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COVER NOTE

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PART 16/19

COMMISSION STAFF WORKING DOCUMENT

IMPACT ASSESSMENT REPORT

Accompanying the document

Proposal for a Council Regulation establishing the Joint Undertakings under Horizon Europe

European Partnership for a Circular Bio-based Europe

{COM(2021) 87 final} - {SEC(2021) 100 final} - {SWD(2021) 38 final}

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Glossary

Term or acronym	*Meaning or definition*
EIT	European Institute of Innovation & Technology
R&I	Research and Innovation
SDGs	United Nations Sustainable Development Goals
SMEs	Small and Medium-sized Enterprises
TFEU	Treaty on the Functioning of the European Union
ERA	European Research Area
P2P	public-to-public cooperation
PPP	Public-Private Partnership
cPPPs	contractual PPPs
KPI	Key Performance Indicators
OPC	Open Public Consultation
RIA	Research and Innovation Action
CSA	Coordination and Support Action
BBI JU	Bio-based Industries Joint Undertaking
BIC	Bio-based Industries Consortium
TRL	Technology Readiness Level
CAP	Common Agricultural Policy
ESIF	European Structural and Investment Fund
ERDF	European Regional Development Fund
EAFRD	European Agricultural Fund for Rural Development

EMFF	European Maritime and Fisheries Fund
SRIA	Strategic Research and Innovation Agenda
MFF	Multiannual Financial Framework

PART 1 - COMMON FOR ALL CANDIDATE INSTITUTIONALISED EUROPEAN PARTNERSHIPS

1. BACKGROUND AND CONTEXT TO EUROPEAN PARTNERSHIPS IN HORIZON EUROPE AND FOCUS OF THE IMPACT ASSESSMENT– WHAT IS DECIDED

1.1 Focus and objectives of the impact assessment

This impact assessment accompanies the Commission proposal for Institutionalised European Partnerships to be funded under Horizon Europe, the 2021-2027 Framework Programme for EU Research and Innovation (R&I).[1] It sets out to **help decide in a coordinated manner the right form of implementation for specific candidate initiatives** based on a common approach and methodology to individual assessments[2]. It also provides an **horizontal perspective on the portfolio of candidate European Partnerships** to identify further efficiency and coherence gains for more impact.

European Partnerships are initiatives where the Union, together with private and/or public partners (such as industry, public bodies or foundations) commit to support jointly the development and implementation of an integrated programme of R&I activities. The rationale for establishing such initiatives is to achieve the objectives of Horizon Europe more effectively than what can be attained by other activities of the programme.[3]

Based on the Horizon Europe Regulation, European Partnerships may be set up using **three different forms**: "Co-funded", "Co-programmed" and "Institutionalised". The setting-up of **Institutionalised Partnerships** involves new EU legislation and the establishment of dedicated implementing structures based on Article 185 or 187 of the Treaty on the Functioning of the EU (TFEU). This requires an impact assessment to be performed.

The Horizon Europe Regulation defines **eight priority areas,** scoping the domains in which Institutionalised Partnerships could be proposed[4]. Across these priority areas, **13 initiatives** have been identified **as suitable candidate initiatives** for Institutionalised Partnerships because of their objectives and scope. This impact assessment aims to identify whether 12 of these initiatives[5] need to be implemented through this form of implementation and would not deliver equally well with traditional calls of Horizon Europe or other lighter forms of European Partnerships under Horizon Europe. This means assessing whether each of these initiatives meets the necessity test set in the **selection criteria** for European Partnerships in the Horizon Europe Regulation, Annex III.

This assessment is done **without any budgetary consideration**, as the overall budget of the Multiannual Financial Framework of the EU – and hence of Horizon Europe – for the next financing period is not known at this stage.[6]

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[1] Horizon Europe Regulation (common understanding), https://data.consilium.europa.eu/doc/document/ST-7942-2019-INIT/en/pdf

[2] Based on the European Commission Better Regulation framework (SWD (2017) 350) and supported by an external study coordinated by Technopolis Group (to be published in 2020).

[3] For further details on these points, see below Section 1.2.2.

[4] Set out in the Annex Va of the Horizon Europe Regulation (common understanding). https://data.consilium.europa.eu/doc/document/ST-7942-2019-INIT/en/pdf

[5] Only 12 are subject to this impact assessment, as one initiative on High Performance Computing has already been subject to an impact assessment in 2017 (SEC(2018) 47).

[6] EU budget commitments to the European Partnership candidates can only be discussed and decided following the political agreement on the overall Multiannual Financial Framework and Horizon Europe budgetary envelopes. The level of EU contribution for individual partnerships should be determined once there are agreed objectives, and clear commitments

1.2 The political and legal context

1.2.1 Shift in EU priorities and Horizon Europe framework

European priorities have evolved in the last decades, and reflect the social, economic, and environmental challenges for the EU in the face of global developments. In her Political Guidelines for the new European Commission 2019 – 2024[7], the new Commission President put forward six overarching priorities, which reach well beyond 2024 in scope[8]. Together with the Sustainable Development Goals (SDGs), these priorities will shape future EU policy responses to the challenges Europe faces, and thus also give direction to EU research and innovation.

As part of the Multi-annual Financial Framework (MFF) 2021-27 the new EU Framework Programme for Research and Innovation **Horizon Europe will play a pivotal role for Europe to lead the social, economic, and environmental transitions needed to achieve these European policy priorities**. It will be more impact driven with a strong focus on delivering European added value, but also be more effective and efficient in its implementation.[9] Horizon Europe finds its rationale in the daunting challenges that the EU is facing, which call for "*a radical new approach to developing and deploying new technologies and innovative solutions for citizens and the planet on a scale and at a speed never achieved before, and to adapting our policy and economic framework to turn global threats into new opportunities for our society and economy, citizens and businesses*." While Horizon Europe continues the efforts of strengthening the scientific and technological bases of the Union and foster competitiveness, a more strategic and impact-based approach to EU R&I investment is taken. Consequently, the **objectives of Horizon Europe** highlight the need *to deliver on the Union strategic priorities and contribute to the realisation of EU objectives and policies, contribute to tackling global challenges, including the Sustainable Development Goals by following the principles of the Agenda 2030 and the Paris Agreement.* [10]

In this context, **at least 35 % of the expenditure from actions under the Horizon Europe Programme will have to contribute to climate action**. Furthermore, a **Strategic Plan** is co-designed with stakeholders to identify **key strategic orientations for R&I support** for 2021-2024 in line with the EU priorities. In the Orientations towards the first Strategic Plan for Horizon Europe, the need to strategically prioritise and "*direct a substantial part of the funds towards the areas where we believe they will matter the most*" is emphasised. The Orientations specify, that actions under Pillar II of Horizon Europe "Global Challenges and European Industrial Competitiveness" will target only selected themes of especially high impact that significantly contribute to delivering on the political priorities of the Union. Most of the candidate European Partnerships fall under this Pillar.

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from partners. Importantly, there is a ceiling to the partnership budgets in Pillar II of Horizon Europe (the legal proposal specifies that *the majority of the budget in pillar II shall be allocated to actions outside of European Partnerships*).

[7] https://ec.europa.eu/info/strategy/priorities-2019-2024_en

[8] 1.A European Green Deal; An economy that works for people; A Europe fit for the Digital Age; Promoting our European way of life; A Stronger Europe in the World; and 6.A New push for European Democracy

[9] EC (2018) *A Modern Budget for a Union that Protects, Empowers and Defends. The Multiannual Financial Framework for 2021-2027*. Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions, COM(2018) 321 final

[10] Article 3, Common understanding regarding the proposal for Horizon Europe Framework Programme.

1.2.2 Key evolutions in the approach to partnerships in Horizon Europe

Since their start in 1984 the successive set of Framework Programmes uses a variety of instruments and approaches to support R&I activities, address global challenges and industrial competitiveness. Collaborative, competition-based and excellence-driven R&I projects funded through Work Programmes are the most traditional and long-standing approach for implementation. Since 2002, available tools also include **partnerships**, whereby the Union together with private and/or public partners commit to jointly support the development and implementation of a R&I programme. These were introduced as part of creating the European Research Area (ERA) to align national strategies and overcome fragmentation of research effort towards an increased scientific, managerial and financial integration of European research and innovation. Interoperable and integrated national research systems would allow for better flows of knowledge, technology and people. Since then, the core activities of the partnerships consist of building critical mass mainly through collaborative projects, jointly developing visions, and setting strategic agendas.

As analysed in the **interim evaluation of Horizon 2020**[11], a considerable repertoire of partnership initiatives have been introduced over time, with 8 forms of implementation[12] and close to 120 partnership initiatives running under Horizon 2020 - without clear exit strategies and concerns about their degree of coherence, openness and transparency. Even if it is recognised that these initiatives allow setting long-term agendas, structuring R&I cooperation between otherwise dispersed actors, and leveraging additional investments, the evaluation points to the complexity generated by the proliferation of instruments and initiatives, and their insufficient contribution to policies at EU and national level.

Box 1 Key lessons from the interim evaluation of Horizon 2020 and R&I partnerships

- The **Horizon 2020 Interim Evaluation** concludes that the overall partnership landscape has become overly complex and fragmented. It identifies the need for rationalisation, improve their openness and transparency, and link them with future EU R&I missions and strategic priorities.

- The **Article 185 evaluation** finds that these public-public partnerships have scientific quality, global visibility and networking/structuring effects, but should in the future focus more on the achievement of policy impacts. From a systemic point of view, it found that the EU public-to-public cooperation (P2P) landscape has become crowded, with insufficient coherence.

- The **Article 187 evaluation** points out that Public-Private Partnership (PPP) activities need to be brought more in line with EU, national and regional policies, and calls for a revision of the Key Performance Indicators. As regards the **contractual PPPs (cPPPs)** their reviews identified challenges of coherence among cPPPs and the need to develop collaborations and synergies with other relevant initiatives and programmes at EU, national and regional level.

Over 80% of respondents to the Open Public Consultation (OPC) indicated that a significant contribution by future European Partnerships is 'fully needed' to achieve climate-related goals, to develop and effectively deploy technology, and for EU global competitiveness in specific sectors/domains. Views converged across all categories of respondents, including citizens, industry and academia.

[11] Interim evaluation of Horizon 2020, Commission Staff Working Document, SWD(2017)221 and 222
Interim evaluation of the Joint Undertakings operating under Horizon 2020 (Commission Staff Working Document, SWD(2017) 339); Evaluation of the Participation of the EU in research and development programmes undertaken by several Member States based on Article 185 of the TFEU, Commission Staff Working Document, SWD (2017)340)

[12] E.g. initiatives based on Article 187 (Joint Technology Initiatives), Article 185 TFEU, Contractual Public-Private Partnerships (cPPPs), Knowledge & Innovation Communities of the European Institute of Innovation & Technology (EIT-KICs), ERA-NETs, European Joint Programmes, Joint Programming Initiatives.

The impact assessment of Horizon Europe identifies therefore the need to **rationalise the EU R&I funding landscape**, in particular with respect to partnerships, as well as to **re-orient partnerships towards more impact** and delivery on EU priorities. To address these concerns and to realise the higher ambition for European investments, Horizon Europe puts forward **a major simplification and reform for the Commission's policy on R&I partnerships**[13]. Reflecting its pronounced systemic nature aimed at contributing to EU-wide 'transformations' towards the sustainability objectives, Horizon Europe indeed intends to make a more effective use of these partnerships with a **more strategic, coherent and impact-driven approach**. Key related changes that apply to all forms of European Partnerships encapsulated in Horizon Regulation are summarised in the Box below.

Box 2 Key features of the revised policy approach to R&I partnerships under Horizon Europe based on its impact assessment

- ✓ **Simpler architecture & toolbox** by streamlining 8 partnership instruments into 3 implementation forms (Co-Funded, Co-Programmed, Institutionalised), under the umbrella 'European Partnerships'
- ✓ **More systematic and transparent approach** to selecting, implementing, monitoring, evaluating and phasing out all forms of partnerships (**criteria** for European Partnerships):
  - The selection of Partnerships is embedded in the strategic planning of Horizon Europe, thereby ensuring coherence with the EU priorities. The selection criteria require that partnerships are established with stronger ex-ante commitment and higher ambition.
  - The implementation criteria stipulate that initiatives adopt a systemic approach in achieving impacts, including broad engagement of stakeholders in agenda-setting and synergies with other relevant initiatives to promote the take-up of R&I results.
  - A harmonised monitoring & evaluation system will be implemented, and ensures that progress is analysed in the wider context of achieving Horizon Europe objectives and EU priorities.
  - All partnerships need to develop an exit strategy from Framework Programme funding. This new approach is underpinned by principles of openness, coherence and EU added value.
- ✓ **Reinforced impact orientation:**
  - Partnerships are established only if there is evidence they support achieving EU policy objectives more effectively than other Horizon Europe actions, by demonstrating a clear vision and targets (**directionality**) and corresponding long-term commitments from partners (**additionality**).
  - European Partnerships are expected to provide mechanisms – based on a concrete roadmap - to join up R&I efforts between a broad range of actors towards the development and uptake of innovative solutions in line with EU priorities, serving the economy and society, as well as scientific progress.
  - They are expected to develop close synergies with national and regional initiatives, acting as dynamic change agents, strengthening linkages within their respective ecosystems and along the value chains, as well as pooling resources and efforts towards the common EU objectives.

Under Horizon Europe, a 'European Partnership'[14] is defined as *"an initiative where the Union, prepared with early involvement of Member States and/or Associated Countries, together with private and/or public partners (such as industry, universities, research organisations, bodies with a public service mission at local, regional, national or international level or civil society organisations including foundations and NGOs), commit to jointly support the development and implementation of a programme of research and innovation activities, including those related to market, regulatory or policy uptake."*

The Regulation further specifies that European Partnerships shall adhere to the *"principles of Union added value, transparency, openness, impact within and for Europe, strong leverage effect on sufficient scale, long-term commitments of all the involved parties, flexibility in implementation, coherence, coordination and complementarity with Union, local, regional, national and, where relevant, international initiatives or other partnerships and missions."*

[13] Impact assessment of Horizon Europe, Commission Staff Working Document, SWD(2018)307.
[14] Article 8 and Annex III of the Horizon Europe Regulation (common understanding))

1.3 Why should the EU act

1.3.1 Legal basis

Proposals for Institutionalised European Partnerships are based on:

1) Article 185 TFEU which allows the Union to make provision, in agreement with the Member States concerned, for participation in research and development programmes undertaken by several Member States, including participation in the structures created for the execution of those programmes; or
2) Article 187 TFEU according to which the Union may set up joint undertakings or any other structure necessary for the efficient execution of Union research, technological development and demonstration programmes.[15]

1.3.2 Subsidiarity

The EU should act only in areas where there is demonstrable advantage that the action at EU level is more effective than action taken at national, regional or local level. Research is a shared competence between the EU and its Member States according to the TFEU. Article 4 (3) specifies that in the areas of research, technological development and space, the EU can carry out specific activities, including defining and implementing programmes, without prejudice to the Member States' freedom to act in the same areas.The candidate initiatives focus on areas where there is a demonstrable value added in acting at the EU level due to the scale, speed and scope of the efforts needed for the EU to meet its long-term Treaty objectives and deliver on its strategic policy priorities and commitments. In addition, the proposed initiatives should be seen as complementary and reinforcing national and sub-national activities in the same area. Overall European Partnerships find their **rationale in addressing a set of systemic failures**[16]:

- Their primary function is to create a platform for a strengthened **collaboration** and knowledge exchange between various actors in the European R&I system and an enhanced **coordination** of strategic research agendas and/or R&I funding programmes. They aim to address **transformational failures** to better align agendas and policies of public and private funders, pool available resources, create critical mass, avoid unnecessary duplication of efforts, and leverage sufficiently large investments where needed but hardly achievable by single countries.
- The concentration of efforts and pooling of knowledge on common priorities to solve multi-faceted societal and economic challenges is at the core of these initiatives. Specifically, enhanced cross-disciplinary and cross-sectoral collaboration and an improved integration of value chains and ecosystems are among the key objectives of these instruments. In the light of Horizon Europe, the aim is to **drive system transitions and transformations towards EU priorities**.
- Especially in fast-growing technologies and sectors such as ICT, there is a need to **react to emerging opportunities** and address systemic failures such as shortage in skills or critical mass or cross-sectoral cooperation along the value chains that would hamper attainment of future European leadership and/or strategic autonomy.
- They also aim to address **market failures** predominantly to enhancing industry investments thanks to the sharing of risks.

[15] Both Articles are under Title XIX of the TFEU - Research and Technological Development and Space.

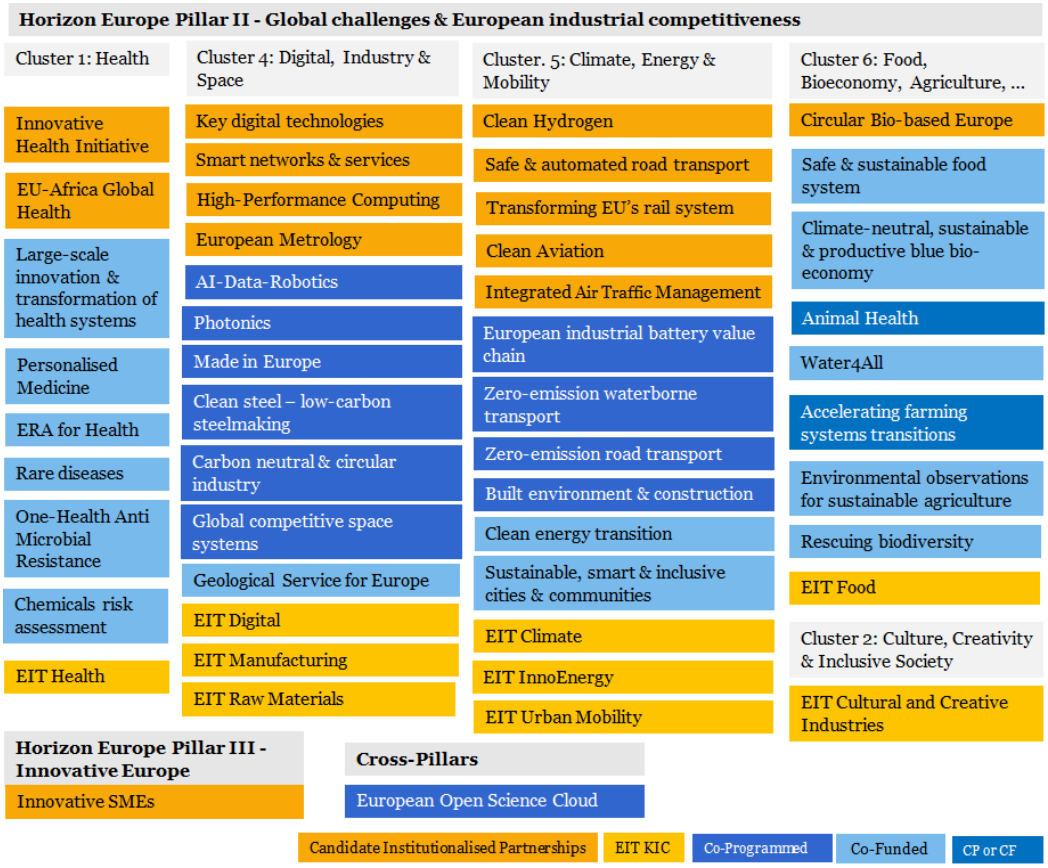
[16] The Interim Evaluation of Horizon 2020 and the impact assessment of Horizon Europe provide qualitative and quantitative evidence on these points. Sections 1 and 2 of each impact assessment on candidate European Partnerships include more detail on the necessity to act at EU level in specific thematic areas.

2. THE CANDIDATE EUROPEAN PARTNERSHIPS – WHAT NEEDS TO BE DECIDED

2.1 Portfolio of candidates for Institutionalised European Partnerships

The new approach for more objective-driven and impactful European Partnerships is reflected in the way candidate Partnerships have been identified. It involved a co-design exercise aiming to better align these initiatives with societal needs and policy priorities, while broadening the range of actors involved. Taking into account the 8 areas for Institutionalised European Partnerships set out in the Horizon Europe Regulation[17], a co-design exercise as part of the Strategic Planning process of Horizon Europe lead to the identification of **49 candidates for Co-funded, Co-programmed or Institutionalised European Partnerships**[18]. Out of these, **13 were identified as suitable candidate Institutionalised Partnerships because of their objectives and scope**[19]. Whilst the Co-Funded and Co-Programmed Partnerships are linked to the comitology procedure (including the adoption of the Strategic Plan and the Horizon Europe Work Programmes), Institutionalised Partnerships require the adoption of legislation and are subject to an impact assessment. The Figure below gives an overview of all candidate European Partnerships according to their primary relevance to Commission priorities for 2019-2024.

Figure 1 - Overview of the candidates for Co-Funded, Co-Programmed and Institutionalised European Partnerships according to Horizon Europe structure



Source: Technopolis group (2020)

[17] Horizon Europe Regulation (common understanding), Annex Va.
[18] Shadow configuration of Strategic Programme Committee for Horizon Europe. The list of candidate European Partnerships is described in "Orientations towards the Strategic Plan of Horizon Europe" - Annex 7
[19] Only 12 are subject to this impact assessment, as one initiative on High Performance Computing has already been subject to an impact assessment in 2017 (SEC(2018) 47)

There are only three partnerships for which implementation as an Institutionalised Partnership under Article 185 is an option, i.e. European Metrology, the EU-Africa Global Health partnership, and Innovative SMEs. Ten partnerships are candidates for Institutionalised Partnerships under Article 187. Overall the initiatives can be categorised into '*horizontal*' partnerships and '*vertical*' partnerships.

The **'horizontal' partnerships** have a central position in the overall portfolio, as they are expected to develop methodologies and technologies for application in the other priority areas, ultimately supporting European strategic autonomy in these areas as well as technological sovereignty. These 'horizontal' partnerships are typically proposed as Institutionalised or Co-programmed Partnerships, in addition to a number of EIT KICs, they cover mainly the digital field in addition to space, creative industries and manufacturing, but also the initiative related to Innovative SMEs. '**Vertical' partnerships** are focused on the needs and development of specific application areas, and are primarily expected to support enhanced environmental sustainability thereby addressing Green Deal related objectives. They also deliver on policies for more people centred economy, through improved wellbeing of EU citizen and the economy, like health related candidate European Partnerships.

2.2 Assessing the necessity of a European Partnership and possible options for implementation

Horizon Europe Regulation Article 8 stipulates that Institutionalised European Partnerships based on Article 185 and 187 TFEU *shall be implemented only where other parts of the Horizon Europe programme, including other forms of European Partnerships would not achieve the objectives or would not generate the necessary expected impacts, and if justified by a long-term perspective and high degree of integration.* At the core of this impact assessment is therefore the need to demonstrate that the impacts generated through a Partnership approach go beyond what could be achieved with traditional calls under the Framework Programme – the Baseline Option. Secondly, it needs to assess if using the Institutionalised form of a Partnership is justified for addressing the priority.

For all candidate Institutionalised European Partnerships the options considered in this impact assessment are the same, i.e.:

- Option 0 – Baseline option – Traditional calls under the Framework Programme
- Option 1 – Co-programmed European Partnership
- Option 2 – Co-funded European Partnership
- Option 3 – Institutionalised Partnership
    - Sub-option 3a Institutionalised Partnerships based on Art 185 TFEU
    - Sub-option 3b Institutionalised Partnerships based on Art 187 TFEU

2.2.1 Option 0 - Baseline option – Traditional calls

Under this option, strategic programming for R&I in the priority area will be done through the mainstream channels of Horizon Europe. The related priorities will be implemented through **traditional calls** of Horizon Europe covering a range of actions, mainly R&I and/or innovation actions but also coordination and support actions, prizes or procurement. Most actions involve consortia of public and/or private actors in ad hoc combinations, while some actions are single actor (mono-beneficiary). There will be no dedicated implementation structure and no support other than what is foreseen in the related Horizon Europe Work Programme. This means that discontinuation costs/benefits of predecessor initiatives should be factored in for capturing the baseline situation when relevant.

Under this option, strategic planning mechanisms in the Framework Programme will allow for a high level of flexibility in the ability of traditional calls to respond to particular needs over time, building upon additional input in co-creation from stakeholders and programme committees involving Member States. The Union contribution to addressing the priority covers the full duration of the initiative, during the lifetime of Horizon Europe. Without a formal EU partnership mechanism, it is less likely that the stakeholders will develop a joint Strategic Research Agenda and commit to its implementation or agree on mutual commitments and contributions outside their participation in funded projects.

2.2.2 European Partnerships

Under this set of options, three different forms of implementation are assessed: Co-funded, Co-Programmed, Institutionalised European Partnerships. These have **commonalities that cannot serve as a distinguishing factor in the impact assessment process**. They are all based on agreed objectives and expected impacts and underpinned by Strategic Research and Innovation Agendas / roadmaps that are shared and committed to by all partners in the partnership. They all have to follow the same set of criteria along their lifecycle, as defined in the Horizon Europe Regulation (Annex III), including ex ante commitment from partners to mobilise and contribute resources and investments. The Union contribution is defined for the full duration of the initiative for all European Partnerships. The Horizon Europe legal act introduces few additional requirements for Institutionalised Partnerships, e.g. the need for long-term perspective, strong integration of R&I agendas, and financial contributions.

Figure 2 - Key differences in preparation and implementation of European Partnerships

Type	**Legal form**	**Implementation**
Co-Programmed	Contractual arrangement / MoU	**Division of labour**, whereby Union contribution is implemented through Framework rogramme and partners' contributions under their responsibility.
Co-Funded	Grant Agreement	Union provides co-funding for an **integrated programme with distributed implementation** by entities managing and/or funding national research and innovation programmes
Institutionalised based on Article 185/187 TFEU	Basic act (Council regulation, Decision by European Parliament and Council)	**Integrated programme with centralised implementation**

The main differences between the different forms of European Partnerships are in their preparation and in the way they function, as well as in the overall impact they can trigger. The Co-Programmed form is assessed as the simplest, and the Institutionalised the most complex to prepare and implement. The functionalities of the different form of Partnerships – compared to the baseline option – are presented in Figure 3. They relate to the types of actors Partnerships can involve and their degree of openness, the types of activities they can perform and their degree of flexibility, the degree of commitment of partners and the priority setting system, and their ability to work with their external environment (coherence), etc. These key distinguishing factors will be at the basis of the comparison of each option to determine their overall capacity to deliver what is needed at a minimised cost.

Figure 3 Overview of the functionalities provided by each form of European Partnerships, compared to the traditional calls of Horizon Europe (baseline)

Baseline: Horizon Europe calls	**Option 1: Co-Programmed**	**Option 2: Co-Funded**	**Option 3a: Institutio-nalised Art 185**	**Option 3b: Institutionalised Art 187**
Type and composition of actors (including openness and roles)				
Partners: N.A., no common set of actors that engage in planning and implementation Priority setting: open to all, part of Horizon Europe Strategic planning Participation in R&I activities: fully open in line with Horizon Europe rules	Partners: Suitable for all types: private and/or public partners, foundations Priority setting: Driven by partners, open stakeholder consultation, MS in comitology Participation in R&I activities: fully open in line with Horizon Europe rules	Partners: core of national funding bodies or govern-mental research organisations Priority setting: Driven by partners, open stakeholder consultation Participation in R&I activities: limited, according to national rules of partner countries	Partners: National funding bodies or governmental research organisation Priority setting: Driven by partners, open stakeholder consultation Participation in R&I activities: fully open in line with Horizon Europe rules, but possible derogations	Partners: Suitable for all types: private and/or public partners, foundations Priority setting: Driven by partners, open stakeholder consultation Participation in R&I activities: fully open in line with Horizon Europe rules, but possible derogations
Type and range of activities (including additionality and level of integration)				
Activities: Horizon Europe standards that allow broad range of individual actions Additionality: no additional activities and investments outside the funded projects Limitations: No systemic approach beyond individual actions	Activities: Horizon Europe standard actions that allow broad range of individual actions, support to market, regulatory or policy/ societal uptake Additionality: Activities/investments of partners, National funding Limitations: Limited systemic approach beyond individual actions	Activities: Broad, according to rules/programmes of participating States, State-aid rules, support to regulatory or policy/ societal uptake Additionality: National funding Limitations: Scale & scope depend on participating programmes, often smaller in scale	Activities: Horizon Europe standards that allow broad range of individual actions, support to regulatory or policy/societal uptake, possibility to systemic approach Additionality: National funding	Activities: Horizon Europe standards that allow broad range of individual actions, support to regulatory or policy/societal uptake, possibility to systemic approach (portfolios of projects, scaling up of results, synergies with other funds. Additionality: Activities/investments of partners/ national funding
Priority-setting process and directionality				
Priority setting: Strategic Plan and annual work programmes, covering max. 4 years. Limitations: Fully taking into account existing or to be developed SRIA/ roadmap	Priority setting: Strategic R&I agenda/ roadmap agreed between partners & EC, covering usually 7 years, incl. allocation of Union contribution Input to FP annual work programme drafted by partners, finalised by EC (comitology) Objectives & commitments set in contractual arrangement	Priority setting: Strategic R&I agenda/ roadmap agreed between partners & EC, covering usually 7 years, incl. allocation of Union contribution Annual work programme drafted by partners, approved by EC Objectives & commitments set in Grant Agreement	Priority setting: Strategic R&I agenda/ roadmap agreed between partners & EC, covering usually 7 years, incl. allocation of Union contribution Annual work programme drafted by partners, approved by EC Objectives & commitments set in legal act	Priority setting: Strategic R&I agenda/ roadmap agreed between partners & EC, covering usually 7 years, incl. allocation of Union contribution Annual work programme drafted by partners, approved by EC (veto-right in governance) Objectives & commitments set in legal act
Coherence: internal (Horizon Europe) & external (other Union programmes, national programmes, industrial strategies)				
Internal: Coherence between different parts of the FP Annual Work programme can be ensured by EC External: Limited for other Union programmes, no synergies with national/regional programmes & activities	Internal: Coherence among partnerships & with parts of the FP Annual Work programme can be ensured by partners & EC External: Limited synergies with other Union programmes & industrial strategies. If MS participate, with national/ regional programmes & activities	Internal: Coherence among partnerships & with parts of the FP Annual Work programme can be ensured by partners & EC External: Synergies with national/ regional programmes & activities	Internal: Coherence among partnerships & with parts of the FP Annual Work programme can be ensured by partners & EC External: Synergies with national/ regional programmes & activities	Internal: Coherence among partnerships & with parts of the FP Annual Work programme can be ensured by partners & EC External: Synergies with other Union programmes and industrial strategies If MS participate, with national/ regional programmes & activities

2.2.2.1 Option 1 - Co-programmed European Partnership

This form of European Partnership is **based upon a Memorandum of Understanding or a Contractual Arrangement** signed by the Commission and the private and/or public partners. Private partners are represented by industry associations, which also support the daily management of the partnership. This type of partnership would allow for a large degree of flexibility for the activities, partners and priorities to continuously evolve. The commitments of partners are political efforts described in the contractual arrangement and the contributions from partners are provided in kind more than financially. The priorities for the calls, proposed by the Partnership's members for integration in the Horizon Europe's Work Programmes, are subject to further input from Member States (comitology) and Commission services. The Union contribution is implemented within the executive agency managing Horizon Europe calls for research and innovation projects proposals. The full array of Horizon Europe instruments can be used, ranging from research and innovation (RIA) types of actions to coordination and support actions (CSA) and including grants, prizes, and procurement.

2.2.2.2 Option 2 – Co-funded European Partnership

The Co-funded European Partnership is **based on a Grant Agreement** between the Commission and a consortium of partners, resulting from a specific call in the Horizon Europe Work Programme. This form of implementation only allows to address public partners at its core. Typically these provide co-funding to a common programme of activities established and/or implemented by entities managing and/or funding national R&I programmes. The recipients of the EU co-funding implement the initiative under their responsibility, with national funding/resources pooled to implement the programme with co-funding from the Union. The expectation is that these entities would cover most if not all EU Member States. Calls and evaluations would be organised centrally, beneficiaries in selected projects would be funded at national level, following national funding rules.

2.2.2.3 Option 3 – Institutionalised European Partnership

This type of Partnership is the most complex and high-effort arrangement, and requires meeting additional requirements. Institutionalised European Partnership are **based on a Council Regulation (Article 187 TFEU or a Decision by the European Parliament and Council (Article 185 TFEU)** and are implemented by dedicated structures created for that purpose. These regulatory needs limit the flexibility for a change in the core objectives, partners, and/or commitments as these would require amending legislation. The basic rationale for this type of partnership is the need for a strong integration of R&I agendas in the private and/or public sectors in the EU in order to address a strategic challenge. It is therefore necessary to demonstrate that other forms of implementation would not achieve the objectives or would not generate the necessary expected impacts, and that a long-term perspective and high degree of integration is needed. For both Article 187 and 185 initiatives, contributions from partners can be in the form of financial and in-kind contributions. Eligibility for participation and funding follows by default the rules of Horizon Europe, unless a derogation is introduced in the basic act.

Option 3a - Institutionalised Partnerships based on Article 185 TFEU

Article 185 of the TFEU allows the Union to participate in programmes jointly undertaken by Member States and limits therefore the scope to **public partners** which are Member States and Associated Third Countries. This type of Institutionalised Partnership aims

therefore at reaching the greatest possible impact through the integration of national and EU funding, aligning national strategies in order to optimise the use of public resources and overcome fragmentation of the public research effort. It brings together R&I governance bodies of most if not all EU Member States (legal requirement: at least 40% of Member States) as well as Associated Third Countries that designate a legal entity (Dedicated Implementation Structure) of their choice for the implementation. By default, participation of non-associated Third Countries is not foreseen. Such participation is possible only if it is foreseen in the basic act and subject to conclusion of an international agreement.

Option 3b - Institutionalised Partnerships based on Article 187 TFEU

Article 187 of the TFEU allows the Union to set up joint undertakings or any other structure necessary for the efficient execution of EU research, technological development and demonstration programmes. This type of Institutionalised Partnership brings together a stable set of **public and private partners** with a strong commitment to taking a more integrated approach and requires the set-up of a dedicated legal entity (Union body, Joint Undertaking (JU)) that carries full responsibility for the management of the Partnership and implementation of the calls. Different configurations are possible:

- Partnerships focused on creating strategic industrial partnerships where, most often, the partner organisations are represented by one or more industry associations, or in some cases individual private partners;
- Partnerships coordinating national ministries, public funding agencies, and governmental research organisations in the Member States and Associated Countries;
- Or a combination of the two: the so-called tripartite model.

Participation of non-associated Third Countries is only possible if foreseen in the basic act and subject to conclusion of an international agreement.

2.3 Overview of the methodology adopted for the impact assessment

The methodology for each impact assessment is based on the Commission Better Regulation Guidelines[20] to evaluate and compare options with regards to their **efficiency, effectiveness and coherence**. This also integrates **key selection criteria for European Partnerships**.

Box 2 Summary of European Partnerships selection criteria[21]

- ***Effectiveness*** in achieving the related objectives and impacts of the Programme;
- ***Coherence*** and synergies of the European Partnership within the EU R&I landscape;
- ***Transparency*** & ***openness*** as regards the identification of priorities and objectives and the involvement of partners & stakeholders from the entire value chain, backgrounds & disciplines;
- Ex-ante demonstration of ***additionality*** and ***directionality***;
- Ex-ante demonstration of the partners' ***long term commitment***.

2.3.1 Overview of the methodologies employed

In terms of **methods and evidence used**, the impact assessments draw on an external study covering all candidate Institutionalised European Partnerships in parallel to ensure a high level of coherence and comparability of analysis, in addition to an horizontal analysis.[22] For

[20] European Commission (2017), Better Regulation Guidelines (SWD (2017) 350)
[21] For a comprehensive overview of the selection criteria for European Partnerships, see Annex 6.
[22] Technopolis Group (2020), Impact Assessment Study for Institutionalised European Partnerships under Horizon Europe, Final Report, Study for the European Commission, DG Research & Innovation

all initiatives, the understanding of the overall context of the candidate institutionalised European Partnerships relied on desk research, including among others the lessons learned from previous partnerships. This was complemented by the analysis of a range of quantitative and qualitative evidence, including evaluations of past and ongoing initiatives; foresight studies; statistical analyses of Framework Programmes application and participation data, and Community Innovation Survey data; analyses of science, technology and innovation indicators; reviews of academic literature; sectoral competitiveness studies and expert hearings. The analyses included a portfolio analysis, a stakeholder and social network analysis in order to profile the actors involved as well as their co-operation patterns, and an assessment of the partnerships' outputs (bibliometrics and patent analysis). A cost modelling exercise was performed in order to feed into the efficiency assessments of the partnership options, as described below. Public consultations (both open and targeted) supported the comparative assessment of the policy options. For each initiative, up to 50 relevant stakeholders were interviewed by the external contractor (policymakers, business including SMEs and business associations, research institutes and universities, and civil organisations, among others). In addition, the analysis was informed by the results of the Open Public Consultation run between September and November 2019, the consultation of Member States through the Strategic Programme Committee and the online feedback received on the Inception Impact Assessments of the set of initiatives.

A more detailed description of the methodology and evidence base that were mobilised, completed by thematic specific methodologies, is provided in Annexes 4 and 6.

2.3.2 Method for identifying the preferred option

The first step of the assessments consisted in scoping the problems that the initiatives are expected to solve given the overall economic, technological, scientific and social context, including the lessons to be learned from past and ongoing partnerships on what worked well and less well. This supported the identification of the objectives of the initiative in the medium and long term with the underlying intervention logic – showing how to get there.

Given the focus of the impact assessment on comparing different forms of implementation, the Better Regulation framework has then been adapted to introduce "**key functionalities needed**" - making the transition between the definition of the objectives and what would be crucial to achieve them *in terms of implementation*. The identification of "key functionalities needed" for each initiative as an additional step in the impact assessment is based on the distinguishing factors between the different options (see Section 2.2.1). In practical terms, each option is assessed on the basis of the degree to which it would allow for the key needed functionalities to be covered, as regards e.g. the type and composition of actors that can be involved ('openness'), the range of activities that can be performed (including additionality and level of integration), the level of directionality and integration of R&I strategies; the possibilities offered for coherence and synergies with other components of Horizon Europe, including other Partnerships (internal coherence), and the coherence with the wider policy environments, including with the relevant regulatory and standardisation framework (external coherence). This approach guides the identification of discarded options while allowing at the same time a structured comparison of the options not only as regards their effectiveness, efficiency and coherence, but also against a set of other key selection criteria for European Partnerships (openness, transparency, directionality)[23].

[23] The criterion on the ex-ante demonstration of partners' long term commitment depends on a series of factors that are unknown at this stage, and thus fall outside the scope of the analysis.

In line with the Better Regulation Framework, the assessment of the effectiveness, efficiency and coherence of each option is made compared to the baseline. Therefore, for each of these aspects the performance of using traditional calls under Horizon Europe is first estimated and scored 0 to serve as a reference point. This includes the discontinuation costs/benefits of existing implementation structures when relevant. The policy options are then scored compared to the baseline with a + and – system with a two-point scale, to show a slightly or highly additional/lower performance compared to the baseline. A scoring of 0 of a policy option means that it would deliver as much as the baseline option.

On the basis of the evidence collected, the intervention logic of each initiative and the key functionalities needed, the impact assessments first evaluate the **effectiveness** of the various policy options to deliver on their objectives. To be in line with the Horizon Europe impact framework, the fulfilment of the specific objectives of the initiative is translated into 'expected impacts' - how success would look like -, differentiating between scientific, economic/ technological, and societal (including environmental) impacts. Each impact assessment considers to which extent the different policy options provides the 'key functionalities needed' to achieve the intended objectives. The effectiveness assessment does not use a compound score but shows how the options would deliver on the different types of expected impacts. This is done to increase transparency and accuracy in the assessment of options[24].

A similar approach is followed to evaluate the coherence of options with the overarching objectives of the EU's R&I policy, and distinguishes between **internal** and **external coherence**. Specifically, internal coherence covers the consistency of the activities that could be implemented with the rest of Horizon Europe, including European Partnerships (any type). External coherence refers to the potential for synergies and/or complementarities (including risks of overlaps/gaps) of the initiative with its external environment, including with other programmes under the MFF 2021-27, but also the framework conditions at European, national or regional level (incl. regulatory aspects, standardisation).

To compare the expected costs and benefits of each option (**efficiency**), the thematic impact assessments broadly follow a cost-effectiveness approach[25] to establish to which extent the intended objectives can be achieved for a given cost. A preliminary step in this process is to obtain a measure of the expected costs of the policy options, to be used in the thematic assessments. As the options correspond to different implementation modes, relevant cost categories generally include the costs of setting-up and running an initiative. For instance, set-up costs includes items such as the preparation of a European Partnership proposal and the preparation of an implementation structure. The running costs include the annual work programme preparation costs. Where a Partnership already exists, discontinuation costs and cost-savings are also taken into account[26]. The table below provides an overview of the cost categories used in the impact assessment and a qualitative scoring of their intensity when compared to the baseline option (traditional calls). Providing a monetised value for these average static costs would have been misleading, because of the different features and needs

[24] In the thematic impact assessments, scores are justified in a detailed manner to avoid arbitrariness and spurious accuracy. A qualitative or even quantitative explanation is provided of why certain scores were given to specific impacts, and why one option scores better or worse than others.

[25] For further details, see Better Regulation Toolbox # 57.

[26] Discontinuation costs will bear winding down and social discontinuation costs and vary depending on e.g. the number of full-time-equivalent (FTEs) staff concerned, the type of contract (staff category and duration) and applicable rules on termination (e.g. contracts under Belgian law or other). If buildings are being rented, the cost of rental termination also apply. As rental contracts are normally tied to the expected duration of the current initiatives, these termination costs are likely to be very limited. In parallel, there would also be financial cost-savings related to the closing of the structure, related to operations, staff and coordination costs in particular. This is developed further in the individual efficiency assessments.

of each candidate initiative.[27] The table shows the overall administrative, operational and coordination costs of the various options. These costs are then put into context in the impact assessments to reflect the expected co-financing rates and the total budget available for each of the policy options, assuming a common Union contribution (cost-efficiency):

- The costs related to the baseline scenario (traditional calls under Horizon Europe) are pre-dominantly the costs of implementing the respective Union contribution via calls and project, managed by the executive agencies (around 4%, efficiency of 96% for the overall investment).
- For a Co-Programmed partnership the costs of preparation and implementation increase only marginally compared to the baseline (<1%), but lead to an additional R&I investment of at least the same amount than the Union contribution[28] (efficiency of 98% for the overall investment).
- For a Co-Funded partnership the additional R&I investment by Member States accounts for 2,3 times the Union contribution[29]. The additional costs compared to the baseline of preparing and implementing the partnership, including the management of the Union contribution implemented by the national programmes, can be estimated at 6% of the Union contribution (efficiency of 98% related to the overall investment).
- For an Article 185 initiative the additional R&I investment by Member States is equal to the Union contribution[30]. The additional costs compared to the baseline of preparing and implementing the partnership, including the management of the Union contribution implemented by the dedicated implementation structure, can be estimated at 7% of the Union contribution (efficiency of 96% related to the overall investment).
- For an Article 187 initiative the additional R&I investment by partners is equal to the Union contribution[31]. The additional costs compared to the baseline of preparing and implementing the partnership, including the management of the Union contribution implemented by the dedicated implementation structure, can be estimated at 9% of the Union contribution (efficiency of 94% related to the overall investment).

Figure 4 - Intensity of additional costs compared with Horizon Europe Calls (for Partners, stakeholders, public and EU)

Cost items	Baseline: traditional calls	Option 1: Co-programmed	Option 2 Co-funded	Option 3a - Art. 185	Option 3b -Art. 187
Preparation and set-up costs					
Preparation of a partnership proposal (partners and EC)	0	↑↑			
Set-up of a dedicated implementation structure	0			Existing: ↑ New: ↑↑	Existing: ↑↑ New: ↑↑↑
Preparation of the SRIA / roadmap	0	↑↑			
Ex-ante Impact Assessment for partnership	0			↑↑↑	
Preparation of EC proposal and negotiation	0			↑↑↑	
Running costs (Annual cycle of implementation)					
Annual Work Programme preparation	0	↑			

[27] A complete presentation of the methodology developed to assess costs as well as the sources used is described in the external study supporting this impact assessment (Technopolis Group, 2020).
[28] Minimum contributions from partners equal to the Union contribution
[29] Based on the default funding rate for programme co-fund actions of 30%, partners contribute with 70% of the total investment.
[30] Based on the minimum requirement in the legal basis that partners contribute at least 50% of the budget.
[31] Based on the minimum requirement in the legal basis that partners contribute at least 50% of the budget.

Cost items	Baseline: traditional calls	Option 1: Co-programmed	Option 2 Co-funded	Option 3a - Art. 185	Option 3b -Art. 187
Call and project implementation	0	0 In case of MS contributions: ↑	↑	↑	↑
Cost to applicants	Comparable, unless there are strong arguments of major differences in oversubscription				
Partners costs not covered by the above	0	↑	0	↑	↑
Additional EC costs (e.g. supervision)	0	↑	↑	↑	↑↑
Winding down costs					
EC	0				↑↑↑
Partners	0	↑	0	↑	↑

Notes: 0: no additional costs, as compared with the baseline; ↑: minor additional costs, as compared with the baseline; ↑↑: medium additional costs, as compared with the baseline; ↑↑↑: higher costs, as compared with the baseline.

The cost categories estimated for the common model are then used to develop a scorecard analysis and further refine the assessment of options for each of the 12 candidate Institutionalised Partnerships. Specifically, the scores related to the set-up and implementation costs are used in the thematic impact assessments to consider the scale of the expected benefits and thereby allow a simple "value for money" analysis (**cost-effectiveness**)[32]. In carrying out the scoring of options, the results of fieldwork, desk research and stakeholder consultation undertaken and taken into account.

For the **identification of the preferred option,** the scorecard analysis builds a hierarchy of the options by individual criterion and overall in order to identify a single preferred policy option or in case of an inconclusive comparison of options, a number of 'retained' options or hybrid. This exercise supports the systematic appraisal of alternative options across multiple types of monetary, non-monetary and qualitative dimensions. It also allows for easy visualisation of the pros and cons of each option. Each option is attributed a score of the adjudged performance against each criterion with the three broad appraisal dimensions of effectiveness, efficiency and coherence.

As a last step, the alignment of the preferred option with key criteria for the selection of European Partnerships is described, reflecting the outcomes of the '**necessity test'**.[33] The monitoring and evaluation arrangements are concluding the assessment, with an identification of the key indicators to track progress towards the objectives over time.

2.4 Horizontal perspective on candidate Institutionalised European Partnerships

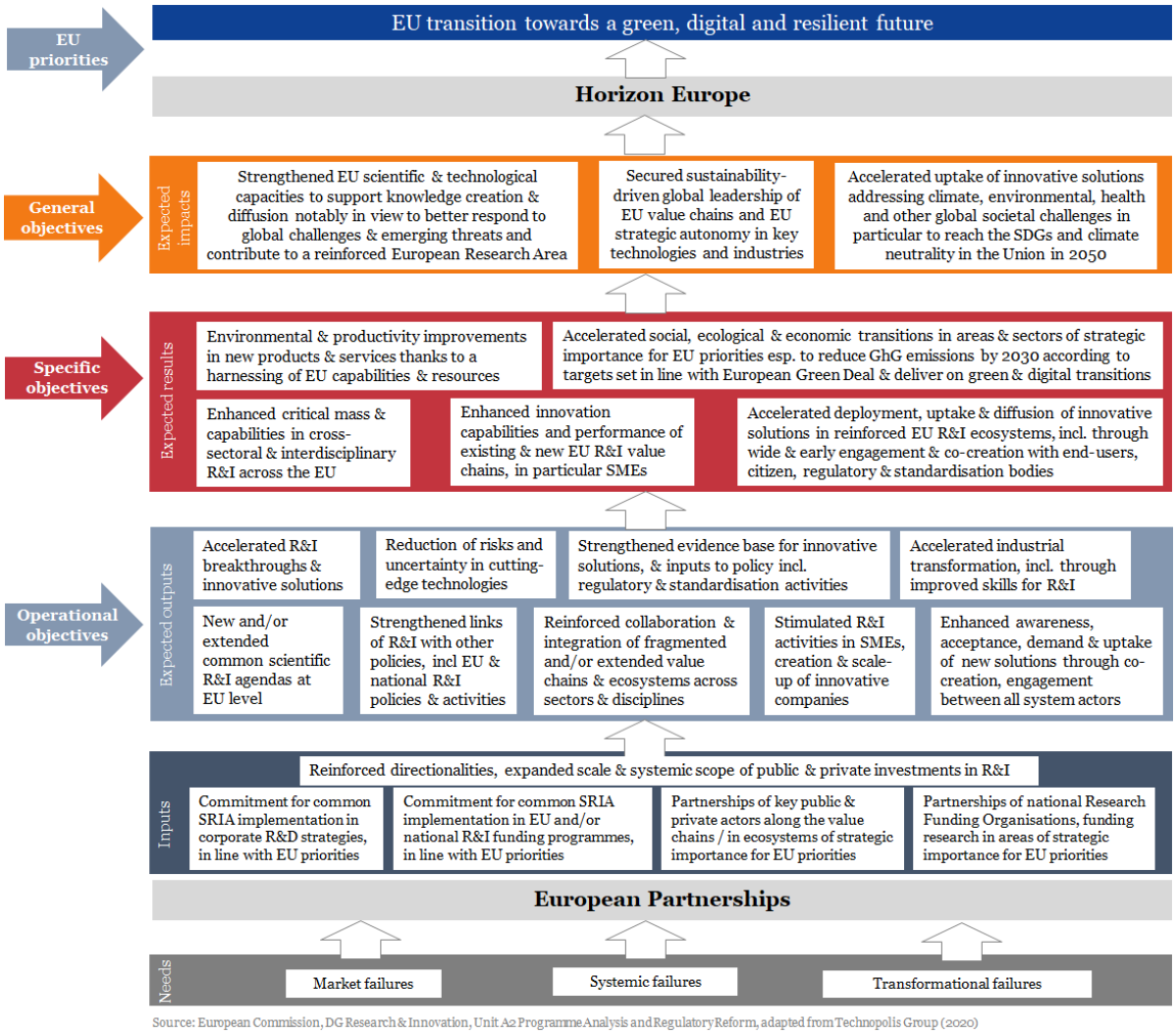
2.4.1 Overall impact orientation, coherence and efficiency needs

The consolidated **intervention logic** for the set of candidate Institutionalised European Partnerships in the Figure below builds upon the objectives as reported in the individual impact assessments.

[32] More details on the methodology can be found in Annex 4.

[33]Certain aspects of the selection criteria will be further addressed/ developed at later stages, notably in the context of preparing basic acts (e.g. Openness and Transparency; Coherence and Synergies), in the Strategic Research and Innovation Agendas (e.g. Directionality and Additionality), and by collecting formal commitments (Ex-ante demonstration of partners' long-term commitment).

Figure 5 – Overall intervention logic of the European Partnerships under Horizon Europe



Source: European Commission, DG Research & Innovation, Unit A2 Programme Analysis and Regulatory Reform, adapted from Technopolis Group (2020)

When analysed as a package the 12 candidate Institutionalised European Partnerships are expected to support the achievement of the European policy priorities targeted by Horizon Europe by pursuing the following joint general objectives:

a) Strengthening and integrating EU scientific and technological capacities to support knowledge creation and diffusion notably in view to better respond to global challenges and emerging threats and contribute to a reinforced European Research Area;
b) Securing sustainability-driven global leadership of EU value chains and EU strategic autonomy in key technologies and industries; and
c) Accelerate the uptake of innovative solutions addressing climate, environmental, health and other global societal challenges contributing to Union strategic priorities, in particular to reach the Sustainable Development Goals and climate neutrality in the Union in 2050.

In terms of specific objectives, they jointly aim to:

a) Enhance the critical mass and scientific capabilities in cross-sectoral and interdisciplinary research and innovation across the Union;
b) Accelerate the social, ecological and economic transitions in areas and sectors of strategic importance for Union priorities, in particular to reduce greenhouse gas

emissions by 2030 according to the targets set in line with the European Green Deal, and deliver on the green and digital transition;

c) Enhance the innovation capabilities and performance of existing and new European research and innovation value chains, in particular SMEs;
d) Accelerate the deployment, uptake and diffusion of innovative solutions in reinforced European R&I ecosystems, including through wide and early engagement and co-creation with end-users, citizen and regulatory and standardisation bodies;
e) Deliver environmental and productivity improvements in new products and services thanks to a harnessing of EU capabilities and resources.

In terms of their operations, taking an horizontal perspective on all initiatives allows for the identification of further possible collective efficiency and coherence gains for more impact:

- **Coherence for impact:** The extent and speed by which the expected results and impacts will be reached, will depend on the scale of the R&I efforts triggered, the profile of the partners involved, the strength of their commitments, and the scope of the R&I activities funded. To be fully effective it comes out clearly that future partnerships need to operate over their whole life cycle in full coherence with their environment, including potential end users, regulators and standardisation bodies. This relates also to the alignment with relevant EU, national or regional policies and synergies with R&I programmes. This needs to be factored in as of the design stage to ensure a wide take-up and/or deployment of the solutions developed, including their interoperability.

- **Collaboration for impact:** Effectiveness could also be improved collectively through enhanced cross-disciplinary and cross-sectoral collaboration and an improved integration of value chains and ecosystems. An adequate governance structure appears in particular necessary to ensure cross-fertilisation between all European Partnerships. This applies not only to initiatives where similar R&I topics are covered and/or the same stakeholders involved or targeted, but also to the interconnections needed between the 'thematic' and the 'vertical' Partnerships, as these are expected to develop methodologies and technologies for application in EU priority areas. Already at very early stages of preparing new initiatives**,** Strategic Research and Innovation Agendas and roadmaps need to be aligned, particularly for partnerships that develop enabling technologies that are needed in other Partnerships. The goal should be to achieve greater impacts jointly in light of common challenges.

- **Efficiency for impact:** Potential efficiency gains could also be achieved by joining up the operational functions of Joint Undertakings that do not have a strong context dependency and providing them through a common back-office[34]**.** A number of operational activities of the Joint Undertakings are of a technical or administrative nature (e.g. financial management of contracts), or procured from external service providers (e.g. IT, communication activities, recruitment services, auditing) by each Joint Undertaking separately. If better streamlined this could create a win-win situation for all partners leading to better harmonization, economies of scales, and less complexity in supervision and support by the Commission services.

2.4.2 Analysis of coherence of the overall portfolio of candidate initiatives at the thematic level

Looking at the coherence of the set of initiatives at the thematic level, the "**digital centric**"

[34] See Annex 6 for an overview of key functions/roles that could be provided by a common back office.

initiatives have a strong focus on supporting the digital competitiveness of the EU ecosystem. Their activities are expected to improve alignment and coordination with Member States and industry for the development of world-competitive EU strategic digital technology value chains and associated expertise. Addressing the Key Digital Technologies, the 5G and 6G connectivity needs as part of a Smart Networks and Services initiative and the underlying supercomputing capacities through a European High Performance Computing initiative present potential for synergies that can be addressed through cooperative actions (e.g. joint calls, coordinated support activities, etc.). They may as well profit from and contribute to Partnerships envisaged for Photonics, AI, data, robotics, Global competitive space system and Made in Europe, together with the EIT Digital. Synergies between these initiatives and several programmes (Digital Europe and Connecting Europe as well as cohesion programmes) are needed in areas where EU industry has to develop leadership and competitiveness in the global digital economy. They are expected to impact critical value chains including on sectors where digital is a strong enabler of transformation (health, industrial manufacturing, mobility/transport, etc.).

The **transport** sector face systemic changes linked to decarbonisation and digitalisation. Large scale R&I actions are needed to prepare the transition of these complex sectors to provide clean, safer, digital and economically viable services for citizens and businesses. Past decades have shown that developing and implementing change is difficult in transport due to its systemic nature, many stakeholders involved, long planning cycles and large investments needed. A systemic change of the air traffic network through an Integrated Air Traffic Management initiative should ensure safety and sustainability of aviation, while a Clean Aviation initiative should focus on the competitiveness of tomorrow's clean aircrafts made in Europe. The initiative for Transforming Europe's rail system would comprehensively address the rail sector to make it a cornerstone in tomorrow's clean and efficient door-to-door transport services, affordable for every citizen as well as the most climate-friendly mode of transport for freight. Connected and Automated Mobility is the future of road transport, but Europe is threatened to fall behind other global regions with strong players and large harmonised markets. The initiative Safe and Automated Road Transport would bring stakeholders together, creating joint momentum in digitalising road transport and developing new user-based services. Stronger links and joint actions will be established between initiatives to enable common progress wherever possible. The Clean Hydrogen initiative would be fundamental to that regard. Synergies would also be sought with partnerships driving the digital technological developments.

To deliver a deep decarbonisation of highly emitting industrial sectors such as the steel, transport and chemical industries would require the production, distribution and storage of **hydrogen** at scale. The candidate hydrogen initiative would have a central positioning in terms of providing solutions to the challenges for sustainable mobility and energy, but also is expected to operate in synergies with other industry related initiatives. The initiative would interact in particular with initiatives on the zero emission road and water transport, transforming Europe's railway system, clean aviation, batteries, circular industry, clean steel and built environment partnerships. There are many opportunities for collaboration for the delivery and end-use of hydrogen. However, the Clean Hydrogen initiative would be the only partnership focused on addressing hydrogen production technologies.

Metrology, the science of measurement, is an enabler across all domains of R&I. It supports the monitoring of the Emissions Trading System, smart grids and pollution, but also contributes to meeting demands for measurement techniques from emerging digital technologies and applications. More generally, emerging technologies across a wide range

of fields from biotechnologies, new materials, health diagnostics or low carbon technologies are giving rise to demands requiring a world-leading EU metrology system.

The initiative for a **Circular Bio-based Europe** is intended to solve a shortage of industry investments in the development of bio-based products whose markets do not have yet certain long-term prospects. The **Innovative Health Initiative** and **EU-Africa Global Health** address the lack of investments in the development of solutions to specific health challenges. The initiative on **Innovative SMEs** supports innovation-driven SMEs in participating in international, collaborative R&I projects with other innovative firms and research-intensive partners. As a horizontal initiative it is expected to help innovative SMEs to grow and to be successfully embedded in global value chains by developing methodologies and technologies for potential application in the other partnership areas or further development by the instruments of the European Innovation Council.

The description of the interconnections between all initiatives for each Horizon Europe cluster is provided in the policy context of each impact assessment and further assessed in the coherence assessment for each option.

PART 2 - THE CANDIDATE EUROPEAN PARTNERSHIP ON A CIRCULAR BIO-BASED EUROPE

1. INTRODUCTION: POLITICAL AND LEGAL CONTEXT

Europe embarked on its course to become the first climate neutral continent by 2050. The roadmap and series of measures and initiatives to lead this green transition are set out in the European Green Deal[35], the Commission's new growth strategy to boost the green economy and protect the environment.

The climate and environmental challenges that Europe is facing are interlinked with and reinforced by unsustainable production and consumption patterns, overexploitation of natural resources, ecosystem degradation, biodiversity loss and dwindling availability of critical raw materials[36]. Research and innovation are fundamental drivers that can turn these complex and multi-faceted challenges into economic and environmental opportunities that are also inclusive and just. They can provide for disruptive innovations that trigger societal transitions, breakthrough technologies that open new market opportunities, as well as sustainable and circular solutions that address environmental challenges.

The bioeconomy – and notably its industrial part 'the bio-based industry' - have a strong role to play in delivering environmental and climate neutral solutions through bio-based innovation. Beyond decreasing EU dependency on and accelerating the substitution of non-renewable fossil raw materials and mineral resources, and providing low-toxicity bio-based alternatives, the bio-based industry has the potential to create value from local feedstock and deliver jobs, economic growth and development not only in urban areas but also in rural and coastal territories where biomass is produced.

Definition of the bioeconomy[37]

"The bioeconomy covers all sectors and systems that rely on biological resources (animals, plants, micro-organisms and derived biomass, including organic waste), their functions and principles. It includes and interlinks: land and marine ecosystems and the services they provide; all primary production sectors that use and produce biological resources (agriculture, forestry, fisheries and aquaculture); and all economic and industrial sectors that use biological resources and processes to produce food, feed, bio-based products, energy and services.[38]"

Definition of bio-based industry[39]

The bio-based industry is the part of economy formed by companies that use biological input (feedstock) to produce material, products and services. The biological input can be the biomass extracted from natural environment and purpose grown biomass (e.g. from agriculture and forestry, marine, fisheries and aquaculture), as well as different forms of biological waste, side streams and residues (e.g. by-products, rejects and waste from agriculture, wood processing, food production, industrial biological waste or municipal biological waste). Bio-based industry can produce bulk materials (continuous industry) or

[35] COM(2019) 640 final, The European Green Deal.
[36] COM(2017) 490 final, 2017 list of Critical Raw Materials for the EU
[37] COM(2018) 673 final, EU Bioeconomy Strategy (2018).
[38] Biomedicines and health biotechnology are excluded.
[39] In this impact assessment biomedicines and health biotechnology is excluded from the definition of the bio-based industry in line with the EU Bioeconomy Strategy,

specific products[40] (discrete industries). Bio-based industries operate in many manufacturing sectors[41].

Definition of bio-based innovation

Bio-based innovation is a novel concept, technology, process, material or product based on the use and transformation of biological input. The benefits of bio-based innovation include one or more of the following: increased energy or material efficiency of production process, new properties of produced material or product, ability to use and valorise waste, and elimination of pollution.

Building on the scientific advances in life-sciences and biotechnology, the area of bio-based innovation is growing fast. This is particularly the case in certain areas of application, such as health, agriculture, nutrition and specialty materials and consumer products, where there are expectations of high economic returns for the industry. However, the scientific advance in biology can be applied more broadly and introduce bio-based innovative solutions in most manufacturing sectors and thus contribute to the needed climate and environmental transition. The bio-based industry is now expected to invent and bring further to the market a wide set of climate- and environment-friendly circular and sustainable bio-based solutions for the production of basic chemicals and materials, plastics, packaging, construction products, textile and other goods with high material use.

To exploit the full potential of the bio-based industry, improved technologies and new transformation processes still need to be developed, tested in the real-life environment and brought to the market. Life sciences and biotechnologies, including industrial biotechnology and engineering (or synthetic) biology as well as digital, chemical, microbial, enzymatic and electrochemical technologies offer new opportunities for improvement of technologies and processes used by the bio-based industry[42]. These technologies are often platform technologies that can be applied in a number of sectors such as agriculture, foods and feed, pharmaceuticals[43], chemicals and materials, energy etc. Some segments of biotechnology are still in their infancy (e.g. marine biotechnology), while others (e.g. industrial biotechnology) are far more advanced and already at the heart of the bio-based industry (e.g. use of enzymes in biomass processing in biorefineries). Yet even in the latter case, the focus on new types of feedstock for processing requires intensive R&I effort to develop more efficient biotechnological processes (e.g. specific enzymatic mixtures or pre-treatment of biomass).

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[40] Bio-fuels are bio-based products and in a broader sense, bio-fuel production is a segment of the bio-based industry. However, the bio-fuel production is excluded from the scope of the proposed R&I initiative as this segment operates in a very different policy and market context from the rest of the industry. The biofuel sector is highly regulated and markets are strongly affected by economic incentives. R&I in biofuel is facing a different set of issues as there are separate R&I and investment programmes and instruments for research in biofuels. From the technological point of view, bio-fuel innovation is still implicitly included in the scope of the proposed initiative, as the technology for production of biofuel is similar to the technology to produce many other bio-based materials. An example is the production of ethanol from agricultural residues through biorefining. This ethanol can be used as bio-additive to fuel or as a feedstock for the chemical industry. Also, the sustainability aspects of the bio-based industry are applicable for biofuels. As a result, the biofuel segment will benefit from this initiative.

[41] In this impact assessment report the term ‘sector’ is interpreted as a part of economy that is defined by the product or service provided. For example there is the “manufacturing of chemicals and chemical products” sector (NACE code C20) which covers all industrial manufacture of chemicals. Within this sector there are companies that use abiotic materials as an input for production of chemicals as well as companies using biological input. The companies using the biological input will be considered as the bio-based industry within the chemicals sector. There is no single NACE code that would be assigned to the bio-based industry.

[42] OECD, Meeting Policy Challenges for a Sustainable Bioeconomy, Paris, 2018.

[43] While biotechnology is at the heart of bio-based processes, health biotechnology and biological medicines are not included in the European Union’s (EU) bioeconomy definition.

The bio-based industry is a capital intensive, high-risk investment area that is facing technological, regulatory and market challenges that cannot be tackled by any Member State alone. It requires concerted action by a wide range of stakeholders and the mobilisation of public and private funding to create a supportive ecosystem that can trigger a green transition. Therefore, since 2014, the European Union supports the 'Bio-based Industries Joint Technology Initiative' (BBI Joint Undertaking or BBI JU) -- a public-private partnership between the EU and the Bio-based Industries Consortium[44]. It is aimed at increasing research and innovation investment in the development of a sustainable bio-based industry in Europe. The interim evaluation of the BBI JU[45] underlined its structuring and mobilising effect on the bio-based industry, but also made recommendations for improvement as regards the scope of its activities, the synergies with other initiatives, and the involvement of stakeholders (e.g. NGOs, brand owners, citizens) and actors such as Member States, regions and municipalities. Since then, the socio-economic, scientific, technological, and political contexts have further evolved putting new demands on these types of partnerships. In particular, the analysis of participation highlighted the need to increase engagement of key actors (e.g. primary biomass producers in bio-based value chains, investors, regions). Furthermore, following the COVID-19 crisis, the bio-based industry is considered a strong catalyst and enabler to drive the green transition to a more resilient and environmentally sustainable EU economy, which is a critical opportunity for the Green Deal and the European recovery plan Next Generation EU[46] - and therefore this has to be reflected in any future initiative.

Based on lessons learned from past experience[47] and new and emerging needs, this Impact Assessment document assesses which of the available instruments under Horizon Europe would be the most effective and efficient to focus, structure and align joint European research and innovation activities in bio-based industrial systems to deliver on EU priorities.

Stakeholder opinion

Some 67% of the 1755 respondents (including industry, academic and research institutions, public authorities and NGOs) to the Open Public Consultation consider that the scope and coverage proposed for this candidate Circular Bio-based Europe partnership are right and appropriate in terms of technologies and research areas covered, geographical and sectoral scope, proposed types of partners and range of activities.

1.1 Emerging challenges in the field

Global challenges like climate change, land and ecosystem degradation, coupled with a growing population are forcing us to seek new ways of producing and consuming that respect the ecological boundaries of the planet[48][49].

Unsustainable production and consumption patterns are on the rise including the use of fossils, minerals and metals with high climate and environmental footprint[50]. The

[44] https://biconsortium.eu/bio-based-industries-consortium
[45] Interim evaluation of the Bio-based Industries Joint Undertaking (2014-2016) operating under Horizon 2020 (2017)
[46] COM/2020/456 final and SWD(2020) 98 final
[47] Importantly, additional sources of evidence since the BBI JU interim evaluation (2017), such as BBI JU Annual Activity Reports 2018 and 2019.
[48] COM(2018) 673 final, EU Bioeconomy Strategy (2018).
[49] COM(2019) 22 final, Reflection paper towards a sustainable Europe.
[50] Approximately one quarter of global GHG emissions is caused by material production (from: Material Economics (2019) Industrial Transformation 2050)

McKinsey Global Institute[51] estimates that 60% of global material input can be made using biological means. Yet this is not happening. There is thus an enormous but not fully tapped potential for substitution of abiotic fossil materials with bio-based material which can offer the same functionality, or even have novel properties unachievable by conventional materials and products, such as lower toxicity or better functional characteristics.

The growing European bio-based industry relies on various types of biomass as main input. This **feedstock availability is not constant and quality is not homogenous by default**. It can be affected among others by geography, climate and soil conditions, seasonality, logistical issues, competing uses of biomass for other applications such as energy production, certification requirements and type of feedstock (primary produce or secondary resources: biowaste, residues, etc.). These elements can lead to large price fluctuations and even unavailability of feedstock, which is an important constraint for the functioning of European bio-based industry. In such cases, if the bio-based industry cannot use alternative feedstock or increase feedstock efficiency, price increases or volatility end up reducing competitiveness and demand for bio-based products compared to fossil-based industry alternatives. As a result, bio-based products may become **more expensive than their fossil-based substitutes,** which is a significant structural competitive disadvantage for bio-based industry[52].

In addition, biomass is the most wasted material – more than one quarter or about 600 megatons of biomass ends up as waste every year, out of which 60 megatons is food waste[53] and 88 megatons is municipal waste[54]. **Only about 25% of this resource is collected and recycled**, showing the high level of opportunities for capturing the economic value and reducing environmental impact of biological waste. Higher utilisation of biological waste as a feedstock would make the bio-based industries more **circular**[55] and contribute to the EU circular economy transition. However, low grade, non-homogenous waste with impurities is difficult to process with the current technologies so the ability of the bio-based industry to use bio-waste feedstock, especially in higher value products accepted by consumers, is a persisting R&I challenge for the future.

Climate change puts pressure on the need to decrease carbon emissions from industry, and bio-based industrial systems are intrinsically carbon efficient. Living organisms and in particular plants bind carbon from the air, soil or water, and turn it into biomass. If this biomass is converted into materials, the carbon stocks contained therein is sequestered for the time until the material is combusted or degraded so that carbon is released back to the atmosphere. However, the overall carbon efficiency of bio-based industrial production systems depends on the amount and form of energy they use in the whole production system including production of biomass, transport, processing, and so on, and can be measured by a whole 'life cycle assessment' (LCA). This is why some industrial systems can be demonstrably very carbon efficient and contribute to climate mitigation while others may even emit more carbon than they bind. For instance, in the biofuel sector some older

[51] McKinsey Global Institute: The Bio Revolution, May 2020.
[52] EIB (2017): Access-to-finance conditions for Investments in Bio-Based Industries and the Blue Economy
[53] Bio-based Industry Consortium and Zero Waste Europe (2020): Bio-waste generation in the EU: Current capture levels and future potential
[54] COM (2010) 235 Communication from the Commission to the Council and the European Parliament on future steps in bio-waste management in the European Union
[55] According to the EC Expert Group on Circular Economy F EIB (2017): Access-to-finance conditions for Investments in Bio-Based Industries and the Blue Economy, the bio-based industry can become circular by: using sustainably sourced renewable biomass as the feedstock, using the biological waste as the feedstock, or by producing materials/products that can be used in circular way (EC Expert Group on Circular Economy Finance (2020): Categorisation System for Circular Economy)

biorefineries in the EU do not meet the current legal requirement for GHG reduction and can actually emit more carbon emissions than equivalent fossil based operations[56]. The scientific community agrees that the carbon efficiency of certain bio-based industrial systems can be improved significantly.

Socio-economic and environmental pressures push for more resilient, circular and local industrial processes. The bio-based industry can make the EU economy more circular and locally sourced. Bio-based technology can use domestic sustainably produced biomass or use local biological waste or residues from agriculture and forestry, industrial processes and municipal waste.

The **recovery from the economic crisis** caused by the Covid-19 pandemic further demonstrates the need for structural changes that will make the EU economy more resilient to future shocks. The bio-based industry can contribute to the economic recovery and maintain high growth for an extended period. As the bio-based industry uses domestic resources, e.g. the biological waste, it makes this industry more resilient to external crises and fluctuation in availability and cost of raw materials. It can bring jobs to economically depressed areas that may be affected by the crisis disproportionately without leaving certain groups or regions behind[57] by providing additional income to those who produce biomass in rural and depressed regions that typically do not benefit from industrial development. This **potential can however be undermined by the unequal capacity for bio-industrial activity in different regions**. The challenge is to ensure the development of bio-industrial activity in those parts of Europe where there are suitable conditions for bio-based industrial activities but insufficient capacity, e.g. in Central and Eastern Europe[58]. This particular issue correlates with the policy support given by some EU Member States, demonstrated by the presence or absence of national Bioeconomy strategies[59].

The overall challenge for the EU bio-based industry to grow in an environmentally sustainable way and deliver jobs and income to rural and low-income regions is not only a concern for the economic actors involved. It is in the public interest that the bio-based industry delivers on its potential to address the societal problems of climate change, resource efficiency and socially fair transition. As research and innovation are fundamental enablers for the bio-based industry, R&I investment in bio-based industrial systems is both in the private and public interest, provided that there are effective safeguards that public policy goals will be pursued by joint activities.

The current state and pace of development is however insufficient for the bio-based industry to play its potential role in the immediate future. The bio-based industry is not yet ready for radically increased investment in the next decade as there are persistent technology, market and policy risks preventing the bankability of bio-based projects. In the context of the post-Covid-19 economic recovery, there is also a risk that unprepared sectors or market players will not be in a position to absorb the investment that could be made available through recovery policies. As a result, this investment is likely go into the conventional industries, thus cementing the unsustainable situation.

[56] Vera I. *et al.* (2019): A carbon footprint assessment of multi-output biorefineries with international biomass supply.
[57] OECD (2020) Policy implications of Coronavirus crisis for rural development
[58] Issue confirmed by the BBI JU Interim Evaluation (2017)
[59] Issue identified by the BBI JU Interim Evaluation (2017). See Section 1.2 below for further details on national strategies.

1.2 EU relative positioning in the field[60]

The relative positioning of the bio-based industry and bio-based innovation can be analysed from different perspectives: the recent development and the current performance of the bio-based industry that indicates how well the EU exploits the potential of the industry based on past innovation; and the level of investment in bio-based industry, the intensity of R&I activities and the development of supporting policies that indicate how the bio-based industry will grow and exploit the potential in the future. This chapter will take both perspectives (within the limits of data availability) comparing the EU to global competitors as well as comparing the situation between different EU Member States.

The EU bio-based industry claims the leadership position in the world[61]. The industry has the annual turnover of 700 billion Euro and employs 3.6 million employees (based on 2016 data that do not reflect the impact of Covid-19 crisis)[62]. This is the result of 17% growth over the period 2008-2016 including the economic slowdown in 2009 and 2010. The fastest growing segments of bio-based industry were pharmaceuticals and chemicals. For example the production of bio-based chemicals grew by 33% in volume (from 15 to 20 megatons) and 40% in value (from 20 to 28 BEUR) in the same period. The bio-based industry also improves its position within traditional sectors, i.e. it grows faster than the rest of the industry. For example the share of bio-based industry in the chemicals sector grew from 5% in 2008 to 7% in 2016.

Within the EU, four Member States – Germany, Italy, France and Spain -- represent more than half of the bio-based industrial activity, both from the turnover and employment perspective[63]. In terms of labour productivity Belgium, Sweden, Denmark, Finland and the Netherlands are the leading Member States[64]. There are 2,362 biorefineries[65] (facilities processing biomass for product manufacturing) in Europe. The Member States where biorefineries are most present are Germany (close to 600), France, Italy, Sweden and Finland. The Central and Eastern European EU Member States lag behind in terms of turnover, jobs, labour productivity and the number of industrial facilities. Figure 7 below shows specifically the distribution in Europe of bio-based facilities identified as smaller size plants which did not yet reach the commercial phase, including pilot, demo and R&D facilities, based on the distribution in terms of product categories.

[60] The relative position of the bio-based industry and bio-based innovation is not yet well described due to the lack of detailed data. The bio-based industry cut across the sectoral taxonomy and other statistical categories. Methodologies in different studies differ and provide incomparable results. Also the international comparison is affected by different definitions of bio-based industry applied in national statistical systems.

[61] Bio-based Industry Consortium (2018): A new EU bioeconomy strategy and action plan: Calling for tangible action to scale up the circular bioeconomy

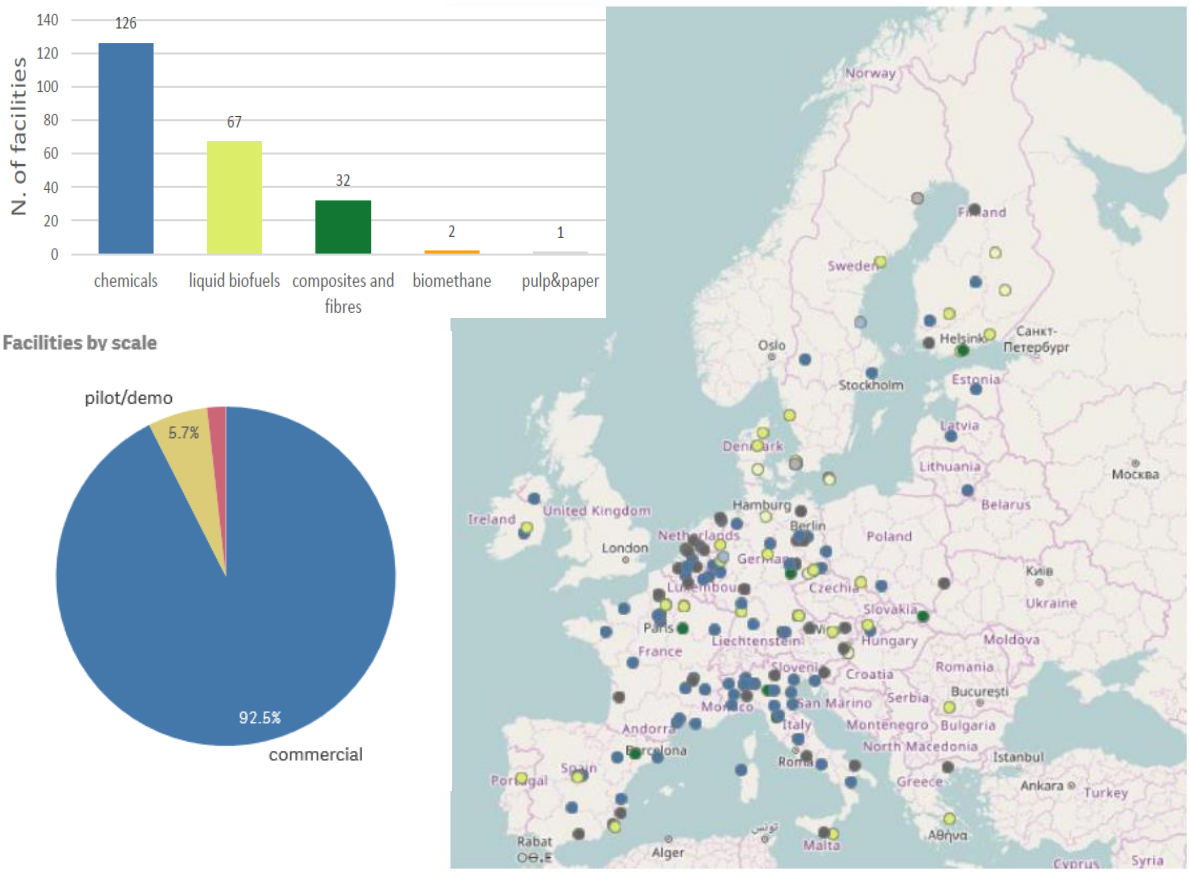
[62] Nova-Institute and Bio-based Industries Consortium (2019): European Bioeconomy in Figures 2008 – 2016

[63] Nova-Institute and Bio-based Industries Consortium (2019): European Bioeconomy in Figures 2008 – 2016

[64] Ronzon T. et al. (2020): Developments of Economic Growth and Employment in Bioeconomy Sectors across the EU, Sustainability 2020 vol. 12

[65] European Commission Joint Research Centre, DataM dashboard on Bio-based industry and biorefineries, https://datam.jrc.ec.europa.eu/datam/perm/news/666

Figure 7 Pilot, demo and R&D bio-based plants across the EU



Source: European Commission Joint Research Centre (2020)[66]*,*

At global level the main competitor to the EU bio-based industry is the bio-based industry in the USA, China and Brazil[67]. The bio-based industry generated added value of 400 billion USD and employed 4 million employees in 2013[68] and the industry was expected to grow fast due to market drivers and proactive policies (tax credits, public procurement, etc.) with expected employment of 5.3 million in 2020. The direct comparison is impossible due to statistical categorisation difference but the most comparable segment – bio-based chemicals – seems to similar dynamics than the EU one with annual growth of 12% in 2014[69] compared to 11% growth in the EU in 2015.

In the fast growing bio-based industry it is important to understand those factors that will affect the growth in the future. These factors include investment in bio-based industry infrastructure (e.g. biorefineries), intensity of research and innovation activities and the development of policies driving the growth (e.g. economic incentives).

Concerning the level of **investment** the total investment in bio-based industry is not available but one of its representative segment – the bio-based chemicals – attracted 9.2

[66] Parisi, C., Distribution of the bio-based industry in the EU, Publications Office of the European Union, 2020, ISBN 978-92-76-16408-1, doi:10.2760/745867, JRC119288

[67] The comparison will be limited to comparison with the US as the industrial structure and statistical systems seems to be most comparable to the EU one.

[68] US Department of Agriculture (2015): An Economic Impact Analysis of the U.S. Biobased Products Industry

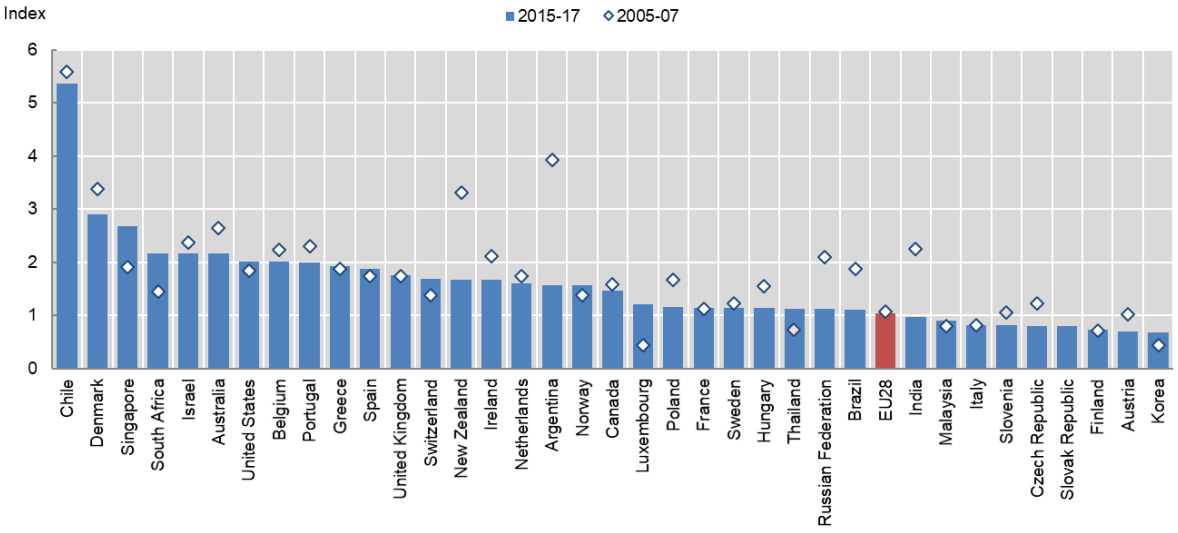
[69] Grand View research (2020): Bio-based Platform Chemicals Market Size, Share & Trends Analysis Report

billion USD globally from 2010 to 2015[70]. The distribution of this investment is approximately equal for the four global regions (Europe, North America, South America and Asia) with the specific focus in Europe and the US on R&I and pilot facilities, while in Asia and South America investment goes more into commercial production plants. The recent investment in all four regions resulted in a comparable production capacity. The remarkable difference is the investment of venture capital funds that is predominantly attracted (82%) by the US market.

The intensity of R&I activities in the bio-based innovation area can be measured by proxy indicators including R&I spending, scientific publications and patents. The **private investment** in biotechnology – the key R&I area for the bio-based innovation – is dominated by the US with more than 50 billion USD in 2017 compared to estimated 15 billion in the EU[71]. As a percentage of biotech R&I on the total private R&I expenditure the US leads before all EU Member States except Belgium (13% in the US and 32% in Belgium). The **public expenditure** in biotech R&I in the EU Member States is estimated to 3.1 billion Euro.

In **scientific publications** in the bio-based area, cumulative statistics for EU countries show EU leadership at global level followed by the US and China[72]. However the US leads on the **number of patents** in the biotechnology area (37% compared to 24% of the EU). The EU is losing its position in patenting also to countries like China and Korea.

Figure 8 Revealed EU28 technological advantage in biotechnologies based on patents, 2005-07 and 2015-17



Source: OECD, STI Micro-data Lab: Intellectual Property Database, Index based on IP5 patent families, fractional counts http://oe.cd/ipstats, October 2019. The revealed technological advantage index is calculated as the share of country (or economy) in biotechnology patents relative to the share of country (or economy) in total patents. Only countries and economies with more than 100 patents per period are included in the figure.

[70] Dammer L. et al., *Current situation and trends of the bio-based industries in Europe. Pilot study by nova-Institute for BBI-JU*, 2017.
[71] OECD (2020): Key biotechnology indicators
[72] Technopolis (2020), the analysis of the bio-based sector performed for the impact assessment study.

Concerning the **favourable policies** that facilitate the uptake of bio-based innovation and growth in the bio-based industry the EU Bioeconomy Strategy encourages Member States to develop their national Bioeconomy Strategies and other policies to stimulate bio-based industries. Currently, nine EU Member States (Austria, Finland, France, Germany, Ireland, Italy, Latvia, Spain, the Netherlands) have a national strategy while other Member States are involved in macro-regional bioeconomy initiatives (e.g. Denmark, Sweden) or have sub-national/regional strategies (e.g. Belgium)[73]. Despite their large biomass potential most Central and Eastern European (CEE) countries lag behind in the development of dedicated national Bioeconomy Strategies[74].

The national and regional Bio-economy Strategies provide an important stimulus for bio-based industry, especially if they include synergies with regional development and agriculture policy, including the utilisation of the EU Regional Development Fund and the Common Agricultural Policy funding to incentivise bio-based industrial development. However, this policy is fragmented as there are national and regional difference in the approach and in some regions such stimuli are missing completely.

Compared to the EU fragmented approach the US has developed a comprehensive approach with effective policy at federal level complemented by policy initiatives at states and regional levels. This policy includes tax incentives (15% tax rebate for bio-based industries), public procurement and labelling policy (BioPreferred Programme), subsidies (USDA Biorefinery Assistance Program) and public investment in R&I activities (e.g. USDA/DoE Biomass research and Development Programme) [75].

The only policy initiative at the EU level specifically focused on bio-based industry is the 'Bio-based Industries Joint Technology Initiative' (BBI Joint Undertaking). Since 2014 the European Union supports this public-private partnership aiming at increasing research and innovation investment in the development of a sustainable bio-based industry in Europe (see the box below).

Box 3 Support for the field in the previous Framework Programmes – key strengths & weaknesses identified

What was/is being done with EU research and innovation funding until now

Dedicated R&I activities related to the bioeconomy have been supported through the Framework Programmes, notably via Horizon 2020 Societal Challenge 2 "Food Security, sustainable agriculture, and forestry, marine and maritime and inland water research and the bioeconomy". In the years 2014 - 2019 there were 807 grants[76] signed under this Societal Challenge, which received 2,7 billion EUR of EU contribution (4,93% of Horizon 2020), with total cost of 3,6 billion EUR (5,1% Horizon 2020). This covers traditional (collaborative) projects but also support provided through the 'Bio-based Industries Joint Technology Initiative' (BBI Joint Undertaking) under Horizon 2020, which in the same period and under the same Societal Challenge funded 104 projects with 602 million EUR of EU contribution, and 909 million EUR of total costs. Thus, 22% of the EU funding (contribution) in Horizon 2020 Societal Challenge 2 was provided through the BBI JU, and 25% of total costs. In total, the BBI JU EU contribution represented 1,07% of Horizon 2020

[73] https://ec.europa.eu/knowledge4policy/visualisation/bioeconomy-different-countries_en
[74] https://publications.jrc.ec.europa.eu/repository/bitstream/JRC120324/how-big-is-the-economy.pdf
[75] USDA (2015): An Economic Impact Analysis of the U.S. Biobased Products Industry

[76] Horizon 2020 Dashboard (data accessed on 20 July 2020).

EU contribution (amounting to 56,28 billion EUR), and 1,29% of total costs of Horizon 2020 (amounting to 70,52 billion EUR).

The Bio-based Industries Joint Undertaking (BBI JU) was initiated in 2014[77] with the aims to attract consistent private investment, promote R&I along whole values chains, to avoid fragmentation and duplication of efforts, and improve coordination in innovation activities of bio-based industries. It has originally been allocated **EUR 975 million** from Horizon 2020, and this sum is planned to be matched by EUR 2.73 billion by industries engaged in the partnership.

In terms of **activities**, the BBI JU partnership focuses on sustainable resource use, especially in resource-intensive and high-impact sectors such as agriculture, textiles, manufacturing and construction, in particular also aiming at local operators, manufacturers, plants and factories. It creates awareness, capacities and appropriate structures in a systemic approach. In addition, it focuses on market-oriented measures, such as engagement of consumers and local communities, cost-competitiveness via enlarging the market volume of bio-based innovation, and social innovation for inclusiveness and reducing overconsumption of resources[78].

In terms of **participants**, it extends beyond industry actors, and mobilises producers of biological resources from land and sea, public authorities managing local development and environmental protection, scientific communities, and end users. The private partner of the BBI JU is the Bio-based Industries Consortium (BIC), which originally included 35 bio-based companies. Since the setup of the BBI JU, the group of BIC members has been growing to over 250 (of which 150 associated members) entities from across different value chains ([79]). Over 80% of them are SMEs – mostly in BIC via regional SME clusters. The members cover the whole value chain, from primary production to the market, across multiple and diverse sectors. BIC associated members include research and technology organisations, universities, European associations and organisations, European technology platforms, public institutions, regional organisations and private banks.

What has or is being achieved so far

One of the unique features of the BBI JU initiative has been to foster the closer collaboration between the scientific community and industry, ascending the scale of Technology Readiness Level (TRL) and thus enabling a swifter move towards innovation mentioned in the Strategic Innovation Research Agenda 2017[80]. The scientific community mobilisation is evidenced by the 28.4% participation level of universities and research centres in the BBI JU projects. It is further confirmed by the annual survey directed to the BBI JU project coordinators[81]: according to the projects' reports, 80% of them contribute to knowledge creation, 79% contribute to increasing the academia-industry cooperation, and more than half contribute to the building of scientific community networks and to technology transfer. With regard to the mobilization of the SME community, the BBI JU has been very successful, with 41% of beneficiaries of BBI JU projects being SMEs, and 35% of funding

[77] Council Regulation (EU) 560/2014 amended by Council Regulation (EU) 2018/121 https://www.bbi-europe.eu/
[78] https://www.bbi-europe.eu/
[79] An overview of BIC's current membership, including information about the type of membership (industry or associate, the industrial sector, large or SME, and so on) is available at https://biconsortium.eu/sites/biconsortium.eu/files/documents/BIC%20members%20list%20January%202020.pdf.
[80] KPI 8 (Technology Readiness Level gain) https://www.bbi-europe.eu/sites/default/files/sira-2017.pdf
[81] BBI JU Annual Activity Report 2018 ; https://www.bbi-europe.eu/sites/default/files/bbi-ju-aar-2018.pdf

dedicated to SMEs. This represents significantly higher level as compared to the 20% target for Horizon 2020.

The expected environmental impact from the projects other than flagships is large as two thirds of them report producing bio-based products with lower GHG emissions[82]. More than half of them expect to contribute to waste reduction, reuse, valorisation or recycling and a decrease of their energy consumption. Finally, 40% of the projects report they expect to improve land use and seven projects report a positive impact on biodiversity, e.g. by developing a sustainable agro-forestry biomass cultivation practice[83].

What are the key areas for improvement & unmet challenges?

However, several issues have come up and many lessons were learnt during the implementation of the BBI JU[84], which have to be taken into account when setting up a new initiative in the area.

Areas for improvement / challenges to overcome:

- **Better synergies with national and regional developments** are needed to develop interconnections between primary producers[85], regional authorities and biorefinery plants, as well private operators such as brand owners[86], and taking into account the need for higher circularity and digitalisation[87], inter-sectorial cooperation[88], as well as improved participation of EU-13 actors[89], and integration of territories in need of revitalisation[90].
- National and regional authorities should be aware of the economic and environmental potential of bio-based solutions and supported in the deployment of bio-based solutions, and an improved exchange of best practices should be put in place[91].
- Programming of the initiative should take into account the public interest, especially critical for long-term impact, and avoiding the risk of industry capture[92], while considering win-win scenarios for international cooperation[93].

[82] As self-evaluated by the projects. A dedicated evaluation of the Key Performance Indicators and validation of impacts is underway (results expected by 1Q2021).

[83] BBI JU Annual Activity Report 2018; https://www.bbi-europe.eu/sites/default/files/bbi-ju-aar-2018.pdf. As mentioned, an independent study is ongoing to further assess the Key Performance Indicators for the current JU..

[84] Commission Staff Working Document - Interim Evaluation of the Joint Undertakings operating under Horizon 2020, {SWD (2017) 339 final}

[85] Addressing their low participation, as found by the BBI JU 2018 study on agricultural primary biomass producers, and following its specific recommendations.

[86] BBI JU interim evaluation, recommendation "To include increasingly brand owners and sectors at the interface with consumers with synergies with the existing ones".

[87] BBI JU interim evaluation, recommendations "To respond to important emerging trends through future calls that could consider conversion of biogenic CO2 into chemicals and materials as well as digitalization (including big-data analysis and exploitation) as one aspect in Bioeconomy value chains" and "To cover emerging trends, such as synthetic biology and platform technologies (e.g. bioinformatics), in the future BBI work programmes".

[88] BBI JU interim evaluation, recommendations "To strengthen the whole value chain approach by a greater participation of end users and customers" and "Efforts should be made to support development of completely new value chains and cross-value chains products and processes".

[89] BBI JU interim evaluation, recommendation "To improve the participation of EU-13 MS and Third Countries through a more open programming strategy, which should take into account potentials for growth at macro regional level, also in synergy with other EU initiatives (e.g. Smart Specialisation Strategies, S3)."

[90] BBI JU interim evaluation, recommendation "To reach out to EU member states and regions with rural or deindustrialized areas for catalysing revitalisation through bio-based industries".

[91] BBI JU interim evaluation, recommendation "To analyse cases of success in terms of national participation and deliver 'best practices' for Member States, offering also mentoring support".

- At this stage of the current BBI JU initiative, for most BBI-specific KPIs, BBI JU projects are expected to largely exceed the key performance (KPI) targets set for 2020. On one hand, this shows that the BBI JU has contributed to the systemic evolution of the bio-based industry in bridging the gap between innovation and market. On the other, it also hints at the possibility that the **KPIs were not assessed accurately** beforehand, or lacked sufficient ambition[94].
- The **low focus on biodiversity preservation and enhancement** as part of the pursued biomass value chains has to be improved[95].
- The private partner of BBI JU, BIC, did not follow up on its **commitment on the financial contribution**[96] for the operational costs; this led to the need to amend the establishing Regulation (thus generating also additional administrative burden). The amended Model Financial Regulation ensures that the private partner will have to follow up its official financial commitment.
- The way of **reporting** the private partner's in-kind contributions[97] to operational and additional costs has proven to be complicated and costly. Based on the lessons drawn from current experience, it is possible to mitigate this risk by following the draft legal guidelines on financial commitments, and improving on the measuring the impact[98].
- The BBI JU Regulation under Horizon 2020 specified that the Union and BIC were to share the JU administrative costs equally. However, a contribution of the grant amount (4%) was asked from beneficiaries that were not members of the JU to cover the private share of these costs. With the adoption of the revised model Financial Regulation and the relevant BBI JU Financial Rules, this practice was put to an end.

Recently, the Corporate Europe Observatory (CEO), a corporate NGO, criticised the existing BBI JU initiative for being captured by private interests[99]. It is legitimate for the public to demand that the public investment in a partnership with the private industry delivers benefits for the society at large. The CEO report also reiterated some of the lessons learned during the implementation of the BBI JU. At the time the BBI JU was established in 2014, it was not subject to an impact assessment process as it is the case for institutionalised partnerships under Horizon Europe. In addition the policy context has changed over the years. Firstly a solid basis was formed based on the interim evaluation report of the BBI JU that covered the years 2014 up to 2016. This was supplemented by information and experience drawn from the publicly available Annual Activity Reports covering the periods

[92] BBI JU interim evaluation, recommendation "To avoid programming strategies aiming at short term benefit of BIC's specific sectors but rather invest resources in topics able to create wider and long lasting benefits both at multi-sectorial and macro-regional levels".

[93] BBI JU interim evaluation, recommendation "To identify win-win strategies for a larger involvement of Third Countries while ensuring the protection of EU industry's interests".

[94] BBI JU interim evaluation, recommendation "To monitor further progress of BBI JU by an annual comparison between BBI-specific KPIs projected, achieved and accumulated in the corresponding year".

[95] Issues identified in BBI JU Annual Activity Report 2018 and 2019.

[96] BBI JU interim evaluation, recommendations "To monitor the effectiveness of the measures implemented for solving the problems related to industrial financial contributions to operational costs and consider possible complementary measures to assure a balanced contribution of the Public and Private members to BBI JU" and "To deliver reports that provide comprehensive description of the actual private and public contributions to BBI JU delivered so far as well as the detailed plan for the delivery of the contribution of the two Partners over the next years"

[97] BBI JU interim evaluation, recommendations "To monitor the effectiveness of the guidelines for reporting and certification of IKOP and IKAA" and "To deliver reports that provide comprehensive description of the actual private and public contributions to BBI JU delivered so far as well as the detailed plan for the delivery of the contribution of the two Partners over the next years"

[98] BBI JU interim evaluation, recommendation "To build up metrics and statistical data on the bio-based industries in the EU with annual reporting on economic growth"

[99] https://corporateeurope.org/en/BBI-research-and-destroy

from 2014 to 2019, experience from managing the BBI JU for the past six years and the continuous interaction with stakeholders from the various sectors of the bioeconomy. Combining the changing policy landscape, the learnings from the mid-term evaluation and experience from the BBI JU programme have allowed to adjust the course during the implementation of the programme but also frame from the outset the design of the proposed successor and its governance structure. This is why any future initiative in the area needs to be based on a sound assessment of policy options from the perspective of governance, including in particular the possibility to set adequate safeguards to ensure that the public interests are duly respected in all operations. This is fully in line with the recommendations from the BBI JU interim evaluation referenced above[100]. CBE initiative will build on the success of BBI but will have evolved by learning from BBI JU shortfalls.

To conclude the EU comparative positioning, the EU is still a leader, together with the USA, in the field of bio-based industry, with strong growth and increasing share in the economy. However, these traditional leaders are being caught up by China, Brazil and other emerging economies of Asia and South America. Pro-growth initiatives, necessary for ensuring the continuing leadership, including the R&I and proactive policies tend to be fragmented and uneven across the EU.

1.3 EU policy context beyond 2021

The policy related to the bio-based industry has evolved in the last two years to provide a comprehensive frame and define what constitutes the public interest in the development of this industry in the near future. It also gives a sense of directionality for incentives, including for public R&I funding focused on sustainability issues.

The Green Deal communication[101] creates the overarching framework for sustainable economic transition and sets the objective of carbon neutrality, resource efficiency and zero pollution. The Green Deal calls for mobilisation of R&I instruments in support of its objectives. It foresees the creation of partnership with the private sector to support R&I on circular bio-based industry[102].

The Clean Planet for All communication[103] considers the circular economy and bioeconomy as key transition pathways to climate neutrality. It foresees the increased use of sustainable biomass in the form of biofuels and bio-based materials and calls for safeguards that increased demand for biomass will not lead to reduction of natural carbon sinks.

In the Circular Economy Action Plan[104] the Commission commits itself to support the sustainable and circular bio-based industry. The New Industrial Strategy[105] announces the EU support to key enabling technologies including industrial biotechnology. The Sustainable Finance Regulation foresees the development of the taxonomy for circular economy in the near future. In the preparatory work for the taxonomy, the Expert Group on Circular Economy Finance Support categorised bio-based industrial activity as a part of circular economy and proposed a set of performance criteria for substantial contribution to circular economy objectives.

[100] Especially the recommendation "To avoid programming strategies aiming at short term benefit of BIC's specific sectors but rather invest resources in topics able to create wider and long lasting benefits both at multi-sectorial and macro-regional levels".
[101] COM(2019)640 final
[102] COM(2019)640 final, p18
[103] COM(2018)773 final, p12, p13
[104] COM(2020)98 final, p6
[105] COM(2020)102 final

The Farm to Fork communication[106] refers to the bio-based economy as the opportunity for farmers and the Commission commits itself to actions to speed up market adoption of bio-based solutions. The Common Agricultural Policy is a powerful instrument for Member States to promote and incentivise the bio-based industry if they consider it as a strategic priority for rural development. The new Biodiversity Strategy[107] announced a plan to assess the availability of biomass for bio-fuel and review the legislative framework[108] as well as set sustainability criteria for use of forest biomass.

The updated EU Bioeconomy Strategy[109] and it Action Plan[110], provides the most detailed operational guidelines on the development of the bio-based industry. Its first action area focusses on the strengthening and scaling up the bio-based industry, unlocking investment and markets. It commits the Commission to the following five actions: (1) to mobilise public and private stakeholders in research, demonstration and deployment of sustainable, inclusive and circular bio-based solutions; (2) to launch a Circular Bioeconomy Investment Fund; (3) to study enablers and bottlenecks for the deployment of bio-based innovations; (4) to promote and develop standards, labels and market uptake of bio-based products; (5) to facilitate the development of new sustainable biorefineries; and (6) to develop substitutes to fossil based materials that are bio-based, recyclable and marine biodegradable.

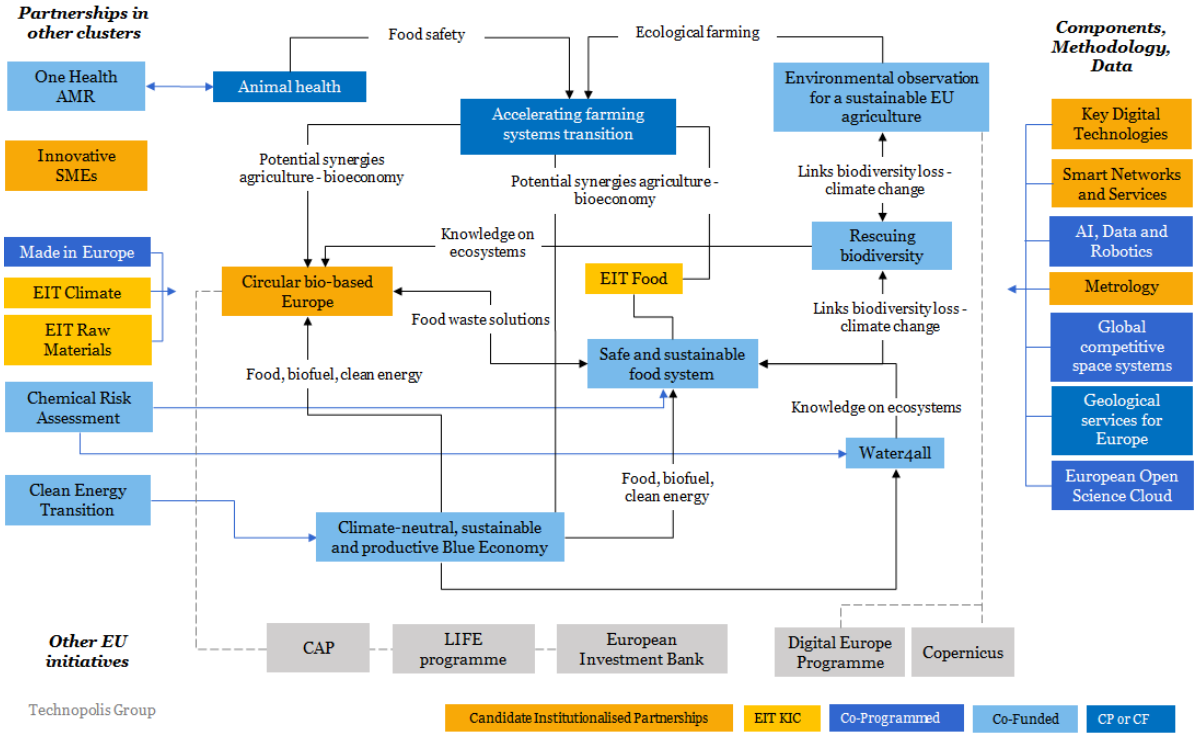
All the above policy objectives and actions have been reflected in the programming documents for the EU R&I programme for the period 2021-2027 – Horizon Europe. The Specific Programme[111] identifies the priority areas for R&I and indicates the plan to establish an initiative with private partners representing the bio-based industry. The priority agreed between the EU institutions in the Specific Programme are now operationalised in lower level planning documents including the Strategic Plan for 2021-2024 and Work Programme 2021-2022.

The overall policy framework is clear about the strategic role of the bio-based industry in contributing to achieving the EU sustainability objectives and about the direction in which the EU support will be oriented in the coming decade. The R&I programme is charged with the task of facilitating the development and deployment of bio-based innovations that contributes to climate neutrality, resource efficiency, biodiversity, and zero pollution objectives while ensuring also the bio-based industry's contribution to economic growth and regional development. In light of the above, the relevant policy question is thus not whether support in this area is justified but rather what form this support should take to deliver the greatest positive impact for EU investments.

The proposed initiative is among the activities envisaged to implement the Commission's vision for the period beyond 2020 under the Horizon Europe Pillar II, specifically Cluster 6 (Food, Bioeconomy, Natural Resources, Agriculture and Environment). It is one of the European Partnerships foreseen in the Partnership Area of 'sustainable, inclusive and circular bio-based solutions'. As shown below, an initiative for a Circular bio-based Europe would have potential interconnections with other candidate European partnerships such as Safe and Sustainable Food Systems, Accelerating Farming Systems Transition, Rescuing Biodiversity and more.

[106] COM(2020)381 final
[107] COM(2020)380 final, p6, p9
[108] The Renewable Energy Directive II, the Emissions Trading Scheme, and the Regulation on land use, land use change and forestry (LULUCF)
[109] COM(2018)673/2 final
[110] SWD(2018) 431
[111] COM(2018)436 final

Figure 9: Potential interconnections between partnership initiatives in the Food, Bioeconomy, Natural Resources, Agriculture and Environment cluster of Horizon Europe

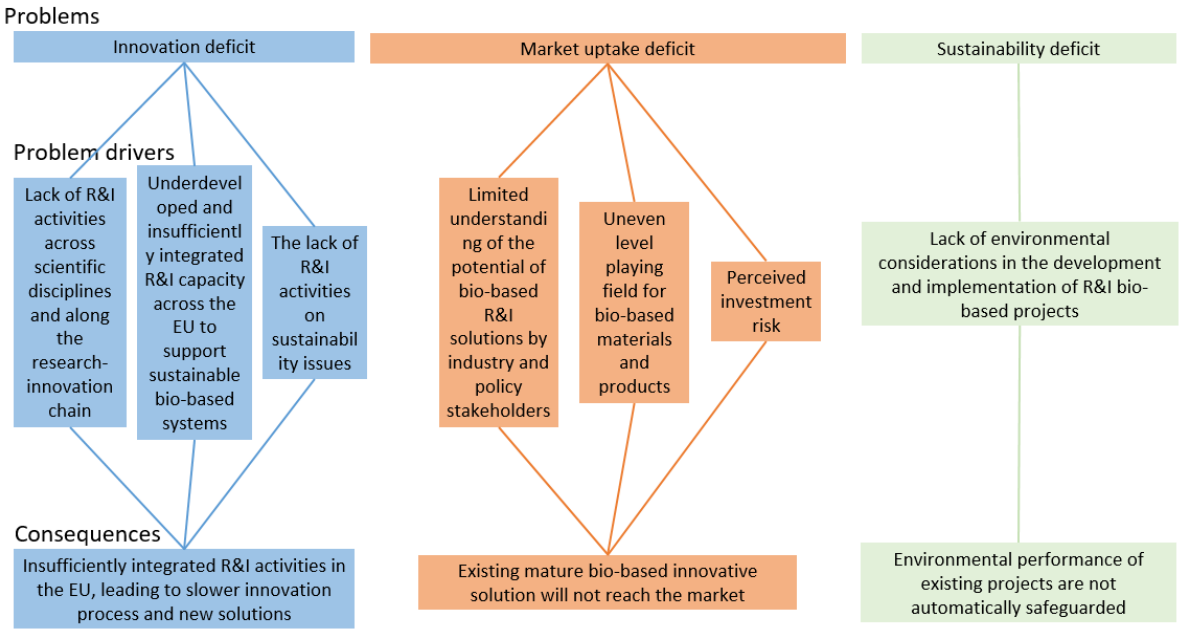


2. PROBLEM DEFINITION

Given the scale of the challenges ahead for the bio-based industry, the current scientific, technological and economic positioning of Europe in the field, and the overarching EU policy context, a set of problems have been identified where EU research and innovation in the circular bio-based industry would have a specific role to play.

The Figure below provides an overview of the problems and problem drivers that will be discussed in this section.

Figure 10: Problem tree for the initiative on Circular Bio-based Europe



2.1. What are the problems?

In general, the EU economy does not exploit bio-based innovation to the full potential and the bio-based industry does not contribute sufficiently to the societal objectives of sustainable and fair growth in the medium and long term. Despite the EU being a world leader in bio-based industry, there are still forgone economic and environmental benefits. As a result, at the moment, the bio-based industry brings a sub-optimal contribution to the carbon neutrality objective of the Green Deal and to the resilient economic recovery objective of the Next Generation EU.

This overarching problem can best be illustrated by focusing on three different strands – insufficient innovation, market failures that prevent mature bio-based innovations from entering markets, and a sustainability challenge to ensure that economically viable bio-based solutions deliver on environmental objectives.

2.1.1. Deficit of cutting-edge science and innovation serving the EU bio-based industry (Innovation deficit)

The bio-based industry is driven by innovation. Although bio-based solutions have been used throughout human history (e.g. food production and preservation, textile, tannery, paper, adhesives, etc.), the modern bio-based industry is based on innovative solutions that enhance the efficacy of natural biological processes. For example, new enzymatic processes or entire bio-based production systems – known as bioroutes – can do one or more of the following: radically improve the efficiency of production processes; enable the use of alternative (more available or cheaper) raw material input; and result in different products with new properties, and increased utility and value.

The biological science is undergoing a revolution that is enabled by advances in molecular biology and computing. The production of biological data is exploding, which is visible in

the accelerating rates of DNA sequencing and the development of "omics"[112]. This accelerating production of scientific results is a consequence of an acceleration of research using applied biological sciences. The biology science is then combined with physics, chemistry, medical, engineering and IT research to turn the theoretical bio-science concepts into innovative solutions in many areas ranging from medicine to i.a. pharmaceuticals, nutrition, industrial production based on biomachines, and IT based on bio-computing. The scientific community considers as scientifically plausible what used to be inconceivable a short time ago[113].

These advances in biological science can also revolutionise more traditional industrial sectors. Specifically, they can make the existing use of biological resources radically more efficient. An example is squalene, a substance used in vaccines and cosmetics that was traditionally produced from shark liver. Squalene is now produced at industrial scale by an engineered yeast. Bio-based solutions can produce materials that are currently derived from non-renewable abiotic resources, e.g. microorganisms are already being used to produce plastics or bio-based alternatives to cement. Completely new materials or products can be produced by microorganisms as a bio-based optical films to be used in computer displays and flexible electronic circuits.

Stakeholder opinion

57.8% of respondents to the OPC (including industry, academic and research institutions, public authorities and NGOs) indicated that the innovation gap in the EU in translating research results into the development of innovative circular/bio-based products is very relevant. Collaborative R&I projects were also considered as very relevant by a large number of respondents (120 respondents or 59.11%). In particular, a large majority of academics, business associations and EU citizens, and all respondents from public authorities, described collaborative R&I projects as relevant.

Despite the theoretical potential of applying cutting-edge bio-science for radically increased use of biological resources as an input into the material and product economy, innovation in this area is trailing behind innovation in medical, pharmaceutical, nutrition and bioengineering areas. Out of 400 innovation pipelines in bio-science that are considered as scientifically feasible and economically plausible[114], the majority of applications is in the areas of health and nutrition. In terms of prospective economic impact of the innovation in the pipeline, these sectors also dominate with 33% of the total bio-based economic impact in the health and 36% in the nutrition sectors respectively. Conversely, innovation in material production represents only 8% of the estimated potential of the emerging innovation. The time of bringing innovation to the market also tends to be shorter for health innovation (5-15) years compared to material innovation (10-25 years), which indicates less intensive activities in testing and demonstration. This innovation deficit problem ultimately results in missing innovation pipelines that could be a basis for future radically improved industrial processes and products and suited to many economic sectors and areas of application.

[112] These include for example genomic, epigenomics, proteomics, glycomics, lipidomics, transcriptomic, metabolomics.

[113] Examples of such breaktrough innovations enabled by the biological revolution include individualised gene therapies for genetic diseases, 3D printing of living tissues or organs, neuroprosthetics or Biocomputing (in McKinsey(2020) The Bio revolution)

[114] McKinsey 2020: The Bio Revolution

2.1.2. Deficit in uptake of bio-based innovative processes in EU industrial value chains (Market uptake deficit)

In addition to the above, the bio-based industry also faces a problem of limited market uptake for current innovation. Existing and technically and economically viable solutions are not penetrating market at sufficient speed. The potential of biomass produced in the EU remains untapped and a large part of it is wasted[115]. An indicator of this situation is that in the EU only 10% of the biomass is used in products and only a small part of it enters long lasting material stocks, such as durable and high-performance materials used in construction or automotive sector (e.g. insulation materials, composites). In contrast, more than half of all biomass is used for energy and one quarter of biomass is wasted.

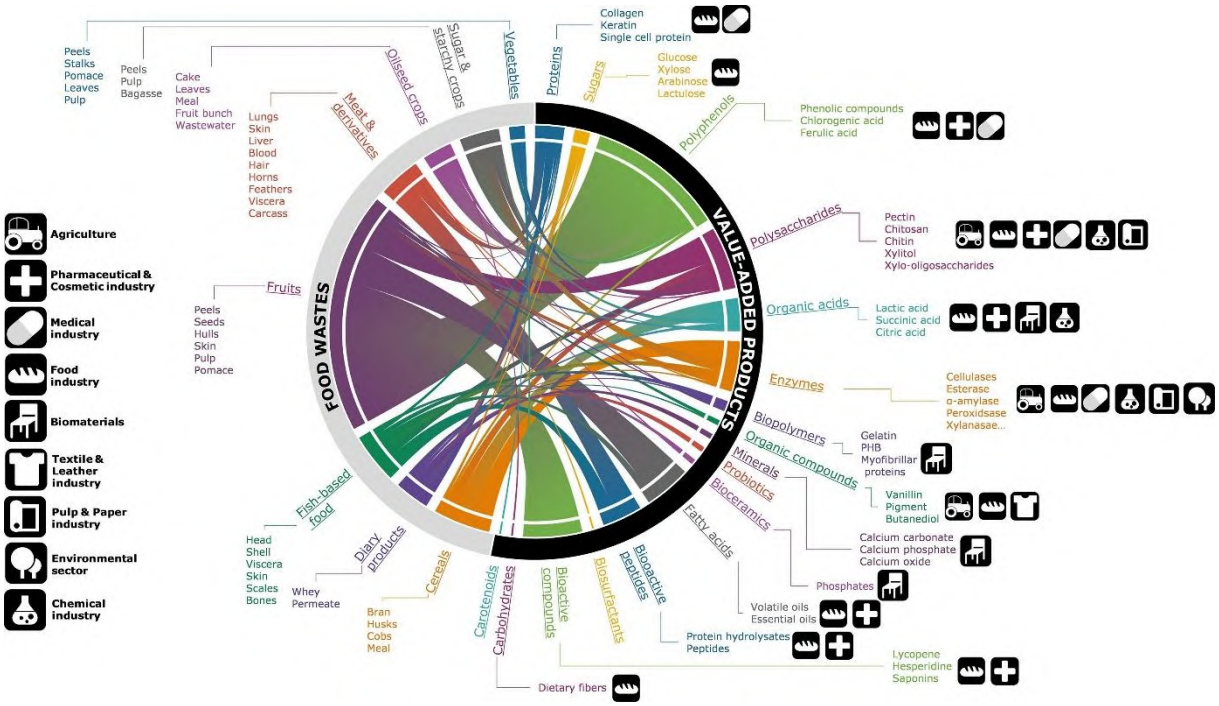
An illustrative example of market uptake deficit is the use of waste from the food industry. This waste is an ideal input in the bio-based industry due to its relative homogeneity[116]. There is abundance of food waste (30 MT a year) as it is unavoidable in the food production process. With growing food production in the EU, this potential feedstock also grows at a compound annual growth rate of 4.3% from 2019 to 2024[117,118]. There are a number of food waste processing bio-based technologies that are mature enough for industrial application. These technologies can also produce a wide range of materials and products for which markets exist (see Figure 11). In some cases, the produced chemicals or materials are very valuable, e.g. lycopene (a natural carotenoid with antioxidant and anti-cancer properties) extracted from tomato waste has a market value of 40 000 EUR per kg. The JRC studied the techno-economic feasibility of industrial installations – biorefineries – focusing on the optimisation of the use of this type of feedstock. The JRC study concludes that for four traditional waste streams (orange, potato, tomato and olive) and a limited scope of technologies and produced materials, there is already potential for profitable investment in 189 biorefineries with payback period up to 15 years and in some cases with a return on investment of 9%[119]. These biorefineries, however, have yet to be constructed and meanwhile this valuable resource – food waste -- is mainly used in low value applications such as combustion or composting and continues to emit methane and/or CO2 in the atmosphere.

A similar deficit in market uptake of technically and economically feasible bio-based applications exists in other biomass streams, including wood-based and aquatic biomass, and municipal biological waste and wastewater. The EU Bioeconomy Strategy estimated that 300 biorefineries should be constructed in the next decade to tap the existing potential of bio-based systems. This would require a total investment at the level of 50 billion EUR. This estimation does not include the potential of innovation in the low technology readiness stage that can further enlarge the economic opportunities of the bio-based industry.

The picture below illustrates how different kinds of food waste can be processed in a number of value added materials and products that can be used in diverse economic sectors.

[115] The European Innovation Partnership on Raw Materials: Raw Material Scoreboard 2018.
[116] Caldeira C. et al. (2020) Sustainability of food waste biorefinery: A review on valorisation pathways, techno-economic constraints, and environmental assessment, Bioresource Technology, vol 312
[117] Caldeira C. et al. (2020) Sustainability of food waste biorefinery: A review on valorisation pathways, techno-economic constraints, and environmental assessment, Bioresource Technology, vol 312
[118] Research and Markets, 2019. Food Processing Market Report: Trends, Forecast and Competitive Analysis. Report.
[119] Cristobal J. et al. (2018) Techno-economic and profitability analysis of food waste biorefineries at European level, Bioresource Technology, vol. 259

Figure 11 Food waste valorisation pathways



Source: Cristobal J. et al. (2018)

Stakeholder opinion

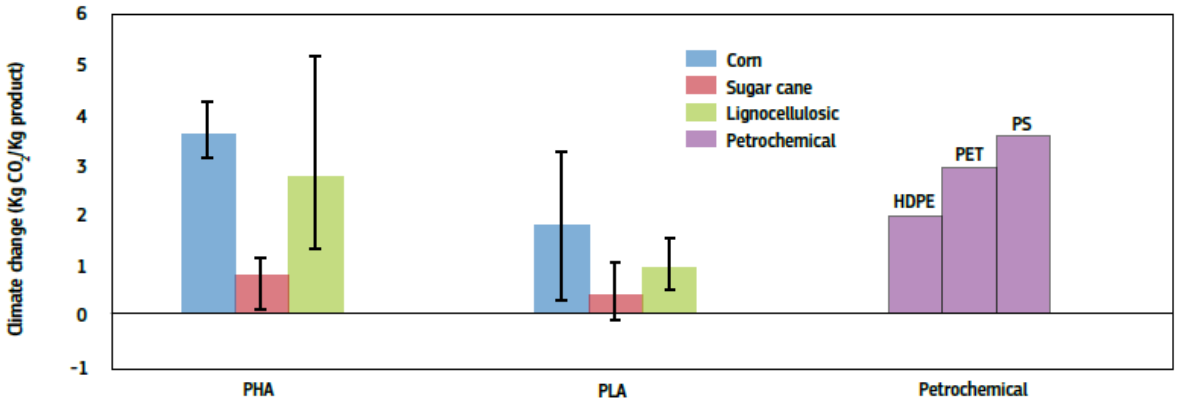
89% of the 206 respondents to the Open Public Consultation stated that it is either relevant or very relevant to maximise the valorisation of organic waste, agriculture and forestry residues. There were no notable differences of views on this point between different respondents categories.

2.1.3. Sustainability deficit of EU industrial production processes (Sustainability deficit)

As explained, the bio-based industrial systems have the potential to improve the environmental performance of industrial production. An example is the production of polyactic acid (PLA), a bio-based thermoplastic polyester that can replace polyethylene or polystyrene in many applications including packaging. The life cycle environmental performance of PLA can be significantly better than polystyrene[120], HDPE or PET (see Figure 12).

[120] Vera I. et al. (2020) A carbon footprint assessment of multi- output biorefineries with international biomass supply: a case study for the Netherlands, Biofuels, Bioproducts, and Biorefining vol. 14(2)

Figure 12: Climate efficiency of bio-based and fossil based plastics



Source: Ronzon T. et al. (2017): Bioeconomy report 2016. JRC Scientific and Policy Report.

This improved environmental performance is mainly due to the intrinsic carbon efficiency of bio-based materials and due to the potential to utilise abundant biological waste, thus reducing the pressure on ecosystems. Many bio-based processes and products are also less polluting or less toxic. However, the overall environmental performance of bio-based systems depends on many factors, including the environmental performance of associated activities upstream and downstream. In this respect, the environmental impact of primary biomass production may have the dominant effect on the overall performance of the whole production system. For example, if the biomass is produced in an intensive agriculture system with high energy and chemical input, and/or biomass must be transported to distant processing facilities, the overall life-cycle negative impact can be significant. Bio-based industrial activity can also be seen as causing biodiversity loss and ecosystem degradation if too much biomass is extracted from valuable natural ecosystems or when excessive biomass demands lead to land use change and conversion of natural area into low biodiversity agricultural land. For bio-based production systems to be sustainable, they have to be designed and implemented with this objective in mind and their performance has to be assessed from a whole life-cycle perspective. This is not always the case, and a number of real life applications have dubious environmental performance.

For instance, in the past, the bio-fuel segment of the bio-based industry faced the criticism that the overall environmental impact of bio-fuel production can be negative due to energy intensive production of biomass used in the first generation bio-fuel refineries, long transport routes and indirect carbon emissions from land use change. As a consequence, sustainability conditions have been set for this sector at EU level[121] in 2018. A number of older bio-fuel refineries fail to meet these sustainability criteria[122] and therefore need to upgrade. All new biofuel facilities have to meet the strict conditions concerning their overall carbon efficiency, e.g. 65% greenhouse gas savings by 2021.

In contrast to the above example, the rest of the bio-based industry operates in an incomplete regulatory environment. Industrial facilities have to comply with the applicable environmental legislation such as the Industrial Emissions Directive[123] or the regulation

[121] Renewable Energy Directive 2018/2001/EU
[122] Vera I. (2019): A carbon footprint assessment of multi-output biorefineries with international biomass supply
[123] Directive 2010/75/EU

concerning the use of GMOs[124] but the issue of sourcing of biomass, potential indirect land use change and biodiversity impact, and the overall carbon efficiency of bio-based systems are not regulated. In the absence of a comprehensive regulatory system, the environmental performance is thus a matter of voluntary commitments in the context of corporate social responsibility. The weakness of voluntary commitments is further exacerbated by the absence of robust methodologies to assess certain environmental impacts and generally accepted sustainability criteria. Uncertainties about the environmental performance of commercial bio-based installations, materials and products deter investors and undermine the public trust in bio-based solutions.

Stakeholder opinion

The majority of the respondents to the Open Public Consultation across all stakeholder groups (industry, academic and research institutions, public authorities and NGOs etc.) considered the proposed initiative Circular Bio-based Europe to be either very relevant (76%) or relevant (14%) for reducing greenhouse emissions. No respondents from different stakeholder groups stated that this target was 'Not relevant at all'.

2.2. What are the problem drivers?

2.2.1. Innovation deficit drivers

The innovation deficit of the bio-based European industry is underpinned by three drivers:

(a) *Lack of R&I activities across scientific disciplines and along the research-innovation chain*

This is linked to the lack of collaboration between scientific disciplines with the objective to develop bio-based materials and product innovation. The intensity of cross-fertilisation between relevant scientific developments tends to be lower for bio-based materials than for health and nutrition applications.[125] Moreover there is less experimenting, testing and demonstrating of bio-based innovative technologies than in other biotech sectors, therefore it takes longer time for the material innovation to reach the market. The bio-based materials and products research competes for talents with sectors that provide more opportunities for revolutionary breakthrough, scientific prestige and profitability. As a result, in recent years there was an insufficient number of radical innovations in bio-based materials and products, compared to what would have been possible thanks to advances in basic research in life sciences or IT (e.g. artificial intelligence). In addition, increase in new products or value chains resulting from cross-disciplinary research remained limited.

Stakeholder opinion

With regard to the uptake in innovation problems, about 64% of the respondents to the OPC (industry, academic and research institutions, public authorities and NGOs etc.) have indicated that the research and innovation efforts at EU level address the issue of lack of competitiveness with traditional products/materials.

(b) *Underdeveloped and insufficiently integrated R&I capacity across the EU to support sustainable bio-based systems*

[124] E.g. Directive 2009/41/EC on contained use of genetically modified microorganisms and Regulation (EC) 1946/2003 on transboundary movement of GMOs.

[125] McKinsey (2020): The Bio Revolution.

There is an underdeveloped capacity for R&I in bio-based systems in some parts of the EU, in particular the Eastern and Southern European regions. The research efforts in bio-based material and products R&I are concentrated in Belgium, the Netherlands, Nordic countries and some regions of Germany, France, Italy and Spain. In other regions, the capacity for R&I has not been sufficiently developed, even though there would be great regional/local potential for bio-based industry due to availability of biomass, or presence of human skills. This missing capacity results in less intensive research and innovation development and commercialisation in those regions.

(c) Lack of R&I activities on sustainability issues

In parallel, there is an insufficient focus of R&I activities on sustainability issues. Due to limited regulatory pressure, R&I on sustainability aspects has not been of the highest priority, especially for corporate R&I. For example, the technological challenge to efficiently process non-homogenous mixtures of biological waste, such as municipal waste, remains untackled. Insufficient scientific effort has been devoted to studying the environmental impact of the bio-based industry; and as result there is still no full understanding of all impacts and their scale. Methods and tools for assessing this impact, including the life-cycle assessment (LCA), LCA databases and sectoral specifications, have not yet been developed at a level comparable to those for other industrial sectors. Consequently, there is insufficient scientific guidance for decision-makers on how to set sustainability conditions for bio-based industry operations in real life.

2.2.2. Market uptake deficit drivers

The market uptake deficit is caused by the following three drivers:

(d) *Limited understanding of the potential of bio-based R&I solutions by industry and policy stakeholders*

There is an information asymmetry between scientific actors who understand the potential of scientific advances in the bio-based systems without a full grasp of business models and the market situation, as opposed to market and policy actors who are not fully aware of the fast development in science and innovation and may thus not entirely understand the opportunities created by scientific inventions.

For companies that did not develop sufficient R&I capacity, especially for SMEs, it takes a longer time to integrate new bio-based technology in their business strategy and models. As a result, companies are not sufficiently engaged in experimentation and demonstration activities that are critical for maturing of technology or miss the opportunity to become part of emerging value chains and markets.

For policy makers at EU, national and local level, especially in less economically developed Member States and regions, it is still difficult to assess the potential of the bio-based industry and integrate it in national and regional development strategies. Indeed, there are a number of countries that have not yet developed their national bioeconomy strategies and only a limited number of regions have developed such strategies at their level. The barriers to market uptake of bio-based solutions are not well understood by policy makers and consequently policies do not necessary create favourable conditions, e.g. through incentives. Existing EU instruments such as the Common Agriculture Policy or the European Regional Development Fund are not adequately deployed in support of bio-based industries in many Member States.

(e) *Uneven playing field for bio-based materials and products*

There is an uneven playing field for conventional and bio-based industries in markets where bio-based materials compete with conventional materials, e.g. bio-based plastics versus plastics made from fossil raw material. Markets with conventional products tend to be consolidated with established supply chains and business relations. Companies may be locked-in into technologies and capital investment that has not yet been repaid. This results in inertia and slow adoption of bio-based solutions if the economic premium is not high enough. This in turn prevents economies of scale from taking effect. A special case of uneven playing field occurs when bio-based products compete with conventional products whose price is distorted by economic incentives or where price does not integrate negative externalities (e.g. CO2 emissions, or impact on biodiversity), especially if markets do not reward positive externalities of bio-based products (e.g. no price premium for carbon efficiency). The latter problem occurs for instance in the competition between bio-based and petrochemical-based products, where the economic viability of bio-based product depends on the price of oil. Without active governmental policies to address this market failure, some beneficial bio-based solutions will not be economically viable in the foreseeable future.

Stakeholder opinion

178 respondents believe that there is a lack of competitiveness, when compared to traditional products and materials.

The uneven playing field is an important driver of the market uptake deficit, however this R&I initiative is not able to address it. This driver is provided as contextual information in the impact assessment, for the sake of completeness and to highlight relevant elements that can impact the proposed initiative.

(f) *Perceived investment risk*

Perceived investment risk reduces access to finance possibilities for bio-based projects, particularly with regard to necessary capital expenditure[126]. Investors perceive the bio-based industry as excessively risky due to technological, market[127] and policy uncertainties. Indeed, novel technologies have not yet proven on the market that they can deliver the expected economic performance. Additional market uncertainties are related to e.g. the instability in supply of biomass, or its price volatility[128], consumer demand, but also to the market failures described above. The policy uncertainty often stems from the fact that the bio-based industry is young and dynamic and it is thus not clear whether it will be subjected to environmental or other regulations and what policies and incentives affecting its economic performance will be developed in the future. The shift in public perception of bio-based solutions both in a positive and negative direction can further increase the uncertainty levels.

[126] Commission Expert Group on Bio-based Products - Final Report, Commission Expert Group, 2017 https://ec.europa.eu/growth/content/commission-expert-group-bio-based-products-calls-alignment-bioeconomy-strategy-eu-policy_en

[127] Innovation Ecosystems in the Bio-economy, OECD, 2019, https://www.oecd-ilibrary.org/docserver/e2e3d8a1-en.pdf?expires=1594641236&id=id&accname=oid031827&checksum=C630B83C3B49E92A37A01241DE4D9C8D

[128] EIB (2017): Access to finance conditions for Investments in Bio-Based Industries and the Blue Economy

As a result, many bio-based projects are not yet considered bankable. In the general absence of venture capital for technological innovation in Europe, these projects will only be financed if there is an active public policy on de-risking the bio-based investment[129].

Stakeholder opinion

A high number of stakeholders who responded to the public consultation believe that there is a lack of public (162) and private (133) investments in the bio-based industry.
Another consultation targeting the bio-based industry stakeholders was carried out by the European Investment Bank in the context of the study on Access to Finance in the European Bio-based Sector[130]. In this consultation 79% of respondents indicate that the limited interest from private financial market participants is related to the lack of understanding of the specificities bio-based industries.

2.2.3. Environmental deficit drivers

The overall environmental performance of the bio-based industry will depend on its performance in the three key unregulated environmental aspects: (1) sourcing of feedstock including biowaste, side streams and residues, (2) indirect land use changes and (3) overall carbon efficiency of bio-based industrial systems. The prospect of future environmental regulation targeting these aspects is questionable – the bio-based industry is so wide and varied in terms of biomass sources, technologies and products that it may not be possible to effectively regulate the entire scope of bio-based activities in the same way as it is possible to regulate the environmental performance of just one particular bio-based value chain of biofuels. In the continuous absence of specific regulation, the environmental deficit problem can be linked to the following driver:

(g) *Lack of environmental considerations in the development and implementation of R&I bio-based projects*

This driver stems from the lack of a commonly accepted regulatory basis for environmental considerations due to the absence of established assessment methodologies and of broadly accepted sustainability criteria[131]. This severely limits the ability to integrate sustainability aspects in decision-making by concerned industries and public authorities.

However, even if such criteria are developed, sustainability considerations may still be missing in the development and implementation of bio-based projects at different TRLs, notably from early innovation to demonstrations until market application.

Due to the absence of active promotion and implementation of sustainability criteria through regulation, voluntary industry commitments, 'soft' policy such as strategies, recommendations and industry standards, or through public pressure, there is a real risk that a number of bio-based projects will be implemented and at a later stage identified as having a poor environmental record. This might result in damage to the reputation of the bio-based industry as a contributor to societal objectives and undermine the public trust in bio-based

[129] EIB (2017): Access-to-finance conditions for Investments in Bio-Based Industries and the Blue Economy
[130] EIB (2017): Access-to-finance conditions for Investments in Bio-Based Industries and the Blue Economy
[131] Note that while problem driver 3 (g) also refers to the absence of methodologies/criteria like problem driver 1 (c), these two issues are different. Under problem 1 (c), the relevant driver is about a lack of R&I on environmental impacts of bio-based solutions. Here instead, the driver concerns the absence of a commonly accepted regulatory basis for environmental considerations and decision-making by concerned industries or public authorities; The two are indirectly connected in the sense that addressing driver 1 (c) allows to develop the necessary building blocks to facilitate the solutions of driver 3 (g).

materials, even if the majority of initiatives have a positive contribution. The BBI JU did not have the appropriate governance structure to assess these type of results.

2.3. How will the problem evolve?

The global population and economy are projected to continue growing over the coming decades. This will drive material consumption including demand for bio-based materials and products globally. The demand for bio-based products will increase also in the EU economy.

At the same time, the Commission's aim to reduce the European ecological footprint and to reach the ambitious policy objectives of climate neutrality by 2050, will require the replacement of many of the fossil-based products with bio-based ones. The need for bio-based innovation that will increase economic efficiency of production and address environmental issues will grow.

In the absence of effective measures to address the problems described above, the underlying drivers will continue to affect negatively the development of a circular bio-based industry. R&I will continue to take place as a result of public and private funding, and innovative solutions will reach the market, albeit at a slower pace than is desirable to meet the EU's climate and environmental objectives for the coming decades. The actual societal benefits will fall short of the potential benefits both in terms of economic and environmental performance.

For example, the annual economic benefit expected in 2030 from the global material bio-based innovations in the current innovation pipeline is estimated to 400 million trillion USD[132]. This 'business as usual scenario' represents only a modest increment in the economic value compared to the actual size and potential of the EU bio-based industry.

In terms of environmental performance, many bio-based industrial activities will bring environmental benefits because of their intrinsic environmental performance. However, and as indicated above, there may also be bio-based projects that do not take environmental considerations into account in their design and implementation, thus leading to possible negative impacts on ecosystems or a limited ability to contribute to climate neutrality objectives.

In general, the current situation of not reaping all the potential benefits of bio-based innovation will continue. These forgone societal benefits are the main negative impact of not acting in this area.

3 WHY SHOULD THE EU ACT?

3.1 Subsidiarity: Necessity of EU action

To further develop the bio-based economy, neither single stakeholders nor individual Member States will be able to reach the required critical mass on their own, thus showing the clear necessity of tackling these ambitions on an EU scale. A multi-sectoral approach is needed to combine the strengths of industries, primary producers across regions and EU countries, enabling a sustainable transition from a fossil-based to a sustainable and circular bio-based economy. There is a need to mobilise the actors of the bio-based value chains and

[132] McKinsey (2020) The Bio Revolution.

to build on the structuring effects already observed in the BBI JU partnership. Actors and stakeholders throughout all segments of the value chain (primary production and waste streams, processing and end applications) are engaged in shaping business models and industrial cooperation which did not exist before, providing evidence of a structuring effect and systemic change in the bio-based industry. To date and through the implementation of the BBI JU, 113 new bio-based value chains were created, many of those involving several sectors and transcending national borders.[133]

An innovative value chain is created when its resulting (new) product or service has been tested and validated, and is ready for a specified and accepted market application. To exist, these new value chains need to be economically viable and to fulfil all relevant sustainability criteria. Each of the value chains has business cases or commercialisation plans.

These new bio-based value chains can thus result from innovative cooperation between several often atypical economic actors, which combine feedstock with innovative or traditional technologies and produce new bio-based products or market applications. They have the potential to be replicated across Europe and beyond, and support the development and competitiveness of the European bio-based market and the creation of new bio-based products.[134]

Such links are clear in the case of the highly forested countries and highly productive agricultural regions, where biomass producers need to be connected to industrial centres in Europe in order to generate new value through the development of integrated sustainable value chains. Another case are those local authorities that require links with industries and support by regions to solve their waste problems in a sustainable way that can also deliver economic added value. It remains very difficult to build and consolidate those links by acting only at the national or local level. Indeed, the need for EU-level intervention in this area was supported by a large majority of respondents to the online public consultation on the proposed CBE initiative.

Moreover, flagship and first-of-its-kind biorefinery plants require costly demonstration. Implementing innovation activities at high Technology Readiness Levels (TRL 6 to 8) requires a strong degree of involvement from all players of the value chain – from primary producers to industry and brand owners. This level of engagement is usually not achievable under standard collaborative research, but only via a partnership as shown by BBI JU. This is why the European Green Deal and the updated Bioeconomy Strategy have indicated the need for a partnership in the bio-based industry.

3.2 Subsidiarity: Added value of EU action

Another rationale for EU-level intervention in this area is that most of the barriers and long-term challenges to further develop the bio-based industry are not adequately addressed at national level but rest firmly upon EU-level regulation. Examples range from sustainable biomass supply to market pull via targets, product standardisation and green public procurement schemes.

A clear EU added value of the proposed CBE initiative lies in its key enabling role for implementing the European Commission's updated Bioeconomy Strategy and Action Plan.

[133] BBI JU, Annual Activity Report 2018
[134] ibid

A coherent EU-wide approach is also necessary to ensure that the right balance is found between growth (European industrial competitiveness) and sustainability (social and environmental) objectives.[135]

Tackling these challenges at European level between industry and the EU would allow:

- Carrying out the research and innovation needed, and that no single company, public research institution or Member State can perform alone precisely because only a combined research capacity can deliver the necessary joint efforts for achieving shared market and European Research Area objectives;
- Tackling the absence of an agreed long-term budget plan and strategic technical and market objectives to encourage industry and the research community to commit more of their own resources. This is needed to reach critical mass, which cannot be achieved by acting at the national level alone, given the ambition of the identified policy objectives and aspirations;
- Promote an optimal coherence of research and innovation efforts between industry and public actors, thereby avoiding gaps, overlaps and fragmentation of research and innovation coverage, when industry and publicly-funded research do not align their funding and agendas;
- Bringing the green transition to the attention of industry and raising the sustainability bar and corporate responsibility via integrated and continuous programmes covering fundamental research, applied research and EU-level demonstration and flagship activities;
- Addressing the need to strengthen the innovation spirit and cooperation for market development between value chains operating across different countries and sectors. This fosters the exchange and pooling of knowledge and experience, and facilitates the involvement of all market actors, in particular the SMEs.

Stakeholder opinion

87% of respondents to the OPC (including industry, academic and research institutions, public authorities and NGOs) mentioned as "very relevant" the involvement of industry in setting joint long-term agendas to ensure that the proposed European Partnership would meet its objectives. A large part of respondents also indicated that the involvement of academia (47%) and Member States and Associated Countries (44%) is 'very relevant'. The answers are more evenly split with regard to Foundations and NGOs (25%) and other stakeholders (27%).

4 OBJECTIVES: WHAT IS TO BE ACHIEVED?

4.1 General objectives of the initiative

Based on the identified problems, the initiative's main objective would be to contribute to accelerating the development and growth of those segments of the bio-based industry that deliver climate and environmentally efficient and innovative solutions to meet the material needs of the society, while ensuring a sustainable, fair and just economic growth. This acceleration would make the bio-based industry play the role that recent EU policies assigned to it and deliver significant contributions towards climate neutrality, resource

[135] Philippidis G. et al. (2018) Sailing into Unchartered Waters: Plotting a Course for EU Bio-Based Sectors, *Ecological Economics* 147

efficiency and zero pollution by 2030. To achieve this overarching goal, general and specific objectives are set for the three problem areas described in section 2, namely:

- To **accelerate the innovation process and development of bio-based innovative solutions**. This does not only imply more intensive basic research in biotechnology and other related scientific and technological disciplines but also accelerating the maturing process to bring innovative solutions to the market through more intensive efforts in experimentation, testing, demonstration and deployment.
- To **accelerate market deployment of the existing mature bio-based innovative solutions**. This implies supporting a more intensive process that goes from demonstration and first market applications to replication, mainstreaming and scaling up of bio-based industrial activities across Europe, especially in regions that have an autochthonous potential for it (e.g. regions with high production of biomass and biological waste), to achieve the significant positive economic and environmental impact associated with these solutions.
- To **ensure a high level of environmental performance of bio-based industrial systems** so that their market deployment contributes to the achievement of EU Green Deal objectives. The focus will be on carbon emissions, circularity and ecosystem protection, i.e. the impact areas where the bio-based industry is currently not regulated. This implies the development of scientifically robust metrics and performance benchmarks to inform future policy and business choices, as well as promoting the consideration of sustainability aspects throughout the whole innovation chain (from basic research, to development of innovative solutions, to market deployment) and across the entire bio-based value chains o (from biomass sourcing to industrial processing, production and consumption).

4.2 Specific objectives of the initiative

In order to achieve these general objectives, five specific objectives are defined. These specific objectives respond to each of the problem drivers discussed in Section 2.2:

(a) to **reap the benefits of the advancement in life sciences and in other scientific disciplines for the development and demonstration of sustainable bio-based solutions** by increasing the intensity of cross-disciplinary research and innovation activities. This acceleration and cross-fertilisation is expected to take place along the whole innovation chain, from basic research to experimentation, demonstration and to first market applications.

(b) to **increase and integrate the R&I capacity of stakeholders across the European Union** that will help to exploit the local bioeconomy potential. The focus will be on the regions that are currently lagging behind the leading Member States and the regions with the greatest bioeconomy gaps. The targeted impact is a more balanced distribution of benefits from bio-based innovation across Member States and regions.

(c) to increase the R&I capacity for **addressing environmental challenges and development of more sustainable bio-based innovations**. This implies the need to intensify R&I activities on the sustainability aspects of bio-based industries to ensure that sustainability issues are considered throughout the whole innovation chain and environmental performance are integrated in future innovative solutions. This sustainability aspect includes also the source of biomass and the development of technologies that can efficiently utilise all sorts of biological waste.

(d) to **reinforce the integration of bio-based R&I processes in EU industrial value chains** by increasing awareness among industry and other R&I stakeholders of the advances in bio-based solutions and mobilising them to develop strategies for applying bio-based solutions as well as specific projects. Engage industry and other R&I actors to participate in innovation development, in particular in the testing, demonstration and replication phases.

(e) To r**educe the risk for R&I investment in bio-based companies and projects** by providing directionality for EU R&I investments in bio-based industries; addressing technological, market and policy barriers,[136] and supporting the development of a level playing field for bio-based materials replacing conventional materials.

Stakeholder opinion

Respondents (1783) to the Open Public Consultation across all stakeholder groups (industry, academic and research institutions, public authorities and NGOs etc.) indicated that deployment and piloting activities are very relevant (72%) or relevant (20%) to ensure that the proposed initiative would meet its objectives. No respondents from different stakeholder groups indicated that these activities were 'Not relevant at all'.

(f) to **ensure that environmental considerations are taken into account in the development and implementation of R&I bio-based projects**, by setting operational sustainability criteria for bio-based industrial systems to support decision making in R&I, market deployment and policy. Sustainability criteria should include robust science-based indicators and benchmarks corresponding to the ambition of the EU Green Deal policies. They should be applicable at sector, value chain, industrial installation and product level and should be based on the life-cycle approach. The application of sustainable criteria should be promoted across the bio-based industry.

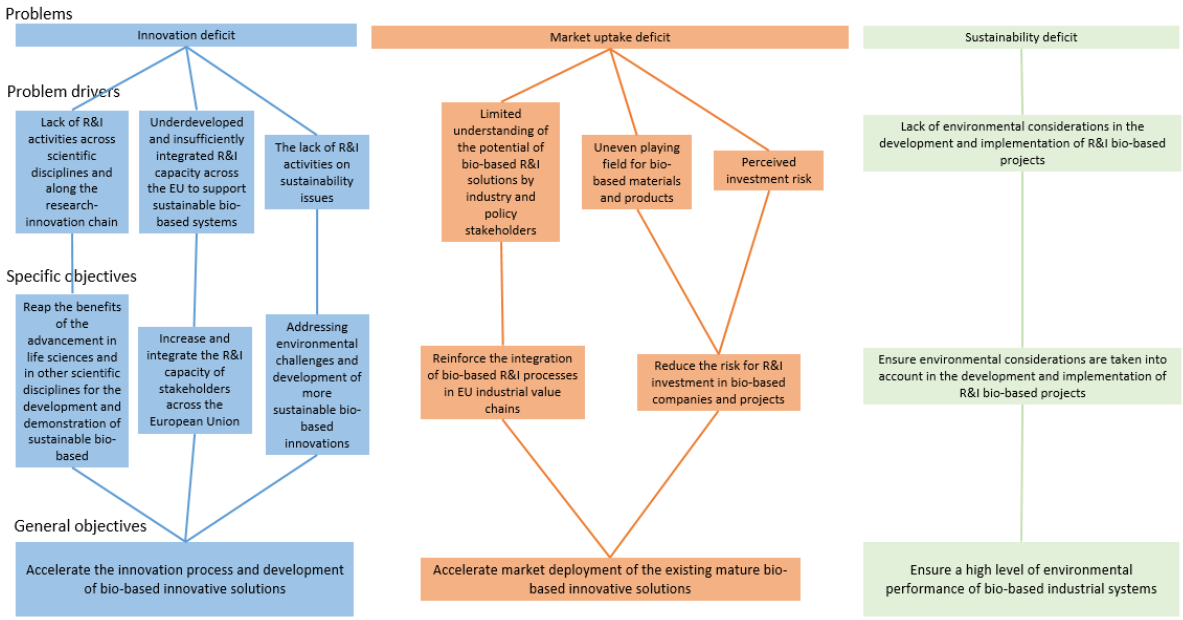
The choice of the proper implementation form is fundamental for these objectives to be achieved. Indeed, lessons from previous experience have shown that the mode of implementation and in particular the governance structure and requirements on the private partners are central for the initiative to stay on the desired track.

4.3 Intervention logic of the initiative

The relationship between the general and specific objectives of the potential initiative for a Circular bio-based Europe is shown in the Figure below. The impact pathways are shown in Annex 6, Figures 1 to 3.

[136] This refers to policy barriers that can be addressed by the initiative. They include the lack of long term strategic support by public authorities to the development of bio-based industry, e.g. through national and regional bioeconomy strategies.

Figure 13: Intervention logic for the initiative on Circular Bio-based Economy



How would success look like?

Should the initiative deliver on its specific objectives, it is expected that it would have the following impacts:

Scientific impacts

- Accelerated development of bio-based innovations that would deliver environmental and productivity improvements through new bio-based production processes and products based on EU resources;
- Reinforced scientific and innovation capacity that is necessary for exploitation of the EU potential for bio-based industrial production, including in the regions where currently this capacity is underdeveloped;
- Increased R&I capacity for addressing the key sustainability challenges and trade-offs in the bio-based industry, particularly as regards the carbon neutrality and circular economy transitions.

As a consequence, the EU would maintain its current leadership in bio-based systems and achieve strategic autonomy in an industry that is critical for the long-term sustainability of EU economy.

Economic/technological impacts

- A number of bio-based innovations demonstrating the economic and environmental potential of specific bio-based solutions would reach the stage of first market application and bring tangible economic and environmental benefits;
- A structured process for collaboration between R&I actors, industry (including SMEs) and other bio-based innovation stakeholders that would facilitate deployment of bio-based innovation;
- Reduced investment risk and improved access to finance for bio-based industrial projects.

In general terms, the initiative would increase the capacity to deploy bio-based innovation that valorises domestic biomass, which would lead to higher growth, competitiveness and resilience of the EU economy.

Environmental/Societal impacts

- Enhanced circularity and environmental sustainability of the European bio-based industries;
- Better integration of primary biomass producers in bio-based value chains to contribute to rural development.

As a consequence, the initiative would make the EU economy and society increasingly circular and environmentally sustainable, and would contribute in particular to the EU climate mitigation objective. In terms of social impact, if successful, the proposed initiative will stimulate the involvement of primary biomass producers and waste and side-stream providers in the bio-based industry, which in turn will increase their revenues and revitalise rural and coastal regions as well as municipalities and urban areas.

With efforts maintained over time, all impacts are expected to materialise within the time framework foreseen for the proposed initiative. The choice of the proper implementation form is fundamental for the general and specific objectives to be achieved. Lessons from previous experience, specifically from the BBI JU have shown that the mode of implementation and in particular the governance structure and requirements on the private partners are central for the initiative to deliver on the targets set out in the intervention logic.

4.4 What is needed to achieve these objectives – Key Functionalities needed

Given the focus of the impact assessment on comparing different forms of implementation, the identification of "key functionalities needed" allows making the transition between the definition of the objectives and what would be crucial to achieve them *in terms of implementation*. These functionalities relate to the type and composition of actors that have to be involved, the type of range of activities that should be performed, the degree of directionality needed and the linkages needed with the external environment.

4.4.1 Type and composition of the actors involved

For the initiative to achieve its objectives, there is a need to foster collaboration, contribution, co-design and co-creation involving a wide set of actors and stakeholders across scientific disciplines, industrial sectors, value chains and territories. It is important to ensure openness towards different actors and stakeholders, and guarantee their involvement in defining needs and priorities, in setting innovation and research agendas, as well as in innovation activities. However, each actor and stakeholder group may have different interests ([137]). This requires that the proposed initiative be able to identify joint interests, define objectives and priorities that all stakeholders can support, and ensure an adequate balance of input and benefits for stakeholders involved in the initiative. In particular, it is important that all stakeholders actively support the public interest objectives of the initiative,

[137] BIOVOICES project (Connecting Biobased Forces for a Sustainable World), *Synthesis of market perspectives to develop bio-based value chains*, 2018.

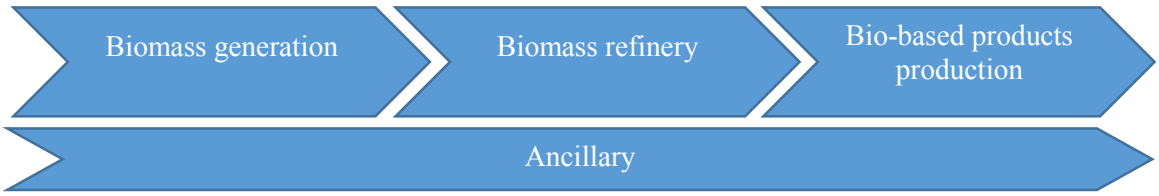
and specifically those related to the sustainability of the bio-based industry. One of the underlying issue of the previous BBI initiative was that certain stakeholders were not as involved as desirable at all stages of implementation, even though SME participation was very prominent in the BBI JU.

Stakeholder opinion
86% of respondents to the open public consultation (industry, academic and research institutions, public authorities and NGOs) see "a broad group" and 75% "flexibility in composition" as very relevant or relevant for the success of the proposed initiative.

It is therefore foreseen to involve the following stakeholders in the proposed initiative:

Industries: the bio-based industry operates as a broader industrial system that includes biomass producers as upstream actors, the bio-refining segment as the core segment that converts biomass into industrial materials and products, and the downstream segment that processes the bio-based materials into final products (Figure 14). Ancillary actors may include providers of technology and necessary inputs such as energy, as well as services such as transport, consultancy, etc. All segments are very wide, as there are many types of biomass, refining processes, and bio-based materials and products, resulting in thousands of bio-based value chains that are increasingly cross-sectoral. The three segments included in the Figure 14 face different R&I challenges related to their specific function but they all recognise the central role of biomass refining to enable business operations upstream and downstream. All segments are interested in the development of complete bio-based value chains enabled by biorefining technologies.

Figure 14 Basic composition of the bio-based industry



Stakeholder opinion
The open public consultation shows that 97% of 205 respondents (industry, academic and research institutions, public authorities and NGOs etc.) see industry as very relevant or relevant for CBE.

Smaller economic actors, such as farmers and SMEs, have been identified as important players in the bio-based value chains. Their active involvement in the bio-based economy in general contributes to local economic development, job creation, and more dynamism in the regions[138]. In the BBI JU, SMEs have already increased their participation in projects (40% SME participation[139] as compared the Horizon 2020 average and 20% target), but there still is a vast room for further outreach and mobilisation of SMEs especially in the rural, coastal and less advanced regions. Many primary biomass suppliers are SMEs and they have

[138] BBI JU, *The BBI JU SME landscape: Driving impact and innovation*, Brussels, 2019.
[139] Analysis by BBI JU.

already been identified as a special group that needs to play a bigger and more specific role in the bioeconomy and bio-based value chains.

Research organisations[140] have been actively contributing to the whole research spectrum from basic research to pilot plants and commercialisation in the BBI JU, by bringing knowledge capital and research facilities as resources to create new bio-based solutions. The input from scientific partners is needed to generate the most innovative solutions ([141]). The interest of research organisations in the proposed initiative is to obtain scientific credit and reputation from quality R&I results as well as funding for their research activities.

Stakeholder opinion
The open public consultation shows that 73% of respondents (industry, academic and research institutions, public authorities and NGOs etc.) see research organisations as very relevant or relevant for CBE.

Public bodies from Member States, regions and municipalities can safeguard the public interest and direct the initiative towards societal objectives. They can also promote and create favourable conditions for the development of bio-based industries. This includes the alignment of European, national and local level strategies and providing co-funding from national, regional and local funds. Regional authorities may play a key regulatory role as bio-based activities may require permits issued at the regional level. This important role of public authorities implies that their function is appropriate in the initiative's governance.

Stakeholder opinion
The open public consultation shows that 75% of respondents (industry, academic and research institutions, public authorities and NGOs) see public authorities as very relevant or relevant for CBE.

Civil society organisations such as consumer organisations or non-governmental environmental organisations can actively contribute to the initiative by ensuring the balance of environmental, social and economic objectives in its agenda, and can also raise the visibility and public awareness of the challenges and solutions emerging under the proposed initiative. The role of civil society organisations in balancing interests in a public-private partnership setup seems not to be fully recognised by stakeholders yet.

Stakeholder opinion
The open public consultation shows that 50% of respondents (industry, academic and research institutions, public authorities and NGOs) see civil society organisations as very relevant or relevant for CBE.

4.4.2 Type and range of activities needed

The activities needed for the initiative to succeed and address the R&I deficit described in Section 2 and accelerate the development and maturing of innovation in the bio-based industry, include:

- **public and private R&I activities** that are programmed to ensure the desired directionality to R&I in bio-based innovation;

[140] The open public consultation shows that around 73% of respondents see them as "very relevant" or "relevant" for CBE.
[141] European Commission, *Interim Evaluation of the Bio-based Industries Joint Undertaking (2014-2016)*, Brussels, 2017.

- a **mobilisation of public and private funding** of R&I activities to increase the overall financial support to the sector;
- multidisciplinary projects to **reach and mobilise R&I actors from different scientific disciplines**;
- intensified **R&I activities** along the whole innovation chain **from low to high TRLs**;
- reaching and **mobilising R&I actors in regions** where the intensity of R&I in the bio-based systems is inadequate compared to the local potential for bio-based industrial activities in that region.
- R&I activities focussed on issues of public interest. For the proposed initiative, this refers to the **environmental performance of the bio-based industry** – both in the terms of understanding the relevant problems and developing solutions to them.

To address the market uptake deficit by accelerating the deployment of innovation in the bio-based industry, the following are needed:

- initiate communication and collaboration between R&I and industrial stakeholders to raise awareness of rapidly evolving knowledge and technology, and facilitate collaboration between industry actors to develop market solutions based on bio-based innovation such as new bio-based products, value chains and business models;
- **reach** other actors and stakeholders such as **national and regional authorities** that are able to create more favourable conditions **for market uptake**, e.g. through bioeconomy strategies and different forms of incentives;
- **de-risk private investment** by using public funds to co-finance close to market projects.

Finally, to address the sustainability deficit and ensure the environmental performance of the bio-based industry, the following are needed:

- **set scientifically robust sustainability criteria and performance benchmarks**, and apply them in all publicly funded R&I activities in the bio-based industry and to all projects supported by the initiative, and
- promote these criteria beyond the initiative, by agreeing with the private partners that **these criteria will become de facto industrial standards to be observed by the industry** on voluntary basis.

4.4.3 Priority setting system and level of directionality required

A strategic vision for the proposed Circular bio-based Europe initiative (including its priorities and directionality) that is shared by all shareholders is essential for maximising the positive impact of the initiative. This strategic vision should safeguard public interests, balance the activities towards different general and specific objectives, and reconcile the different priorities of a diverse group of bio-based stakeholders. The focus should be on synergistic solutions that would reconcile potentially conflicting objectives and interests towards an effective contribution to the Green Deal and the Next Generation EU policy objectives.

This shared strategic vision would be defined in the Strategic Innovation and Research Agenda (SIRA) and annual Work Programme documents. These documents would be subject to extensive consultation involving all relevant stakeholders. Decision should be taken within a governance system that ensures balanced representation of the industry and its segments and gives an appropriate role to other stakeholders. In this governance system, the Commission should have the role of the ultimate guardian of the public interest and the

coherence of the initiative with EU policies. This also implies adequate financial contribution of private partners to the initiative.

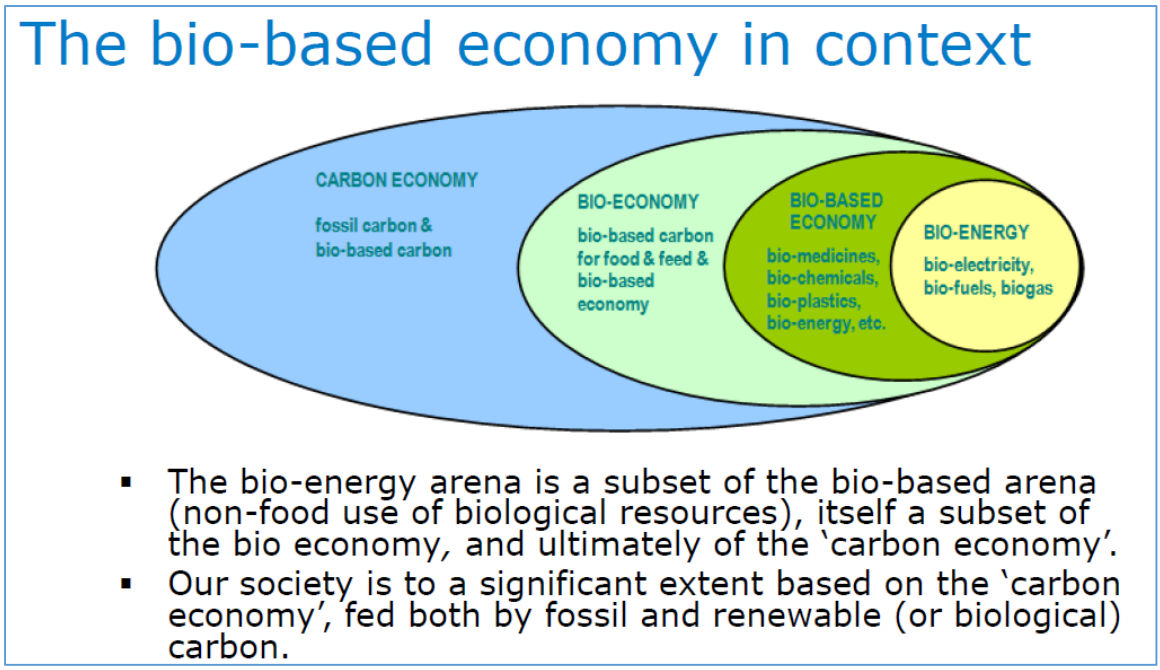
Stakeholder opinion

The open public consultation shows that 66% of 202 respondents (industry, academic and research institutions, public authorities and NGOs etc.) considers securing private investment in bio-based innovation as very relevant or relevant for CBE.

4.4.4 Coherence needed with the external environment

An initiative for a Circular bio-based Europe would need to be firmly anchored to the European Green Deal, the EU Bioeconomy Strategy, the new Circular Economy Action Plan, the new Industrial Strategy, the Farm to Fork Strategy and the Sustainable Development Goals. Figure 15 shows how the bio-based economy is fitting within the larger context of the bioeconomy.

Figure 15: The bio-based economy in context



After: Kwant K.W., *Biobased Economy in the Netherlands and the regions – Opportunities & Challenges*, Netherlands Enterprise Agency, 2017 (after: van Beeck, N. et al., *An innovative perspective: Transition towards a bio-based economy*, in: Sustainable Energy Solutions in Agriculture, ed. J. Bundschuh and G. Chen, London, 2014).

Inter alia, the initiative would need to seek synergies in terms of funding projects as well as in terms of programme development with the following programmes and the initiatives mentioned below, while avoiding overlaps. In particular, strong complementarities are expected with Cluster 6 of Horizon Europe as well as with all other initiatives in the same area. It is important to highlight that the proposed CBE initiative`s centre of gravity lies with bio-based industry actors and value chains.

- At the EU level[142]: Horizon Europe (mainly Pillar II, Cluster 6), the InvestEU instrument, the European Regional Development Fund (ERDF), the European

[142] The open public consultation shows that 75% of the respondents see this as very relevant or relevant for CBE.

Agricultural Fund for Rural Development (EAFRD), the LIFE programme, EU's Common Agricultural Policy (CAP), the European Maritime and Fisheries Fund (EMFF), the Agricultural European Innovation Partnership (EIP-Agri), the European Circular Bioeconomy Fund (ECBF), the BIOEAST initiative[143], and the EU Protein Strategy. Blending approaches promoted by InvestEU[144] could combine e.g. loans for infrastructure with CBE research grants to develop especially large scale biorefineries, where infrastructure needs could be financed with sources other than supporting programmes such as CBE. Joint transdisciplinary projects ([145]) with other partnerships[146], e.g. CCNI (Circular and Climate Neutral Industries; the potential successor of SPIRE), could build on the earlier successful cooperation between BBI JU and SPIRE, which succeeded in turning redundancies into synergies[147].

- At national and regional levels, CBE would interact with Member States and regions considering the strategies and plans such as bioeconomy strategies and programmes to advance on synergies and partnering for regional developments [148] for example on synergies with financing instruments and programmes for infrastructure and biorefineries deployment. This will include following up on the recommendations from the BBI JU interim evaluation[149] to increase participation of the EU-13 Member States, which is partially expected via the above-mentioned synergies with the BIOEAST initiative.
- On the international level, many stakeholders suggested that CBE could be kept open to the international players, especially to technology and research leaders and providers, in order to benefit from collaborations with them, and ensure a European leading role in the international development of the bio-based economy. CBE could follow up on the existing recommendations from the interim evaluation of the BBI JU initiative, to identify win-win strategies for a larger involvement of Third Countries while ensuring the protection of EU industry's interests[150].

Finally, it is worth adding that a favourable policy framework is an important factor for the viability of new bio-based value chains and innovations, especially if markets fail to provide sufficient incentives to pick them up. CBE could contribute to the regulatory aspects[151] and contribute to harmonising standards[152], developing Life Cycle Assessment methodologies that could support these standards or products, and develop project assessment processes. It can also support expanding the market for bio-based products and solutions by promoting green public procurement. This could contribute to raise awareness, identify regulatory bottlenecks and provide success stories to address regulatory aspects.

[143] Central-Eastern European Initiative for Knowledge-based Agriculture, Aquaculture and Forestry in the Bioeconomy.

[144] https://ec.europa.eu/commission/priorities/jobs-growth-and-investment/investment-plan-europe-juncker-plan/whats-next-investeu-programme-2021-2027_en

[145] The open public consultation shows that 90% of the respondents see this as very relevant or relevant for CBE.

[146] The open public consultation shows that 73% of the respondents see this as very relevant or relevant for CBE.

[147] like use and capture of CO2 where an agreement between BBI and SPIRE was reached where BBI focused on biogenic sources of CO2 and SPIRE on emissions from other such as non-biogenic processing industries

[148] Dietz, T. et al., *Governance of the bioeconomy: A global comparative study of national bioeconomy strategies,* Sustainability, 2018.

[149] https://op.europa.eu/en/publication-detail/-/publication/eebcfc39-ae32-11e7-837e-01aa75ed71a1/language-en

[150] https://op.europa.eu/en/publication-detail/-/publication/eebcfc39-ae32-11e7-837e-01aa75ed71a1/language-en

[151] The open public consultation shows that around 86% of the respondents see this as very relevant or relevant for CBE.

[152] The open public consultation shows that around 60% of the respondents see this as very relevant or relevant for CBE.

5 WHAT ARE THE AVAILABLE POLICY OPTIONS?

This section describes the specific functionalities that could be provided under the baseline scenario of traditional Horizon Europe calls and under the other possible forms of implementation for the proposed initiative.

5.1 What is the baseline from which options are assessed?

The baseline scenario used in this impact assessment is the basic mode of implementation of the EU R&I programme, i.e. traditional calls without any partnership structure with the industry. This scenario takes into account the existence of the predecessor of this initiative – the BBI JU. The existing BBI JU partnership will continue to have impact through ongoing projects and continuous engagement with the industrial actors at least for the next 4 years, until 2024. This impact is considered as part of the effectiveness of the baseline scenario. Winding up of the BBI JU will have also different costs and benefits that are accounted for in the efficiency assessment of the baseline scenario.

Stakeholder opinion

During the preparation of the Impact Assessment, Member states were also consulted. Overall there is a strong agreement (96%) on the use of a partnership approach for a Circular bio-based Europe and a broad agreement (83%) that the partnership is more effective than traditional calls in achieving the objectives and delivering clear impacts for the EU and its citizens.

Table 1: Key characteristics of the baseline situation – Horizon Europe calls

	Implications of option
Enabling appropriate profile of participation (actors involved)	• The Commission needs to consult extensively with a wide range of stakeholders to translate the strategic R&I agenda for the circular bio-based economy into work programmes. • A well-defined process is needed to ensure that the programme committees are properly informed about R&I priorities for the circular bio-based economy.
Supporting implementation of R&I agenda (activities)	• Implementation relies on standard infrastructure underpinning the open calls procedure, drawing on resources of relevant executive agencies and Commission IT systems. • Administrative costs for the European Commission are similar to those in Horizon 2020. • Calls for proposals are published in the work programmes of Horizon Europe. • Transparency and open publication of results ensure their availability to all interested parties.

Ensuring alignment with R&I agenda (directionality)	• Strategic programming and the research agenda are defined by the European Commission via co-creation, with the support of an advisory group and the programme committee. • Work programmes need to reflect the requirement for R&I across TRLs, with input from representatives of all relevant stakeholders. • Commission input into specifications and oversight of calls help ensure alignment with overarching policy objectives, but full integration with other programmes requires additional coordination. • Specification of calls for activities at higher TRLs, particularly demonstration and flagship actions, needs substantial input from industry.
Securing leveraging effects (additionality)	• Pooling and leveraging of resources are not facilitated. Requirements for in-kind contributions can be applied at the project level (reduced funding rates for higher TRLs), but are not high. • The progress of the R&I effort largely depends on EU funding, with no expectation of a significant triggering of additional industry support. • Demonstration and flagship projects require significant in-kind support and collaboration from industry, but it is not sure whether critical mass can be reached. • Given more limited funding than in the past, critical R&I priorities need to be identified from the outset.
Key differences compared to the current situation	Moving from the current BBI JU to Horizon Europe calls (baseline option) would entail the dismantling of the JU with the following consequences: • The implementation of a common vision and ambitious objectives in the area would not be possible due to the absence of a structured private partner. • The basis for R&I cooperation under a stable structure would disappear. • Large scale R&I actions (flagships) could not be implemented, affecting the coverage of TRL 7-8 and diminishing the impact of the initiative. • EU support to the area would considerably lower the leveraging of private funding, with a much lower volume of resources available due to significantly lower financial commitment of private partners. • Discontinuation cost, with a 4-year winding down period for the current JU until 2024 (legal end point of current initiative), will be higher (see rationale at 6.2 Efficiency).

5.2 Description of the policy options

Table 2: Key characteristics of Option 1 – Co-Programmed European Partnership

	Implications of option
Enabling appropriate profile of participation (actors involved)	• Option 1 enables participation by all key stakeholders potentially contributing to the specifications and delivery of the strategic R&I agenda. • A wide range of stakeholders needs to be consulted to ensure that the R&I agenda, and ultimately the work programmes, are aligned with industry and market needs. • There is more flexibility to change the profile of the stakeholder groups consulted over time, with new partners joining to support new areas of activity in response to emerging results and changing priorities. This is notwithstanding to the openness principle. • The partnership is based on a memorandum of understanding between the private partner

	represented by the industry and the public side represented by the Commission. Strategic programming and the research agenda are defined through co-creation between industry, Commission and relevant stakeholders including programme committee and advisory groups.
Supporting implementation of R&I agenda (activities)	• Implementation relies on standard administrative infrastructure underpinning the open calls procedure, drawing on resources of relevant executive agencies and Commission IT systems. • Administrative costs for the European Commission are slightly higher than under the baseline because of the needed partnering process. • Calls for proposals are published in the work programmes of Horizon Europe. • Transparency and open publication of results ensure their availability to interested parties. • The private partner is responsible for implementing its part of the research agenda.
Ensuring alignment with R&I agenda (directionality)	• Work programmes need to reflect the requirement for R&I activities across TRLs, with input from the various partners to achieve an appropriate balance of activities directed towards different markets. • The partnership is responsible of ensuring that priorities for calls are specified in line with R&I priorities defined in the Strategic Research and Innovation Agenda. • R&I activities are likely to focus on the medium-term needs of the industry, but the Commission has full influence on where to put its own focus. • The programme committee ensures alignment with overarching policy objectives and coordination with related programmes.
Securing leveraging effects (additionality)	• Aspirations for partner contributions are clearly defined from the outset. • Industry commitments are not legally binding, but based on past experiences they are usually fulfilled. • Expected in-kind contributions from the private sector are identified in the work programmes. • The mobilisation of private and public funding is more favourable in a co-programmed form than under the baseline scenario, covering all relevant TRL levels including more capital intensive ones.
Key differences compared to the current situation	Moving from the current BBI JU to Option 1 - Co-programmed European Partnership would entail the dismantling of the JU with the following consequences: • The implementation of a common vision and ambitious objectives in the area would be less efficient and take longer. • Reach and mobilise R&I actors from different scientific disciplines would pose a challenge for a co-programmed partnership. • Without a programme office, reaching national and regional authorities would be less favourable than with a dedicated office, additionally a co-programmed option would create worse conditions for market uptake of new innovative bio-based solutions. • The basis for R&I cooperation under a stable structure would disappear. • Discontinuation cost, with a 4-year winding down period for the current JU until 2024 (legal end point of current initiative), will be comparable to the baseline (see rationale at 6.2 Efficiency)

Table 3: Key characteristics of Option 3b – Institutionalised European Partnership based on Article 187 TFEU

	Implications of option
Enabling appropriate profile of participation (actors involved)	• The partnership enables participation of all key stakeholders potentially contributing to the specifications and delivery of the strategic R&I agenda through a clearly defined membership structure. • It provides a forum for co-drafting R&I priorities and the work programmes, ensuring that they are aligned with industry and market needs. • Participation is less flexible than under other options, but it is nevertheless possible to change the profile of participation over time, with an open Membership policy and new partners joining to support new areas of activity in response to emerging results and changing priorities.
Supporting implementation of R&I agenda (activities)	• A dedicated administrative structure (Joint Undertaking – JU) is established to coordinate the specification of R&I activities, manage implementation, and report on the results (with administrative expenditure limited to 4% of the budget and subject to 50:50 allocation between the Commission and private partners). • The Joint Undertaking provides specific thematic competences for the implementation of the initiative and deploys a broader range of activities, compared to what the executive agencies supervising projects under Option 0 and 1 can provide. • To reach and mobilise R&I actors from different scientific disciplines, a Joint Undertaking provides a favourable platform for multidisciplinary projects. • Under the umbrella of a programme office, public and private R&I activities that are programmed to ensure the desired directionality to R&I in bio-based innovation perform better than in a co-programmed form of partnership.
Ensuring alignment with R&I agenda (directionality)	• Both partners, private and the Union, are co-responsible for specifying work programmes that are fully in line with the R&I priorities identified by the partners beforehand to fulfil European policy needs and the needs of the industry, combining activities across low and high TRLs and in different areas. • The work programmes reflect the medium- to long-term needs of the industry, drawing on the perspectives of different stakeholders. • Commission participation in the partnership governance (including work programme adoption) helps ensure alignment with overarching policy objectives and enables integration with other programmes. • R&I activities focus on issues of public interest. In an Institutionalised format this refers to the **environmental performance of the bio-based industry** – both in the terms of understanding the relevant problems and developing solutions to them.
Securing leveraging effects (additionality)	• Formal commitments and funding requirements are clearly defined from the outset and are legally binding (contribution are defined in the legal act), with the private partners expected to provide 50% to 75% of partnership resources through in-kind and financial contributions. • Given more limited funding than in the past, critical R&I priorities need to be identified from the outset. • A Joint Undertaking can assist in de-risking private investment by using public funds to co-finance close to market projects.
Key differences compared to the current situation	Remaining an Institutionalised Partnership under Art 187 TFEU 1 - would entail: • The CBE partnership would build on the BBI JU structure, allowing for necessary improvements by drawing on lessons learned and past experiences. • Modifications will be introduced in administrative procedures and practices to ensure that operations are lean and efficient as possible.

- Setting scientifically robust sustainability criteria and performance benchmarks, and apply them in all publicly funded R&I activities in the bio-based industry and to all projects supported by the initiative, and promote these criteria beyond the initiative, by agreeing with the private partners that these criteria will become de facto industrial standards to be observed by the industry on voluntary basis.
- The governance structure of the CBE initiative would include two major improvements compared to the current BBI JU.
    - The role of the Deployment Groups is to advice the Governing Board on issues critical to market uptake of bio-based innovation and to promote deployment of sustainable bio-based solutions. Their composition shall ensure appropriate thematic focus and representativeness of the bio-based innovation stakeholders.
    - In addition to the general Governing Board meetings, the Governing Board shall hold at least once per year a Strategic Meeting with the primary objective to identify challenges and opportunities for sustainable bio-based industry and provide additional strategic orientation for the partnership. In the Strategic Meeting additional chief executive officers or officers with decision-making power of leading European bio-based companies and the Commission, shall be invited. The chairpersons of the States Representative Group, the Scientific Committee and the Deployment Groups may be invited in the role of observers.

5.3 Options discarded at an early stage

Option 2: Co-funded European Partnership and **Option 3a: Institutionalised Partnership based on Article 185 TFEU** are discarded from the outset.

These two partnership models exclude industries in the partnership agreement, which does not create any basis for involving them in the R&I agenda setting and does not provide adequate incentives for industries to commit to the policy objectives and to programme success. In achieving the key objectives of securing long-lasting competitiveness of the European bio-based industries and ensuring their circularity and sustainability, it is necessary to have involvement and commitment of the industries concerned.

Furthermore, the limited possibility of connecting various sectors would fail to deliver the structuring effect that is highly needed for the development of the EU bio-based industry and of new value chains. This is especially the case with the value chains that could potentially valorise waste biomass by integrating providers of e.g. agricultural and forestry waste, food waste, fisheries waste or urban waste in the production of novel bio-based products.

6 How do the different policy options compare to achieve the expected impacts?

Based on the intervention logic, the initiative aims to deliver scientific, economic/ technological and environmental (including societal) impacts through a set of pathways (Section 4.3), which require a number of critical factors in place for the impacts to be

achieved in the best possible way (Section 4.4). In what follows, each option for implementation is assessed in terms of effectiveness, efficiency and coherence compared to the baseline scenario of traditional calls. The analysis is primarily based on the degree to which the different options would cater for the key needed functionalities. All options are compared to the baseline situation of traditional calls, which is thus consistently scored at 0 to serve as reference point.

6.1 Effectiveness

To be in line with the Horizon Europe impact framework, the fulfilment of the specific objectives of the initiative is translated into 'expected impacts' - how success would look like , differentiating between scientific, economic/ technological, and societal (including environmental) impacts. This section considers to which extent the different policy options would allow delivering these expected impacts – comparing what is needed (functionalities) with what each form of implementation can provide in practice. The assessments in this section set the basis for the comprehensive comparative assessment of all retained options against all dimensions in Section 6.4, based on a scoring system.

Scientific impacts

- Accelerated development of bio-based innovations;
- Reinforced scientific and innovation capacity for bio-based solutions, including in the regions where this capacity is currently underdeveloped;
- Increased R&I capacity for addressing the key sustainability challenges.

The baseline option:

A significant scientific impact can be achieved under the baseline scenario. Through traditional Horizon Europe calls, it is possible to set priorities and directionality for R&I activities through strategic programming. Adequate financing can be mobilised for grants targeting low- to medium-TRL projects. However, financing of capital intensive high-TRL projects can be limited because of insufficient mobilisation of private investment under this option. The baseline scenario can also effectively contribute to long-term scientific progress by investing in novel exploratory and interdisciplinary research (score 0).

The scientific and innovation capacity in general will be reinforced under the baseline scenario but there is limited possibility to target those R&I partners and regions where the capacity is currently underdeveloped. Calls for projects are open, which implies that anyone could potentially benefit. However, the interim evaluation of Horizon 2020 and the experience with the predecessor partnership indicate that traditional calls tend to largely attract actors that are already active in public R&I support programmes. Many relevant bio-based stakeholders, e.g. biomass producers, bio-waste recyclers, SMEs, etc., especially in the regions where the bio-based industry is less developed, may not have information or capacity to participate in the calls. Lack of capacity and the absence of support structures facilitating outreach (such as from a JU programme office) would be a barrier. Therefore, this option is unlikely to achieve the desired strong impact in terms of diversity of actors and in terms of targeting the underdeveloped regions (score 0).

Finally, the baseline scenario is able to contribute to knowledge development in the area of sustainability through the strategic programming process (score 0).

Option 1 – Co-programmed partnership:

A co-programmed European partnership can deliver more in terms of the scientific impact, mainly due to a higher amount of resources pooled in the programme via contributions of partners and better representation of relevant actors and stakeholders. A co-programmed partnership has also greater capacity than the baseline to support high-TRL projects (demonstrations and flagships) due to the action of private industrial partners. It can effectively set priorities and give directionality to R&I activities, while aligning the public and private R&I agendas (score +).

The co-programmed partnership is flexible in terms of involvement of different partners and can attract and facilitate participation of a wider scope of actors and stakeholders; however it would most likely not specifically target stakeholders and regions with underdeveloped capacity (score +).

The ability to focus the R&I activities on sustainability issues is comparable to the baseline of traditional Horizon Europe calls (score 0).

Option 3b – Institutionalised European Partnership based on Article 187 TFEU:

Similar to the co-programmed partnership, an institutional partnership under Article 187 can deliver more on the scientific impact than the baseline scenario, mainly due to a higher amount of resources pooled in the programme via contributions of partners and better representation of relevant stakeholders. A co-programmed partnership has the greatest capacity to support high-TRL projects due to co-funding of these projects by public and private partners (score +).

It can effectively set priorities and give directionality to R&I activities, while aligning the public and private R&I agendas. Due to the institutionalised form and formal financial commitments by partners, it is less flexible in terms of involvement of different partners but can effectively target specific key stakeholders (primary biomass producers, SMEs) and regions with underdeveloped capacity (score ++).

The ability to focus the R&I activities on sustainability issues is comparable to the baseline scenario (score 0).

Stakeholder opinion:

46% of OPC 1782 respondents (industry, academic and research institutions, public authorities and NGOs)answered that a legal structure would have a very high relevance in terms of achieving certain impacts such as effective implementation of activities; synergies with other EU and national programmes; and collaboration with other European partnerships.

Economic/technological impacts

- Bio-based innovations reaching first market application and bringing real economic and environmental benefits;
- A structured process for collaboration between R&I actors, industry including SMEs and other bio-based innovation stakeholders focused on the deployment of bio-based innovation;
- Reduced investment risk and improved access to finance for bio-based industrial projects.

The baseline option:

The baseline scenario has a limited ability to support the market application of bio-based innovation, due to limited resources for large scale, capital-intensive flagship projects, and the absence of mechanisms for collaboration with important deployment stakeholders such as regional authorities or investors. Market uptake is supported mainly by indirect dissemination activities (score 0).

The baseline scenario does not have a structuring effect on the dynamic bio-based industry and no possibility to facilitate business innovation through collaboration along and across bio-based value chains (score 0).

The baseline scenario does not have any tools to address the investment risk for bio-based projects other than generic R&I investment tools and calls planned under the Horizon Europe (score 0).

Option 1 – Co-programmed European Partnership:

A co-programmed partnership has much higher capacity than the baseline scenario to implement capital-intensive demonstration and flagship projects through the actions of private partners. The commitment of partners is however voluntary, and comes without guarantees that the investment actually happens (score +).

The co-programmed partnership can develop a well organised process for collaboration and structuring of the industry. This form of implementation foresees the possibility to establish bodies and processes that will involve relevant partners and facilitate collaboration and business innovation based on bio-based solutions. However, without a more institutionalised form and dedicated structures, this process may not be effective enough to reach the intended objectives (score +).

The co-programmed partnership can also address some investment risks. For instance, by involving the investment community, raising awareness of available bio-based solutions and their techno-economic parameters, or by involving regulatory stakeholders to address some regulatory risks. The co-programmed partnership cannot directly de-risk projects implemented by the private partners (score +).

Option 3b – Institutionalised European Partnership based on Article 187 TFEU:

The institutionalised partnership has much higher capacity than the baseline scenario to implement capital-intensive demonstration and flagship projects through the joint actions of public and private partners. This joint action and co-financing by partners guarantees better than the other options that the investment happens and projects are implemented (score ++).

The institutionalised partnership can develop a well-organised process for collaboration and structuring of the industry. The institutionalised partnership establishes a dedicated body with the capacity to assist the structuring process and to target the relevant actors from industry. It can also involve other deployment stakeholders, e.g. regional authorities, primary biomass producers, and so on in a more formal and structured way, aiming at the creation of favourable conditions for deployment of bio-based innovation. This dedicated body with the necessary expertise and capacity is the key to the effectiveness of these activities (score ++).

The institutionalised partnership can tackle some of the investment risk, e.g. by involving the investment community, raising awareness of the bio-based solutions and their techno-economic parameters, or by involving regulatory stakeholders to address some regulatory risks. In addition, the co-financing of the demonstration and flagship projects from EU funds

helps to de-risks the private investment in these projects and may attract and convince other investors invest in these projects (score ++).

Stakeholder opinion

With respect to the relevance of coordination, alignment or integration with specific stakeholders' groups in pooling and leveraging resources (such as financial, infrastructure, in-kind expertise etc.)to meet Partnership objectives, the patterns in stakeholders' responses are very similar. In the Open Public Consultation, 76% of respondents from all stakeholder groups (industry, academic and research institutions, public authorities and NGOs) indicated that industry was very relevant. Member States and Associated Countries (54%) were also found to be very relevant. As regards academia, the share of respondents that found their involvement very relevant was somewhat lower (42%) Most of the respondents among different stakeholder groups did not indicate Foundations and NGOs as very relevant (21%).

Environmental/Societal impacts (social, fundamental rights)

- Enhanced circularity and environmental sustainability of the European bio-based industries;
- Better integration of primary biomass producers in bio-based value chains to contribute to rural development.

The baseline option:

Under the baseline scenario, it is possible to develop sustainability criteria and benchmarks and apply them to all the bio-based projects funded by the EU R&I programme. This scenario does not have any mechanism to enforce or promote the application of sustainability criteria outside of Horizon Europe operations, e.g. by privately funded projects (score 0).

As the baseline scenario has only a limited capacity to integrate primary biomass producers such as farmers in the high-TRL projects and limited structuring effect, it cannot effectively integrate farmers in the bio-based value chains. It is unlikely that this scenario will have significant positive effect on farmers' income and on rural development (score 0).

Option 1 – Co-programmed European Partnership:

Under the co-programmed partnership, the application of sustainability criteria can be guaranteed for the publicly funded R&I actions. Other partners may respect sustainability criteria on a voluntary basis (score 0).

The co-programmed partnership also allows for the involvement of primary biomass producers and can integrate their interest and needs in the activities of the partnership (score +).

Stakeholder opinion

81% of the 207 respondents to the Open Public Consultation (industry, academic and research institutions, public authorities and NGOs) stated that it is either relevant or very relevant to create jobs in the bio-based industry in rural and underdeveloped areas.

Option 3b – Institutionalised European Partnership based on Article 187 TFEU:

Under the institutionalised partnership, the application of sustainability criteria can be guaranteed for the all co-funded R&I actions (the Commission holds a veto power on the

formulation of co-financed calls). The institutionalised form could also foster the acceptance of the sustainability criteria by the industrial partners also beyond the operation of the partnership as an industrial benchmark (score +).

The institutionalised partnership allows for the involvement of primary biomass producers and can integrate their interest and needs in the activities of the partnership. Moreover, the institutionalised partnerships have a designated body that could actively target primary biomass producers so as to integrate them in the partnership activities. (score +)

Impacts on fundamental rights

Impacts on fundamental rights are not expected.

Stakeholder opinion

In the Open Public Consultation, respondents (industry, academic and research institutions, public authorities and NGOs) were asked about the relevance of the Partnership composition, such as the flexibility in the composition of partners over time and the involvement of a broad range of partners (including across disciplines and sectors), to reach Partnership objectives. No statistical differences were found between the views of citizens and other types of respondents.

Ensuring the involvement of a broad range of partners has more 'very relevant' answers (67%) than the flexibility in the composition of partners (48%).

Table 4: Overview of the options' effectiveness compared to the baseline

	Baseline: Horizon Europe calls	Option 1: Co-programmed European Partnership	Option 3b: Institutionalised Article 187 TFEU
Accelerated development of bio-based innovations	0	+	+
Reinforced scientific and innovation capacity for bio-based solutions including in the regions where currently this capacity is underdeveloped	0	+	++
Increased R&I capacity for addressing the key sustainability challenges	0	0	0
Bio-based innovations reaching first market application and bringing real economic and environmental benefits	0	+	++
A structured process for collaboration between R&I actors, industry including SMEs and other bio-based innovation stakeholders focused on deployment of bio-based innovation	0	+	++
Reduced investment risk and improved access to finance for bio-based industrial projects	0	+	++
Enhanced circularity and environmental sustainability of the European bio-based industries	0	0	+
Better integration of primary biomass producers in bio-based value chains to contribute to rural development	0	+	+

Notes: Score ++ : Option presenting a *high* potential compared to baseline; Score +: Option presenting a *good* potential compared to baseline; Score 0: Potential of the baseline.

6.2 Efficiency

In order to compare the policy options consistently in terms of their efficiency, a standard cost model was developed for the external study supporting the impact assessment for the set of candidate Institutionalised Partnerships. The model and the underlying assumptions and analyses are set out in the Common Part of this impact assessment, Section 2.3.2 and in the Methodology Annex 4. A dedicated Annex 3 also provides more information on who is affected and how by this specific initiative in line with the Better Regulation framework. The scores related to the costs set out in this context allow for a "value for money" analysis (cost-effectiveness) in the final scorecard analysis in Section 6.4.

In addition, for this specific initiative under the baseline scenario of traditional calls, there would be winding down and social discontinuation costs for the existing implementation structure of the current Article 187 initiative. There would also be longer term financial cost-savings related to the closing of the structure, related to operations, staff and coordination costs in particular. Overall it is estimated that the overall longer term cost savings from using traditional calls instead of an existing Article 187 initiative would considerably exceed the costs incurred for winding down operations. This overall situation is set as the starting point for the comparison of options. The score of this baseline scenario (traditional Horizon Europe calls) is set to 0 to be used as a reference point.

On this basis, the scores for the costs of the different options range from a value of 0, in case an option does not entail any additional costs compared to the baseline, to a score of (-) when an option introduces limited additional costs when compared to the baseline and a score of (- -) when high additional costs are expected in comparison with the baseline. In case the scores are lower than for the baseline scenario, (+) and (++) are used. For option 1, additional costs for the call and project implementation have been considered. It has been taken into account that for option 3b there are moderate additional costs for the setup of a dedicated implementation structure, as such a structure (BBI JU programme office) already exists.

It is considered that while there is a clear gradation in the overall costs of the policy options, the cost differentials are less marked when one takes into account the expected co-financing rates and the total budget available for each of the policy options, assuming a common Union contribution. From this perspective, there are only one or two percentage points that split the most cost-efficient policy options – the baseline (traditional calls) and the Co-Programmed options – and the least cost-efficient – the Institutionalised Partnership option. Indeed, in terms of cost-efficiency, the Co-Programmed Partnership (Option 1) is 2 percentage points more efficient than the baseline; while an Article 187 Partnership is 2 percentage points less cost-efficient than the baseline. A score of + is therefore assigned for **cost-efficiency** to the Co-Programmed option and a score of (-) for the Institutionalised Partnership policy option[153].

It should be noted that the potential for the creation of crowding-in effects for industry has been taken into account when assessing the effectiveness of the policy options, above.

Table 5: Matrix on overall costs and cost-efficiency

[153] The baseline (traditional calls) is scored 0, as explained above.

	Option 0: Traditional calls under the Framework Programme	Option 1: Co-programmed European Partnership	Option 3b – Institutionalised European Partnership based on Article 187 TFEU
Administrative, operational and coordination costs	0	0	- -
Administrative, operational and coordination costs adjusted per expected co-funding (i.e. cost-efficiency)	0	+	-

Notes: Score 0 = same costs as for the baseline; score (-) = limited additional costs compared with the baseline; score (-)(-) = substantial additional costs compared with the baseline.

6.3 Coherence

6.3.1 Internal coherence

In this section we assess the extent to which the policy options show the potential of ensuring and maximising coherence with other actions, programmes and initiatives under Horizon Europe, in particular European Partnerships (internal coherence).

Baseline: Horizon Europe Calls

Coherence of the research agenda is likely to be achieved. However, complementarities are limited by the smaller number of actions at higher TRLs, leading to a loss of knowledge transfer from R&I actions to demonstration and deployment activities. This will be reinforced by the lack of continuity in projects teams, as answers to individual calls usually lead to ad-hoc consortia. There will be a limited scope for synergies between projects, as there is a lack of structuring of the community in the absence of a dedicated body. Synergies and complementarities with the rest of Horizon Europe are likely to be achieved. Links with other partnerships ([154]) or EIT-KICs ([155]) could be made, but they would be ad hoc. The lack of a dedicated team that engages with other partnerships limits the creation of links and might result in duplication or misalignment of work (score 0)

Option 1 – Co-programmed European Partnership:

The Memorandum of Understanding (MoU) envisaged under this option ensures the coherence of the R&I agenda over time. In addition, the flexibility of the governance model would secure the timely involvement of the most relevant actors, ensuring continuity across projects and best internal synergies. As the European Commission retains a strong steering role, coherence with the rest of Horizon Europe is achieved. Both Commission staff and the network's secretariat theoretically have the means to create synergies and complementarities with other partnerships ([154]) or KICs ([155]), but this depends on the availability and expertise of the staff, and good coordination between them. Its score would therefore be higher than the baseline (score +).

Option 3b – Institutionalised European Partnership based on Article 187 TFEU:

[154] Safe and Sustainable Food System for People, Planet & Climate; Carbon Neutral and Circular Industry; Rescuing Biodiversity; Water4All.
[155] Food; Climate; Raw Materials; Manufacturing.

The institutionalised partnership provides for the creation of a dedicated secretariat (programme office) with specialised staff with a complete understanding of bio-based issues and who would have the means to fully exploit the potential for synergies and complementarities of all actors. It also acts as a single contact point for interested parties. An institutionalised partnership can count on a stronger contribution from industrial partners, secured through a legal agreement, which benefits project partners and ensures a strong structuring effect. The research agenda has to be fully in line with Horizon Europe objectives and therefore coherence with the rest of Horizon Europe is ensured. With the resources to engage with other European partnerships ([154]) or KICs ([155]), an institutionalised partnership is able to exploit synergies and complementarities within Horizon Europe. As explained by a majority of interviewees, this is the option with the highest visibility and strongest position to engage with other parties. Its score would therefore be very high compared to the baseline (score ++).

Stakeholder opinion

Some 59% of the 1782 respondents to the Open Public Consultation (industry, academic and research institutions, public authorities and NGOs) consider that setting up a specific legal structure for the proposed initiative Circular Bio-based Europe is either relevant or very relevant.

6.3.2 External Coherence

In this section we assess the extent to which the policy options have the potential of ensuring and maximising coherence with their external environment, including EU-level programmes and initiatives beyond the Framework Programme and/or national and international programmes and initiatives, but also with overarching framework conditions, such as regulation, standardisation, etc. (external coherence).

Baseline: Horizon Europe Calls

Links can theoretically be made with other programmes under the Multiannual Financial Framework 2021-27 (MFF) (beyond Horizon Europe), but on an ad-hoc basis. Under the baseline, there is no dedicated team that could devolve time to engage with other programmes to develop structured, long-lasting synergies. Nonetheless, activities that are unlikely to be carried out through Horizon Europe calls (especially deployment actions) could be envisaged to be funded under other programmes (e.g. InvestEU). Horizon Europe calls are unlikely to contribute to setting up infrastructure, and projects would have to rely on their infrastructure to be provided by other funders.

The absence of Horizon Europe funding for biorefineries impacts on the capacity to conduct research, as other funders are unlikely to match the missing element, leading to a loss of complementarity. No work on regulation can be expected via Horizon Europe calls, and their capacity to contribute to the debate through Coordinating and Support Actions (CSA) is limited. Especially, the results of CSAs in this domain, as well as overall directionality and engagement of the community, might be impeded by the lack of a community structuring effect, scattered actors with highly diverse opinions, and no clear overall identification of needs (score 0).

Option 1 – Co-programmed European Partnership:

The administration of the partnership by an EC executive agency ensures that staff has the means to continuously engage with other programmes beyond Horizon Europe to develop synergies and complementarities. The network's secretariat can also take part in this bridge-making. A wider range of actors involved in the network can create the conditions for stronger synergies with other public bodies at European, national or regional level. Continued alignment with national and regional strategies can be ensured, as under the BBI JU ([141]). However, in a co-programmed partnership the industry might be less engaged, an issue frequently raised by interviewees (especially companies). It would therefore not benefit from strong complementarities with purely private initiatives, and might attract less attention from brand owners. Overall, its score would be high compared to the baseline (score +).

Option 3b – Institutionalised European Partnership based on Article 187 TFEU:

A strong involvement of the European Commission will be needed to ensure that an institutionalised partnership engages with other Multiannual Financial Framework (MFF) programmes. However, the need to look for complementarities, especially regarding access to finance when demonstration and deployment activities end, creates a strong incentive for the programme office of the partnership to engage with these programmes (e.g. EIB's European Circular Bioeconomy Fund, InvestEU). In addition, it would have the resources to then support project holders in their transition. The proposed initiative could set up a 'one-stop' contact point for interested parties to make them aware of the availability of the different funding sources, and of the possibility to combine (more easily) different funding sources.

Involving a wide set of actors within the network who benefit from the structuring effect of an institutionalised partnership, creates the conditions for synergies with other public bodies at European, national, regional and local level. The high level of involvement required of the industry would also encourage them to join forces and develop the links that are necessary to create and strengthen bio-based value chains in an integrated manner. The structuring effect of an institutionalised partnership also provides for the constitution of a common understanding of needs, especially of regulation, infrastructure or human capital. Overall, this options scores very high compared to the baseline (score ++).

Table 6: Overview of the options' potential for ensuring and maximising coherence

	Option 0	Option 1	Option 3b
Internal coherence	0	+	++
External coherence	0	+	++

Score ++: Option presenting a very high potential; Score +: Option presenting a high potential; Score 0: Potential of baseline

6.4 Tabular comparison of options and identification of preferred option

The table below gives a summary of the comparative analysis done above. The table given in Technopolis' Impact Assessment Study Report has been corrected and developed further.

Table 7: Ranking of the policy options

	Criteria	Option 0 – Traditional calls under the Framework Programme	Option 1 – Co-programmed European Partnership	Option 3b– Institutionalised European Partnership based on Article 187 TFEU
Effectiveness	**Accelerated development of bio-based innovations**	0	+	+
	Reinforced scientific and innovation capacity for bio-based solutions including in the regions where currently this capacity is underdeveloped	0	+	++
	Increased R&I capacity for addressing the key sustainability challenges	0	0	0
	Bio-based innovations reaching first market application and bringing real economic and environmental benefits	0	+	++
	A structured process for collaboration between R&I actors, industry including SMEs and other bio-based innovation stakeholders focused on deployment of bio-based innovation	0	+	++
	Reduced investment risk and improved access to finance for bio-based industrial projects	0	+	++
	Enhanced circularity and environmental sustainability of the European bio-based industries	0	0	+
	Better integration of primary biomass producers in bio-based value chains to contribute to rural development	0	+	+
Coherence	Internal coherence	0	+	++
	External coherence	0	+	++
Efficiency	Overall cost	0	0	- -
	Cost-efficiency	0	+	-

Score ++: High performance; Score +: Medium performance; Score 0: same performance as baseline; Score (-) = limited additional costs compared with the baseline; Score (-)(-) = substantial additional costs compared with the baseline.

The ranking shows that the baseline option performs less well against all dimensions and criteria compared to options 1 and 3b. Even though it reached a higher score against the overall cost criterion, this does balance against its lower performance against all other criteria. The ranking also shows that options 1 scores lower than 3b in various respects. Option 3b is higher overall and more advantageous regarding its expected impacts.

The assessment concludes with a preference for option 3b, the institutionalised partnership. However, considering the challenges faced in implementing the BBI JU, the lessons learned (see section 1.2) have to be taken into account while transiting to a CBE initiative, both on content and on implementation, for example as follows:

- The initiative needs to broaden the scope of its activities and strengthen synergies, while enlarging the range of actively involved stakeholders;
- The private partner of CBE should include representatives of all bio-based economy actors;
- The industrial partners should interact more with other actors in the value chains and help to develop a favourable ecosystem for the bio-based industry as a whole;
- In particular, primary producers such as farmers, foresters, fishermen and producers of biomass from aqueous environments need to be better represented by involving their representatives as partners. In addition, one could reflect about involving representatives of municipalities and waste collectors as partners or in specific fora;
- A more balanced decision-making process would be needed, where diverse stakeholder voices, also from outside the industry, are heard and considered in shaping the research agenda. Better synergies with national and regional developments have to be built, by involving regional authorities in the partnership and its governance;
- The partnership's environmental and socio-economic impact has to be measured constantly and not only ex post;
- The KPIs have to be assessed more accurately beforehand to better reflect what can be achieved by the initiative, and the corporate IT tools need to accommodate for such reporting;
- Biodiversity protection could be mentioned as one of the objectives of the partnership, which could lead to involving more biodiversity specialists in the governance of the partnership, for example in the scientific committee;
- A system has to be put in place to ensure that a situation is avoided in the future in which the private members are unable to fulfil their obligation related to financial contributions. Given the revised Model Finance Regulation, there should be a clear understanding with partners from the very beginning that they have sustainable and reliable long-term sources that will allow them to contribute financially to the administrative costs of the new partnership;
- The complicated way of reporting the private partner's in-kind contributions to operational and additional costs has to be simplified.

Box 4 - Comparison between the preferred option & the current partnership existing in the area taking into account lessons from past evaluations

What continues	What is different
• Art 187 Union Body, with EC as Founding Member • Strong link with Bio-based Industries • Structuring of the fragmented European bio-based industry • Building on the momentum established by the high participation of the SME sector • Close collaboration between the scientific community and industry • Most of the projects expect to contribute to job creation, as around half of them are located in rural and coastal areas • Better synergies with other Horizon Europe and national initiatives • Systemic approach to collaborative research • Overall partner composition involving many segments of the bio-based industry and SMEs • Long term financial commitments from the industrial partner.	• Broaden the scope of present activities and strengthen synergies • Improved governance system ensuring better representation of stakeholders and protection of the public interest • Increased focus on sustainability and circularity of bio-based solutions, including utilisation of waste, side-streams and residues as feedstock for bio-based industry • Better involvement of the agricultural primary sector • Better involvement of European regional authorities • Definition of new KPIs.

Regarding the improved governance mentioned above, the Commission will exercise its power as the member of the Governing Board of the partnership and ensure that the new partnership will respond to the recommendations from the evaluation of its predecessor as well as to concerns raised over the balance of public and private interest in partnership operation. The governance will in particular improve in the following aspects:

- Openness, transparency and representativeness: the partnership has to represent (through the private partner) the whole bio-based industry and relevant bioeconomy actors (e.g. farmers and other primary biomass producers).
- Integration and protection of public interest: The public interest will be clearly formulated and anchored in the Strategic Research and Innovation Agenda (SRIA) and operational documents (Annual Work Programmes). This includes that sustainability criteria and benchmarks are met by all projects supported by the partnership.
- Effectiveness in achieving the objectives: All bodies of the partnership will collaborate in programming, implementation and monitoring of activities to maximise the impact. New formations of stakeholders important for deployment of bio-based innovation (e.g. regional authorities and investors) – deployment groups – will be formed to assist the partnership in acceleration of market application of bio-based innovation.

7 THE PREFERRED OPTION - HOW WILL ACTUAL IMPACTS BE MONITORED AND EVALUATED?

7.1 The preferred option

In Table 8, below, the alignment of the preferred option of Institutionalised European Partnership under Article 187 TFEU with the selection criteria for European Partnerships defined in Annex III of the Horizon Europe Regulation is depicted. Seeing that the design process of the candidate Institutionalised Partnerships is not yet concluded and several of the related topics are still under discussion, the criteria of additionality/directionality and long-term commitment are covered in terms of *expectations* rather than ex-ante demonstration.

Table 8: Alignment with the selection criteria for European Partnerships

Criterion	Alignment of the preferred option
Higher level of effectiveness	The Institutionalised Partnership is more effective than the Horizon Europe calls in achieving the related objectives of the programme through involvement and commitment of industry partners, as well as engaging other actors (Member States, regions, academia and civil society organisations) through a governance model that needs to be more participative than the one that is currently operated in the BBI JU.
Coherence and synergies	Coherence and synergies of the Institutionalised Partnership within the EU research and innovation landscape will be ensured through the formal agreements between the proposed initiative and other initiatives, as well as through the co-creative process of the agenda setting and dedicated efforts in the course of implementation by the support team.
Transparency and openness	The preferred option offers an adequate level of transparency and openness in the selection of priorities and objectives and the involvement of partners and stakeholders from across the entire value chain, from different sectors, backgrounds and disciplines, including international actors (when relevant and not interfering with European competitiveness). Formalised procedures will offer clear modalities for promoting SME participation, as well as for disseminating and exploiting results.
Additionality and directionality	The preferred option offers high additionality, namely high potential for structuring the bio-based industries and ensures directionality by formalising commitments of partners toward achieving specific targets, eventually feeding high-level policy objectives.
Long-term commitment	In the case of Institutionalised European Partnerships, established in accordance with Article 187 TFEU, the financial and/or in-kind contributions from partners other than the Union will at least be

Criterion	Alignment of the preferred option
	equal to 50 % and may reach up to 75 % of the aggregated European Partnership budgetary commitments. It is expected that most of the commitment will be realised via in-kind and, to a lesser extent, financial contributions within projects, rather than at the programme level.

7.2 Objectives and corresponding monitoring indicators

7.2.1 Operational objectives

To deliver on the general and specific mid- and long-term objectives, the proposed CBE partnership aims to achieve several operational objectives in the short term. These also include activities going beyond R&I and that can be implemented under Horizon Europe. This reflects the definition of European Partnerships in the Horizon Europe regulation as initiatives where the Union and its partners "commit to jointly support the development and implementation of a programme of research and innovation activities, including those related to market, regulatory or policy uptake."

For each of the specific objectives, the following operational objectives could be identified:

(a) to **reap the benefits of the advancement in life sciences and in other scientific disciplines for the development and demonstration of sustainable bio-based solutions**

- Support interdisciplinary research projects advancing the development, experimentation, demonstration and deployment of bio-based industrial solutions;
- Mobilise corporate and national R&I actors to fund research and innovation action in bio-based innovation;
- Coordinate and align EU, national and corporate R&I strategies to give R&I in bio-based solutions appropriate priority.

(b) to **increase and integrate the R&I capacity of stakeholders across the Union to develop more sustainable bio-based innovations**

- Support the regional R&I actors in the development of their R&I programs, smart specialisation strategies, rural development programmes and other relevant strategic plans to prioritise the bio-based sector;
- Engage regional R&I actors to participate in EU funded collaborative projects to facilitate transfer of skills and competences;
- Support research action to better understand the environmental performance and risks of the bio-based industry and bio-based industrial systems;
- Support R&I actions that integrate sustainability aspects in the innovation development along the whole innovation chain;
- Develop technology solutions to the problems that currently prevent low quality heterogeneous biological waste from use as a feedstock for bio-based industry.

(c) to **reinforce the integration of bio-based R&I processes in EU industrial value chains**

- Establish a mechanism that will facilitate collaboration between R&I and industrial actors;
- Support national and regional authorities to develop their bioeconomy strategies and policies to create favourable environment for deployment of bio-based innovation;
- Support demonstration and flagship projects involving industrial actors.

(d) To **reduce the risk for R&I investment in bio-based companies and projects**

- Support R&I actions to improve techno-economic performance of bio-based systems;
- Support R&I actions that address the scientific and technological issues related to biomass feedstock and that are source of concerns for stability of supply;
- Recommend measures to national and regional policy makers that can reduce the risk to investment and improve access to finance for bio-based projects;
- Facilitate collaboration between R&I and industrial actors to create new value chains to develop markets and demand for bio-based products;
- Step up co-financing, together with industry and/or with private investors, of the first market application projects (flagships).

(e) to **ensure environmental considerations are taken into account in the development and implementation of R&I bio-based projects**

- Develop sustainability criteria for all relevant levels of decision-making in the bio-based sector through a collaborative R&I action;
- Apply the sustainable criteria to all EU funded R&I projects in the bio-based industry;
- Negotiate with the bio-based industry a voluntary commitment that the EU sustainability criteria will be accepted as the industry standard and observed by industry in their activities outside of publicly funded R&I projects;
- Promote the sustainability criteria among national and regional authorities so that they are applied in their policy actions including bioeconomy strategies and financial incentives through the CAP and regional development funds.

7.2.2 Monitoring indicators

The table below suggests a number of possible key monitoring indicators for tracking the progress of the initiative towards its specific objectives in addition to the ones identified for the Horizon Europe key impact pathways.

Table 9: Monitoring indicators in addition to the Horizon Europe key impact pathway indicators

	Short-term **(typically as of year 1+)**	**Medium-term** **(typically as of year 3+)**	**Long-term** **(typically as of year 5+)**
Scientific impact	N of scientific publications from CBE projects N of participants from the regions with limited bio-based R&I capacity N of projects addressing the sustainability knowledge gap	N of patents from CBE projects N of CBE projects with new technologies demonstrated	N of technologies and products patented or demonstrated in CBE that reached the market and have been commercialised Scientific performance of the EU increases in international statistics on bio-based and circular economy
Technological / economic impact	N of new circular bio-based building blocks identified N of new circular bio-based value-chains created N of new biorefineries set up N of new circular bio-based products created	N of jobs created as a result of the new value chains, technologies and (commercialised) products Value added created as a result of the new value chains, technologies and	Economic performance indicators (turnover, export, etc.) of the EU increases in international statistics on bio-based and circular economy or products Performance of the EU on

	Short-term (typically as of year 1+)	Medium-term (typically as of year 3+)	Long-term (typically as of year 5+)
	N of new feedstock suppliers engaged in projects or new value chains N of new cross-sectoral collaborations	(commercialised) products N / % of regions with new building blocks, value chains, biorefineries and products	sustainable biomass production and sustainable use of bio-waste improved. Investments in the EU of in the circular bio-based industry increased
Societal impact	N of feedstock suppliers reached by information campaigns on opportunities of the bio-based and circular economy N of new feedstock suppliers in CBE projects N of SMEs engaging in CBE projects N of activities on streamlining regulations, standards and certifications	N of new feedstock suppliers engaged in new value chains N of regulations, standards and certifications schemes improved by CBE results, tested and/or launched	Global performance of the EU in creation of high-quality jobs in the circular bio-based economy increased Increased income of primary producers active in the circular bio-based sector
Environ-mental impact	New ways of bio-waste valorisation (or diversion from discard) introduced New ways to avoid CO_2 emissions avoidance or new carbon sink functions More efficient biomass use processes introduced Sustainable primary production practices introduced as parts of new value chains	Tons of biomass waste valorised of diverted from discard Tons of CO_2 emissions avoided or sunk Change (%) in efficiency of biomass use per ton of bio-based product Square km of land on which sustainable agricultural or forestry practice is envisaged to be introduced as part of new value chains	Diffusion of sustainable practices on biomass and waste valorisation beyond CBE projects National and regional climate neutrality improved Circular economy targets approached Biodiversity enhancement observed as a result of sustainable biomass supply to bio-based value chains Ecosystem services improved or emerged as a result of sustainable biomass supply to bio-based value chains

7.2.3 Evaluation framework

The evaluation of the Partnership will be done in full accordance with the provisions laid out in Horizon Europe Regulation Article 47 and Annex III, with external interim and ex-post evaluations feeding into the overall Horizon Europe evaluations. As set in the criteria for European Partnerships, the evaluations will include an assessment of the most effective policy intervention mode for any future action; and the positioning of any possible renewal of the Partnership in the overall European Partnerships landscape and its policy priorities. In the absence of renewal, appropriate measures will be developed to ensure phasing-out of Framework Programme funding according to conditions and timeline agreed with the legally committed partners ex-ante.