance, coherence, efficiency, effectiveness, EU added value, additionally, directionality, international positioning and transparency and openness of the implementation of the partnership in relation to the Horizon 2020 and Horizon Europe objectives targeting a Green Transition. The assessment focuses on the operational and strategic facets of the organization, its overall societal, economic, and environmental impact, and the implications of its transformation on the broader bio-based economy. In the current time marked by escalating emphasis on sustainability, understanding the dynamics of this transition is crucial as it showcases the pivotal role of the BBI/CBE JU in driving and fortifying a thriving, circular bio-based economy across Europe.

The BBI/CBE JU is an innovative public-private partnership model that serves as the cornerstone of the European Union's bio-based economy. With its distinctive structure and evolving focus in the CBE compared to BBI, a further alignment to EU's objective of achieving a green transition in Europe has been managed, by focusing on environmental objectives related to primary production and use of bio-resources as well as fostering circularity concepts and developments. Therefore, the strategic orientation of the organization is in harmony with the broader policy objectives of the EU, especially the European Green Deal and the EU Bioeconomy Strategy. Its endeavours are instrumental in bolstering sustainable and inclusive growth, thereby demonstrating the indispensable role it plays within the European Union's economic and environmental landscape.

This assessment mainly focuses on the current implementation of the CBE. However, concerning project achievements, the projects of the BBI JU are investigated in more-depth, as the first projects for CBE have not started during the period of analysis. The assessment provides several crucial insights across a variety of aspects. The BBI/CBE JU's operational structure has yielded significant impacts, with a prime example being the creation of various novel cross-sector interconnections within the bio-based sector, a clear indication of high operational efficiency. Moreover, the organization's steadfast commitment to transparency and openness has been noteworthy. This commitment is evident through its encouragement of the active participation of a diverse range of entities, particularly SMEs, in their programs. However, alongside these accomplishments, there remain a few areas for improvement. These include alignment and coherence with other relevant framework programs, building a stronger narrative around bioeconomy, added value of bio-based products for the customers, and further upscaling bio-based products. Addressing these concerns may be helpful for ensuring the continued advancement of the bio-based economy.

A host of valuable lessons were derived through the course of this assessment. These include the efficacy of the structure and the partnership model. The assessment underscored the importance of robust communication strategies and stakeholder engagement mechanisms in achieving the organization's objectives. It also highlighted the necessity for

agility and responsiveness within the BBI/CBE JU, given the brisk pace of technological advancements and the dynamic policy landscape in the bio-based economy. Moreover, there is a crucial role of seamless integration of the organization's initiatives with other EU policies and activities, and the significance of ensuring inclusive participation across all strata of society in achieving BBI/CBE JU's objectives. In light of the insights garnered, a set of recommendations are proposed to address the identified challenges and seize emerging opportunities.

More generally, the transition from the BBI JU to the CBE JU marks a significant chapter in the unfolding narrative of Europe's bio-based economy. This transition symbolizes an essential paradigm shift in bolstering a sustainable and circular bio-based economy. As the steward of Europe's bio-based economy, the future role of the CBE JU is set to be even more instrumental. It has the potential to shape a future wherein the bio-based economy contributes substantially to the prosperity of Europe and the resilience of its environment, forging a sustainable, inclusive, and economically viable pathway forward.

2. Key definitions, acronyms and glossary

AGRI	Directorate General for Agriculture and Rural Development
AWP	Annual work programme
BBI	Bio-based industries
BBI JU	Bio-Based Industries Joint Undertaking
BIC	Bio-based Industries Consortium
CBE	Circular Bio-Based Europe
CBE JU	Circular Bio-Based Europe Joint Undertaking
CEO	Chief executive officer
CSA	Coordination and support action
DEMO	Demonstration project
EC	European Commission
EIB	European Investment Bank
EIP-AGRI	European Innovation Partnership for Agricultural Productivity and Sustainability
EIT	European Institute of Innovation and Technology
EU	European Union
FLAG	Flagship project

HES	Higher or secondary education establishments
H2020	Horizon 2020
IA	Innovation action
JU	Joint undertaking
KBBE	Knowledge-based bioeconomy
KPI	Key performance indicator
MAP	Multi-annual programming
NGO	Non-governmental organisation
OA	Open access
PRC	Private for-profit entities
PRIMA	Partnership for Research and Innovation in the Mediterranean Area
REC	Research organisation
RIA	Research and innovation action
R&I	Research and innovation
SME	Small and medium-sized enterprise
SRIA	Strategic Research and Innovation Agenda
TRL	Technological readiness level
UK	United Kingdom
US	United States

3. Introduction

3.1. Purpose and Scope

This partnership progress report on the public-private partnership “Bio-Based Industries Joint Undertaking (BBI JU)/Circular Bio-Based Europe Joint Undertaking (CBE JU)” is part of the ex-post evaluation of Horizon 2020 (H2020) and the interim evaluation of Horizon Europe activities related to a green transition. This progress report focuses on timeframe of H2020 (i.e. 2014-2020) and Horizon Europe (i.e. since 2021).

The partnership progress report aims to provide an overview on the background of BBI JU and CBE JU, implementation state of play, evidence on the relevance, coherence, effectiveness, European Union (EU) added value, transparency and openness, and efficiency of the implementation of the partnership in relation to the H2020 and Horizon Europe objectives targeting a Green Transition. Additional evaluation dimensions will include the directionality of the partnership, the international positioning and visibility, of the partnerships.

3.2. Methodology

The partnership progress report follows the principles of a case study analysis and comprises a mixed method approach of both quantitative and qualitative data analysis.

The quantitative data analysis comprises an analysis of the project portfolio of the institutionalised partnership based on eCorda. The time horizon covered with the analysis is 2014 – July 2023.

The qualitative analysis comprises desk research activities and text analysis of the partnership strategic documents and existing monitoring, progress and evaluation reports, etc., provided by the partnership.

In addition to the text research activities, ten targeted interviews with partnership members and stakeholders were performed for the first phase of the study in order to gain additional insights and validate the findings of the analysis. The interviews follow a semi-structured, exploratory approach based on guidelines referencing the evaluation questions in focus. The interviewees were selected experts from the European Commission (EC), members of CBE's scientific committee, members of CBE JU governing bodies (e.g. Governing Board, Executive Director), and beneficiaries (e.g. coordinators of selected ongoing projects including flagships). The analysis of the second phase is mainly based on the available published data of CBE JU and expert interviews.

The data collection process for the partnership evaluation comprised two phases, incorporating information from both H2020 and the initial phase of the partnerships in Horizon Europe. The primary data collection was concluded by July 2023 and based on a CORDA extraction from March 2023. Supplementary data from the forthcoming Biannual Monitoring Report 2024 was incorporated in December 2023. Due to the short runtime of the Horizon Europe Partnerships, it is noteworthy to bear in mind that many of the partnerships' activities are still ongoing and have not yet been fully accomplished.

3.3. Background of BBI JU/CBE JU

The BBI JU was initially established by Council Regulation (EU) No 560/2014 of 6 May 2014 (Official Journal L 169, 7.6.2014, pp. 130-151) as a public-private partnership under Article 187 of the Treaty on the Functioning of the European Union (TFEU) (European Council 06.06.2014). This initiative was built upon the foundation of the EC's first Bioeconomy Strategy released in 2012, which aimed to promote the bio-based industries and their potential for sustainable economic growth. The primary function of the BBI JU was to allocate funding to bio-based projects through competitive calls under the Horizon 2020 framework (European Commission 2017a). By bringing together the EC and the Bio-based Industries Consortium (BIC), the BBI JU formed a collaboration between companies, universities, research centres, innovative small and medium-sized enterprises (SMEs), and other organizations active within the bio-based economy. The main objective of this partnership was to enhance coordination, research, and innovation across the entire bio-based value chains, stimulate private investments, and address issues of fragmentation and duplication within the sector (European Commission 2017a). Throughout its operational period, the BBI JU launched seven calls for project proposals under H2020, providing funding and support to numerous bio-based innovation projects (European Commission 2017b).

Under the BBI JU, 142 bio-based innovation projects were funded, benefiting 1,055 participants from 39 EU Member States and Associated Countries. The BBI JU administered projects in the bio-based industries sector between 2014 and 2020 for a total budget of €3.7 billion. The financial contribution of the EU was set at EUR 975 million, as stated in the regulation (European Council 06.06.2014). The members of the BBI JU, other than the EU, were expected to contribute a total of at least EUR 2.73 billion over the same period (2014-2024).

While the BBI JU projects are still in progress, a transition took place with the establishment of its successor, the CBE JU, in November 2021 under the Horizon Europe Regulation and on the basis of the Council regulation (EU) 2021/2085 known as Single Basic Act. The CBE JU represents the next phase of the partnership, building upon the achievements and experiences of the BBI JU. With its establishment, the CBE JU inherits the legacy and accomplishments of the BBI JU, including the completion of the ongoing BBI JU projects, along with a new budget of €2 billion. The CBE JU is mainly funded by Horizon Europe Cluster 6, specifically in the intervention area 6 Bio-based Innovation System, which provides roughly 90% of the allocated Horizon budget to the CBE JU and 10% to the area of agriculture (intervention area 3) for a total of almost €1 billion of EU financial contribution.

Compared to the BBI JU, the CBE JU brings about several notable changes. One of the key changes is the increased emphasis on circular economy principles throughout the entire bio-based value chains. The CBE JU seeks to foster the transition from linear to circular business models, promoting resource efficiency, waste valorisation, and the sustainable use of biomass. Another significant change is the expanded scope of the CBE JU to include additional sectors beyond the bio-based industries. While the BBI JU primarily focused on bio-based sectors, the CBE JU aims to integrate circular bio-based economy approaches across a wider range of sectors, including stronger participation of the primary sector. This broader scope allows for greater synergies and collaboration across different industries, fostering cross-sectoral innovation and systemic change. Additionally, the CBE JU is expected to enhance the participation of underrepresented EU countries and regions.

3.4. Governance of CBE JU

The set-up and design of activities for the CBE JU involve collaboration between private industry and the European Commission (EC). The Bio-based Industries Consortium (BIC), a non-profit organization, represents the private sector's interests and serves as the main private partner in this public-private partnership. BIC consists of a wide range of stakeholders covering the entire bio-based value chain, including SMEs, large industrial companies, regional clusters, universities, research centres, trade associations, and European Technology Platforms (BBI JU 2019). The BIC brings together these stakeholders to drive - together with the European Commission the strategic direction and implementation of activities within CBE JU.

On the EU side, the EC plays a crucial role in the set-up and design of joint undertakings. The EC is represented by multiple Directorates-General, including the Directorate General for Research and Innovation (R&I), which is the parent DG and oversees the research and innovation aspects, the Directorate General for Agriculture and Rural Development (AGRI), which focuses on agricultural aspects, and the Directorate General for Internal Market, Industry, Entrepreneurship, and SMEs (GROW), which deals with the market and industry dimensions. These Directorates General work together to ensure the strategic alignment, governance, and effective implementation of activities within the CBE JU.

The collaboration between the BIC and the EC, along with their respective stakeholders, enables the development and execution of a comprehensive agenda to drive bio-based innovation, research, and market uptake. The partnership between private industry and the EU ensures a coordinated and impactful approach to advancing the bio-based economy, promoting sustainability, and contributing to the EU's strategic objectives.

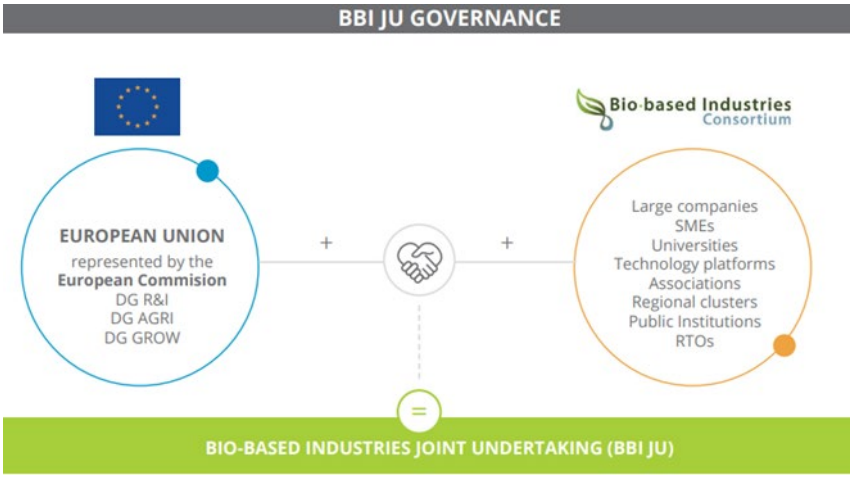

Figure 1 Overview of the governance of BBI JU
Source: picture taken from BBI JU 2020b, p.8

CBE JU's governing bodies are defined in the Statutes attached to the Single Basic Act (SBA). The Governing Board, the Executive Director, the Scientific Committee, the States

Representatives Group, and the Deployment Groups shape the governance. The governing bodies of CBE JU and their tasks are briefly summarized in the following table[1].

Table 1 The roles and tasks of CBE JU's governing bodies

Governing Body	Roles and Duties (non-exhaustive List)	Positions
Governing Board	Main decision-making body of the partnership Supervises the implementation of the yearly work programme and budget as proposed by the Executive Director Approves the annual work programme and activity report Adopts the Strategic Research and Innovation Agenda Oversees the objectives of CBE JU Reviews and approves the list of actions to be selected Ensures compliance with the regulations and legal framework Provides strategic guidance and direction Responsibility for the strategic orientation, coherence with relevant Union objectives and policies, and operations of that joint undertaking	Representatives from the European Commission and members other than the Union including SMEs
Executive Director	Implements decisions of the Governing Board Accountable to the Governing Board Serves as the legal representative of CBE JU Manages the day-to-day operations of CBE JU Oversees the implementation of the Strategic Research and Innovation Agenda (SRIA) Manages the programme office and its various functions Reports directly to the Governing Board	Executive Director
States' Representatives Group	Provides opinion on the operations of CBE JU Advises on the progress of programme implementation, SRIA, annual work programme (AWP), and activity report Expresses judgement on measures taken to address specific objectives of the initiative Provides information on regional and national research and innovation programs and initiatives to ensure complementarities and synergies with the CBE JU program	Representatives from EU Member States and associated countries to Horizon Europe
Scientific Committee	Provides advice on scientific priorities and areas to be addressed in the work programme	Scientific experts

[1] https://wayback.archive-it.org/12090/20221205133850/ https://www.cbe.europa.eu/governance

Table 1 The roles and tasks of CBE JU's governing bodies		
	Highlights scientific achievements of the programme Suggests corrective measures for programme implementation when necessary Provides independent scientific advice on specific issues at the request of the Governing Board	
Deployment Groups	Advises the Governing Board on issues related to the deployment of sustainable bio-based solutions Provides input and expertise on deployment strategies, market uptake, and innovation potential Contributes to the identification of barriers and opportunities in the field of bio-based industries Facilitates stakeholder engagement and collaboration	A wider range of stakeholders active in the bioeconomy is expected to join, including e.g. financial and banking institutions, primary producers groups, farmer associations, cooperatives, forestry consortia, or aquaculture or algae initiatives
Programme Office	Manages call management and programme monitoring Handles administration and financial management Provides legal control and compliance Manages human resources and staffing Implements communication activities and stakeholder relations Supports the Executive Director in the day-to-day management of CBE JU	Staff of the JU

3.5. Transition from the BBI JU to the CBE JU

The transition from the BBI JU to the CBE JU has brought about changes in the governing bodies. While the overall structure remains similar, the CBE JU has introduced a new governance body called Deployment Groups, which are not in place yet and may include the Finance & Investment Group, as well as an upcoming Deployment Group on Primary production. The governance structure and exact composition of these groups are yet to be determined. Additionally, strategic governing board meetings are foreseen, involving high-level Commission delegates and chief executive officers (CEOs) from the private sector.

Furthermore, there have been personnel changes in the specific representatives within the Governing Board and the Executive Director. These adjustments reflect the evolving priorities and objectives of the CBE JU in promoting the circular bio-based economy and sustainability, with a heightened focus on environmental aspects and biodiversity enhancement. In addition, the CBE JU Widening Strategy aims to expand its outreach and impact on underrepresented Member States and regional stakeholders.

The programming approach has also evolved to incorporate a higher level of co-creation between the founding partners (EC and BIC), with the Multi-Annual Programming (MAP) exercise facilitating a more systematic and detailed procedure that provides the necessary link between the strategic objectives reflected in the SRIA and the annual work programmes.

The main strategic document guiding the activities of the CBE JU is the Strategic Innovation and Research Agenda (SIRA), formerly Strategic Research Agenda and Innovation (SRIA) for the BBI JU. The development of the SIRA/SRIA involves extensive consultation with both public and private stakeholders. This collaborative approach aims to achieve that the strategic priorities and research agenda of the joint undertakings reflect the needs and aspirations of the bio-based industries and related sectors.

The CBE JU programming is based on its SRIA and serves as a lasting document laying out the partnership's long-term vision. This agenda strives to provide a clear, high-level focus on principles and priorities within the bio-based economy. To effectively operationalize the vision laid out in the SRIA, the CBE JU has developed the Multi-annual Program, a document that connects high-level objectives with the annual work programmes. The MAP undergoes yearly reviews to ensure alignment with evolving political and industrial priorities. Moreover, while the SRIA offers a foundational vision from 2022, it is also amenable to changes and updates, facilitating flexibility to adjust based on evolving strategies and goals. The collaborative development and potential revisitation of the SRIA demonstrate the CBE JU's commitment to ensuring that the strategic research direction remains in sync with the changing landscape of bio-based industries.

Similar to the BBI JU, the decision-making processes within the CBE JU involve the active participation of various stakeholders, including the representatives of the private sector through the BIC. The BIC members[2] represent companies of different sizes, sectors, and geographical areas, such as agriculture, agri-food, aquaculture, chemicals, forestry, pulp and paper, technology providers, and waste management. This diverse representation ensures a comprehensive and inclusive decision-making process.

When it comes to the adoption of annual work programs, the decision process is collaborative and involves multiple stages. The topics for the work programs are developed through a co-creation process between the BIC, the EC, and the CBE JU Programme Office. The draft text is then consulted with the advisory bodies of the CBE JU. Finally, the Executive Director presents the draft to the Governing Board for their decision on the adoption, following the regulations outlined in the Council Regulation (EU) No. 560/2014 (BBI JU 2019). This process ensures that the final decision on the work programs is well-informed and takes into account the inputs from all relevant stakeholders.

Overall, the decision-making processes within the BBI JU and CBE JU are characterized by the involvement of diverse stakeholders, including the private sector, and a consultative approach that fosters collaboration and consensus in shaping the direction and priorities of the joint undertakings.

Another change made was concerning the contribution of the private partners. A new 'award criterion' has been integrated into the evaluation process to ensure that the level of in-kind contribution to operational activities (IKOP) defined in the project proposal (as a percentage of the total eligible cost of the project) is a minimum 15% for IA-Demo projects and 20% for

IA-Flagship projects. Only contributions of members of the BIC are accounted for IKOP. In addition, for Innovation Actions, the funding for profit-organization is 60%, which is below the funding rate of Horizon Europe (70%).

3.6. Intervention Logic

The BBI JU and CBE JU have been crucial vehicles for fostering collaboration and driving innovation in the bio-based sector. Operating under H2020 and Horizon Europe, the joint undertaking has facilitated partnerships between the private sector, represented by the BIC, and the EU, represented by the EC. Their missions encompass advancing the bio-based economy, promoting circularity, and supporting sustainable and competitive bio-based industries.

The mission of the BBI JU, during its tenure under H2020, was to implement its SIRA, which was developed through collaboration between the BIC and the EU. It aimed to support the entire bio-based value chain by organizing calls for proposals and providing funding for research, demonstration, and deployment activities. The main objective of the BBI JU was to "*contribute to a more resource-efficient and sustainable low-carbon economy and to increase economic growth and employment, in particular in rural areas, by developing sustainable and competitive bio-based industries in Europe..*" p.10 (BBI JU 2020b). The BBI JU focused on areas such as biomass feedstock, biorefineries, innovative bio-based products, and market uptake (BBI JU 2020b). Its overarching objective was to promote the development of a sustainable and competitive bio-based economy in Europe.

Under Horizon Europe, the CBE JU continues the mission of advancing the bio-based economy while placing a stronger emphasis on circularity and the sustainable use of biomass and, in general, the sustainability of all its projects. It aligns with the EU's ambitious sustainability goals and the European Green Deal. The CBE JU aims to integrate circular bio-based economy approaches into various sectors, including plastics, chemicals, textiles, and more. Its mission is to drive the transition to a circular bio-based economy by promoting resource efficiency, waste reduction, and the sustainable utilization of renewable resources. The general and specific objectives of CBE JU, as per Council Regulation (EU) 2021/2085 of 19 November 2021, establishing the Joint Undertakings under Horizon Europe, are reported below in Figure 2.

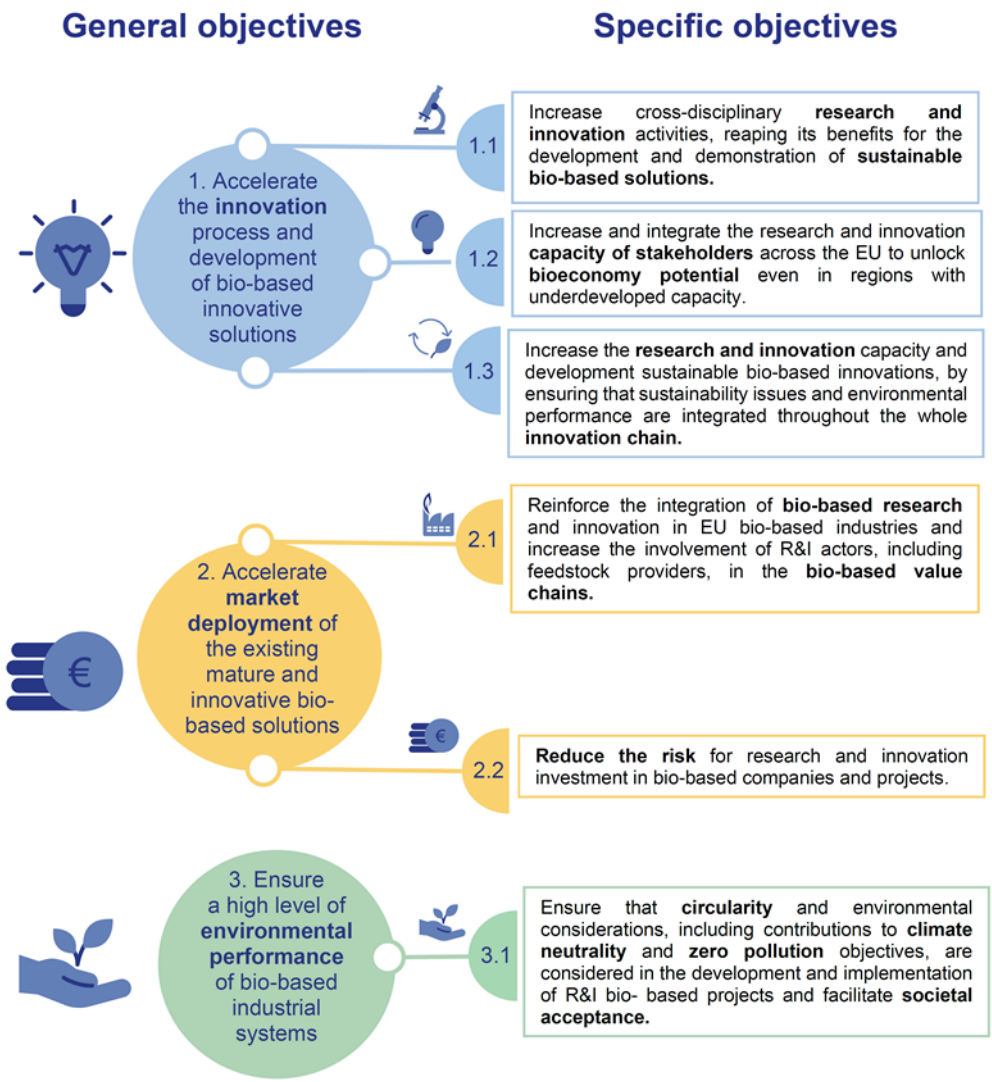

Figure 2 General and specific objectives of CBE JU
Source: CBE JU 2023a

For the establishment of the CBE JU, an impact assessment was done in 2021 by the EC in order to assess, based on past learnings (e.g. the Interim evaluation of the BBI JU), which of the available instruments in Horizon Europe can be most effective and efficient for aligning the research and innovation activities in the bio-based industrial systems (EC 2021). This impact assessment also provided an approach for an intervention logic (Figure 3).

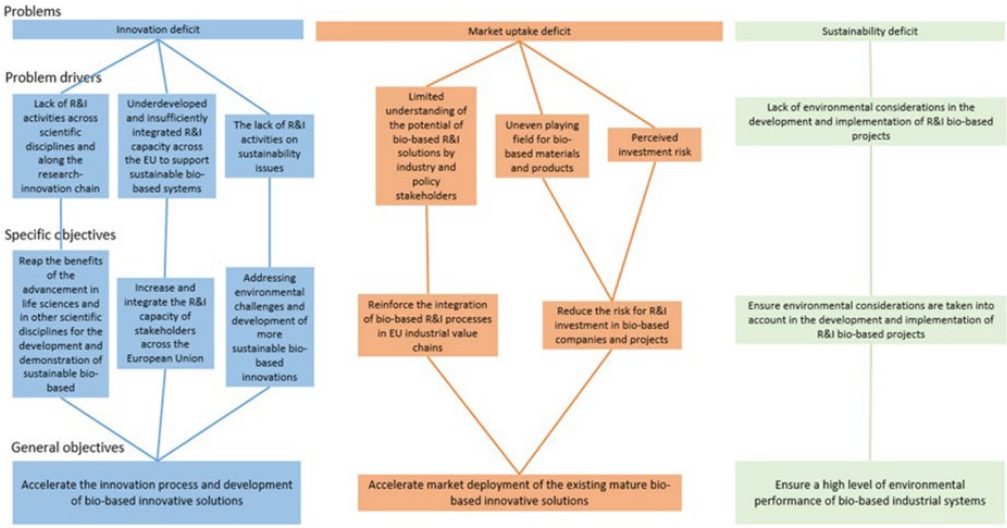

Figure 3 Intervention approach as proposed in the impact assessment report of the EC in 2021)
Source: EC (2021), p.53

4. Implementation state of play

4.1. Thematic structure of R&I activities

Regarding the implementation of the SIRA, the BBI JU had the mission to fund projects in the H2020 programme under different types of actions (Teknologisk Institut 2021):

- Research and Innovation Actions (RIAs) for projects on a technological readiness level (TRL) 3-5
- Innovation Actions (IAs)
  - Demonstration projects (DEMOs) for projects with a target TRL level of 6-7
  - Flagship projects (FLAGs) for projects with a target TRL level of 8
- Coordination and Support Actions (CSAs), overarching, no specific TRL level

The following Figure 4 illustrates the relationship between the different types of actions and their corresponding TRL levels, highlighting the progression from early-stage research and innovation to more advanced demonstration and flagship projects. This framework allowed the BBI JU to support a range of projects at various stages of technological development, contributing to the overall objectives of the SIRA (BBI JU 2021a):

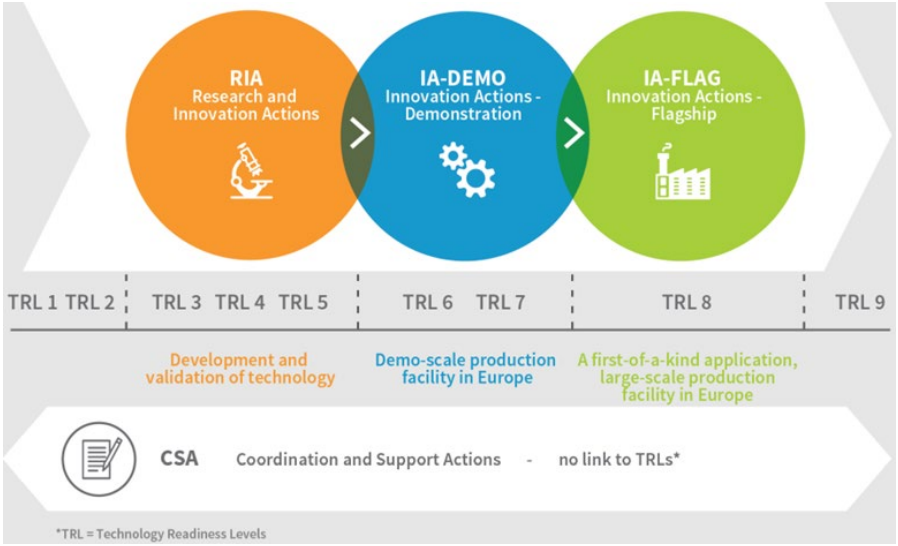

Figure 4 Types of action of BBI JU according to their (expected) TRL-levels
Source: graph taken from p.26 of Annual report 2020

The types of actions included RIAs for projects at TRL 3-5, IAs, which consisted of DEMOs at TRL 6-7, and FLAGs at TRL 8. Additionally, CSAs were implemented as overarching actions with no specific TRL-level requirement. These different types of actions formed a logical progression in terms of technological readiness levels.

Most of the BBI JU funding was invested in DEMOs, then FLAGs, RIAs and, with a smaller sum CSAs. Between 2014 and 2020 there were various projects funded by the BBI JU in the respective categories of types of action, as shown in Table 2 with the corresponding budgets (BBI JU 2020a) :

Table 2 Budget allocation of BBI JU

Type of action	Number of projects	Budget (BBI JU Funding)
FLAGs	14 projects	€272 million
DEMOs	39 projects	€274 million
RIAs	71 projects	€256 million
CSAs	18 projects	€19 million

Source: BBI JU 2020a

With this focus and differentiation of IAs, the CBE JU has a rather unique characteristic.

4.2. Project portfolios: Horizon 2020

The CBE JU started with its first calls in 2022 (in 2021, there were no calls in the JU) and its second call around spring 2023. Therefore, information on CBE JU projects was not yet publicly available on eCorda in July 2023, so only the portfolio of BBI JU can be analysed.

Between 2014 and 2020, 142 projects were funded by the BBI JU. Most of these projects have been RIAs (71), then IAs (53) and then CSAs (18). The analysis shows that 66.5% of the EC contribution to the funded projects was for innovation actions (IAs including the DEMOs and FLAGs), while 31.1% was allocated to RIAs and only 2.3% to CSAs.

When looking at the detailed types of instruments in the category of the IAs there were mostly DEMOs when looking at the absolute number of projects (39) and only 14 FLAGs. However, the FLAGs are very large projects, making them account for 33.1% of the EC contribution share.

Table 3 Detailed type of actions/instruments in case study BBI – Bio-based Industries

Action/instrument	Number of projects	Participations		EC contribution		EC Contr. per part. (EUR 1,000)
		Nb	Share (%)	EUR (1,000)	Share (%)	
JTI-BBI-RIA	71	993	52,8%	255.898,4	31,1%	257,7
JTI-BBI-IA-FLAG	14	196	10,4%	272.073,4	33,1%	1.388,1
JTI-BBI-IA-DEMO	39	538	28,6%	274.363,1	33,4%	510,0
JTI-BBI-CSA	18	153	8,1%	19.188,5	2,3%	125,4
All types	**142**	**1880**	**100,0%**	**821.523,4**	**100,0%**	**437,0**

Source: ScienceMetrix/eCorda

The analysis of the BBI JU projects in the timeframe from 2014-2020 shows that the participants from the private sector are very much involved in IAs (73%) and RIAs (57%), while they are only partly in CSAs (34%). This pattern is observed because the Flexible Biorefineries FLAGs and DEMO projects are also highly valued by the industry. These initiatives are particularly instrumental in addressing the critical challenge known as the "valley of death", which refers to the phase where innovative concepts face barriers in transitioning from research and development to practical implementation in the market.

Table 4 Share of group of participants in each group of action/instrument

Group of Action/instrument	HES	OTH	PRC	PUB	REC	Total (All types)
IA	9%	5%	73%	0%	13%	100%
RIA	15%	6%	57%	1%	22%	100%
CSA	14%	28%	34%	3%	21%	100%

Source: ScienceMetrix/eCorda

The projects comprise mainly Industry driven actions covering a broad range of TRLs (5-8). As BBI JU became more established and known, the variety of industries in the projects also increased in the BIC and with this expanded membership, a broader scope of the programs was introduced. According to the analysis of the Teknologisk Institut, the diversity of the partners that are involved in the BBI JU projects shows that there are collaborations between academic institutions, consultancies/experts, technology providers, manufacturing companies, biorefineries, environmental specialists and many other organizations (Teknologisk Institut 2021).

The project portfolio has gradually changed from a focus on biomass resources derived from agriculture and forestry in the first annual work programmes (AWPs) towards the introduction of new sources (e.g. aquatic, municipal bio-waste, wastewater, biogenic CO2) from the AWP 2016 onwards. This has also been mirrored by funding a flagship project of a “first-of-its-kind” biorefinery valorising organic fraction of municipal solid waste and aquatic-based feedstock in 2020 (CBE JU 2022b).

According to Lange et al. (2021), the BBI JU has shown a gradual growth in different types of feedstock topics in the calls released between 2014 and 2020. This indicates an increasing focus on various feedstock sources for bio-based projects supported by the BBI JU (Figure 5).

The evaluation of the project portfolio by the Teknologisk Institut shows that the use of biomass has been improved in several ways, especially by integrating other feedstocks such as residues from agriculture, agri-food, forestry or aquatic sectors and developing technologies for the extraction and isolation of new materials and substances with environmental and health benefits competitive with fossil-based materials (Figure 5).

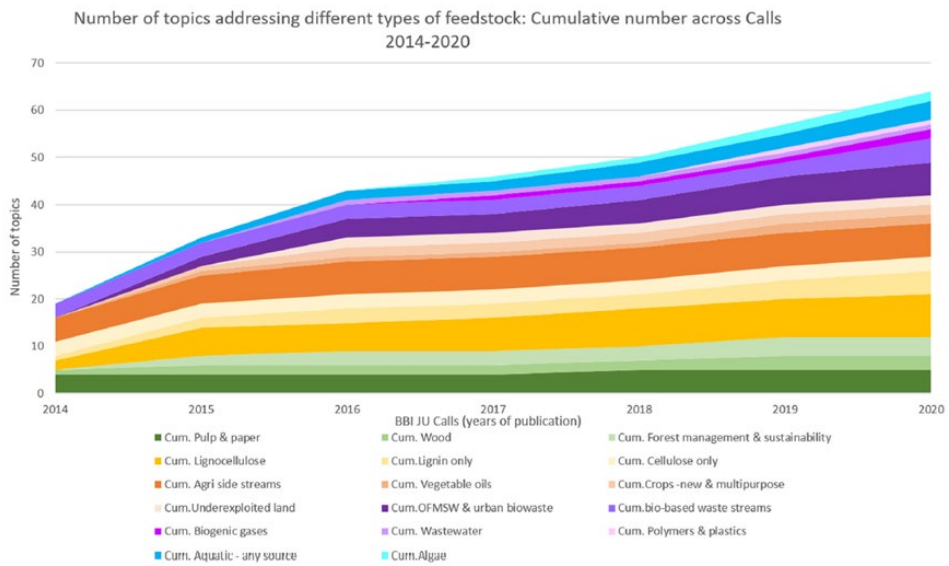

Figure 5 Number of topics addressing different types of feedstock in cumulative numbers across BBI JU Calls 2014-2020
Source: Lange et al. 2021:8

The number of BBI JU’s projects shows that the relative distribution of projects was not the same from 2014 to 2019 (Figure 6). Notably, there was a significant increase in the number of projects focused on packaging in 2016, which can be attributed to growing environmental concerns and the need for sustainable packaging solutions. On the other hand, the number

of biofuel-related projects experienced a decline after 2017, indicating a shift in priorities or a saturation of the biofuel sector. There are also themes, which remain with a same relative distribution in different years such as food, feed, textile, automotive, chemical industry, etc.

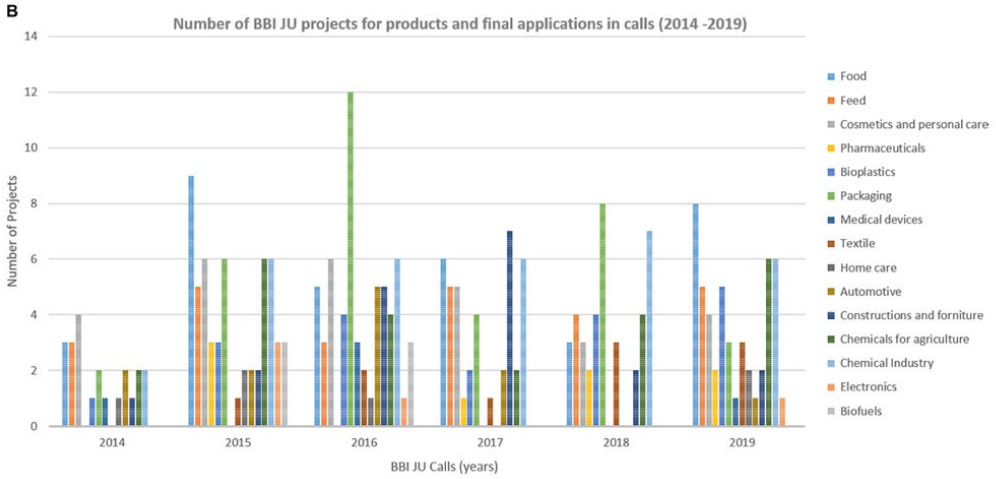

Figure 6 Thematic distribution of BBI JU projects in calls 2014-2019
Source: (Lange et al. 2021)

According to Figure 7, the BIC has undergone changes in its membership over time. There has been a significant increase in actors from the chemical industry, technology providers, pilot plants, and regional SME clusters, particularly in 2018/2019. This reflects a growing recognition of the importance of these sectors in driving bio-based innovation and sustainable practices. The diverse membership within the BIC promotes cross-sector collaboration and the scaling up of bio-based technologies, fostering innovation in the bio-based economy (Lange et al. 2021).

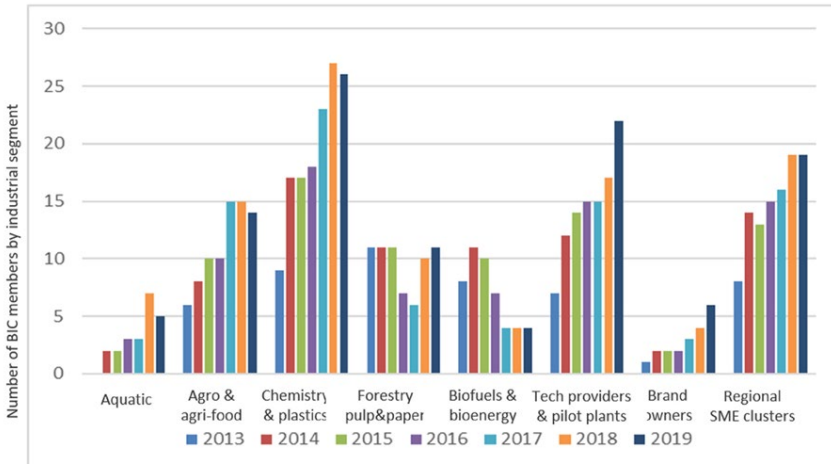

Figure 7 Overview of the governance of BBI JU
Source: picture taken from BBI JU 2020b, p.8

As of December 2023, the CBE JU has marked a milestone with the successful completion of its calls from 2022, resulting in 21 ongoing projects. This achievement reflects the initial plans made by the CBE JU, following a year without calls in 2021. Although the specifics of

these projects are not yet detailed in eCorda and it is still early for comprehensive results analysis.

4.3. Project type and geographical distribution

The participation in BBI JU projects reflects this openness, with various types of organisations involved. Private for-profit (PRCs) entities contribute the highest share of participation at 61%, demonstrating strong industry engagement. Research organisations (RECs) follow with 18% of participation, while participants from higher or secondary education establishments (HES) contribute 12% to the BBI JU projects between 2014 and 2020. Additionally, other organisations contribute 7%, and public bodies (PUB, excluding RECs and HES) contribute 1%. This diversity of participants showcases the accessibility and openness of partnerships within the BBI/CBE JU.

Table 5 Type of organisation in BBI projects

Type of organisation	Number of projects	Participations		EC contribution		EC Contr. per part. (EUR 1000)
		Nb	Share (%)	EUR (1000)	Share (%)	
HES	100	234	12%	97.396	12%	416,2
OTH	77	136	7%	41.875	5%	307,9
PRC	141	1153	61%	530.893	65%	460,4
PUB	11	15	1%	1.560	0%	104,0
REC	121	342	18%	149.799	18%	438,0
Total (All types)	**142**	**1880**	**100%**	**821.523**	**100%**	**437,0**

Source: own calculation based on Science-Metrix/eCorda

When looking at the geographical distribution, the participants, coordinators, as well as DEMOs and FLAGs were quite evenly distributed in the EU. However, there seems to be a geographical imbalance. When looking at the number of supported organisations in projects funded by the BBI-JU, we can see that EU-13 countries make up only 7% of the participation (with an 11.2% share of EC contribution). The associated countries make up 4.9% of the participation while covering 6.1% of the EC budget. Organizations from the United Kingdom (UK) make up 5% of the participation and third countries only 0.3%.

Table 6 Share of different country groups of the supported organisation in BBI projects

Group of country	Number of projects	Participations		EC contribution		EC Contr. per part. (EUR 1,000)	Number of countries
		Nb	Share (%)	EUR (1,000)	Share (%)		
H2020-EU27	142	1.687	89,7%	727.879	88,6%	431,5	26
EU-14	*142*	*1.556*	*82,8%*	*636.269*	*77,4%*	*408,9*	*14*
EU-13	*63*	*131*	*7,0%*	*91.609*	*11,2%*	*699,3*	*12*
H2020-associated (exclude UK)	56	93	4,9%	50.304	6,1%	540,9	8
United Kingdom	56	94	5,0%	43.341	5,3%	461,1	1
Third Countries	5	6	0,3%	0	0,0%	0,0	4
All countries	**142**	**1.880**	**100,0%**	**821.523**	**100,0%**	**437,0**	**39**

Source: own calculation based on Science-Metrix/eCorda

Based on the analysis of eCordis data from Science Metrix, Germany stands out as the country with the highest share of participation in BBI JU projects in terms of the number of projects. However, when considering the number of participants, Spain takes the lead. Italy and Belgium closely follow both countries.

Overall, the top countries with supported organisations by the BBI JU primarily consist of Western and Southern European countries. There are a few exceptions from other regions, including Finland, the UK, Sweden, Denmark, and Ireland. These findings indicate that BBI JU projects have attracted a diverse range of organisations from across Europe, with a strong presence from countries in Western and Southern Europe.

Table 7 Top countries (of supported organisations) in BBI JU projects

Top 15 country	Number of projects	Participations		EC contribution		EC Contr. per part. (EUR 1,000)	Order
		Nb	Share (%)	EUR (1,000)	Share (%)		
Germany	107	197	10,5%	79.623	10%	404,2	1
Spain	92	318	16,9%	112.633	14%	354,2	2
Italy	83	209	11,1%	83.436	10%	399,2	3
Belgium	80	149	7,9%	63.995	8%	429,5	4
Netherlands	74	178	9,5%	70.531	9%	396,2	5
France	64	179	9,5%	96.290	12%	537,9	6
United Kingdom	56	94	5,0%	43.341	5%	461,1	7
Finland	36	73	3,9%	31.041	4%	425,2	8
Austria	31	51	2,7%	16.236	2%	318,4	9
Switzerland	28	34	1,8%	7.739	1%	227,6	10
Sweden	28	53	2,8%	19.394	2%	365,9	11
Portugal	26	42	2,2%	13.219	2%	314,7	12
Denmark	25	40	2,1%	14.915	2%	372,9	13
Ireland	25	36	1,9%	26.298	3%	730,5	14
Greece	22	30	1,6%	8.543	1%	284,8	15

Source: own elaboration based on Science-Metrix/eCorda

When considering the number of coordinating organisations from each country, the distribution differs from the overall participation numbers. It is observed that fewer countries (4.2%) from the EU-13 group have taken on coordinating roles in BBI JU projects. It is important to note that the absolute numbers of coordinating organisations should be viewed in relation to the respective national R&D spending or investment of each country. This suggests that the capacity and resources for assuming coordinating roles in BBI JU projects may vary among countries, with factors such as per capita income influencing the level of participation in leadership positions.

Table 8 Group of countries (of coordinating organisations) in BBI JU projects

Group of country	Number of projects	Participations		EC contribution		EC Contr. per part. (EUR 1,000)	Number of countries
		Nb	Share (%)	EUR (1,000)	Share (%)		
H2020-EU27	130	130	91,5%	212.689	82,2%	1.636,1	18
EU-14	*124*	*124*	*87,3%*	*183.245*	*70,8%*	*1.477,8*	*13*
EU-13	*6*	*6*	*4,2%*	*29.444*	*11,4%*	*4.907,3*	*5*
H2020-associated (exclude UK)	*7*	*7*	*4,9%*	*29.631*	*11,4%*	*4.233,0*	*3*
United Kingdom	5	5	3,5%	16.503	6,4%	3.300,5	1
Third Countries	0	0	0,0%	0	0,0%	N/A	0
All-countries	**142**	**142**	**100,0%**	**258.822**	**100,0%**	**1.822,7**	**22**

Source: own elaboration based on Science-Metrix/eCorda

The network analysis of collaborations among organisations in the projects supported by the BBI JU/CBE JU confirms a high level of collaboration intensity among core countries, primarily from the EU-14 (Figure 8). The analysis also reveals that countries receiving the most funding display the strongest collaboration patterns. This indicates that the BBI and the CBE JU have successfully fostered collaboration and synergies among organisations, creating a cohesive and active network within the bio-based economy.

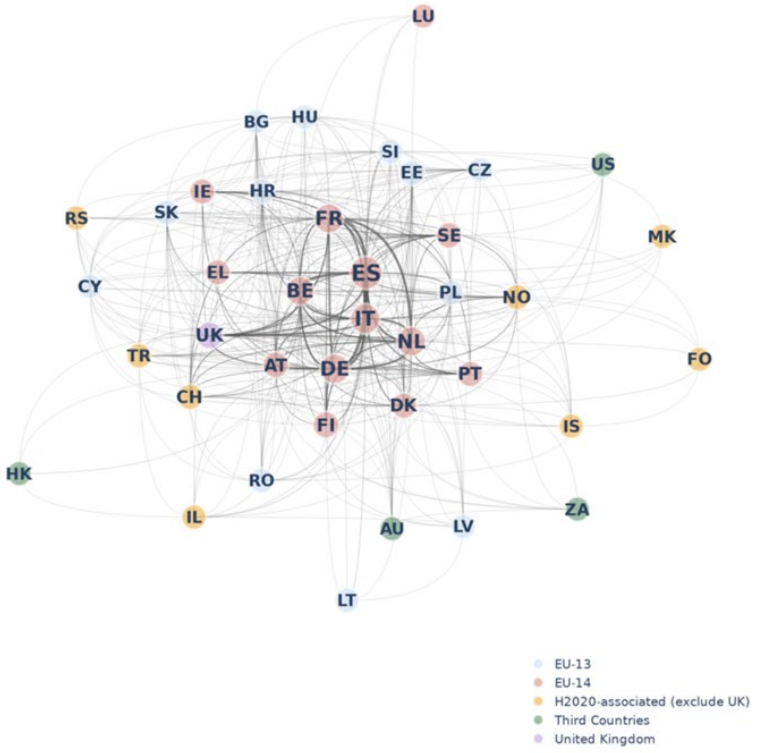

Figure 8 Networks of collaboration in BBI JU projects
Source: Own elaboration based on Science-Metrix/eCorda

4.4. Other activities

Concerning activities beyond project funding, the BBI JU's open approach has facilitated the involvement of actors from associated and third countries, expanding the reach and impact of bio-based economy initiatives. For example, interviewees report that the CBE Governing Board has initiated exchanges with a few countries around the world (e.g. information days in the United States, Canada and Brazil).

The BBI/CBE JU goes beyond funding activities and actively engages stakeholders through various initiatives and events. The partnerships value the input and perspectives of stakeholders, seeking their feedback and advice to improve the content and priorities of their initiatives. This stakeholder engagement approach ensures that the partnerships align with evolving policies and address the needs and expectations of the bio-based economy.

One of the key initiatives of the BBI/CBE JU is the Stakeholder Forum, which brings together a diverse group of participants, from researchers to industry representatives, policymakers, and other relevant actors. This forum serves as a platform for networking, knowledge sharing, and the creation of new R&I networks. By organising such events, the partnerships actively foster interactions and collaborations among stakeholders, contributing to the development of a vibrant and interconnected bio-based economy community in Europe.

The BBI/CBE JU also collaborates with national and regional actors to ensure broader participation and engagement. Close cooperation with national contact points and regional clusters helps disseminate information about funding opportunities, raise awareness, and encourage the involvement of actors from diverse regions. This collaborative approach ensures that the benefits of the partnerships' initiatives reach stakeholders at various levels, promoting inclusivity and integrating national and regional R&I networks into the broader European landscape.

There is a recognition that there is a need to increase the involvement and participation of countries across the EU in the BBI/CBE JU, particularly in regions that are currently -less represented, such as Central and Eastern Europe. Efforts have been made to address this issue, as evidenced by the inclusion of this objective in the Single Basic Act and the SRIA, including a specific key performance indicator (KPI) No.10. However, despite these efforts, there is still a gap in the participation of these regions, and a dedicated CBEJ U widening strategy[3] has been developed to address this gap. This strategy includes exploring synergies with Widening participation in future calls, conducting workshops and information sessions, and focusing on both Widening Countries and regions that are currently not represented. It is recognized that increasing the involvement of these regions is a long-term process that requires dedicated efforts and a multi-stage approach.

In terms of communication and outreach, the BBI/CBE JU has implemented various strategies to raise awareness of primary biomass producers and bio-based industries and promote participation in their programs. Their communications activities have targeted different stakeholder groups, aiming to disseminate information, engage stakeholders, and encourage their active involvement. By organizing events, conferences, and workshops, the

[3] https://www.cbe.europa.eu/system/files/2023-09/CBE-JU-widening-strategy.pdf and https://www.cbe.europa.eu/system/files/2023-09/CBE-JU-widening-action-plan-2023-2024.pdf

partnerships have fostered knowledge exchange, networking, and collaboration among stakeholders.

5. Findings

5.1. Relevance

The objectives of BBI/CBE JU have been and continue to be highly relevant in addressing the challenges and needs within the Framework Programme, as supported by insights from interviews. The bio-based economy sector's significant contribution to the EU economy, accounting for 3.6 million jobs and approximately €700 billion turnover, highlights its relevance. It serves as a key instrument to reduce dependency on raw material imports, especially in times of international instability. Additionally, the bio-based economy plays a vital role in achieving a green transition, promoting sustainable growth, and revitalising rural and coastal areas. Its potential to address societal challenges such as food security, resource scarcity, fossil resource dependence, and climate change underscores its importance (CBE JU 2022b).

Interview results indicated that the bio-based economy sector is still in the early stages of development, facing challenges such as fragmentation across actors and regions. Investments in the bio-based economy carry inherent risks, necessitating the establishment of more sustainable and circular value chains. BBI/CBE JU's overarching initiative was designed to tackle these challenges by fostering collaboration and innovation across the bio-based economy.

Over time, BBI JU and later CBE JU have exhibited flexibility and adaptability in responding to external factors and policy contexts. BBI/CBE JUs have demonstrated a high level of flexibility in updating their SIRA/SRIA or equivalent strategic documents and adjusting their objectives, activities, and resources to meet changing market and policy needs. The partnership has recognised the need to incorporate a broader range of sectors into their agendas, with a particular emphasis on food ingredients and the transition towards cross-sectoral value chains, circularity, and climate neutrality.

The interviews conducted with relevant experts in the field have provided insights that corroborate the partnerships' flexibility in updating their strategic documents. The feedback and perspectives shared during the interviews underscored the adaptability of BBI/CBE JU in adjusting their objectives, activities, and resources to meet changing market and policy needs. Over time, there has been a notable evolution in the strategies and activities of BBI/CBE JU, reflecting their ability to adapt to changing market dynamics and policy priorities. The updates to the BBI JU SIRA in 2017 and the new CBE SRIA in 2022 reflect this adaptability and ensure alignment with the Green Deal objectives, positioning BBI/CBE JU as a proactive contributor to Europe's green transition (CBE JU 2022b).

The partnerships' flexibility also extends to the allocation of resources, as they have been able to adjust funding priorities and investment strategies based on the evolving market and policy dynamics. This allows for targeted support to projects and initiatives that align with the changing needs and priorities of the bio-based economy.

Insights from interviews confirmed that BBI/CBE JU's strategic orientation and commitments align closely with the objectives of the EU's Green Deal. The partnership is dedicated to contributing significantly to objectives such as increasing the EU's climate ambition, achieving

climate neutrality, and driving the green transition of European economies. The continuous evolution of strategies and alignment with evolving policy contexts reinforce the ongoing relevance and importance of BBI/CBE JU objectives in addressing the challenges and needs within the Framework Programme.

5.2. Coherence

The coherence between BBI/CBE JUs, other relevant partnerships and the activities of the Framework Programme has been further strengthened by the alignment and complementarity at the programme level. Within H2020, there are specific areas that align closely with the objectives of BBI JU, such as the leadership in nanotechnologies, advanced materials, biotechnology, and advanced manufacturing and processing program, as well as Societal Challenge 2 focused on improving food security, developing sustainable agriculture, and promoting research in the bio-based economy (European Commission 2017a). Additionally, there are common themes with Societal Challenge 3, which aims to address secure, clean, and efficient energy, and Societal Challenge 5, which focuses on climate action, environment, resource efficiency, and raw materials.

In the current Horizon Europe programme, CBE JU has been positioned within Cluster 6, which exhibits important synergies with Cluster 4 (Industrial dimension)) and their respective partnerships.

Within Societal Challenge 2 in H2020 and now Cluster 6 in Horizon Europe, the BBI/CBE has a clear focus on practical implementation, which is reflected by the very high importance of the IA instrument and its differentiation between DEMOs and FLAGs to address the need of supporting high TRLs and scaling up. It is complementary to other Horizon activities because of its unique features, which include high TRLs within the partnership, yearly calls for proposals, distinct governance structures, and a different timeline from Horizon Europe.

At the level of specific initiatives and partnerships, there have been deliberate efforts to achieve synergies with BBI JU under H2020. For example, partnerships such as the EU partnership for a climate-neutral, sustainable, and productive blue economy, the Knowledge-Based Bioeconomy (KBBE), the sustainable chemistry initiative SusChem, the Partnership for Research and Innovation in the Mediterranean Area (PRIMA), the European Innovation Partnership for Agricultural Productivity and Sustainability (EIP-AGRI), the European Institute of Innovation & Technology (EIT) InnoEnergy, and EIT Food were established with the intention of fostering collaboration and alignment. While BBI JU decided not to focus on biomass for renewable energies like EIT Inno Energy, there were still areas of overlap, particularly with EIT Food, where circular bio-economy pathways and contributions to a circular bio-based economy were explored, emphasizing the potential for coherence and collaboration (Özbolat et al. 2019). Moreover, coordinated and joint activities have been performed with the Partnerships Made in Europe, Process4Planet, Blue Economy, EIT Food and Industries as well as the missions Restore our Ocean and Waters and Soil Deal for Europe. [4] Furthermore synergies with the LIFE Programme for Environment and Climate Action as well as InvestEU Programme are explored.

Regarding coherence with national policies, the State Representatives Group (SRG) is the advisory body which ensures that all the CBE JU programming levels, from SRIA to Annual Work Programmes, are well aligned with national policies & priorities via its consultations. In particular, during the consultation processes of the AWPs, the SRG members provide advice

[4] BMR-Survey Data 2023 received from EC

to the Governing Board to ensure that CBE JU priorities are well aligned with the policies & priorities at a national level. In addition, CBE JU maintains an open and structured dialogue with the Member States through the SRG to find synergies between the EU level and the national and regional levels and to maximize the impact of the initiative. [5]

5.3. Efficiency

BBI/CBE JU has demonstrated a high level of cost-effectiveness in its operations. According to the 2020 annual report, the Programme Office of BBI JU, which was responsible for implementing the decisions, has been highly efficient in its work in delivering services to its stakeholders (BBI JU 2021a). Although the pandemic interrupted its activities significantly at the beginning of 2020, the Programme Office adapted quickly to the new circumstances and still showed a very good performance. Due to the pandemic, expected expenses for missions/travel, as well as events and public relations, were even underutilized. These resources were used instead for the development and maintenance costs of the new CBE website. Furthermore, ex-ante controls for all grant operations and payments have been put in place.

While the Programme Office has been working since 2018 to improve the internal procedures for tendering procurement contracts in order to decrease administrative burdens, the pandemic in 2020 led to a quick transition to fully paperless workflows. This made the process overall more efficient, especially with regard to payment times for instance (BBI JU 2021a). The annual activity report of 2021 states (referring to the analysis of the governing board) the efficient performance of BBI JU and the CBE JU in the core operations of the partnerships, confirming the positive trend from the previous years. All the KPIs to monitor the efficiency (which are similar to other joint undertakings (JUs) under H2020, show that the partnership is operating efficiently (CBE JU 2022a). In 2021, the BBI JU project portfolio reached 142 projects (of which 71 RIAs, 39 DEMOs, 14 FLAGs, and 18 CSAs).

All in all, the partnership was able to be highly cost-efficient. In its initial 8 years of existence, the programme office had received around € 31 million for administration costs. This only makes up 51% of the 10-year administrative budget envisaged under Article 12(2) of the Statutes of BBI JU (CBE JU 2022a). Also, there has been cooperation with other JUs in order to enhance efficiency of the programme office: Together with 5 other JUs of the EC, the BBI JU jointly worked on a risk assessment and a data protection Impact Assessment related to the use of Microsoft System (CBE JU 2022a).

Furthermore, the BBI's programme office has consistently met targets for timely information dissemination, granting decisions, pre-financing payments, and periodic payments (Table 9). The BBI JU Annual Report 2021 highlights the programme office's efficiency in meeting these targets (CBE JU 2022a). This punctuality in administrative processes ensures that stakeholders receive timely support and funding for their projects.

[5] BMR-Survey Data 2023 received from EC

Table 9 Efficiency of BBI's programme office

Indicators and targets in Horizon 2020 for the partnerships	KPI Target in SIRA 2017	Annual report 2020	Annual report 2019	Annual report 2018	Annual report 2017	Annual report 2016	Annual report 2015
Time to inform	153	137	104	102	99	99	146
Time to grant	245	237	235	231	231	243	241
Time to pay on average for pre-financing	30	12	10	11	11	N.A.	14
Time to pay on average for periodic payments	90	72	74	71	83	N.A.	N.A.

Source: BBI's Annual Activity Report 2015-2020

The interviewees expressed overall satisfaction with the implementation of partnership activities, particularly in terms of administration, management, project application, and selection processes. They commended the efficiency of the application and evaluation processes, emphasizing the adherence to set deadlines and the provision of timely results. Furthermore, the selection process for bio-based projects was noted to be comparatively faster than other types of projects, and the evaluation criteria were found to be well-explained and transparent.

However, the interviews also shed light on certain areas where improvements could be made. One recurring concern was the limited budget and success rate, leading to the inability of many deserving projects to secure funding. While the efficiency of the partnership was acknowledged, interviewees pointed out that the highly competitive nature of the evaluation process sometimes resulted in deserving projects being excluded based on small differences in evaluation scores. This aspect was highlighted as a potential source of frustration for researchers. Moreover, the Partnership proposes that an increase in coherence between different levels of reporting (e.g. HE KIPs, JU Common indicators) and synchronisation in the reporting times should be sought. For example, all relevant indicators could be reported annually on the Annual Activity Reports, which would serve as a source of data for further levels of reporting.[6]

[6] BMR-Survey Data 2023 received from EC

5.4. Effectiveness

The implementation of the SIRA by the BBI JU involved launching calls and work programs to fund projects within the H2020 program. The BBI JU funded projects under various types of actions, each targeting a specific TRL.

The interview results emphasized the multidisciplinary and multi-stakeholder nature of BBI JU projects. The four different BBI JU instruments facilitate the involvement of various actors, including large companies, SMEs, research institutes, and civil society non-governmental organisations (NGOs). This inclusive approach has promoted collaboration, knowledge sharing, and the exchange of best practices among stakeholders, resulting in synergistic outcomes and the acceleration of innovation in the bio-based economy (Lange et al. 2021).

By implementing these types of actions and related projects, the BBI JU was effective in its activities towards reaching its objectives. In the assessment of the Teknologisk Institut, it is shown that most projects under the funding of the partnership have reached their key project objectives. The objectives of developing new products and technologies with great commercial potential and environmental and socio-economic benefits could be addressed by the BBI JU projects. The project documentation shows that the processes and substances developed are energy-efficient, have beneficial effects on the environment and health, as well has to have the characteristics to replace fossil-based materials - which is, of course, highly relevant with regards to the Green Transition objectives (Teknologisk Institut 2021).

The achievement of objectives of BBI JU relating to the projects' outcomes were measured based on the SIRA 2017, and the corresponding KPIs are monitored by the Programme Office on an annual basis. The results reported in Annual Activity Reports of BBI JU from 2015 to 2020 show that:

- Regarding KPI 1: the number of created new cross-sector interconnections is far beyond the initial defined target of SIRA 2017. This confirms the very positive impact of BBI JU in mobilizing actors in the bio-based economy.

- Regarding KPI 2, the number of new bio-based value chains is quite largely exceeding the target of 10 set in the SIRA 2017.

- Regarding KPI 3: 124 Grant Agreements in 2020 are already signed out of 200 expected by the end of 2024.

- Regarding KPI 4, the creation of 128 new bio-based building blocks has been reported by BBI JU projects by the end of 2020. It is expected that the ongoing projects create 106 new building blocks by 2024.

- Regarding KPI 5, the creation of 232 new bio-based materials has been reported by BBI JU projects by the end of 2020. Ongoing projects are expected to create 208 new materials by 2024, while finalised projects already reported the creation of 24 new materials compared to the defined target of 50 in the SIRA.

- Regarding KPI 6, the creation of 152 new bio-based consumer products has been reported by BBI JU's projects (DEMOs and FLAGs) by the end of 2020. Specifically, ongoing projects are expected to create 135 consumer products by 2024, while finalised projects already reported the creation of 17 consumer products, which represent 57% of the SIRA target.

- Regarding KPI 7, 11 Flagship projects have been funded, more than double the initial target of five Flagships outlined in the SIRA 2017.

- Regarding KPI 8: Both ongoing and finalised RIA projects reported a TRL gain for 55 key technologies against the target of 20 in the SIRA 2017.

In 2020 already, some of the KPIs were surpassing the targets set in the SIRA 2017. While in the SIRA, there was the target to achieve 36 new interconnections and 10 new value chains, in 2020, the partnership had reached 47 new interconnections and 33 new value chains (Johnson et al. 2021). That most of the projects were found to be highly efficient in reaching their results is confirmed by the assessment of the Teknologisk Institute (2021). According to this report, the so far completed RIAs; DEMOs and FLAGs have attained and documented their main objective and environmental impacts. However, the report notes that only a few projects can really document their socio-economic impacts. This is especially due to the fact that most projects take place in a pre-market context (Teknologisk Institut 2021). Also their portfolio analysis of the projects shows that 40 out of 50 projects contribute to the EU Bioeconomy Strategy, while fewer contribute to the European Green Deal (24 of 50 projects) or the renewed EU Industrial Policy Strategy (20 of 50 projects). With regards to the environmental impact, the report shows that almost all selected projects have developed innovative processes with impacts such as 1) less use of energy, 2) less carbon emission, 3) less use of water, 4) less use of land 5) new raw materials 6) soil restoration and circular approaches 7) enhance biodiversity. (Teknologisk Institut 2021).

For the CBE JU, no data regarding the achievement of the KPIs were available until July 2023.

Based on the interviews, it is evident that the BBI/CBE JUs have achieved notable outcomes and impacts in various areas related to the green transition. The deployment of solutions, particularly through the FLAGs, has yielded positive results, with high participation of SMEs exceeding the set targets. This collaboration between industry and the public sector, as well as engagement from actors across different sectors, has contributed to the success of market creation and support. However, the interviews also highlighted that achieving direct impacts on regulations and standards has been challenging for individual projects within the partnership. While some projects have had a partial influence on standards, the overall impact on regulations has been limited. These findings emphasize the effectiveness of the BBI/CBE JU in driving market deployment and collaboration while also indicating the need for further efforts to enhance its influence on regulatory frameworks and standards.

With its projects and the progress in the KPIs, the partnership has contributed to a systemic transformation of the bio-based industry in Europe. Although having reached this important objective, the uptake of the results also depends on external dynamics such as markets and, therefore can take time to realize without being in the sphere of control of the programme intervention (Teknologisk Institut 2021).

In terms of achieving outcomes and impacts, the BBI/CBE JUs partnerships have made significant achievements in various areas, according to interviews. One notable achievement is the establishment of new types of biorefineries across Europe, which combines the efforts of the public and private sectors. This development has had a significant impact on the bio-based economy and contributes to the goals of the partnership. Additionally, the partnership has successfully facilitated networking and system structuring, bringing together industry and university representatives to discuss collaboration and address industry requirements.

Bibliometric research output by BBI

The following section summarises the results of a bibliometric analysis of BBI research output from 2014-2021 (see Annex 9.1 for the related figures). All values are rounded. BBI publications recorded comparable achievements to those of SC2 projects in the following dimensions:

- A percentage share of ~17% of BBI publications were written as academic-private co-publications, which is clearly above SC2 publications (9%).
- The overall share of international co-publications in BBI publications is similar to the one found in other SC2 publications (55% to 57%).
- A proportion of 85% of BBI publications were available under an open access modality (open access).
- BBI publications recorded mostly better citation impact performance as SC4 publications on the average of relative citations.

However, the bibliometric analysis also revealed some weaknesses in the following dimensions:

- BBI publications have been mentioned in online policy-related documentation clearly above world-level (2,7 vs 1,0) but lie below the level of SC 2publications (4,7)
- BBI publications recorded lower levels in most altmetrics dimensions then SC2 (mentions in journalistic pieces, on Facebook, and Wikipedia). Only for Twitter the values are slightly higher

5.5. EU added value

The value resulting from the BBI JU/CBE JU partnerships in the bio-based economy sector goes beyond what could be achieved through interventions carried out at regional or national levels. One key aspect highlighted by the interviewees was the multinational nature of BBI/CBE JU projects. This multinational collaboration is crucial for projects at higher Technology Readiness Levels (TRLs), as it allows for the formation of consortia with diverse expertise and resources. The consortia span across countries, fostering cross-border cooperation and knowledge exchange. This collaborative approach ensured that each country had a role in the cooperation along the value chains, leading to more comprehensive and impactful outcomes.

The interviewees emphasized that without the BBI JU/EU framework of cooperation and funding, the implementation of their research and innovation projects would have been challenging, if not impossible. The BBI/CBE JU provides funding that incorporates industry priorities, creating added value for universities and research institutions by aligning their work with industry expectations. Moreover, the BBI JU acted as a catalyst for collaboration, forcing actors to consider the entire value chain and seek optimal cooperation partners on an international scale. This led to the creation of new networks and the integration of companies into value chains, fostering innovation and enabling them to find suitable partners and clients even after the projects.

The BBI/CBE JU partnership also contributed to the mobilization and coordination of resources. By attracting substantial financial investments from both public and private sources, the partnership has been enabled the implementation of large-scale projects (e.g. FLAGs) and the scaling up of technologies and processes. The BBI JU's industry-led operations and its ability to de-risk conditions for investors have played a crucial role in driving the growth of bio-based businesses in the EU. The joint undertaking's governance structure and its own tools and advisory groups provide a solid foundation for strategic decision-making, further enhancing its impact on the growth of the EU bio-based economy.

The BBI/CBE JU plays a crucial role in facilitating the creation and expansion of R&I networks that bring together relevant and competent actors from across Europe, thus contributing to the realization of the European Research Area (ERA). These networks are instrumental in driving collaboration, knowledge exchange, and the sharing of best practices, ultimately leading to enhanced innovation and scientific advancements in the bio-based economy (BBI JU 2020a).

One of the key way in which the BBI/CBE JU fosters the formation of R&I networks is through its project funding. By providing financial support to collaborative projects, the partnership encourages the establishment of consortia that consist of diverse stakeholders, including industry partners, academic institutions, research organizations, and civil society groups. These projects often require the involvement of actors from different countries, promoting cross-border cooperation and enabling the pooling of expertise and resources. The projects were distributed over participants from 27 EU Member States plus 12 Associated Countries, for instance the FLAG biorefineries are in Estonia, France, Ireland, Italy, Latvia, Netherlands, Norway, Romania and Spain (BBI JU 2021b). The collaborative nature of these projects leads to the development of strong R&I networks that transcend national boundaries and bring together actors with complementary skills and knowledge.

There has been an evolution towards a more balanced geographical expansion of flagships across the EU. The map below shows where the projects coordinators and participants, but also the demonstration and flagship plants were located (BBI JU 2020a). An updated map of DEMO and FLAG, however with lower level of detail (can be found here: https://www.cbe.europa.eu/). Such support and diffusion of demo plants and Flagship plants would not have been possible in a non-partnership approach.

Figure 9 Overview on BBI JU's project participants, DEMOs and FLAGs
Source: BBI JU 2020a:7

5.6. Additionality

The financial contributions from the private side, alongside the public funding, play a crucial role in advancing the goals and objectives of the BBI/CBE JU.

The leverage effect demonstrated by the BBI/CBE JU is an important indicator of its impact in mobilizing additional resources. In Horizon 2020 the BBI achieved a Leverage factor of 1,90 (ratio of in-kind and financial contributions of participants divided by the EU contribution), highlighting the ability of the partnership to attract private investments that surpass the initial public funding. Although this effect is slightly below the target when compared to previous years (CBE JU 2022). Nevertheless, this leverage effect signifies the confidence and interest of industry stakeholders in the bio-based economy projects supported by the BBI JU. In-kind contributions of the BBI JU amount € 2,7 billion, whilst in-cash contributions made by partners

other than Union amount € 2 billion. By leveraging private investments, the partnership has made a considerable effort to amplify the scale and reach of its initiatives, enabling the realization of larger and more impactful projects.

For the CBE JU, the most current BMR survey data[7] shows significant in-kind contributions of € 411 million and € 1.6 million in-cash contributions. Compared to the set targets, 41% of the in-kind contributions and 7% of the in-cash contributions have been already reached.

Table 10. Leverage Factor Calculations: Horizon Europe 2021-2023

	A. EC Contribution *	B1. Public Partners Contribution	B2. Private Partners Contribution	C1. In Cash Contribution	C2. In-Kind Contribution	D1. Direct Leverage	D2. Direct Leverage Target	E1. Direct Leverage Factor
Value:	1000			1,6	411,3	412,9	1023,5	0,41
Source:	Cordis BMR 2022			**BMR-Survey 2023**				

*NB! Does not include National Investments.

Source: BMR-Survey Data 2023 received from EC.

These results underscore the commitment and support of private partners towards driving innovation and research in the bio-based economy. However, there have been challenges in generating in-kind contributions due to various factors, including the impact of the COVID-19 pandemic. The BBI/CBE JU recognizes the isnimportance of meeting the contributions from private partners and continues to work towards ensuring the expected level of investment leverage is achieved (CBE JU 2022a). The mobilization of private and public R&I resources by the BBI/CBE JU has significant implications for EU priorities. By attracting private investments and fostering collaboration between industry and research institutions, the partnership is able to address key challenges and promote innovation in line with EU strategies and objectives. The creation of flagship biorefineries, supported by both public and private funding, not only contributes to the growth of the bio-based economy but also generates substantial employment opportunities. The initial eleven BBI JU-funded flagship biorefineries have been generated 3,500 direct jobs and over 10,000 indirect jobs underscores the socio-economic impact of the BBI/CBE JU initiatives (BBI JU 2021a).

5.7. Directionality

The BBI/CBE JU has made significant progress towards the strategic vision of the European Partnership, demonstrating its commitment to delivering results for the EU and its citizens. The partnership recognizes that addressing global challenges and fostering competitiveness requires a comprehensive approach that goes beyond traditional calls and work programs.

The interviews shed light on the potential of the bio-based economy in marginalized areas with geographical challenges and development difficulties. It is recognized that these regions offer unique opportunities for sustainable development and economic growth. However, realizing this potential requires a deep understanding of local production and social structures. The BBI/CBE JU has acknowledged the importance of aligning the worlds of agriculture, development, and the bio-based economy to effectively address the complex challenges faced by these regions. By fostering collaboration and knowledge exchange, the

[7] BMR-Survey Data 2023 received from EC

partnership aimed to drive regional development, create employment opportunities, and promote sustainable practices in these areas.

The current CBE JU puts more emphasis on the circularity and environmental impacts of the bio-based economy. As the BMR survey data of 2023 indicates, EIT Food plans to spend 100% of its total partnership budget on activities linked to the Green Deal objectives.[8] This is also reflected in the current KPIs, which were further developed n comparison to BBI and include in particular the following KPIs closely related to sustainable impacts, which are operationalized by various indicators[9]:

- KPI 3 - Ensure environmental sustainability of feedstock
- KPI 4 - Improve environmental sustainability of bio-based production processes and value chains
- KPI 5 - Expand circularity in bio-based value chains

In addition, the AWPs and the design of the calls put more emphasis on environmental issues, e.g. the few CSA calls published yet under the CBE JU concern measurement, awareness and common understanding of sustainability impacts of the bio-based economy.

Still, the interviews highlighted several areas for improvement. One such area is the need to focus on citizen and consumer awareness. While the BBI/CBE JU has made progress in this regard, there is room to further expand educational efforts and raise awareness about the bio-based economy starting from early ages, meaning long-term education of citizens is important.

Stakeholder engagement is another crucial aspect of the BBI/CBE JU's approach. The partnership values the input and perspectives of relevant stakeholders and seeks to involve them in shaping strategies and priorities. This includes consulting with key stakeholders during the development of the strategic research and innovation agenda, as well as involving them in thematic workshops, consultations, and advisory groups. By fostering dialogue and ensuring a participatory approach, the BBI/CBE JU has to some extent made an EU-wide impact on harnessing the collective knowledge and expertise of stakeholders to drive the bio-based economy forward. Moreover, the BBI/CBE JU aims to contribute to strengthen the European strategic autonomy be decreasing the EU dependency on several raw materials, products and supply chains, while at the same time replacing traditionally fossil-based value chains by circular bio-based value chains, which rely on locally and sustainably sourced biomass. Some examples are reducing the European proteins gap for food and feed, or reducing external dependencies on Phosphorus (P), Potassium (K), and Nitrogen (N).[10]

5.8. International positioning and visibility

Building upon the interview results, it becomes evident that while the BBI/CBE JU has acknowledged the global nature of the bio-based economy, its efforts towards international collaboration beyond the EU have been limited. Interviewees noted their involvement in international activities related to the bio-based economy, but these were not directly linked to

[8] BMR-Survey Data 2023 received from EC
[9] https://www.cbe.europa.eu/system/files/2022-07/CBE%20JU%20KPIs-Handbook.pdf
[10] BMR-Survey Data 2023 received from EC

the BBI JU or CBE JU. There is a sense that collaborations outside of Europe promoted by the BBI JU may have gone unnoticed or were not actively pursued.

The BBI JU has adopted the general approach of the Framework Programme that allows participating of third countries, depending on the country's status. However, the participation from third countries was limited to less than one percent (see Table 6).

The efforts of the BBI/CBE JU towards international cooperation have been limited, as it was not considered as the mandate of the partnership. This may be an area for further development and exploration. While some interviewees have noted limited collaborations outside of Europe promoted by the BBI/CBE JU, there is recognition of the future, potential importance of establishing collaboration on research projects and aligning research objectives with the understanding that the bio-based economy extends beyond Europe. The partnership recognizes the need to extend collaboration beyond European boundaries and engage with countries outside of Europe. The partnership has also participated in a few bioeconomy related info days outside Europe to inform stakeholders about relevant international opportunities. Such actions may contribute to reinforcing the EU's relative positioning in the bio-based economy by expanding collaborations and promoting knowledge exchange on a global scale.

5.9. Transparency & Openness

The BBI/CBE JU maintains an inclusive approach, welcoming participation from a diverse range of entities across the bio-based value chain. Every legal entity has the opportunity to apply for the BBI/CBE JU programs, ensuring an open platform for collaboration and innovation. The BIC, as the private side platform of the partnership, is open to new members to achieve a broad industrial involvement. Interested stakeholders along the bio-based value chain may apply for membership to the BIC, ensuring a diverse and inclusive participant pool (BBI JU 2019). According to an expert, the concept of bio-based economy has gained global importance over the last decade, necessitating an open and flexible approach to encompass different relevant aspects and dimensions. The BBI/CBE JU's open approach facilitated the inclusion of stakeholders from various regions, including Southern Europe and associated countries, thereby achieving a better understanding of concept/definition of bio-based economy on a broader level.

To facilitate the involvement of new members, the BBI/CBE JU has implemented the following mechanisms that enhance accessibility. While the drafting of topics is not open to external actors, the decision-making processes are transparent and the calls are fully open, allowing any interested stakeholders to participate. One measure is the future set-up of a deployment group that focuses on the integration of primary producers as well as an action plan to enhance the participation of the agricultural sector in the CBE JU programme and the bio-based value chains. Another issue is the limited participation of Central/Eastern Europe actors. As described in section 5.4 there have been several actions to increase the participation of those countries. However, according to the interviews no increase in participation in the first annual Call of CBE has been achieved.

SMEs are recognized as crucial contributors to the bio-based economy and play a significant role in the BBI/CBE JU projects. Between 2014 and 2020, SMEs received 37% of the total BBI JU funding, representing 40% of all beneficiaries and comprising two-thirds of the private organizations involved in the projects (BBI JU 2021b). These participation rates of SMEs exceed their rate in H2020 by far (Figure 10). While this difference is probably partly due to the more industry-related calls, the high effort by BBI JU to address and include SMEs is obviously successful.

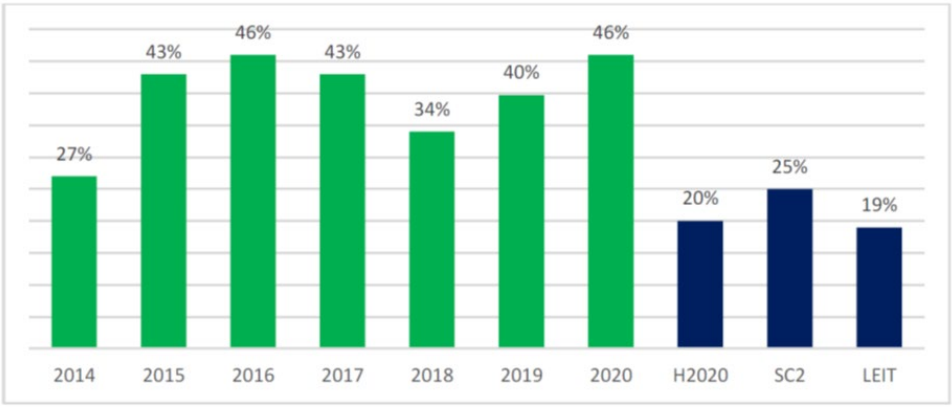

Figure 10 SMEs participants in BBI JU funded calls (green bars) vs. other parts of H2020 (blue bars)
Source: Annual Activity Report 2021

This emphasis on SME involvement acknowledges their importance as drivers of innovation in the bio-based economy. The BBI/CBE JU has implemented measures to support SME participation and ensure accessibility for industry partners. For example, the creation of a membership category specifically for project members, which does not require membership fees, encourages the engagement of SMEs and industry partners. These initiatives enhance the accessibility and inclusivity of the BBI/CBE JU for SMEs and industry stakeholders. The BBI/CBE JU framework has seen a transformative rise in SME engagement, underscoring their evolving roles in the bio-based economy. Initially, SMEs were mainly involved in innovation actions, often partnering with larger enterprises. However, they have progressively taken the lead, not only in research phases with lower TRLs, but also as primary coordinators for flagship projects.

Transitioning from 37% participation in BBI to about 40% in the CBE's inaugural call, SMEs, predominantly technology-focused, are now at the forefront of project leadership. Their ability to leverage BBI/CBE JU funding and secure additional capital underlines their agility and innovation. Many SMEs attest that the BBI JU framework has been pivotal in their ventures. Undoubtedly, SMEs represent the core of the European innovative spirit, catalysing the green transition.

Based on the interview results, the transparency and openness of the BBI/CBE JU to societal groups, such as NGOs and societal groups, is addressed to some extent. Societal groups are expected to be involved in the deployment group, particularly in primary production However, there may be room for improvement in terms of effectively capturing and harnessing the impact of all actors involved in the projects. The involvement of societal groups and the consideration of their perspectives can contribute to a more inclusive and holistic approach to bio-based economy initiatives. Based on the interview results, the BBI/CBE JU recognizes the importance of expanding partnerships and engaging a broader set of stakeholders across Europe. According to experts, discussions have taken place within the scientific committee regarding the involvement of various actors, such as farmers or biomass producers, in the evaluation of the annual work programme.

The BBI/CBE JU demonstrates a commitment to openness in the use of research results. The CBE JU adheres to the Horizon Europe requirements for open access (OA) publication of peer-reviewed articles resulting from project funding. This ensures that research findings are freely accessible online, facilitating knowledge dissemination and fostering collaboration among stakeholders.

According to the annual report of 2021, there has been a lot of activities in communication and outreach, including a successful launch campaign for the CBE JU performed by the programme office (CBE JU 2022a). This is crucial to ensure transparency and openness towards all potential participants.

In terms of gender, the CBE JU's commitment to gender balance and inclusion is evident across its organizational hierarchy and its various projects. At the core of the unit, the emphasis on gender balance is showcased by the representation of women in key roles, such as management, with an overall trend towards hiring women based on merit rather than a prescriptive gender quota. This organic approach to gender balance is buttressed by the organization's internal policies, which prioritize work-life balance through scheduling considerations and flexible work options. These policies not only support gender inclusivity but also cater to the broader needs of all employees, allowing for better work-life integration. In 2022, the CBE JU achieves gender balance in management positions with 50% female representation (CBE JU 2023).

On a structural level, the CBE JU acknowledges the areas where it holds direct influence, such as the advisory bodies and the Scientific Committee, and proactively strives for gender parity in these domains. In contrast, for entities like the governing board, where members are predominantly nominated externally, the JU provides guidance and encourages gender-balanced nominations, though the final discretion rests with the nominating bodies. Despite this, there is a palpable shift towards ensuring balanced representation, reflecting a broader, systemic recognition of gender diversity's importance. Moreover, regarding evaluation expert in 2022, out of the invited 84 expert-evaluators, 48.8% were female and 51.2% male (CBE JU 2023).

The introduction of Horizon Europe's tools, which facilitate better tracking of gender-related data, has significantly bolstered the CBE JU's efforts in monitoring gender balance across projects. This proactive approach during the consortium formation and proposal submission phases reinforces the importance of gender inclusivity at the project level. The Commission's tools are actively leveraged to evaluate projects, ensuring that alongside scientific viability, gender balance remains a critical parameter. This not only emphasizes the holistic approach adopted by the CBE JU, but also contribute to its alignment with Horizon Europe's broader objectives of ensuring gender parity in the realm of research and innovation. The numbers in the table below are that the share of female participations in the projects is 39%.

Table 11 Gender participations in projects

partnership	Nb projects	Nb participations (organizations)	Nb participations (researchers)	Share female participations	Nb female participations	Nb male participations
CBE	21	293	274	39%	108	166

Source: Science-Metrix

5.10. Phasing out preparedness

While a dedicated phasing out strategy of the JU is still underway, there are intensive activities of achieving sustainable long-term impact on the bio-based innovation ecosystem. One of the defining goal and characteristic of the BBI/CBE JU partnership framework is its emphasis on sustained investments, particularly those referred to as "additional activities" that are expected to kick in post-project completion. Crucially driven by private partners, these investments symbolize the industry's unwavering financial commitment towards realizing the objectives championed by both BBI and CBE. As explicated in sections related to leverage effects or industry contributions, these investments, amounting to around 2 billion euros according to the annual activity report, are channelled into following up on projects after their conclusion. The ultimate vision here is not just to usher in an initial industrial unit but to lay a solid foundation for subsequent implementation, ensuring broad-based deployment. This industry-led approach, especially keen on replicating the successes of pioneering biorefineries, aims to achieve an expansive impact across Europe – from job creation and CO2 emission reduction to broader climate change mitigation. While this model predominantly suits more significant projects, its principles are equally relevant to specific innovation actions and demonstration projects, with some coordination and support actions undergoing continuous scrutiny.

Furthermore, in assessing project outcomes, it is evident that the achievements of some initiatives naturally fit within the broader multi-annual programming approach, given their advanced progress. For instance, while Research and Innovation Actions (RIAs) typically advance up to TRL5, they later need to transition to higher readiness levels. The Commission retains the flexibility to either encompass these into innovation actions topics going up to TRL7 or migrate them to different programs, like Cluster 6, to capitalize on promising results. This multifaceted approach embodies the Commission's strategy of synergy, where the goal is to adeptly navigate stakeholders through subsequent stages of their initiatives. While addressing high TRLs and industry aspirations remains paramount, for endeavours at lower TRLs, the strategy revolves around leveraging varied instruments to bridge to higher TRLs. The BBI/CBE JU framework acknowledges that not every project can solely rely on CBE funding. Some might find a niche within new topics and programs, while others might tap into alternative financial reservoirs.

Additionally, Coordination and Support Actions (CSAs) play a pivotal role in navigating specific challenges, providing invaluable insights both to the Commission and the Bio-based Industries Consortium (BIC). Some CSAs are tailored to enhance certain competencies or deepen understanding in areas like consumer acceptance. The intelligence harvested is then channelled to beneficiaries, serving as a foundation for future projects. Such mechanisms elucidate the myriad pathways available for augmenting and sustaining funded activities.

The BBI/CBE JU's role in managing the transition and continuation of projects under the Horizon 2020 and Horizon Europe frameworks has been crucial. By measuring the continuity of projects, the magnitude of industry investments post-project conclusion, and the uptake of innovative biorefineries across Europe, it is evident that the partnership has played a pivotal role in bridging the gap between project completion and industrial realization. Its collaborative structure, encompassing both public and private sectors, has facilitated a consistent focus on scalability and replication, ensuring that innovations do not stagnate after initial success. Furthermore, by actively integrating feedback from annual activity reports and regularly evaluating its alignment with the broader objectives of the European Commission, the BBI/CBE JU has demonstrated adaptability and foresight in guiding projects to successful outcomes beyond their initial life cycle.

The phasing out of projects within the BBI/CBE JU framework is not without its set of challenges. Firstly, ensuring a seamless transition from project conclusion to industry-driven additional activities often encounters financial, technological, and market-based roadblocks. Even with private partners geared up to drive post-project investments, there is a constant balancing act between maintaining the momentum of initial achievements and navigating the uncertainties of market scalability. Furthermore, as projects transition to higher Technology Readiness Levels (TRLs), they may fall into the "valley of death", a phase where innovations struggle to move from the developmental to the commercial stage due to lack of funding or market readiness. Additionally, the inherent challenge of aligning the varied objectives of stakeholders, especially when shifting from BBI/CBE JU's specialized framework to broader European programs, can lead to potential misalignments and missed opportunities.

The CBE JU relies on external experts to assess the alignment of project outcomes with predefined terms, emphasizing not only the completion of objectives but also effective communication of results. While the maturity and potential of technologies developed within a project may suggest the need for further investments, it does not guarantee direct funding. Instead, decisions about technological progression often necessitate navigating through open calls for proposals. The broader project portfolio, rather than individual projects, is assessed through comprehensive KPI reporting and analysis, shaping future call priorities and strategic directions. This approach underscores the balance between advancing promising projects and maintaining competitive integrity in the broader Horizon Europe landscape.

6. Conclusions

The transition from the Bio-based Industries Joint Undertaking (BBI JU) to the Circular Bio-based Europe Joint Undertaking (CBE JU) represents a critical evolution in the European Union's commitment towards promoting a sustainable, circular bio-based economy. This transition signifies a shift towards a broader, more holistic perspective, emphasizing the need for a systemic transformation that encompasses every facet of the bio-based economy - from resource sourcing and utilization to waste management and the closing of production loops. As society increasingly recognizes the need to transition away from unsustainable, fossil-based industries, the role of bio-based industries in driving economic growth, job creation, and environmental sustainability becomes ever more paramount. This makes the function of the CBE JU – to guide, support, and facilitate these industries – vitally important.

The operational structure of BBI/CBE JU, characterized by strategic priorities, has demonstrated remarkable efficacy in steering its ventures towards achieving set objectives. The organization has utilized a potent combination of decision-making process, operational management competency, and public-private partnerships to effect change in the bio-based economy. However, the organizational architecture, while largely effective, has also posed challenges, particularly in the realm of communication, necessitating enhanced strategies for stakeholder engagement and cross-tier dialogue.

With sustainability being a global priority, BBI/CBE JU's mandate is increasingly **relevant**. It has a crucial role in driving innovation, fostering industry engagement, and aligning policies within the bio-based economy. The organization's approach aligns with the urgency of addressing environmental challenges, thereby placing BBI/CBE JU at the forefront of the transition towards a circular bio-based economy. BBI/CBE JU's strategic orientation is congruous with the broader policy objectives of the EU. Its initiatives significantly contribute to the European Green Deal and the EU Bioeconomy Strategy, enhancing sustainable and inclusive growth across the region. In an evolving bio-based economy marked by rapid

technological advancements and dynamic policy landscapes, agility and responsiveness are of the essence. BBI/CBE JU's journey shows the need to remain flexible and responsive to these changes. The organization's ability to adapt to these shifts will largely determine its continued relevance and effectiveness in driving the bio-based economy.

In terms of operational **efficiency**, BBI/CBE JU has made considerable strides, with the creation of various novel cross-sector interconnections within the bio-based industry serving as a testament to its high operational efficiency. However, some areas, such as the timely achievement of predefined objectives and the successful execution of flagship projects, call for more focused efforts to bolster efficiency.

The BBI/CBE JU's initiatives are **coherent** with other EU policies and activities, substantiating its contribution to the EU's overarching sustainability objectives. However, potential friction points have been identified, particularly where the BBI/CBE JU's specific focus intersects with other EU policies and priorities, necessitating further investigation to ensure seamless integration and mutual reinforcement of initiatives across sectors.

The partnership has been **effective**. Most of the targets of the KPIs of the (previous) BBI JU have already been achieved during the set periods. The BBI/CBE JU has achieved notable outcomes and impacts in various areas related to the green transition. The deployment of solutions, particularly through the FLAGs, has yielded positive results, with high participation of SMEs exceeding the set targets. This collaboration between industry and the public sector, as well as engagement from actors across different sectors, has contributed to the success of market creation and support.

BBI/CBE JU's commitment to **transparency and openness** is laudable. Its efforts to engage a diverse range of entities in its programs, with a particular focus on SMEs, points out its commitment to inclusivity. However, the report identified areas where this commitment could be deepened, especially in the involvement of societal groups such as NGOs.

BBI/CBE JU was successful in achieving a leverage factor of about 1.9 for 2020, which lies slightly below the targets in the previous year. Still, a significant leverage of private investment can be stated. Moreover, the **additionality** of BBI/CBE JU goes beyond financial leverage factors. BBI/CBE JU significantly fosters the formation of R&I networks. By providing financial support to collaborative projects, the partnership encourages the establishment of consortia that consist of diverse stakeholders, including industry partners, academic institutions, research organizations, and civil society groups. These projects often require the involvement of actors from different countries, promoting cross-border cooperation and enabling the pooling of expertise and resources.

The BBI JU/CBE JU partnership provides **significant EU added value**. The impact goes beyond what could be achieved at regional or national levels. The implementation of research and innovation projects in such quantity, especially those in higher TRL stages, would not have been possible without the partnership. Moreover, enhanced multinational collaboration is crucial for projects at higher Technology Readiness Levels (TRLs), as it allows for the formation of consortia with diverse expertise and resources.

SMEs have emerged as vital cogs in the machinery of BBI/CBE JU's initiatives. Their increasing participation, from innovation actions to leading flagship projects, signifies the attractiveness and suitability the organization extends to these enterprises. SMEs, with their inherent agility and innovation-driven approach, have been instrumental in bridging gaps, driving research, and facilitating market readiness for bio-based solutions. BBI/CBE JU

recognizes their significance, ensuring they receive ample opportunities, resources, and platforms to amplify their impact within the European bio-based economy.

BBI/CBE JU has demonstrated a consistent commitment to **gender balance**, both within its organizational hierarchy and in its overarching strategies. This commitment is not just a matter of policy but is reflected in the real-world composition of its teams and leadership. While recognizing the industry-wide challenges of gender representation, BBI/CBE JU's efforts aim to ensure that the best candidates, irrespective of gender, are at the forefront of driving its mission.

Regarding phasing-out preparedness, the BBI/CBE JU emphasizes sustained investments **after a project's conclusion**, ensuring innovations progress beyond the initial stages. Guided by insights from annual reports and ongoing evaluations, the partnership champions scalability and practical deployment. The focus is on bridging the gap between the project end and broader industry application, all within a competitive and supportive European framework.

Lastly, the analysis of BBI/CBE JU's **international impact** has shown the potential of active and globally visible partnerships. The future possibilities for initiating or expanding international collaboration would enhance the international positioning of CBE JU but also foster a greater global impact.

7. Lessons Learned and Recommendations

The analysis of BBI/CBE JU has offered crucial insights into the efficacy and challenges of the partnership's model and structure. The partnership's effectiveness is apparent in the organization's ability to drive its ventures towards achieving set objectives. However, it also underscores the complexities inherent in such partnerships, such as building a strong narrative around bioeconomy examples, communication gaps addressing bioeconomy policy coherence with relevant policy domains, the added value of bio-based products for customers, and stimulating market updates of bio-based products. Therefore, while the partnership provides a strong basis for decision-making and operational management, its potential drawbacks require thoughtful mitigation strategies to maintain its overall efficacy.

Looking towards the future, the CBE JU has the potential to play a pivotal role in the bio-based economy by effectively leveraging its strengths, learning from past experiences, and embracing opportunities for improvement, as outlined in this report. In particular, the CBE JU can ensure it fosters innovation, nurtures industry engagement, and aligns with evolving policies and global best practices.

As the bio-based economy continues to evolve, the CBE JU will need to stay agile and responsive, ready to navigate emerging challenges and seize new opportunities. Its ability to do so will be instrumental in shaping a sustainable, resilient, and inclusive bio-based economy that delivers value for all stakeholders, from industry players and policymakers to citizens and the environment. Hence, while the CBE already provides a strong contribution to the bio-based economy and related challenges, some further actions are recommended to exploit its full potential. These recommendations are coming mostly from interviewees but are backed up by the assessment findings.

- Strategies to Enhance Communication and Stakeholder Engagement

  - Develop a comprehensive and strategic communication plan, underlining clear and consistent messaging across all levels of governance and operations. The plan should include details about key messages, communication channels, frequency of communication, and feedback mechanisms.

  - Implement a robust stakeholder engagement strategy that encourages two-way dialogues with all stakeholders. This could involve hosting regular forums for discussion, workshops, and webinars to enable stakeholders to provide their insights, feedback, and suggestions on various initiatives and operations.

- Approaches to Remain Responsive in the Evolving Bio-based Economy

  - Enhance CBE JU's role by strengthening internal collaboration with the EC and BIC programming teams, aligning with other Joint Undertakings. This strategic enhancement, respecting SBA constraints and avoiding duplication with Commission services, can be considered for future mandates or upon assigning new tasks, ensuring effective contribution to the evolving bio-based sector.

  - Build partnerships with academic institutions, research bodies, and industry associations for ongoing knowledge exchange, enabling CBE JU to stay current with the evolving sector and adapt strategies accordingly.

- Methods to Address Operational Hindrances in the Implementation of Flagship Projects

  - Implement a comprehensive risk management framework that helps in the early identification of potential obstacles and allows for timely remediation. Regular risk assessments should be conducted throughout the lifecycle of projects, with mitigating measures implemented promptly.

- Techniques for Seamless Integration with Other EU Policies and Activities

  - Regular inter-sector dialogues and meetings with relevant DGs (ENV, CLIMA, ENER) and EU agencies (EFSA, EPVO, EEA, ECHA, etc.) can facilitate mutual understanding and alignment, contributing to continuous integration. These dialogues could serve as platforms to clarify overlapping priorities, identify synergies, and foster collaboration. However, the possibilities and resource limitations need to be considered.

- Measures to Ensure Inclusivity in All Facets of the Organization's Initiatives

  - Implement an Inclusive Participation Strategy that includes specific measures to increase the involvement of diverse entities such as NGOs, small businesses, and underrepresented groups, as well as countries or regions. Such a strategy could involve targeted outreach initiatives, capacity-building programs, and dedicated funding or support mechanisms.

  - In addition to encouraging diverse external participation, CBE JU could strengthen its internal culture of diversity and inclusion. This can be achieved by recruiting a diverse workforce, implementing inclusive practices, and fostering an environment that values diverse perspectives and ideas.

- Cultivating Active and Globally Visible Partnerships

  - Explore possibilities for establishing a dedicated International Relations Unit that can be tasked with relevant partnerships in different countries, international organizations, and global industry associations.

  - Promote the Organization's Impact and Success Stories by showcasing the organization's impact and success stories on international platforms can enhance its visibility, attracting potential international partners and facilitating collaborations.

8. Annex

A8.1 Supplementary evidence: Results

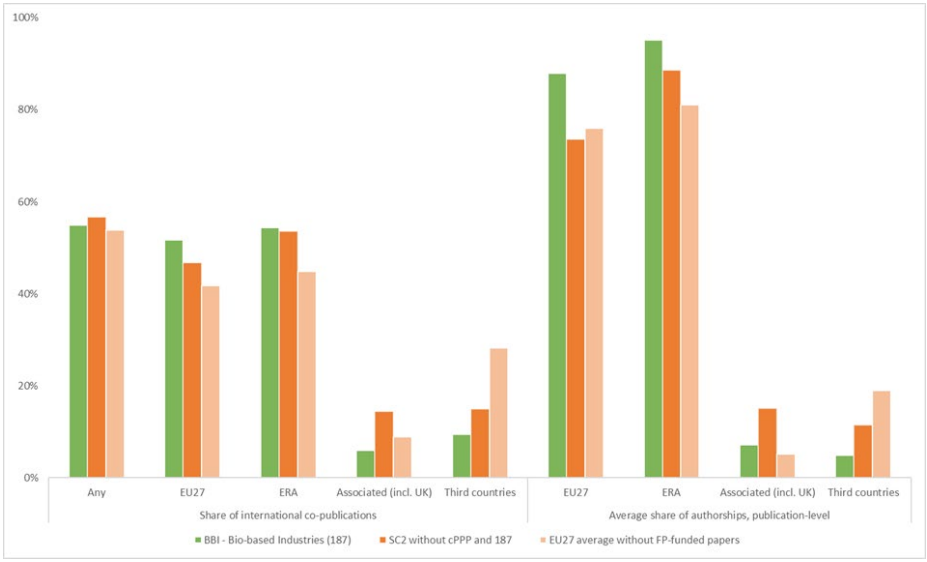

Figure 11 BBI International co-publication profiles (2014-2021). Note: Share of international co-publications with at least one first, last or corresponding author from the aggregate of interest. Share of authorships: average publication-level share of authorships held by researchers from the country aggregate of interest.
Source: Science-Metrix/Elsevier using data from Scopus (Elsevier) and eCorda; own calculations

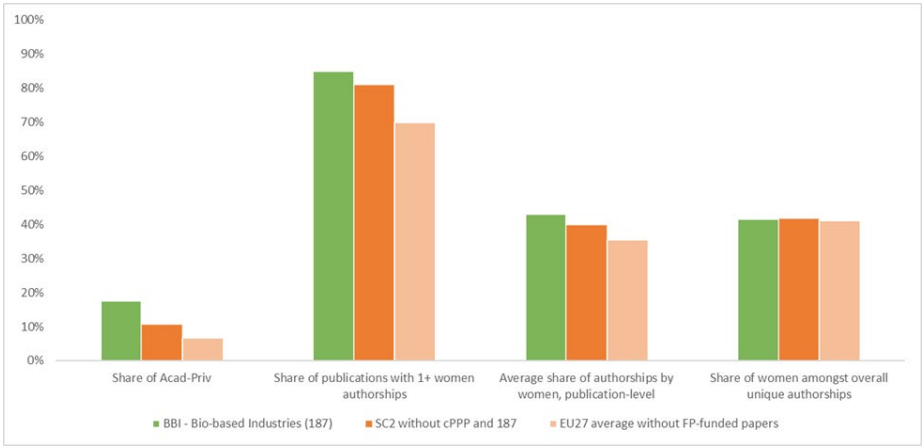

Figure 12 BBI Academic-private co-publications and gender equity in authorship (2014-2021).
Source: Science-Metrix/Elsevier using data from Scopus (Elsevier) and eCorda; Own calculations.

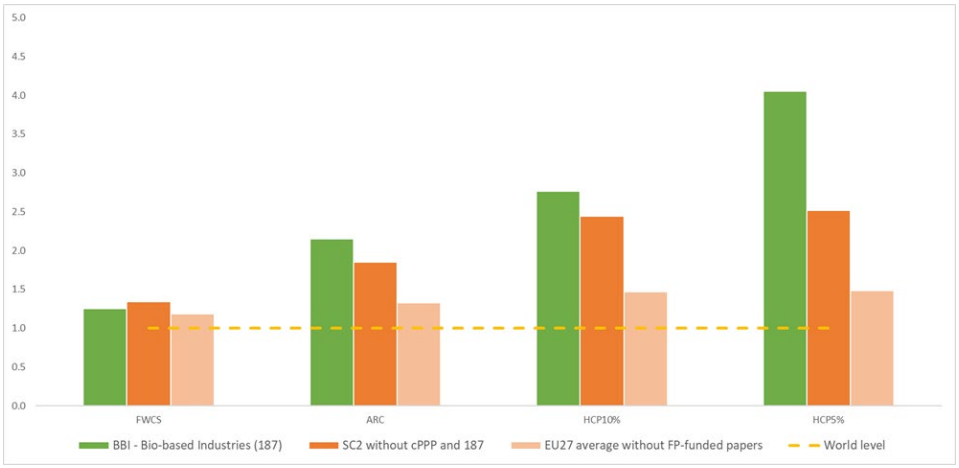

Figure 13 BBI CiteScore and citation impact profiles (2014-2021).
Source: Science-Metrix/Elsevier using data from Scopus (Elsevier) and eCorda

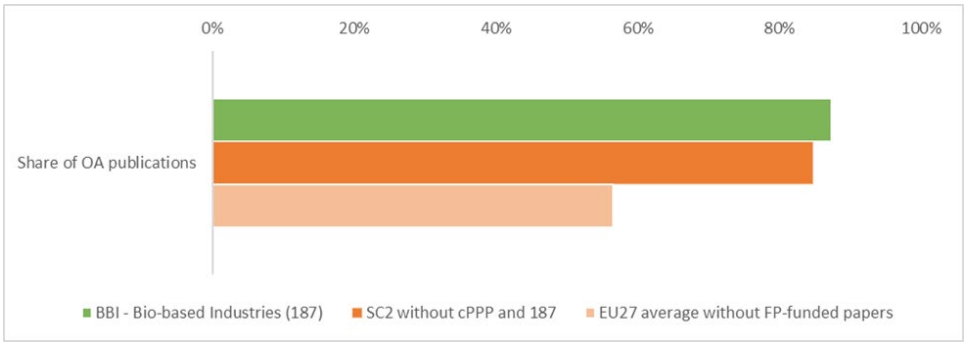

Figure 14 BBI Open access publication).
Source: Science-Metrix/Elsevier using data from Scopus (Elsevier), eCorda and Unpaywall

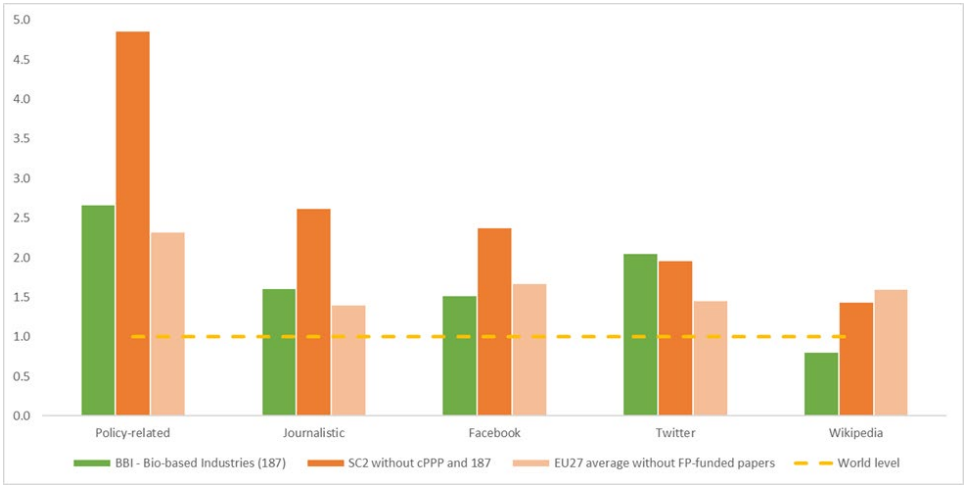

Figure 15 O BBI Policy-related, and metrics mentions profiles (2014-2021).
Source: Science-Metrix/Elsevier using data from Scopus (Elsevier), eCorda, PlumX and Overton; own calculations

Calibre Analysis

Notes on interpretation of the partnership calibre analysis

The KIP monitoring framework recommends that scientific outputs such as journal publications or citations towards these publications be evaluated no earlier than two years after the supported projects of interest have been completed. On this basis, as of fall 2023, it is not appropriate, nor is even the necessary data even available, to conduct a bibliometrics evaluation exercise of Horizon Europe journal-publication-mediated scientific outputs.

To measure instead enabling factors of Horizon Europe effectiveness, a so-called calibre analysis can be performed on the prior scientific achievements of researchers involved in projects selected for Horizon Europe funding. Cluster 4 researchers' prior publications (from 2017 to 2021) were retrieved to establish their track records on dimensions such as academic-private co-publication, cross-disciplinarity, or scientific excellence (proxied through citation impact), among others. It was hypothesized that Horizon Europe funding competitions should select, for example, researchers with past experience in conducting cross-disciplinary research, as a mechanism to increase the likelihood that societal impacts will be realized from supported projects.

One important limitation of this approach is that past achievements are no guarantee of continued performance; and that successful funding instruments may in fact succeed in greatly changing researchers' past practices towards improved practices. Therefore, the calibre analysis does not obviate the need for future monitoring and evaluation, but it can provide a baseline against which to measure future developments, and help focus future on areas that will might require particular improvement and/or monitoring.

The calibre analysis of researchers now active in Cluster 4 destinations, interventions areas, action types, or partnerships, has been performed using the same set of indicators as used in phase 1 of this evaluation. They have been applied to the set of 2017-2021 publications by researchers identified as now active in Cluster 5 and Cluster 6 projects, including partnership projects.

To help differentiate these past achievements by Cluster 5 and Cluster 6 researchers, benchmarks have been assembled as follows:

- EU27+UK overall: all 2017-2021 GT publications with at least one EU27 or UK affiliation, but excluding FP-supported articles

- LERU: all 2017-2021 GT publications with at least one affiliation with an institution that is part of the League of European Research Universities, but excluding FP-supported articles

- EU27+UK industry: all 2017-2021 GT publications with at least one EU27 or UK private sector affiliation, but excluding FP-supported articles

By definition, EU27+UK industry researchers have a strong academic-private co-publication score. Therefore, the benchmark should not be used on this specific indicator.

For the three altmetric indicators used here (citation from online policy-related documents, Wikipedia mentions, and trade and journalistic news outlets mentions), a new normalization method is being rolled out as part of Phase 2 work. Indeed, for each altmetric finding, a custom synthetic world level (often referred to as the "expected") is provided. Synthetic world

levels are the average level of publications with one or more altmetrics mentions in equivalent (in terms of disciplinary distribution) global reference sets. This normalization method differ from normalization methods commonly used for citation impact indicators to better control for effects associated with sparser altmetrics signal.

'Pre-Horizon Europe' track record of CBE researchers on dimensions that are enabling factors for project effectiveness

CBE researchers' track record on team diversity and societal readiness

- Arguably, the most striking feature of CBE investigators' track record was their capacity for cross-disciplinarily research. A share of 16% of their past publications were highly interdisciplinary (against a benchmarking range of 9%-11%), and a share of 24% were highly multidisciplinary (against a benchmarking range of 13%-17%).

- A share of 22% of past publications by CBE investigators was written as academic-private co-publications, much above the two relevant benchmarks.

- The proportion of these publications that were thematically aligned with one or more SDGs was 64%, well above the three benchmarks.

- The share of these publications that was highly interdisciplinary was slightly below the benchmark range (9% to 11%), at 6%.

- The average share of authors that were women in CBE researchers' prior publications was within the benchmarking range at 39%, a performance that could be interpreted positively considering most other partnerships' low or very low scores on this dimension.

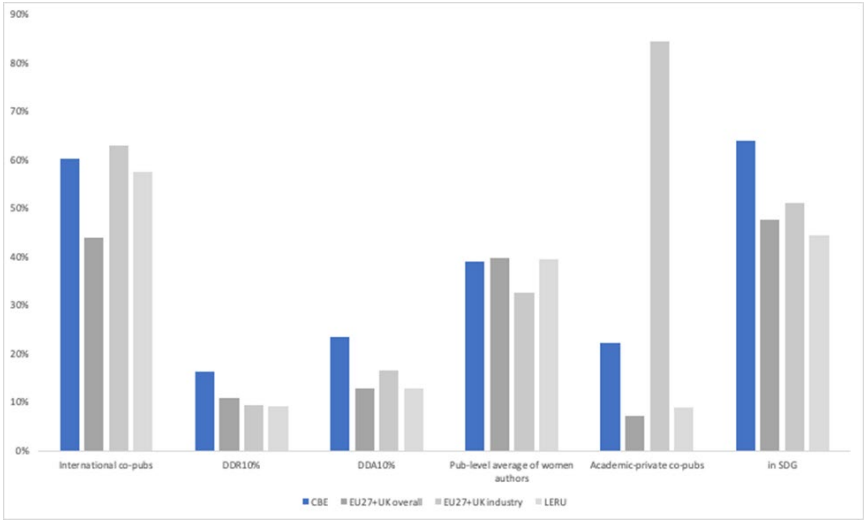

Figure 16 Pre—Horizon Europe track record of CBE researchers on selected dimensions of diversity and societal readiness of research teams (2017-2021)[11]
Source: Scopus, NamSor and eCorda databases processed by Science-Metrix

CBE researchers' track record on citation impact as proxy for scientific excellence and leadership

- Past CBE researchers' publications recorded citation impact scores well above the LERU and EU27+UK industry levels (the two high benchmarks) on the CDI indicator. For instance, its CDI score of 19.3 compared against 12.3 for LERU.

- CBE investigators' track record at producing high citation impact outliers (captured through the ARC and HCP10%) was closer to the benchmarks, indicating as strong but evenly distributed citation impact profile.

[11] DDR10%: share of publications amongst the top decile of publications with most disciplinary diversity in references (i.e., most interdisciplinary) in their subfield, year and document type. DDA10%: share of publications amongst the top decile of publications with most disciplinary diversity in authorships (i.e., most multidisciplinary) in their subfield, year and document type.

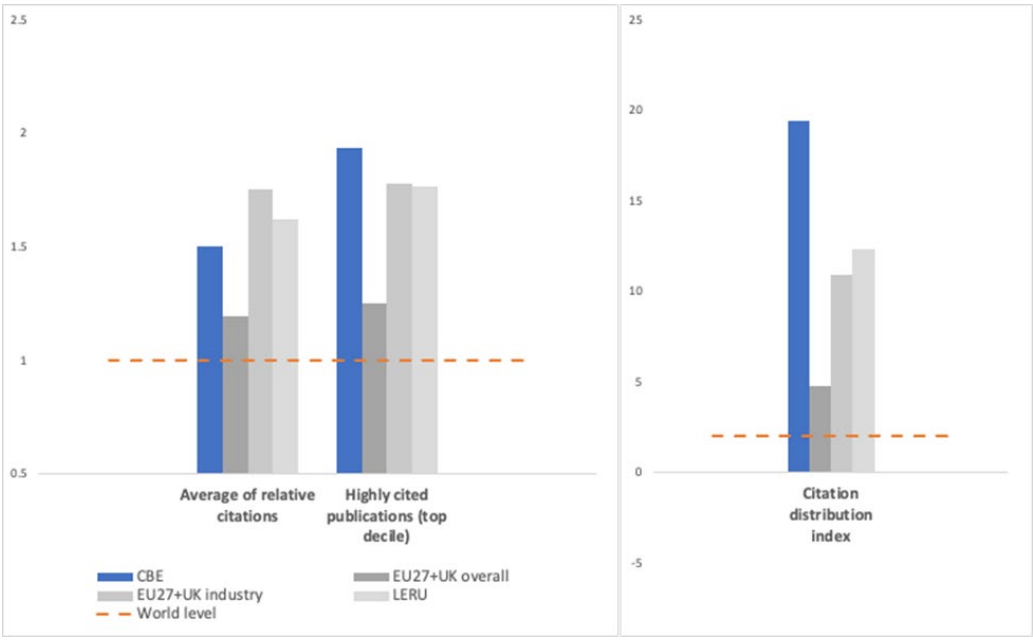

Figure 17 'Pre-Horizon Europe' track record of CBE researchers on citation impact (2017-2021)
Source: Scopus and eCorda databases processed by Science-Metrix)

CBE researchers' track record on online dissemination capacity, including OA and online policy-related uptake

- CBE researchers' track records on online policy-related citations and trade and journalistic news mentions fell within the benchmarking range.
- The share of prior publications by CBE researchers with mentions on Wikipedia was below the expected, by 0.3 percentage points to an expected of 1.8%.
- CE investigators' track record on OA publication was at 69%, in the middle of the benchmarking range (65% to 75%).

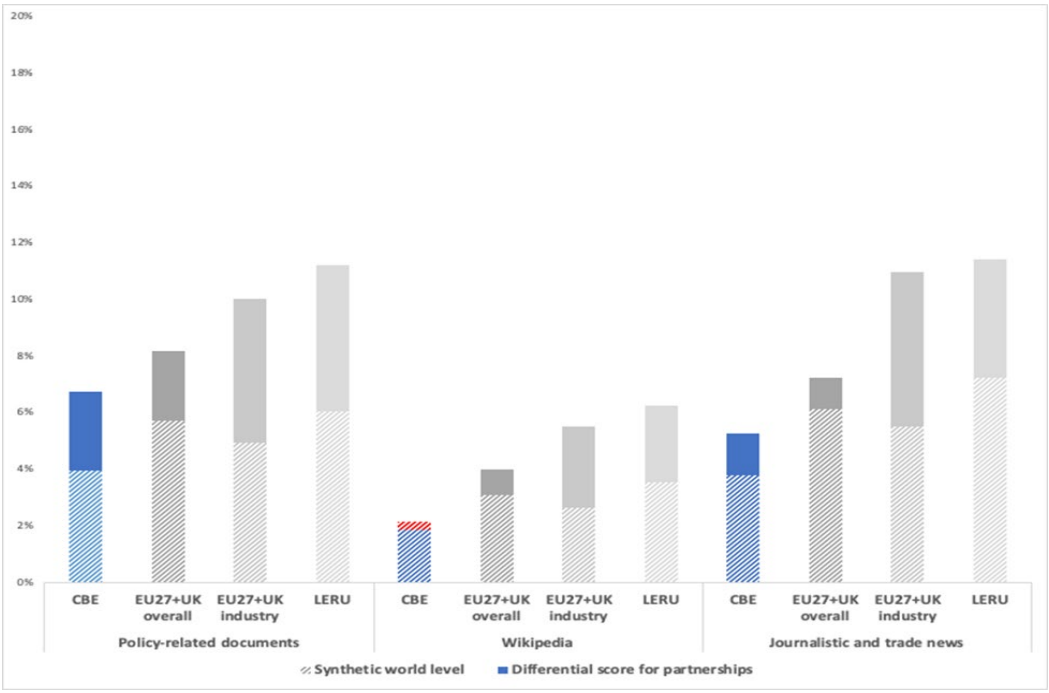

Figure 18 'Pre-Horizon Europe' track record of CBE researchers on selected online dissemination dimensions (2017-2021)[12].
Source: Scopus, PlumX, Overton and eCorda databases processed by Science-Metrix

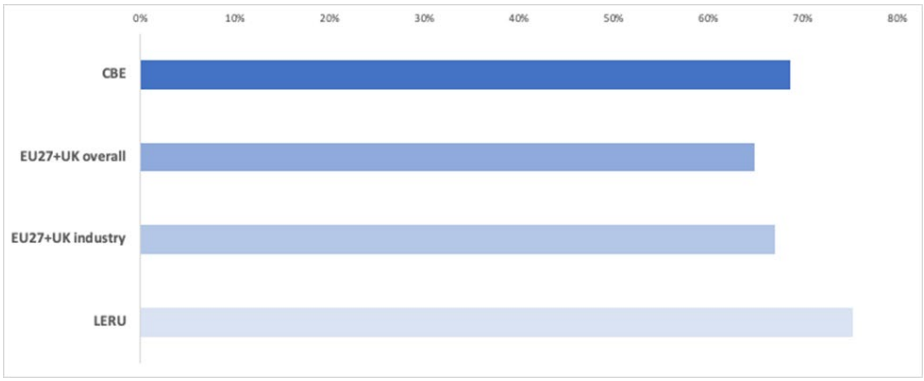

Figure 19 Pre- Horizon Europe track record of CBE researchers on OA publishing (2017-2021)
Source: Scopus, Unpaywall and eCorda databases processed by Science-Metrix

[12] Synthetic world levels are the average level of publications with one or more altmetrics mentions in equivalent (in terms of disciplinary distribution) global reference sets. Comparisons with benchmarks should be made on the differential scores (represented by the full bar sections as opposed to the stripped sections representing the synthetic world level). Differential scores are presented in red where they are negative, that is, below the expected world level.

A8.2 Sources

BBI JU (2019): Amended Annual Work Plan and Budget 2019 for the Bio-based Industries Joint Undertaking. Annex to GB decision 3/2019.

BBI JU (2020a): 2014-2020: Bio-based Industries Joint Undertaking. A high-impact initiative for green recovery of Europe. Bio-based industries Joint Undertaking.

BBI JU (2020b): Call for Proposals 2020. H2020-BBI-JTI-2020. https://www.bbi.europa.eu/sites/default/files/media/bbiju-call2020.pdf.

BBI JU (2021a): Annual Activity Report 2020. Hg. v. Bio-based Industries Joint Undertaking.

BBI JU (2021b): 7 year advancing the European bio-based industry. BBI JU 2014-2020.

CBE JU (2022a): Annual Activity report 2021. Circular bio-based Europe.

CBE JU (2022b): Strategic Research and Innovation Agenda. Circular Bio-based Europe Joint Undertaking.

CBE JU (2023) Annual Activity report 2022. Circular bio-based Europe.

EC (2021): Impact Assessment Report. Accompanying the document proposal for a Council Regulation establishing the Joint Undertaking under Horizon Europe. European Partnership for a Circular Bio-based Europe. Hg. v. European Commission (Commission Staff Working Document, SWD(2021) 37 final, part 16/19).

European Commission (2017a): Interim evaluation of the Bio-based Industries Joint Undertaking (2014-2016) operating under Horizon 2020. Experts group report. Luxembourg: Publications Office of the European Union.

European Commission (2017b): Interim Evaluation of the Joint Undertakings operating under Horizon 2020. Comission Staff Working Document (SWD (2017) 339 final).

European Council (06.06.2014): Council Regulation (EU) No.560/2014 establishing the Bio-based Industries Joint Undertaking. Online verfügbar unter https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:02014R0560-20180215&from=FR.

Johnson, Chloe; Ruiz Sierra, Ana; Dettmer, Jan; Sidiropoulou, Kleopatra; Zicmana, Elina; Canalis, Antonella et al. (2021): The Bio-Based Industries Joint Undertaking as a catalyst for a green transition in Europe under the European Green Deal. In: EFB Bioeconomy Journal (100014), S. 1–8.

Lange, Lene; Connor, Kevin O.; Arason, Sigurjon; Bundgård-Jørgensen, Uffe; Canalis, Antonella; Carrez, Dirk et al. (2021): Developing a Sustainable and Circular Bio-Based Economy in EU: By Partnering Across Sectors, Upscaling and Using New Knowledge Faster, and For the Benefit of Climate, Environment & Biodiversity, and People & Business. In: Frontiers in bioengineering and biotechnology 8, S. 619066. DOI: 10.3389/fbioe.2020.619066.

Özbolat, Nida Kamil; Haegeman, Karel; Sereti, Katerina (2019): Institute of Innovation and Technology (EIT) Knowledge and Innovation Communities (KICs): Collaboration in a RIS3 Context. Hg. v. Publications Office of the European Union.

Teknologisk Institut (2021): Study on BBI JU project portfolio and KPIs validation. Exectutive Summary. Prepared for Bio-Based Industries Joint Undertaking. Hg. v. Danish Technological Institute / Food & Bio Cluster Denmark.

GETTING IN TOUCH WITH THE EU

In person

All over the European Union there are hundreds of Europe Direct centres. You can find the address of the centre nearest you online (european-union.europa.eu/contact-eu/meet-us_en).

On the phone or in writing

Europe Direct is a service that answers your questions about the European Union.
You can contact this service:

- by freephone: 00 800 6 7 8 9 10 11 (certain operators may charge for these calls),
- at the following standard number: +32 22999696,
- via the following form: european-union.europa.eu/contact-eu/write-us_en.

FINDING INFORMATION ABOUT THE EU

Online

Information about the European Union in all the official languages of the EU is available on the Europa website (european-union.europa.eu).

EU publications

You can view or order EU publications at op.europa.eu/en/publications. Multiple copies of free publications can be obtained by contacting Europe Direct or your local documentation centre (european-union.europa.eu/contact-eu/meet-us_en).

EU law and related documents

For access to legal information from the EU, including all EU law since 1951 in all the official language versions, go to EUR-Lex (eur-lex.europa.eu).

EU open data

The portal data.europa.eu provides access to open datasets from the EU institutions, bodies and agencies. These can be downloaded and reused for free, for both commercial and non-commercial purposes. The portal also provides access to a wealth of datasets from European countries.

This evaluation report is part of the interim evaluation of Horizon Europe activities related to the Green Transition. It presents the assessment of the European Partnership Circular Bio-Based Europe Joint Undertaking (CBE) against the evaluation criteria of relevance, coherence, efficiency, effectiveness, EU added value, additionality, directionality, international positioning and visibility, transparency and openness as well as phasing out preparedness. The evaluation of the partnership is based upon a mixed-method approach including quantitative and qualitative data analysis.

Studies and reports

Publications Office
of the European Union