

European Bioeconomy
Project Development
Best Practice Report



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Executive Summary

This main objective of this report is to describe the state of development of Bioeconomy in Europe, to analyse Bioeconomy Project Development Best Practices, to describe the role of a Bioeconomy Project Accelerator, and start to build a methodology for Bioeconomy Project Development. The document is divided into three parts.

Part I describes the **Bioeconomy Development in the EU** including the policy and historical context, the general trends in bioeconomy development in European regions and cities, and bioeconomy definition, characterisation, potential impacts, and key stakeholders. This first part is based mostly on the EU Bioeconomy Strategy and its 2018 Progress Report, as well as on a literature review about the historical development of bioeconomy, bioeconomy strategies in place, and policies supporting bioeconomy development.

Part II presents the **Bioeconomy Project Development Methodology** to be implemented by the BioBoost Bioeconomy Project Accelerator, which is based on and adapted from the CCRI methodology, and it includes an analysis of EU bioeconomy projects best practices and key challenges.

Part III describes the envisioned role of the **BioBoost Bioeconomy Project Accelerator Office** and how it can be replicated in other regions to unlock the bioeconomy potential and meet the 2050 goals.

This report aims to serve as a guide mostly for Bioeconomy Project Facilitators and Promoters that want to implement **Bioeconomy System Solutions** in their city or region, to help them design, deploy, and implement bioeconomy projects and to engage key stakeholders and align with Eu and local policies to boost the potential social, economic, and environmental impacts.

Introduction

The transition to a new societal and economic model based on the sustainable and circular use of resources has emerged as one of the European Union's primary goals, as our current linear and fossil fuel-based economy has reached its breaking point.

The European Commission created a Bioeconomy Strategy in 2012¹ to address this issue, and it was updated in 2018,² that reaffirmed its five objectives: i) ensure food and nutrition security, ii) manage natural resources sustainably, iii) reduce dependence on non-renewable, unsustainable resources, (iv) mitigate and adapt to climate change, and (v) strengthen European competitiveness and create jobs.

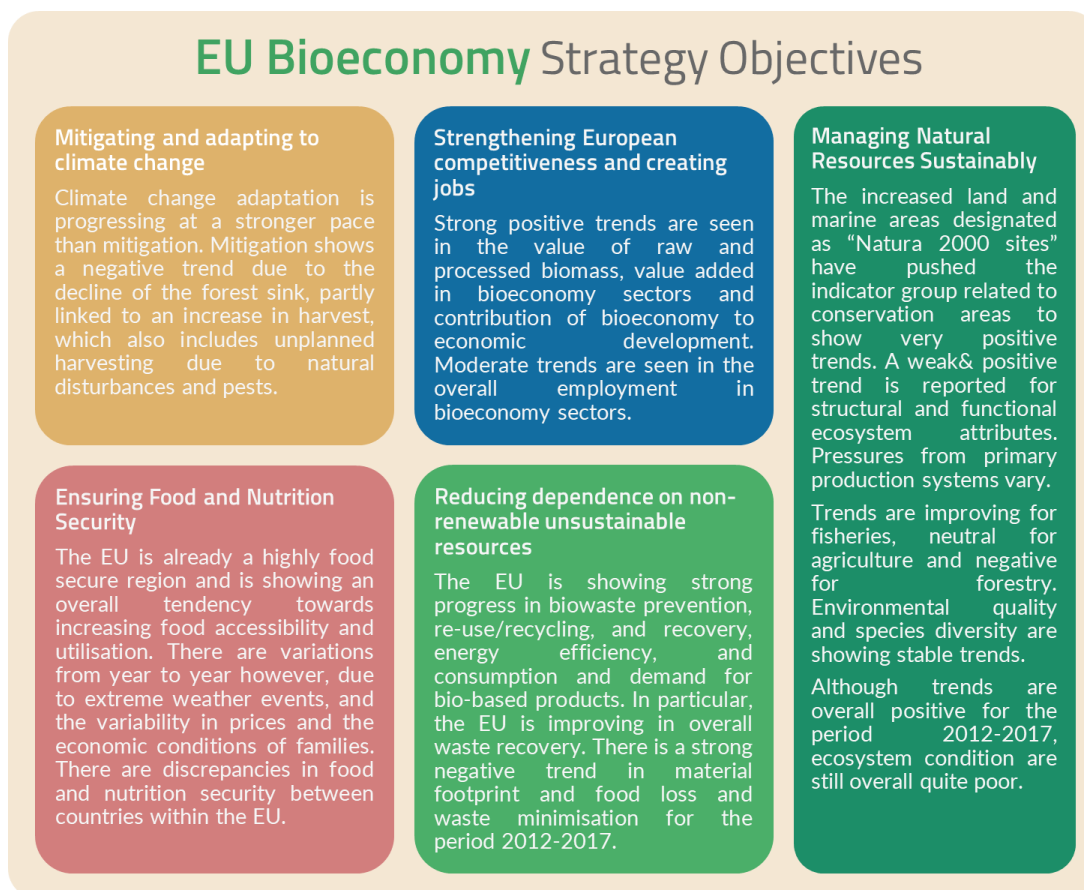


Figure 1. EU Bioeconomy Strategy Objectives¹

These objectives, in line with the targets of the [European Green Deal](#), are now more relevant than ever, following the geopolitical and energy markets crisis that unfolded after Putin's invasion of Ukraine. The new reality requires to drastically accelerate the change of paradigm towards a clean energy and to increase Europe's energy independence from unreliable suppliers and fossil fuels, and the need to strengthen food security.

The EU Bioeconomy Strategy enables a green and just transition and covers all three dimensions of sustainability: environment, society, and economy. The major goal is to create a society that is more inventive, resource-efficient, and competitive while balancing environmental protection, food security, and the responsible use of renewable resources for industrial purposes.¹

To reach these objectives, the updated Bioeconomy Strategy was accompanied by a targeted Action Plan along three main action areas: (1) strengthen and scale-up the bio-based sectors, unlock

¹ [EU Bioeconomy Strategy 2012](#)

² [EU Bioeconomy Strategy Progress Report](#)

investments and markets; (2) deploy local bioeconomies rapidly across Europe; and (3) understand the ecological boundaries of the bioeconomy.¹

The European bioeconomy is one of the EU's largest and most important sectors encompassing agriculture, forestry, fisheries, food, bioenergy, and bio-based products with an annual turnover of around 2 trillion euro and employing around 18 million people.

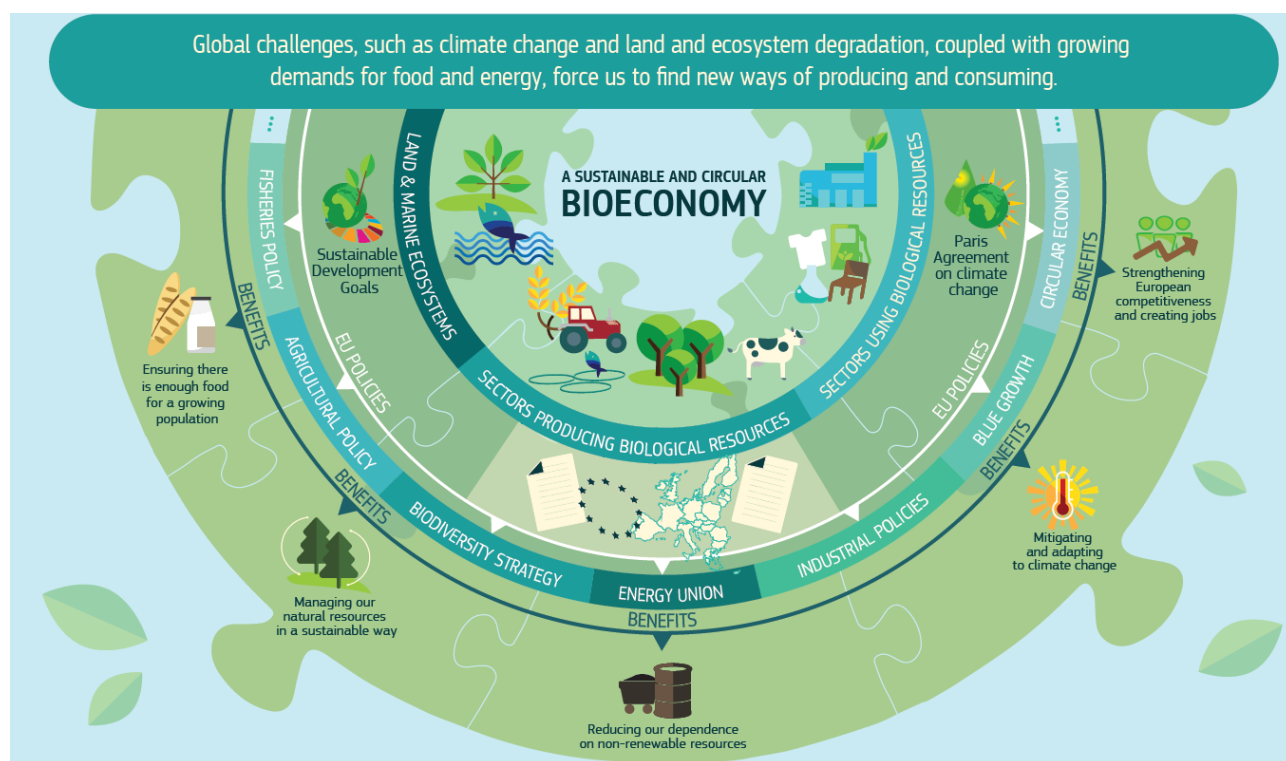


Figure 2. Infographic from the Knowledge Centre for Bioeconomy describing bioeconomy.³

Bioeconomy plays a key role in implementing the European Green Deal.⁴ The bioeconomy, strives for new methods of resource production and consumption while respecting our planetary boundaries and moving away from a linear economy based on extensive use of fossil and mineral resources, addresses the economic, social, and environmental aspects of the Green Deal as a catalyst for systemic change.

A circular and sustainable bioeconomy has the potential to contribute to all dimensions and objectives of the European Green Deal by i) delivering on EU's economic prosperity and ensuring a fair and just transition, ii) producing fossil-free materials for a climate-neutral future, and iii) enhancing the protection of the environment and ecosystems.

It is estimated that bioeconomy accounts for 4.7% of the EU-27's GDP and nearly 9% of its labour force,⁵ and the Joint Research Centre has identified more than 2,300 bio-based plants across Europe that are already implementing bioeconomy practices and projects.⁶

Dedicated bioeconomy policies, investments, and innovation are needed at all levels in the EU in order to fully enjoy the economic, social, and environmental benefits of the bioeconomy. Because of this, the 2018 update to the European Bioeconomy Strategy stresses the importance of developing national and regional bioeconomy strategies. The European Commission is therefore supporting a series of initiatives and dedicating public funds to bioeconomy such as the BIOEAST initiative, which will aid in

³ https://knowledge4policy.ec.europa.eu/bioeconomy/about_en

⁴ [EU Green Deal](#)

⁵ Ronzon, T., Piotrowski, S., Tamosiunas, S., Dammer, L., et al., 2020. Developments of economic growth and employment in bioeconomy sectors across the eu. Sustainability 12, 4507. [10.3390/su12114507](https://doi.org/10.3390/su12114507).

⁶ https://ec.europa.eu/knowledge4policy/visualisation/bio-based-industry-eu_en

the creation of national bioeconomy strategies in Central and Eastern Europe, and under Horizon 2020, the European Commission already has dedicated €3.85 billion of public funds into bioeconomy projects over the past seven years, yet further research on innovative bioeconomy areas is needed and will be financed through Horizon Europe (2021-2027).⁷

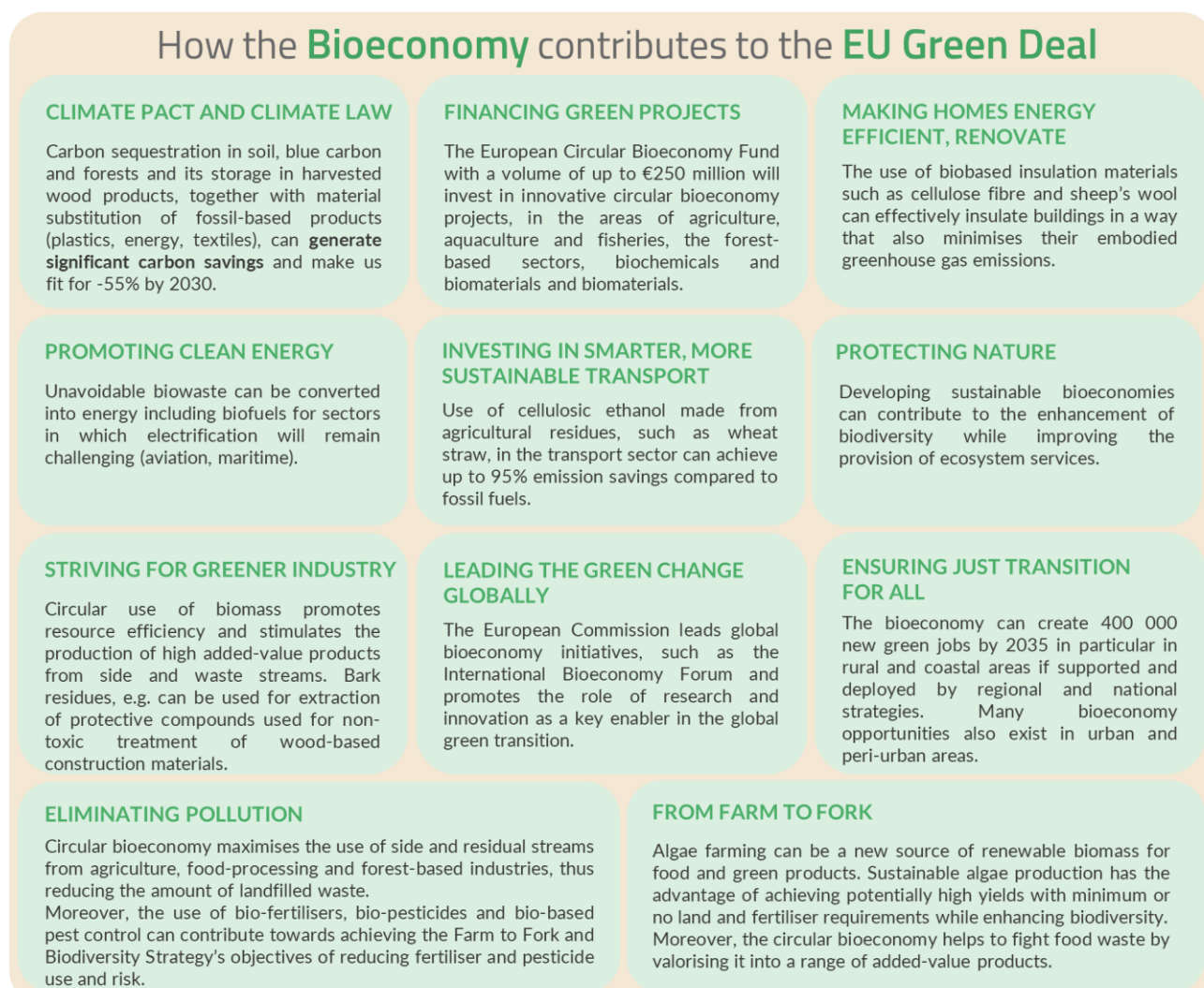


Figure 3. How bioeconomy contributes to the EU Green Deal. Adapted from "How the bioeconomy contributes to the Green Deal"⁷

⁷ [How the bioeconomy contributes to the European Green Deal.](#)



BOOST

Acceleradora
de projectes de
bioeconomia

Bioeconomy Development in the
EU: policy context, general trends,
and bioeconomy definition and
characterisation

01

General Trends and Policies for the Bioeconomy Development in the EU

Historical Context in Development of the Bioeconomy in Europe

The birth of the bioeconomy in the European Union has been to a large extent the result of chance and necessity. Since 1982, the European Commission has been in charge of preparing, managing and implementing the EU Framework Programmes in Biotechnology and Life Sciences. Over the years, the different research programmes increased in budgetary size, industry participation, number of participants per project, and scientific and technological ambitions of projects, etc. These changes triggered programme managers of the EC to create new managerial instruments to address the increasing size and complexity of the research projects and programmes.⁸

These instruments included mostly different research and industry platforms associated to very innovative projects. These research programs' content was also constantly evolving to address the most urgent issues at the cutting edge of science, technology, and society. The overarching goals of EU research programs were to advance scientific excellence in Europe by uniting the most active and innovative research teams in order to encourage the utilization of research findings for the benefit of business and society.⁸

Early biotechnology programs served as the managerial and policy frameworks for building strong foundations for European research, including: European transnationality participation in research projects; increased industrial participation; independent peer review of proposals; development of sound managerial research tools; and promotion of scientific excellence and commercial exploitation of results. The biotechnology-related programs and, notably, the "Cell Factory" Key Action in the Fifth Framework Programme (1998–2002), along with the concurrent creation of a Strategy on Biotechnology in 2002, provided a strong framework for the development of the then-referred-to Knowledge-Based Bio-Economy (KBBE). The KBBE idea first surfaced in 2005, a few years before the 7th Framework Programme was introduced (2007–2013). The EU launched a Strategy on Bioeconomy in 2012 as a result of experience gained over time and changing social expectations, which was reviewed in 2017.⁹ The two most important impacts of the EU Strategy on Bioeconomy: the Bioeconomy dedicated activity within the Programme Horizon 2020 (2014–2020), and the other the creation of a public-private partnership of bio-based industries.⁸

In parallel with the number of bioeconomy-related initiatives triggered by the EU, such as the ones mentioned above, other countries and international organisations developed simultaneously other approaches to the concept of bioeconomy, such as the German National Bioeconomy Strategy launched in 2010, which was the first one in Europe.¹⁰

Moreover, in 2016 the Paris Agreement¹¹ entered into force and in 2019 the EU Green Deal was adopted,¹² setting ambitious measures and goals to reduce its greenhouse gas emission, in which bioeconomy plays a crucial role to achieve.

In September 2020, the Commission proposed to raise the 2030 greenhouse gas emission reduction target to at least 55%, compared to 1990 levels, with the goal of reaching climate neutrality by 2050. In July 2021, the European Commission presented the Fit for 55 package,¹³ which consists of a set of inter-connected proposals setting out how the EU can achieve these targets in a fair, cost effective and competitive way. The package strengthens existing pieces of legislation and presents new

⁸ Patermann, C., & Aguilar, A. (2018). The origins of the bioeconomy in the European Union. *New biotechnology*, 40, 20-24.

⁹ [Review of the EU bioeconomy strategy and its action plan](#)

¹⁰ <https://bioeconomie.de/en/bioeconomy-germany-background>

¹¹ <https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement>

¹² https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en

¹³ https://ec.europa.eu/commission/presscorner/detail/en/IP_21_3541

initiatives, with specific targets across a range policy areas and economic sectors: climate, energy and fuels, transport, buildings, land use and forestry.

A sustainable and circular EU bioeconomy is central to most of these initiatives and thus to achieving a climate-neutral future.

In addition, bioeconomy will also contribute to the EU Missions¹⁴ and [REPowerEU](#), a plan to underline the urgency for the EU to diversify its energy consumptions and accelerate the energy transition towards more sustainable gases like green hydrogen and biomethane.¹⁵ On the demand side, the market for renewable gases has seen a staggering growth over the past years, as consumers and regulators are increasing conscious of the need to produce renewable gas locally.¹⁶ The European Commission's proposals on common rules for the internal markets in renewable gases and in hydrogen create necessary conditions for a shift from fossil natural gas to renewable and low-carbon gases.¹⁷ In line with the policy scenarios that underpin the European Fit for 55 initiative, biogas, biomethane, renewable and low-carbon hydrogen and synthetic fuels (E-gas) will gradually replace fossil natural gases and represent very significant shares of the gaseous fuels in the energy mix towards 2050 with around a fifth of final energy consumption by 2050. On the opposite, the share of natural gas is projected to be significantly reduced.¹⁸ Even if policy targets for renewable fuels in the EU (e.g. green certificates) were not in place, research shows that off-takers are willing to pay a “green premium” for renewable gas as it is expected from the revised Energy Taxation Directive (ETD) to further increase tax rates for non-renewables heating fuels, which could be costly in the long-term period for the producers.¹⁹

General Trends and Progress of Bioeconomy Activities

Specific actions to promote the adoption, updating, and coherence of national and regional bioeconomy strategies throughout Europe were included in the 2018 Bioeconomy Strategy Action Plan. Significant progress has been made since its adoption. Seven EU Member States are presently formulating their separate bioeconomy policies, while 10 EU Member States currently have specialized bioeconomy strategies. As a result, five additional Member States have begun the process of producing national strategies, and three additional Member States have established them since 2018.

Some examples of initiatives implemented by EU Member States include the Nordic Bioeconomy (three Member States – Denmark, Finland, and Sweden),²⁰ the Bioeconomy in the Baltic Sea Region initiative (eight Member States: Germany, Denmark, Estonia, Finland, Lithuania, Latvia, Poland, and Sweden),²¹ and BIOEAST, the Central-Eastern European Initiative for Knowledge-based Agriculture, Aquaculture and Forestry in the Bioeconomy which offers a common political commitment and shared strategic research and innovation framework for working towards sustainable bioeconomies in the Central and Eastern European (CEE) countries: Bulgaria, Czechia, Estonia, Croatia, Hungary, Lithuania, Latvia, Poland, Romania, Slovenia and Slovakia.²²

All around Europe progress of bioeconomy activities have been identified, generally following 5 development activities trends (Figure 4). To read more about specific bioeconomy strategies in EU regions refer to the report elaborated by the Joint Research Centre (JRC) – [Bioeconomy Strategy Development in EU Regions](#).

¹⁴ EU Missions

¹⁵ https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal/repowereu-affordable-secure-and-sustainable-energy-europe_en

¹⁶ <https://www.euractiv.com/section/energy/news/eu-paves-way-for-renewable-and-low-carbon-gases-to-replace-fossil-fuel/>

¹⁷ <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52021PC0803&qid=1640002501099>

¹⁸ <https://www.mckinsey.com/industries/oil-and-gas/our-insights/global-gas-outlook-to-2050>

¹⁹ https://energy.ec.europa.eu/topics/markets-and-consumers/energy-taxation_en

²⁰ Three Member States: Denmark, Finland, and Sweden. <https://www.norden.org/en/bioeconomy>

²¹ Eight Member States: Germany, Denmark, Estonia, Finland, Lithuania, Latvia, Poland, Sweden, <http://bsrbioeconomy.net/>

²² Bulgaria, Czechia, Estonia, Croatia, Hungary, Lithuania, Latvia, Poland, Romania, Slovenia, and Slovakia. <https://bioeast.eu/>

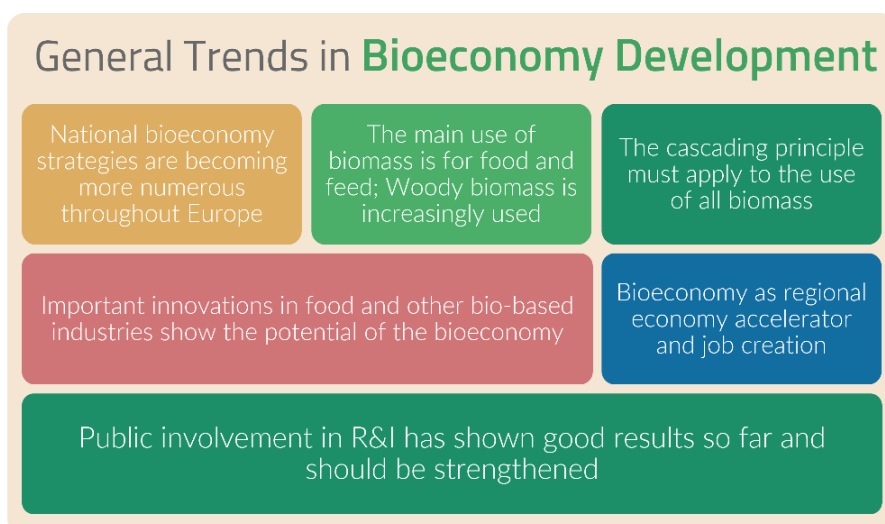


Figure 4. General trends in development of the bioeconomy in EU

At the national level, the following developments have occurred since 2018: A (new) national plan has been created by Austria,²³ the Netherlands, and Portugal,²⁴ while Sweden, Croatia, Czechia, Poland, and Slovakia have begun the process of creating one with help from the BIOEAST initiative.²² Additionally, Germany,²⁵ Ireland,²⁶ Italy,²⁷ and Finland²⁸ have modified their present national strategies or action plans, while Finland,²⁹ France,³⁰ and Spain are in the process of doing the same. As a result, 10 EU Member States presently have bioeconomy-specific plans. These strategies' sectoral breadth generally corresponds to the European Strategy's. Their efforts center on initiatives to support the application of the principles of resource efficiency, circularity, and cascading use of biomass, investments in bioeconomy research, innovation, and market development, integration of bioeconomy concepts or priorities within existing regulatory frameworks, facilitation of intergovernmental and stakeholder collaboration, promotion of public procurement of bio-based products, national labels, and action.

²³ Austria published its national dedicated [bioeconomy strategy in 2019](#); a progress report about the implementation of key measures was published in July 2021.

²⁴ The "Plano de Ação para a Bioeconomia Sustentável (PABS) – Horizonte 2025" was approved by the Council of Ministers on the 26th November 2021 and published in the national official journal on the 28th December 2021 (<https://apambiente.pt/apa/bioeconomia>).

²⁵ A new national bioeconomy strategy was adopted in 2020 (https://www.bmbf.de/bmbf/en/research/energy-and-economy/bioeconomy/bioeconomy_node.html) and a dedicated Bioeconomy Action Plan is currently under elaboration.

²⁶ In Ireland, after the adoption of the "[National Policy Statement on the Bioeconomy](#)" in February 2018, the Bioeconomy Implementation Group published its First Progress Report in autumn 2019, which includes an Action Plan for 2019-2020.

²⁷ Italy adopted an updated [Bioeconomy Strategy in 2019](#) and its [Implementation Action Plan](#) (2020-2025) in 2021.

²⁸ Finland published its updated national bioeconomy strategy in April 2022 (<https://julkaisut.valtioneuvosto.fi/handle/10024/163969>).

²⁹ Finland is preparing an update of its 2014 [Bioeconomy Strategy](#). The update will build upon the 2018 EU Bioeconomy Strategy and the Council conclusions.

³⁰ France is preparing a future Bioeconomy Action Plan 2021-2022 to update the former [Action Plan 2018-2020](#). Furthermore, a [public consultation](#) for a specific strategy to accelerate bio-based products and sustainable fuels has taken place in Q1 2021.

Bioeconomy Strategies of Member States		AT	DE	ES	FR	FI	IE	IT	LV	NL	PT
Focus											
Sectors covered	Agriculture	●	●	●	●	●	●	●	●	●	●
	Forestry	●	●	●	●	●	●	●	●	●	●
	Fisheries		●	●	●	●	●	●	●	●	●
	Aquaculture	●	●	●	●	●	●	●	●	●	●
	Organic waste	●	●	●	●	●	●	●	●	●	●
	Food	●	●	●	●	●	●	●	●	●	●
	Wood, wood products & furniture	●	●	●	●	●	●	●	●	●	●
	Pulp & paper	●	●	●	●	●	●	●	●	●	●
	Biotechnology	●	●	●	●	●	●	●	●	●	●
	Bio-based textiles	●	●	●	●	●	●	●	●	●	●
	Bio-based chemicals and materials	●	●	●	●	●	●	●	●	●	●
	Bioenergy (incl. transport biofuels, bioelectricity and H&C)	●	●	●	●	●	●	●	●	●	●
	Ecosystem services	●	●	●	●	●	●	●	●	●	●
	Other specific sectors	●	●			●	●	●	●		●
Policy actions	Embed the bioeconomy into new legislative frameworks				●			●			
	Revisit existing regulatory frameworks to include bioeconomy concepts/priorities	●	●		●	●	●	●	●	●	●
	Promote the establishment of intra-governmental groups to support policy coherence or collaboration amongst different bioeconomy stakeholders	●	●	●	●	●	●	●	●		●
	Promote labels and standards for bio-based products	●	●	●	●	●	●	●	●		●
	Promote public procurement of bio-based products	●	●	●	●	●	●	●	●		●
	Enhance land management for new production systems and ecosystem functions	●	●			●		●	●		●
	Promote specific bioeconomy sectors	●	●		●	●		●	●		●
	Promote the principles of "cascading use", "circularity" and "resource efficiency" for biomass	●	●	●	●	●	●	●	●	●	●
	Enhance the knowledge on bioeconomy by setting-up knowledge hubs, observatories, information systems, web portals, conferences, etc.			●	●	●	●	●			●
	Implement specific studies (feasibility, impact assessments, land use, territorial development analyses, market analyses, foresight studies etc.)	●	●	●	●	●	●	●	●		●
	Develop monitoring systems for the bioeconomy		●			●	●	●		●	●
	Promote communication campaigns for awareness raising (e.g. bioeconomy awards, information systems, events, etc.)	●	●	●	●	●	●	●	●	●	●
	Promote educational/training programmes	●	●	●	●	●	●	●	●		●
	Promote investments in bioeconomy research, innovation, market development	●	●	●	●	●	●	●	●	●	●
	Market incentives for bio-based production/consumption (e.g. subsidies, taxes)	●	●		●	●		●	●	●	

Figure 5. Overview of sectors and actions in Bioeconomy Strategies of Member States (source: JRC (2021). European Commission's Knowledge Centre for Bioeconomy) <https://knowledge4policy.ec.europa.eu/bioeconomy/>.

The bioeconomy has been incorporated into sector-specific or overarching policies in other Member States, such as Bulgaria, which is currently working on a strategy for "Strengthening the Role of the Agricultural Sector in the Bioeconomy" and the "National Strategy for Transition to a Circular Economy." Estonia is currently drafting a national bioeconomy policy framework paper, which the government intends to implement by the start of 2022. Prior to the 2018 European Bioeconomy Strategy, work was begun in Hungary and Lithuania on a specific bioeconomy strategy, although it has not yet been completed.

At the regional level, 28 of the EU's 27 (NUTS-1, NUTS-2, or NUTS-3) regions have implemented their own specific bioeconomy strategies, and another region is in the process of doing so. In contrast, 62 other regions have adopted strategies in which the bioeconomy is a key component, and 7 more regions are in the process of doing so. Furthermore, 2 more areas are drafting such a strategy, while 94 other EU regions already have plans with at least some bioeconomy component. Regional sector-specific strategies exist and aid in the development of regional bioeconomies, as do broader, overarching, and cross-cutting strategies (on topics like the circular economy, research and technology, etc.). Sector-specific regional strategies direct the management of particular biological resources and/or bioeconomy sectors.³¹

³¹ JRC (2022), <https://publications.jrc.ec.europa.eu/repository/handle/JRC128740>

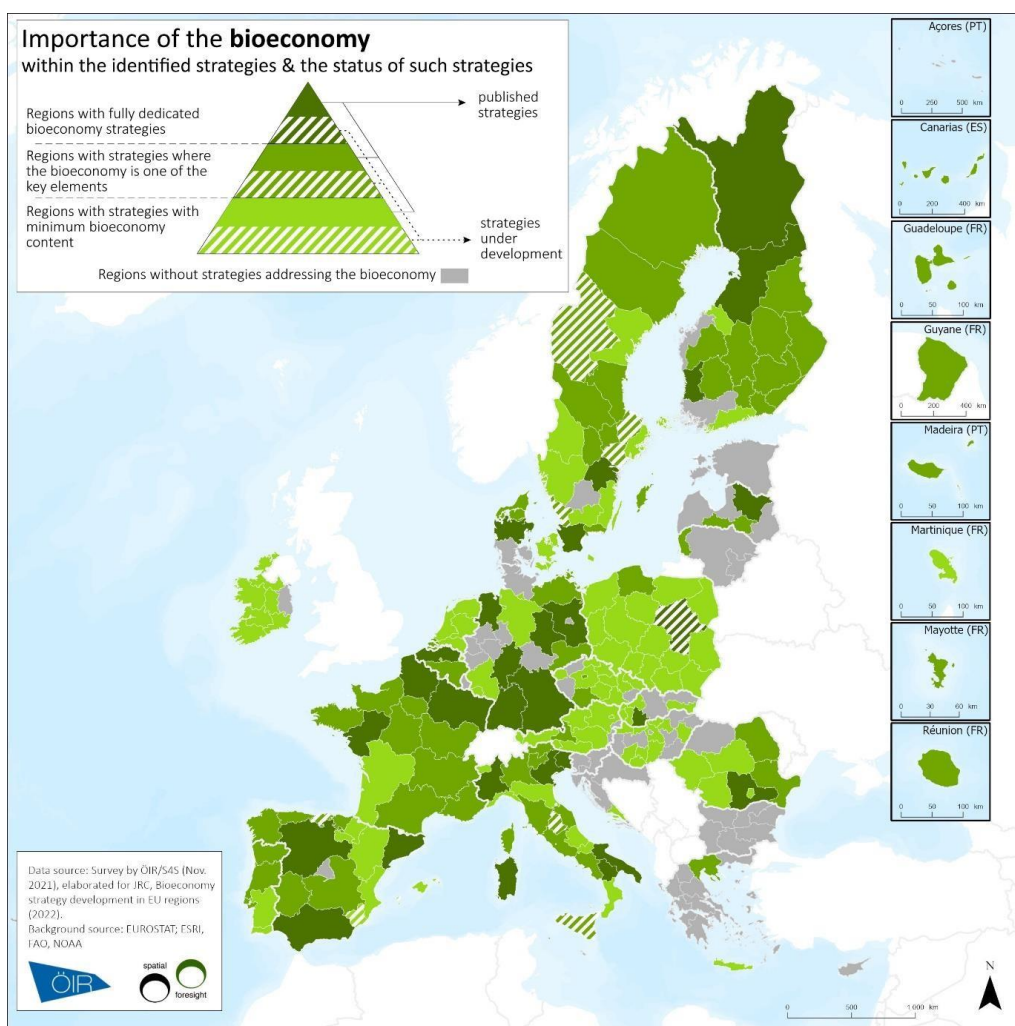


Figure 6. EU regions (NUTS-1, NUTS-2 or NUT-3 scale) with strategies and other policy initiatives on the bioeconomy according to the role the bioeconomy plays (fully dedicated to the bioeconomy / strong bioeconomy focus / minimum bioeconomy content) and the status (published / under elaboration). Source: JRC (2022). <https://publications.jrc.ec.europa.eu/repository/handle/JRC128740>

Policy Context

In order to increase policy coherence and identify and resolve trade-offs, such as those regarding land and biomass demands, bioeconomy policies adopt a cross-sectoral view. Bioeconomy policies help to create a bioeconomy that takes into account all **three dimensions of sustainability**:

- i. **Environment – Management of land and biological resources within ecological boundaries:** by optimising the use of biological resources from land and sea, the bioeconomy maximises co-benefits, such as production of biomass, mitigating climate change and enhancing biodiversity, while safeguarding and benefiting from other ecosystem services.²
- ii. **Economy – sustainable value chains and consumption:** promotion of use of biomass and other biological resources obtained from land and sea to fulfil and respect human needs and rights, such as the right to adequate and nutritious food,³² and the right for land managers and primary producers to fair living and working conditions.³³ Promotion of Sustainable consumption patterns³⁴ and boost sustainable innovation³⁵ and create solutions for sustainable food and bio-based products, bio-based and bio-derived chemicals, advanced biofuels, and bioenergy.²

³² <https://www.ohchr.org/sites/default/files/Documents/Publications/FactSheet34en.pdf>

³³ COM(2021)102 final: The European Pillar of Social Rights Action Plan

³⁴ Supported by actions on carbon removals via carbon farming and industrial solutions.

³⁵ Supported by actions on carbon removals via carbon farming and industrial solutions.

- iii. **Society – social fairness and just transition:** bioeconomy policies enable a green and socially fair transition³⁶ by developing sustainable business models³⁷ based on the principles of due diligence and by promoting sustainable trade and social fairness in Europe and beyond. This will reduce disparities, and generate new green jobs in emerging circular, bio-based and food industries and services, adding value to the regional economies. Creation of jobs, particularly in coastal and rural areas through the growing participation of primary producers in their local bioeconomies. In the bio-based industries one million new jobs could be created by 2030, according to industry estimates.²

To maximize the synergistic impacts of sectoral policies, establish fair competition, and establish consistent sustainability standards across policy domains, bioeconomy governance is essential.³⁸ The promise of the bioeconomy can be realized by promoting interministerial cooperation, policy coherence, and vertical coordination at local, national, EU, and worldwide levels.

A bioeconomy based on all sustainability features can be built with the aid of bioeconomy policies.³⁹ Through the provision of both material (food, fiber, bio-based materials, energy) and immaterial (clean air and water, biodiversity, climate mitigation and adaptation, leisure) products and services, they enable all people to live a "bio-based" lifestyle, supporting the goals of the New European Bauhaus⁴⁰ and its values of sustainability, inclusion, and quality of experience.

Cross-cutting policies relevant for the bioeconomy

Green Deal	➤ COM (2019) 640 final: is the sustainable growth strategy that aims to transform every aspect of the European economy, environment and society, including energy use, food use, production and consumption of products. The bioeconomy is included as an integral part of the Commission's strategy to implement the United Nations 2030 Agenda and the Sustainable Development Goals.
REPowerEU	➤ COM(2022)108 Joint European Action for more affordable, secure, and sustainable energy. ➤ Saving energy, producing clean energy, diversifying EU energy supply.
Paris Agreement	➤ Objective to keep the global temperature below 2°C and pursue efforts to keep it to 1.5°C.
Circular Economy Action Plan	➤ COM(2020)98. A new Circular Economy Action Plan. For a cleaner and more competitive Europe ➤ Transform the European production and consumption system to reduce its environmental footprint and, among others, create new, circular, and bio-based business opportunities. ➤ Commission communication 'Towards a circular economy: a zero-waste programme for Europe' (EC 2014e) ➤ Fertiliser Regulation (Regulation (EC) No 2003/2003) ➤ Commission communication 'The role of waste-to-energy in the circular economy' (EC 2017a)

³⁶ Proposal for a Council Recommendation on ensuring a fair transition towards climate neutrality, COM(2021)801 final

³⁷ e.g. the Farm to Fork Strategy's EU Code Of Conduct on Responsible Food Business and Marketing Practices, https://ec.europa.eu/food/system/files/2021-06/f2f_sfpd_coc_final_en.pdf

³⁸ See recommendations of the Policy Support Facility <https://op.europa.eu/s/vzU7>

³⁹ In line with the Sustainable Development Goals: <https://sdgs.un.org/goals>

⁴⁰ COM(2021)573. New European Bauhaus: Beautiful, Sustainable, Together.

Industrial Strategy	➤ COM(2020)102. A New Industrial Strategy for Europe. And COM(2021)350 final. Updating the 2020 New Industrial Strategy: Building a stronger Single Market for Europe's recovery ➤ Modernisation and strengthening of the EU industrial base through the creation of new value chains and greener, more cost-effective industrial processes - advances in life sciences and biotechnologies. Research and innovation and the deployment of innovative solutions to produce new and sustainable bio-based products (such as bio-chemicals, biofuels, etc.) will also enhance our capacity to substitute fossil raw materials in very significant parts of European industry (e.g. construction, packaging, textiles, chemicals, cosmetics, pharma ingredients, consumer goods) in line with the renewed Industrial Policy objectives. ➤ Commission Communication 'Investing in a smart, innovative and sustainable Industry- A renewed EU Industrial Policy Strategy' (COM/2017/0479 final)
Biodiversity Strategy	➤ COM(2020)380. EU Biodiversity Strategy for 2030. Bringing nature back into our lives. Targets include protection 30 % of the land and sea area, strictly protection of 10 % of land and sea area; reverse decline of pollinators; 50 % reduction in the number of Red List species threatened by invasive alien species; significantly reduce by-catch of species; three billion new trees are planted in the EU; aligned to targets of the farm to fork strategy. ➤ Supporting healthy ecosystems is a European priority. The bioeconomy can contribute to restoring ecosystems, for instance achieving plastic-free seas and oceans. The European Environmental Agency already advises that bio- based, biodegradable materials alternative to plastics should be used where the risk of dispersion into the ecosystem is high, such as lubricants, materials subject to wear and tear, and disposable products.
Sustainable Blue Economy Strategy	➤ Allow sustainable growth in the marine and maritime sectors. As part of the Integrated Maritime Policy, the Blue Growth is the long-term strategy to support sustainable growth in the marine and maritime sectors, taking duly into account the environmental pillars embedded in the Integrated Maritime Policy.
Farm to Fork Strategy	➤ Part of the Common Agricultural Policy ➤ COM(2020)381. A Farm to Fork Strategy for a fair, healthy and environmentally-friendly food system. Targets by 2030 include 50 % reduction in the use and risk of chemical pesticides and a 50 % reduction in the use of the more hazardous pesticides, hazardous chemicals, nutrient losses, and sales of antimicrobials in farming; 25 % of agricultural area under organic farming
Common Fisheries Policy	➤ The Common Fisheries Basic Regulation (EU) No 1380/2013 ➤ Commission communication 'Blue growth: opportunities for marine and maritime growth' (EC 2012e) ➤ Report on the Blue Growth Strategy, Towards more sustainable growth and jobs in the blue economy, SWD (2017) 128 final

	➤ Commission communication 'Strategic guidelines for the sustainable development of EU aquaculture' (EC 2013e) ➤ Joint communication "International ocean governance agenda for the future of our oceans" (EC 2016)
Renovation Wave	➤ COM(2020)662. A Renovation Wave for Europe - greening our buildings, creating jobs, improving lives. See also COM(2021)802 proposal for a directive on the energy performance of buildings (recast).
European Climate Law	➤ EU(2021)1119. 'European Climate Law'. Targets include by 2030 reduction of GHG emissions by 55 %; achieving climate neutrality by 2050. See also Carbon Border Adjustment Mechanism COM(2021)564 final
Chemicals Strategy	➤ COM(2020)667. Chemicals Strategy for Sustainability - Towards a Toxic-Free Environment.
Adaptation Strategy	➤ COM(2021)82. Forging a climate-resilient Europe - the new EU Strategy on Adaptation to Climate Change
Sustainable Financing	➤ COM(2021)390. Strategy for Financing the Transition to a Sustainable Economy and EU(2020) 852. Taxonomy Regulation.
Zero Pollution Action Plan	➤ COM(2021)400. Pathway to a Healthy Planet for All - EU Action Plan: 'Towards Zero Pollution for Air, Water and Soil'. Targets by 2030 include reduce number of premature deaths by air pollution by 55 % and share of people chronically disturbed by transport noise by 30 %; sign. waste generation, residual municipal waste and plastic litter at sea (by 50 %), microplastics released into the environment by 30 %; nutrient losses and chemical pesticides' use by 50 %; EU ecosystems where air pollution threatens biodiversity by 25 %.
Renewable Energy Directive	➤ COM(2021)557. Amendment of EU(2018) 2001. On the promotion of the use of energy from renewable sources. Targets of amendment include increased to 40 % share renewable energy, increased sustainability criteria incl. cascading principle. ➤ Commission communication: 'Accelerating Europe's transition to a low-carbon economy' (EC 2016k) ➤ Clean Energy Package (2016) ➤ EU Renewable Energy Directive (2009/28/EC)
Forest Strategy	➤ COM(2021)572. New EU Forest Strategy for 2030 ➤ Blueprint for the EU Forest-based Industries (SWD(2013)343) ➤ Commission staff working document 'Multiannual implementation plan of the new EU forest strategy' (EC 2015a)
Sustainable Carbon Cycles	➤ COM(2021)800. Communication on Sustainable Carbon Cycles; including a target of 20 % of the carbon used in the chemical and plastic products from sustainable non-fossil sources by 2030 and announcing an action on Integrated Land Use Assessments
Action Plan on Critical Raw Materials	➤ A reliable, secure, and sustainable access to raw materials is a precondition for Europe's Green Deal and for industrial leadership of Europe in the technologies of the future.

	➤ The Action Plan on Critical Raw Materials outlines the challenges lying ahead and provides ten actions to foster transition towards a green and digital economy and, at the same time, bolster Europe's resilience and open strategic autonomy.
The European Commission's post Covid-19 Recovery plan	➤ Deploy a reinforced EU budget to help repair the immediate economic and social damage brought by the coronavirus pandemic, kickstart the recovery and prepare for a better future for the next generation. ➤ Next Generation EU: €750 billion as well as targeted reinforcements to the long-term EU budget for 2021-2027, will bring the total financial firepower of the EU budget to €1.85 trillion.
Clean Planet for All	➤ COM(2018) 773: 2050 long term strategy for climate neutral economy.
Other Initiatives	➤ LULUCF: Land Use and Land Use Change and Forestry. For example, climate neutrality of the land sectors by 2035 and net GHG sink of 310 Mt CO₂eq yr⁻¹ by 2030. ➤ EU and national Adaptation Strategy ➤ European Urban Initiative ➤ Intelligent Cities Challenge Initiative ➤ EIB Circular City Funding Guide ➤ European Circular Economy Stakeholder Platform ➤ Circular Cities and Regions Initiative ➤ EU Nature Restoration Regulation: place at least 20% of degraded ecosystems under restoration by 2030. ➤ European Pillar of Social Rights Action Plan. ➤ Contribution of SDG 2 (Zero Hunger), SDG 12 (Sustainable Consumption and Production), and SDG 13 (Climate Action). ➤ Circular Economy Investment Plan
Regional Policies	➤ Commission communication 'Regional policy contributing to smart growth in Europe 2020' (EC 2010g) ➤ Commission communication 'Strengthening Innovation in Europe's Regions: Strategies for resilient, inclusive and sustainable growth (EC 2017)

Table 1. Cross-cutting policies relevant for the bioeconomy

Realising this potential will not happen on its own. It requires investments, innovation, developing strategies and implementing systemic changes that cut across different sectors (agriculture, forestry, fisheries, aquaculture, food, bio- based industry). It means enhancing our capacity to translate opportunities from all types of innovation into new products and services on the market, creating new jobs locally. And it means doing it the European way: being economically viable with sustainability and circularity in the driver's seat.

Bioeconomy Financing Programmes

There are many Bioeconomy Financing Programmes in place that allow to finance project at different development stages, and in the third phase of the project development (3.1. Prepare for adopting and financing), the project promoter can assess the different funding types and their potential risks. The [Circular City Funding Guide](#), provides an overview of funding types that are applicable for projects at different development stages with varying risk profiles, including for example Equity, Grants, and Debt.

Figure 7 shows the many funding choices that the bioeconomy project coordinator may select based on the project's level of development.

Making a distinction between public and private financing options is crucial when determining which type(s) of funding will best support the development of the project. Applications for grants differ significantly from those for other forms of support, and this distinction must be taken into account. For instance, some of the most popular public funding programs in Europe are LIFE, Interreg: European Territorial Cooperation, Horizon 2020 and Horizon Europe, European Institute of Innovation and Technology (EIT), European Structural & Investment Funds, and Urban Innovation Actions (UIA). For a comprehensive overview the reader can refer to the list of relevant grant programmes to [Circular City initiatives](#).

Other forms of financing are typically less regulated and dependent on a financial institution. Options include addressing EU financial institutions like the European Investment Bank (EIB) or the European Bank for Reconstruction and Development (EBRD), as well as taking into account financial institutions in the private sector (e.g., banks, investors, vendor financiers).

Debt
- A contractual agreement between a borrower (project/company) and lender (often banks). The borrower pays back the loan before a specified date, usually with a specified (annual) interest rate. - Suitable for CSS from "scale-up" to "Mature" level
Equity
- Funding type in which the founder invest money for a share in a project gaining a return from dividends or sales at increased value - Suitable for CSSs from "R&D" to "Growth" level
Quasi-equity (venture debt)
- Financing instrument that combines the elements of equity and debt, and where the capital is paid back based on the performance of the project - Quasi-equity is specially applicable to (innovative) SMEs and mid-caps seeking to invest in R&D. Due to the equity component, the firm is given a more generous schedule for repayment of the loan than would be the case with a traditional loan.
Grants and subsidies
- Grants and subsidies are offered by governments as different governing levels (local, national, EU) and imply that the funder gives money to support a project stimulating necessary developments. Projects usually do not need to repay the money back, provided that the grantee complies with the contractual agreements - Especially suitable for "R&D" and "Start-up" CSS level
Alternative forms of funding
- Alternative forms of funding including: crowdfunding, lease financing, social impact bonds (SIB) and other financial instruments (e.g. green bonds, revolving loan facilities) - Especially suitable for "R&D" CSS level
Guarantee
- Loan guarantees and commitments in which a third party takes over (part of) the debt obligations in the cast the borrower defaults (i.e., fails to repay the debt). Thereby, guarantees enable financial institutions to invest in business or initiatives showing higher default risk, such a highly innovative Circular City initiatives. - Generally suitable for "R&D" and "Start-up" CSS level

Figure 7. Funding options (elaborated on the Circular City Funding Guide). Adapted from the CCRI methodology.⁵⁰

Some of the most important financing programmes at EU level are the following, check Annex IV for more information.

HORIZON EUROPE - [CLUSTER 6](#) (Food, Bioeconomy, Natural Resources, Agriculture and Environment): This cluster addresses the interlinked challenges of safeguarding the natural resource base, resilient biodiversity and ecosystem services, restoring and sustaining the health of our planet, sustainable agricultural, forest, marine and freshwater production, promoting alternatives to fossil-based economies, sustainable consumption, closing nutrient cycles, and food and nutrition security.

At its heart is the circular economy, which aims to maintain the value of land, products, materials, and resources for as long as possible through a cascade of dematerialisation and sustainable use by design, reuse, remanufacture and recycling of materials. It is an essential contribution to the EU's efforts to develop a sustainable, low-carbon, resource-efficient and competitive economy. A sustainable bioeconomy is the renewable segment of the circular economy.

The Commission has proposed that R&I priorities for Horizon Europe will be on Environmental Observation, Biodiversity and Natural Capital, Agriculture, Forestry and Rural Areas, Circular Systems, Bio-based Innovation Systems, Food Systems, and Seas, Oceans and Inland Waters. Together these priorities address key aspects and enablers within a circular and sustainable bioeconomy.

HORIZON EUROPE - [CLUSTER 5](#) (Climate, Energy, and Mobility): This clusters aims to fight climate change by better understanding its causes, evolution, risks, impacts and opportunities, and by making the energy and transport sectors more climate and environment-friendly, more efficient and competitive, smarter, safer and more resilient.

The areas of intervention consist on the following: climate science and solutions, energy supply, energy systems and grids, buildings and industrial facilities in energy transition, communities and cities, industrial competitiveness in transport, clean, safe and accessible transport and mobility, smart mobility, energy storage.

CIRCULAR BIO-BASED EUROPE JOINT UNDERTAKING: [CBE JU](#) is a €2 billion partnership between the **European Union** and the **Bio-based Industries Consortium (BIC)** that funds projects advancing competitive circular bio-based industries under Horizon Europe, the EU's research and innovation programme.

[LIFE](#) is the European Programme for co-financing projects that demonstrate or pilot solutions that tackle environmental (including circular economy, nature and biodiversity) or climate issues. The general objective of the programme is to contribute to the implementation, update, and development of effective policies and legislation in these areas. LIFE was created already in 1992 and has an active budget of EUR 3.4 billion for the period of 2014-2020. The instrument is structured in sub-programmes: one for Environment (representing 75% of the total budget) and one for Climate Action (representing 25%). Both are structured by three priority areas.

[INNOVATION FUND](#) is one of the world's largest funding programmes for the demonstration of innovative low-carbon technologies. The funding originates from credits of the Emission Trading Scheme (ETS). The Innovation Fund can be seen as one of the key funding instruments for delivering the EU's economy-wide commitments under the Paris Agreement and supporting the European Commission's strategic vision of a climate-neutral Europe by 2050.

The Innovation Fund supports cross-cutting projects on innovative low-carbon solutions that lead to emission reductions in multiple sectors, for example through renewable energy generation or industrial symbiosis. Since transitioning to a circular economy can involve energy-intensive practices, such as recycling and recovering materials, the demand for clean energy technologies will increase. The Innovation Fund can therefore contribute significantly to speeding up the circular economy transition.

Scope and Characteristics of the Bioeconomy

Definition and Opportunity

According to the EU Bioeconomy Strategy,⁴¹ bioeconomy is described as:

“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. To be successful, the European bioeconomy needs to have sustainability and circularity at its heart. This will drive the renewal of our industries, the modernisation of our primary production systems, the protection of the environment and will enhance biodiversity.”

There is strong evidence showing that the potential for continuing to develop bioeconomy opportunities is very large, and that most of the resources are still untapped, as is shown by some facts gathered by the Food, Bioeconomy, Natural Resources, Agriculture, and Environment Cluster:⁴¹

- Four of nine planetary boundaries have been crossed as a result of human activity: climate change, biodiversity loss, land-system change and altered nitrogen and phosphorus cycles.
- We are witnessing the sixth mass extinction, and loss of biodiversity. Today, 75% of terrestrial ecosystems, 40% of marine ecosystems and 50 % of freshwater streams have been severely altered.
- Agriculture and forestry cover 85% of EU territory, drive rural economies and provides € 430 billion in annual turnover in the EU.
- Food systems use 70% of our freshwater and 30% of our energy and produce over 25% of our greenhouse gas emissions. Nearly 1 billion people suffer from hunger, while 2 billion overweight people are at risk of non-communicable diseases, and one third of our food is wasted. EU food systems provide 44 million post-farm jobs, 6% of GDP and 7% of exports.
- The bioeconomy provides about €2 trillion in annual turnover in the EU, over 18 million jobs, with one million new green jobs expected by 2030, for example by developing new biodegradable products.
- Circular economy: only 10% of material input and 40% of EU waste is reused or recycled. A circular economy can generate a net economic benefit of €1.8 trillion in Europe by 2030.
- The Ocean covers 70% of the Earth's surface and provides half of the oxygen we breathe. It has absorbed a quarter of our CO₂ emissions, puts food on our plates, and hosts the greatest biodiversity of the planet. According to the most recent figures, the established sectors of the EU Blue Economy directly employed over 4 million people, generated €658 billion of turnover and €180 billion of gross value added in 2017.
- The overall environmental costs of all reactive nitrogen losses in Europe are estimated at €70-320 billion per year due to loss of air and water quality and impacts on ecosystems and human health.
- The observation and monitoring of the Planet produces terabytes of data every day that are transformed into solutions for a healthier environment and contribute to the digital economy.

According to the most recent data (2017), the EU-27 obtained 1 billion tonnes of biomass (dry matter) from primary sources. The majority was produced on EU territory from forestry (27%) and agricultural

⁴¹ https://research-and-innovation.ec.europa.eu/system/files/2019-12/ec_rtd_factsheet-food-bio-resources-agri-envi_2019.pdf

crops (50%) as well as their collected residues (9%), grazing biomass (9%), and fisheries and aquaculture (1%). The final 5% came from imports.⁴²

Secondary sources, including recycled paper, industrial by-products from forest-based sectors, and the recovery of other biowaste, contributed an additional 0.2 billion tonnes. Thus, about 1.2 billion tonnes of biomass (dry matter) were utilized overall.⁴²

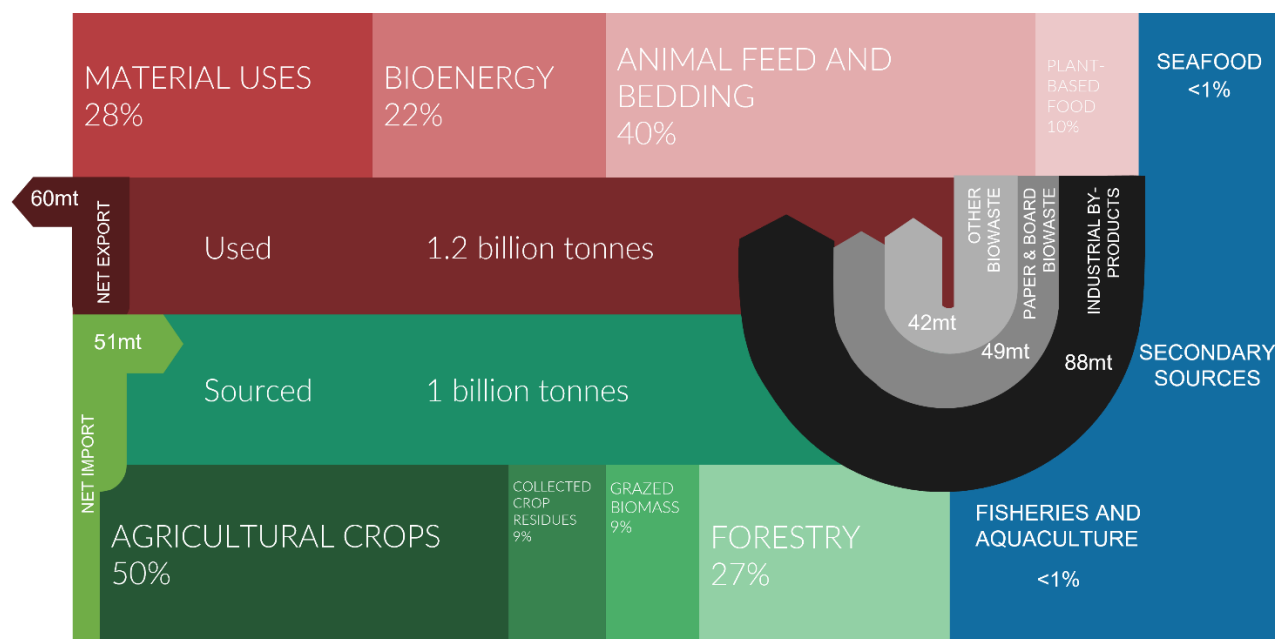


Figure 8. Biomass sources and uses in the EU-27 (based on 2017 data,⁴³ units in tonnes dry matter). Adapted from [Knowledge for policy 2022](#).

Of these 1.2 billion tonnes used, 40% of the total biomass was used for animal feed and bedding. While seafood made up less than 1% of all uses and plant-based food made up only 10%, biomass was used for 28% of its material needs and 22% of its energy needs, respectively.⁴²

According to the EU Bioeconomy Progress Report,² the increase of the use of biomass in the period 2009-2017 was in the order of 1 % for food and 10 % for non-food purposes over the past two four-year periods of available data (2010-2013 and 2014-2017). Primary⁴⁴ and secondary⁴⁵ woody biomass use has increased by 25 % and 29 % respectively in the past two decades. Energy-use of woody biomass has increased in the EU by about 12 % over the past two four-year periods of available data (2010-2013 and 2014-2017).⁴⁶ At least half of all woody biomass used in the EU for energy (49 %), and about 19 % of all woody biomass entering the industrial process for materials, is from secondary sources and post-consumer wood.⁴⁷ Although the use of the secondary woody biomass emphasises the cascading use of biomass in the forest-based industries, it could be improved by reinforcing the implementation of the cascading principle⁴⁸ and more emphasis on long-lived materials and products, for example in buildings and furniture. Such materials and products can enable the transformation of the built environment into a carbon sink rather than a source of emissions, helping to protect and expand the biosphere, stabilise the climate, and ensure human health and well-being, in line with the New European Bauhaus objectives. Moreover, in order to improve the circularity of the wood-based industries, focus should be put on the recovery and reuse of the post-consumer wood (currently 38

⁴² [Knowledge for Policy](#).

⁴³ [JRC Biomass Mandate](#)

⁴⁴ Approximately 551Mm³ Solid Wood Equivalent (SWE). https://knowledge4policy.ec.europa.eu/glossary-item/primary-woody-biomass_en, https://knowledge4policy.ec.europa.eu/glossary-item/solid-wood-equivalent_en

⁴⁵ Almost 260 Mm³ SWE. https://knowledge4policy.ec.europa.eu/glossary-item/secondary-woody-biomass_en

⁴⁶ JRC (2021). <https://publications.jrc.ec.europa.eu/repository/handle/JRC126552>

⁴⁷ JRC (2022). <https://ec.europa.eu/knowledge4policy/publication/forestry-sankey>

⁴⁸ The Cascading Principle as applied to woody biomass, is when woody biomass is used according to its highest economic and environmental value in the following order of priorities: Wood-based products; Extending their service life; Re-use; Recycling; Bioenergy; Disposal.

Mm3 SWE). In view of increasing biomass demands and a limited sustainable biomass supply, a gap in biomass availability is expected.

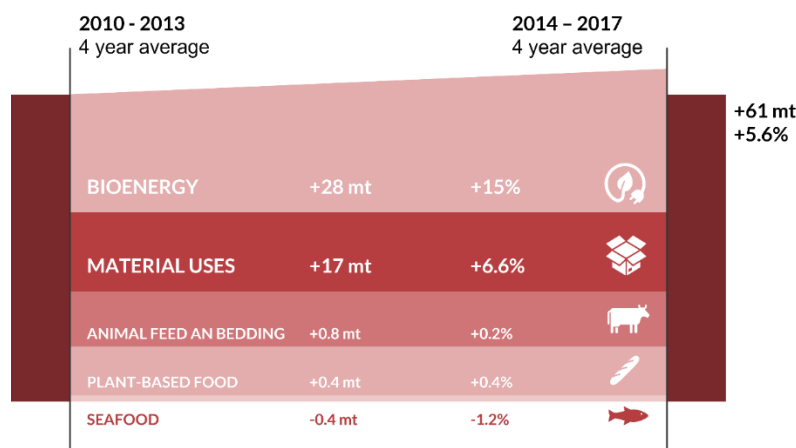


Figure 9. Biomass in the EU (dry matter). Adapted from [Knowledge for policy 2022](#)

The overall biomass use in the EU has increased by around 5.6% over two four-year periods, taking into account the averages between the periods of 2010-2013 and 2014-2017.⁴² The rise in demand for bioenergy (+28 Mtdm), followed by the rise in demand for bio-based materials (+17 Mtdm), was largely responsible for the growth in total biomass uses throughout these two years. Between the counted periods, the usage of biomass for bioenergy has increased steadily by roughly 15%. The overall increase in the utilization of biomass for material production is 6.6%.

There are rising trends in the supply of biomass from waste recovery. Over two average 4-year periods, the amount of biological waste recovered (via recycling or energy recovery) had increased by 4.1% while the amount not recovered had reduced by 35.4%. (2010-2013 and 2014-2017).⁴²

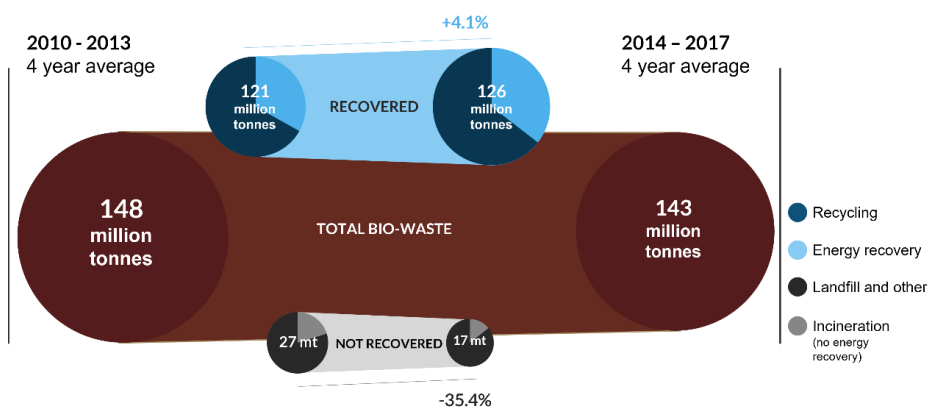


Figure 10. Biomass in the EU (dry matter). Adapted from [Knowledge for policy 2022](#).

Sectors

The sectors that have an important role in bioeconomy are the following:

- Agriculture
- Forestry
- Fishing and aquaculture (including algae)
- Food and beverages
- Bio-based textiles
- Wood products
- Paper

- Bio-based chemicals, pharma, plastics, and rubber
- Liquid biofuels
- Bioelectricity

In the EU-27, the bioeconomy sectors' ability to produce economic value has increased during the previous ten years. In fact, between 2008 and 2019, the value added of the biomass producing and processing sectors increased by EUR 143 million (Figure 11, left chart). Manufacturing of food, beverages, and tobacco saw the largest growth (+62 million euro), followed by agricultural (+34 million euro), bio-based chemicals, medicines, and plastics (+21 million euro), and paper (+11 million euro). The most dynamic industries, however, were those producing liquid biofuels and bioelectricity, which saw annual growth rates of 129% and 100%, respectively.

On the other hand, a general decline in the number of employees in the sectors responsible for producing and processing biomass is noted (Figure 11, right chart), probably due to the decrease in agricultural employment and the increase in efficiency of the production. It's interesting to note that, measured in terms of value added per employee, all industries represented saw an increase in labour productivity. The primary biomass production, mainly agriculture, provides a majority of the entire employment (54 %) but a comparative low turnover (20 %).^{2, 49}

The data also shows distinct variations among Member State groups. For instance, Poland, Romania, and Bulgaria are more prevalent in the lowest value-added sectors of the bio-based economy, which support a large number of jobs. This points to a robust agriculture sector that is more labour-intensive than those with high value-added. Western and Northern European nations produce significantly more turnover in contrast to employment, reflecting a higher proportion of reprocessing and value-added sectors. Finland, Belgium, and Sweden have the greatest ratios of turnover to employment.⁴⁹

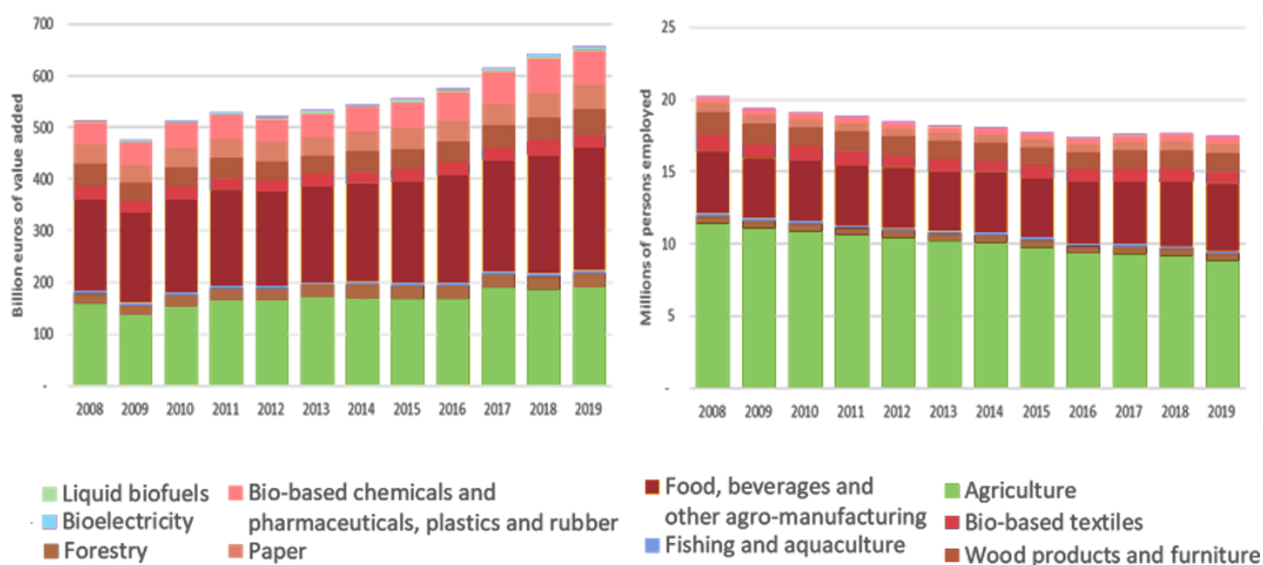


Figure 11. Value added (left chart) and employment (right chart), 2019 data for EU-27.²

According to an examination of the 2018 Eurostat data, the EU-27 and the United Kingdom's overall bioeconomy turnover, which includes food and drink as well as the main agricultural and forestry sectors, is slightly over 2.4 trillion EUR, up around 25% since 2008. About half of the revenue is generated by the food and beverage industry, followed by the bio-based industries—which include chemicals and plastics, pharmaceuticals, paper and paper products, textiles, and biofuels and bioenergy—by about 30% of the revenue and the primary agricultural and forestry sectors by almost another 20%.⁴⁹

⁴⁹ [European Bioeconomy in Figures 2008-2018](#) by Bio-based Industries Consortium.

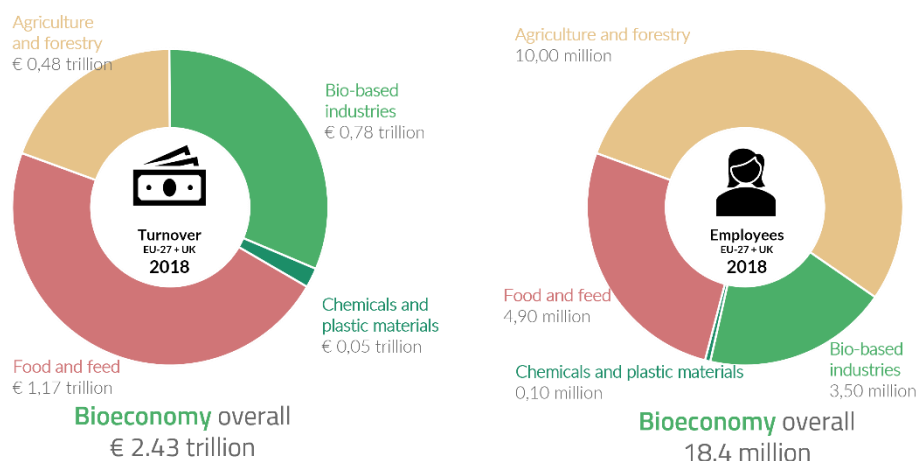


Figure 12. Overall turnover and employment of the bioeconomy and its bio-based industries in the EU-27 (+UK) in 2018.⁴⁹

The turnover development of the total bioeconomy (including food and beverages and the primary sectors agriculture and forestry) over the period 2008–2018 has increased from a total of € 2 trillion to € 2.43 trillion, with the food sector being the largest contributor.⁴⁹ About half of the 2.43 trillion Euro in 2018 (Figure 13) comes from the food and beverage sector (47 %) and 20 % of the turnover is generated by the primary sectors (agriculture and forestry). The rest is attributed to the so-called bio-based industries (which includes chemicals and plastics, pharmaceuticals, paper and paper products, forest-based industries, textiles and textile products, biofuels, and bioenergy).⁴⁹

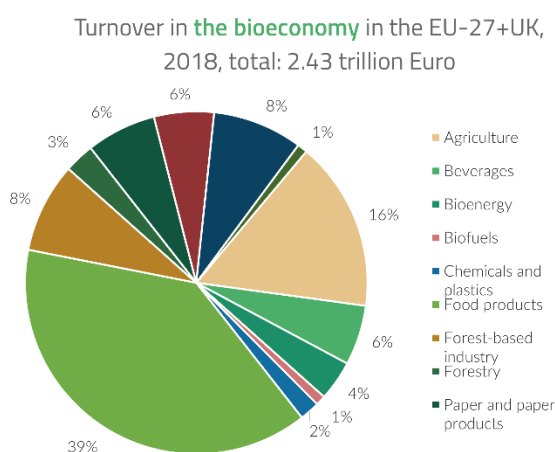


Figure 13. Turnover in the bioeconomy in the EU-27 (+UK), 2018.⁴⁹

Figure 14 displays the revenue for just the EU industrial sectors that are referred to as the "bio-based economy." According to the European Bioeconomy in Figures report,⁴⁹ biofuels and bioenergy represent for around 15% of overall revenue, or about 114 billion euro. The biggest percentages of turnover are made up by the sectors of paper and paper products (23%) and the forest-based industry (wood goods and furniture) (27%). They total roughly 387 billion euro when combined. Bio-based chemicals and plastics account for 54 billion Euro (7 %). The bio-based industries generated over 776 billion Euro in total revenue in 2018, up from approximately 600 billion in 2008.⁴⁹

The development of the turnover in the bio-based industries from 2008 to 2018 shows that the chemicals and plastics sector has increased its turnover by 68 % from 32 billion Euro to around 54 billion Euro. The pharmaceutical sector is experiencing a similar transformation, in which revenue grew from 100 billion to 142 billion Euro, a 42% rise. Other industries, including the paper industry, either saw consistent growth, like the textile sector (from 78 billion to 79 billion euro in 2018; an increase of about 1%), or very modest increases in revenue (161 billion euro in 2018 to 178 billion euro in 2018; an increase of 10.5%).²

Turnover in the **bio-based economy** in the EU-27+UK,
2018, total: 776 billion Euro

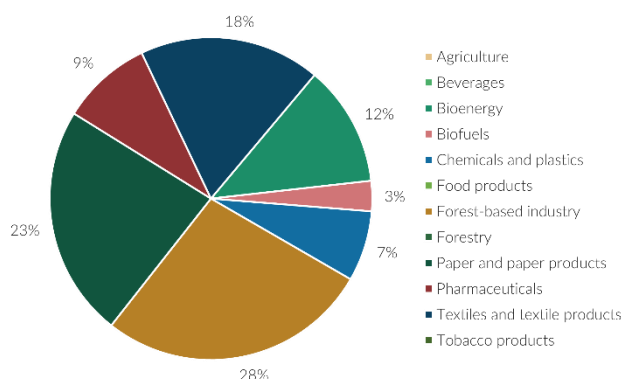


Figure 14. Turnover in the bio-based economy in the EU-27 (+UK), 2008–2018.⁴⁹

The main data source for all sectors of the bioeconomy shown in the following figures is Eurostat, more specifically the two databases PRODCOM (Eurostat 2021) and the Structural Business Statistics (SBS, Eurostat 2021a). For further information on the sources and methodology used to quantify the turnover and employment check the European Bioeconomy in Figures 2088–2018 Report by the Bio-based Industries Consortium⁴⁹ and the EU Bioeconomy Strategy Progress Report.²

Impact

It is necessary to move beyond research and innovation and have a strategic and systemic approach to the deployment of innovations to fully reap the economic, social, and environmental benefits of the bioeconomy. Such an approach should bring together all actors across territories and value chains to map the needs and actions to be taken. It will require addressing the systemic challenges that cut across the different sectors, including synergies and trade-offs, to enable and speed up the deployment of circular economy models.



Job creation

The bioeconomy already accounts for 8% of the EU's workforce. Bio-based industries **could create up to 1 million green Jobs by 2030** especially in rural and coastal areas.

Example: the local deployment of one biorefinery can create up to 4000 Jobs in four years and better recycling of high value organic waste in cities could create 1200 new Jobs in the long run



Climate mitigation and a carbon-neutral future

The bioeconomy **reduces emissions and our dependence on fossil resources.**

Example: the use of 1 ton of wood instead of 1 ton of concrete in construction can lead to 2.1 ton carbon dioxide reduction. Algae farming can be a new source of renewable biomass for food, materials and energy use.



A renewed and strengthened EU industrial base and modernised primary production

Deploying the bioeconomy across Europe with **bio-based innovation will modernise agriculture, aquaculture, fisheries and forestry, and will renew industries.**

Example: Avoiding food waste can save up to 143€ billion annually. Agri-food waste can be turned into biodegradable plastic.



Restoring healthy ecosystems and enhancing biodiversity

The bioeconomy contributes to **the UN Sustainable Development Goals** and to the **EU target of restoring at least 15% of degraded ecosystems by 2020.**

Example: up to 12 million tons of plastic are dumped in our oceans every year, but with bioeconomy this amount can be reduced by 90% by 2025.

In 2019, 17.42 million people were employed by the production of biomass and its conversion into foods, beverages, manufactured bio-based goods, liquid biofuels, and bioelectricity, which adds € 657 billion in value (Figure 15). Therefore, these bioeconomy sectors account for 4.7% of the European Union's GDP and 8.3% of its labour force. Agricultural production and the production of food,

beverages, and tobacco accounts for 65% of the total value added produced by the aforementioned industries. Tobacco products, bio-based textiles, bio-based clothing, leather, paper, and wooden products, as well as bio-based chemicals, pharmaceuticals, plastics, and rubber, are all examples of products that are manufactured using bio-based materials.²

		EMPLOYMENT (MILLION JOBS)	VALUE ADDED (BILLION JOBS)	VALUE ADDED (SHARED TOT)	
	AGRICULTURE	8.8	193	29%	
	FORESTRY	0.5	25	4%	
	FISHING AND AQUACULTURE	0.2	6	0.9%	
	FOOD SEVERAGES AND OTHER AGRO MANUFACTURING	4.7	237	36%	EMPLOYMENT (MILLION JOBS) 17.4
	BIO-BASED TEXTILES	0.8	25	4%	
	WOOD PRODUCTS AND FURNITURE	1.3	50	8%	VALUE ADDED (BILLION JOBS) 657
	PAPER	0.6	48	7%	
	BIO-BASED CHEMICALS AND PHARMA- CEUTICALS, PLASTICS AND RUBBER	0.5	65	10%	
	LIQUID BIOFUELS	0.03	3	0.5%	
	BIOELECTRICITY	0.03	5	0.8%	

Figure 15. Employment and value added generated in the biomass producing and manufacturing sectors in the EU-27.²

The biomass producing and converting sectors contribute tremendously to the economy of the EU and its Member States:

- The biomass producing and converting sectors of the EU bioeconomy created up to EUR 657 billion of value added and employed 17.4 million people in the EU-27 in 2019.
- These values represent 4.7% of the EU's gross domestic product (GDP) and 8.3% of its labour force.
- The labour productivity has been steadily growing over 2009-2019, especially in the agriculture sector, but significant differences exist amongst sectors and Member States.
- The concentration of the national labour markets in the bioeconomy also differs across Member States.
- Since 2008, the bioeconomies in the EU Member States have been following different trajectories in terms of jobs and growth. While the labour productivity has generally increased in the EU, the productivity gap between distinct groups of Member States is widening.

Figure 16 shows the evolution of employment for the entire bioeconomy from 2008 to 2018, expressed as a percentage of all employees, demonstrating unequivocally that, in contrast to total turnover, total employment in the EU bioeconomy is decreasing. The agricultural sector's fall, which is brought on by this sector's growing optimisation, automation, and digitalization, is the main driver of this decline in employment across the entire bioeconomy. Like the pharmaceutical industry, other industries have maintained or even gained employment. 18.4 million people were employed across the board in the EU bioeconomy in 2018.⁴⁹

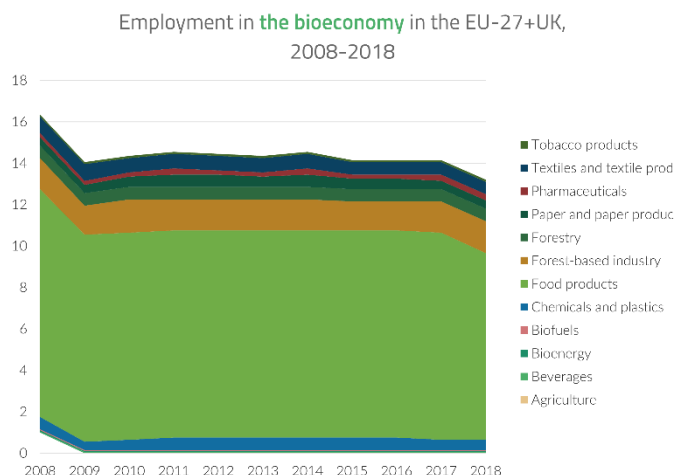


Figure 16. Employment in the bioeconomy in the EU-27 (+UK), 2008–2018.⁴⁹

Figure 17 shows on the left the employment statistics for the bioeconomy in 2018 and reveals that the so-called main sectors (agriculture, forestry, and fisheries) account for over 50% of all jobs created in the sector (10 million employees). With 4.9 million workers (26%), the food and beverage industry come in second. Nearly 20% of the remaining jobs are in the bio-based industries (3.5 million employees).⁴⁹ Only including employment in bio-based businesses, there were 3.5 million jobs overall in 2018. With 45% of all jobs coming from forest-based industries, textiles account for 20% of all jobs, and paper and paper products account for 17% of all jobs (Figure 17).⁴⁹

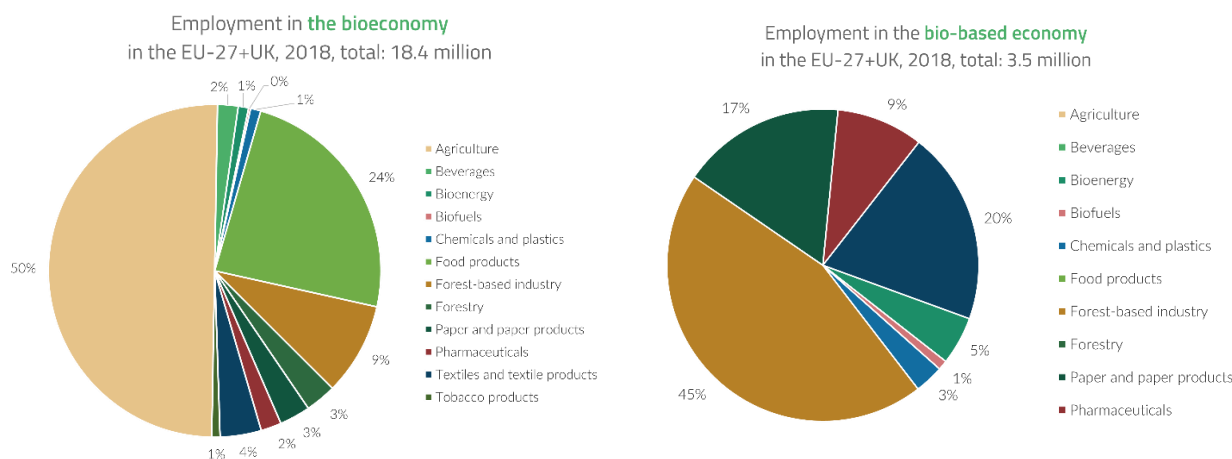


Figure 17. Employment in the bioeconomy in the EU-27 (+UK), 2018 (left). Employment in the bio-based economy in the EU-27 (+UK), 2018 (right).⁴⁹

Key Stakeholders

Successful stakeholder knowledge and engagement is key to develop bioeconomy projects from a systemic approach to maximise regional impact. It is important to involve them in the decision-making process from the beginning of the action, to engage a wider range of stakeholders in order to carry out joint collaborative action and align their interests and objectives.

The stakeholders' groups and interactions model shown in Figure 18 are based on the model used by the Circular Cities and Regions Initiative Methodology: the Circular Economy-Centric Quintuple-Helix Model,⁵⁰ which shows the necessary actors to trigger innovation. Stakeholders are represented by separate helices for academia, industry, and public administration, respectively, while civil society acts as the overarching helix.

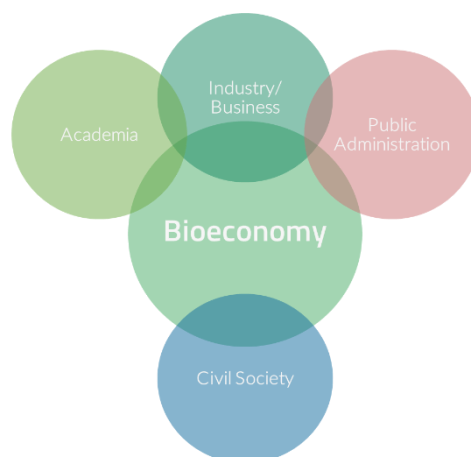


Figure 18. Bioeconomy systemic solutions arise from the intersection of the different stakeholder groups. Adapted from CCRI Methodology.⁵⁰

ACADEMIA and technological organisations contribute to developing and bringing innovative technological research to the industries to facilitate and enable the novel bioeconomy solutions in the different sectors to be able to maximise biomass utilisation.

A barrier sometimes can be transferring the knowledge in the academia, where many technologies at TRL 6-7 can be found, to the market. Therefore, it is important to establish strong relationships and long-term communication channels aimed at sharing know-how and selecting effective ways to introduce innovative products/services. This role can be taken by bioeconomy facilitators, the public administration, NGOs, and industries, to keep track of all technological developments taking place at regional and European scale.

Some actions that could be taken into place are bottom-up initiatives or policy advocacy actions in a range of sectors, to raise awareness for citizens and businesses, and carry out capacity-building programmes on circular economy and bioeconomy practices, as well as Best available Techniques Reference Documents (BREFs) Reports.

Examples of existing networks to enable knowledge sharing, providing capacity-building and cross-sector opportunities, to bring together different types of stakeholders are the [European Circular Economy Stakeholder Platform](#), the [Knowledge Centre for Bioeconomy](#), the [Circular Cities and Regions Initiative](#), [ICLEI](#) (Local Governments for Sustainability), [ACR+](#) (Association of Cities and Regions for Sustainable Resource Management), and the [Council of European Municipalities and Regions](#).

INDUSTRY and BUSINESS have a critical role in the deployment of bioeconomy projects in the specific regions and cities. Businesses and industries that shift towards more sustainable and circular business models pull the green transition and can have a high environmental benefits and large profitability.

Both large industries and SMEs can contribute by implementing resource efficiency measures, producing more environmentally friendly consumer products, by using renewable energy sources, and adopting circular economy actions such as valorising their waste and by-products, and utilizing renewable resources as inputs to their processes.

Transition to circular business model based on bioeconomy also implies changes to the supply chain, opening collaboration possibilities to create synergies between industries and sectors. Therefore, both **Industrial and Energy Symbiosis** take an important role in finding innovative ways to re-use and valorise

⁵⁰ Circular Cities & Regios Initiative – [Methodology for the implementation of a circular economy at the local and regional scale](#)

industrial by-products as inputs in other industries. To create synergies within the different actors and increase business collaborations, in the last years there has been several strategies and partnerships in place to promote the role of the **Industrial Symbiosis Facilitators**. In this context, one of the key elements of the Processes4Planet⁵¹ Partnership Strategic Research and Innovation Agenda are the Hubs4Circularity12 (H4Cs).⁵² Under these Hubs, the European Process Industries are joining forces with regions and cities to support the action plan announced in the European Green Deal, bringing European Process Industries at the core of CE, and will focus on the deployment of industrial symbiosis and industrial-urban symbiosis. Other examples are the [H2020 INCUBIS Project](#) which has developed the INCUBIS Digital Platform that provides a working environment assisting the energy symbiosis facilitator along each stage of energy symbiosis project lifecycle building capacity at individual, organizational, regional, and European levels to lift key systemic barriers. In concrete terms, The INCUBIS Digital Platform enables: i) to train stakeholders on methods and tools (Density map, Waste Heat Potential Map, Ranking of best potential ESI partners), ii) to facilitate delivering energy symbiosis projects (Synergies matchmaking and Project management tool), iii) to present standards and best available techniques (Webinars, Training, Mentoring, Best practices) and iv) to build capacity of investors by proposing an investor-oriented taxonomy of energy symbiosis (Investments and Funding portal). Moreover, the [SYNER platform](#) developed by Simbiosy acts as a hub for industrial symbiosis as well as offering cities and companies the tools, and the information and knowledge generated in each of these projects to facilitate coordination and networking.

PUBLIC ADMINISTRATION plays a crucial role in supporting and accelerating the transition towards solutions based on bioeconomy, by implementing and updating policies, regulatory frameworks, legal standards, and enforcement policies. Public administrations can act as an active agent, actively stimulate business activity, and promote circular consumption models. They can directly implement and facilitate bioeconomy strategies by directly intervening in territorial planning, the building and construction sector, mobility/transport, and waste management.

Moreover, they can also bring together key activities in a specific place and optimise the flow of materials and products and create financing schemes for different bioeconomy and circular economy actions is also a good way of actively intervening in the bioeconomy deployment.

Through a variety of initiatives, local governments can actively assist firms in implementing circular business models. First, by making sure that there is a structure that allows for increased circularity. This entails reducing red tape, modifying regulations, as well as fostering more collaboration between businesses and the public sector. Second, business representatives and small firms should be directly included in the development of the bioeconomy strategy for the city or region by policymakers. Thirdly, the successful implementation of bioeconomy depends on cooperation through public-private partnerships (PPPs). Moving toward a circular economy, according to the Ellen MacArthur Foundation, "offers a unique possibility for firms and politicians to collaborate accelerate specific business prospects while at the same time helping to achieve wider societal goals." Additionally, local governments can establish incubators and research and development (R&D) programs that can assist creative enterprises in creating circular business models by gaining access to funding, collaborating, and improving their capabilities.

Additionally, local governments have a big influence on changing consumption patterns to be circular. The use of circular public procurement is conceivably the most effective method to achieve this result. Public procurement that is circular must encourage products and services that have less of an impact on the environment and fully guarantee that resources can join the economy again. In order to determine how they may aid in the adoption of circular products, local governments should analyze

⁵¹ Processes4Planet Partnership is a European co-programmed public-private partnership established between A.SPIRE – as the private entity – and the European Commission in the context of the Cluster 4 (Digital, Industry and Space) of [Horizon Europe](#) funding programme <https://www.aspire2050.eu/p4planet/about-p4planet>.

⁵² [https://www.aspire2050.eu/p4planet/hubs4circularity: A new flagship initiative – Hubs for Circularity' Concept, opportunities & challenges for successful implementation \(europa.eu\)](https://www.aspire2050.eu/p4planet/hubs4circularity: A new flagship initiative – Hubs for Circularity' Concept, opportunities & challenges for successful implementation (europa.eu))

their public procurement procedures. Creating awareness campaigns to increase consumer acceptance of circular products and supporting product standards and certifications for goods made from recycled materials are two more policies that might be used to promote circular consumption models.

CIVIL SOCIETY has an important role in modifying consumption habits and pushing the transition from linear to circular economy, and the relationship between consumers and producers will be significantly altered by the adoption of circular business and industries.

There are many ways in which civil society can play a role in promoting bioeconomy implementation, for example by facilitating the circularity of materials, where the recycling industry depends on consumers for the collection of recyclable materials, and municipalities and regions can take different actions to incentivise the collection of materials. As well as in demanding more sustainable and bio-based products.

Moreover, in the reuse and redistribution models as well as the repair and maintenance ones, consumers are directly involved in the value co-creation process with corporate actors. Users must take their items to repair facilities or send damaged components to a collection location in order to maintain them. Alternately, they must request that service providers who can handle reverse logistics activities pick up damaged or used merchandise. In this way, consumer willingness to fix the damaged components affects how long a product lasts. In the reuse and redistribution models, consumers must send used clothing or other things back to be repaired. Then, these goods might be sold again in the secondary market.



BOOST

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bioeconomia

Bioeconomy Project Development Methodology and Best Practices

02

Bioeconomy Project Development Methodology

The standard stages of the bioeconomy project lifecycle represented in this report are based on and summarised from the Circular Cities and Regions Initiative Methodology,⁵⁰ in which they have already designed a guideline for project promoters, policy and decision-makers operating at various levels of local and regional governance, who may be willing and competent to promote the development and implementation of circular economy initiatives and projects as well as the development of circular economy systemic solutions within their respective territories.

The BioBoost project is part of the CCRI stakeholders as a [CCRI Project](#) and as project promoters in the region of Catalonia we will put this methodology in practice and follow their best practices and recommendations to operate the **Bioeconomy Project Accelerator** office.

Their proposed methodology is divided into three phases that define a tiered approach to generate relevant knowledge-based decision-making from early stages until the implementation of concrete projects. Moreover, the methodology suggests for each phase the needed inputs, possible assessment and governance tools and guidance as well as expected outcomes for proceeding with further decision-making.

The CCRI Methodology distinguishes three phases:

1. **MAP:** understand the local context and stakes
2. **DESIGN:** prioritise intervention areas, define and evaluate a **Circular Systemic Solution (CSS)** project
3. **IMPLEMENT:** identify funding and get the CSS in motion.

The CCRI Methodology aims at ensuring a decision-making process that is based on the following principles and values, and has designed an impact monitoring and evaluation process based on them:

- scientific, environmental, economic, and social evidence
- evaluation of the cost/benefit balance based on local factors, including environmental and societal impacts
- the involvement of multiple actors to ensure a systemic and inclusive approach to decision-making
- transparency and traceability.

The CCRI Methodology is based on a four-year collaboration led by the Coordination and Support Office with the European Commission and the members of cities and regions selected as Pilots. It also draws on feedback from the wider CCRI network, including CCRI Fellows, Projects and Associated Partners, received during CCRI dedicated events - i.e., webinars, coordination, and support workshops.⁵⁰

The CCRI Methodology has been built in two stages. The first building process is based on past and current efforts aimed at providing actionable guidance for the diffusion of the circular economy, where more than 50 documents were reviewed, including toolkits, methodologies and guidelines in order to consolidate the state-of-the-art of CE implementation guidance. The result of this review is a comprehensive methodological framework which serves as the main reference/guidance within the CCRI laboratory to help the pilot groups develop and implement CEAPs and CSSs, including the respective Circular Economy Investment Plans (CEIP).⁵⁰

The second building process aims at improving and adapting the methodology according to the needs of the pilot groups during the four years of the CCRI-CSO term. In this period, the methodology will be iteratively applied, tested, and upgraded through collaboration with Pilots and feedback from the

Advisory Panel of CCRI-CSO, via feedback loops from the CCRI stakeholders (Pilots, Fellows, Projects, and Associated Partners). Therefore, the CCRI stakeholders will implement the actions and tools presented in the methodology and through working groups and tailored support activities they will give feedback to the CCRI-CSO, and the CCRI-CSO will follow-up on the outcomes of the self-assessments conducted by the different pilot groups⁵⁰

To learn more about the CCRI Methodology building process please refer to section 4.2 of the CCRI Methodology document.⁵⁰

Therefore, the CCRI Methodology will be applied to operate the BioBoost Bioeconomy Project Accelerator and collaborate with the CCRI-CSO providing feedback. In a future BioBoost report “**Accelerator Operational and Monitoring Plan Dossier**” we will adapt the methodology to make it specific for the needs in the Catalonia region and to bioeconomy projects, by: 1) expanding the methodology to define the architecture and operating procedures of the Accelerator, 2) defining the application and evaluation process and how resources are allocated to these projects, in particular establishing an Request for Proposals terms sheet that will establish a clear and transparent methodology for selecting projects, and 3) defining the suit of PDA services, delivery partners, costs, and selection criteria.

The terminology used by the CCRI methodology has been adopted, and we have considered in this report that a bioeconomy project lies within what is it considered a Circular Systemic Solution (CSS), therefore, when the term CSS is used, it includes Bioeconomy Systemic Solutions as well. We have summarised only the phases that apply specifically to bioeconomy projects, and for more detailed information please refer to the CCRI Methodology.

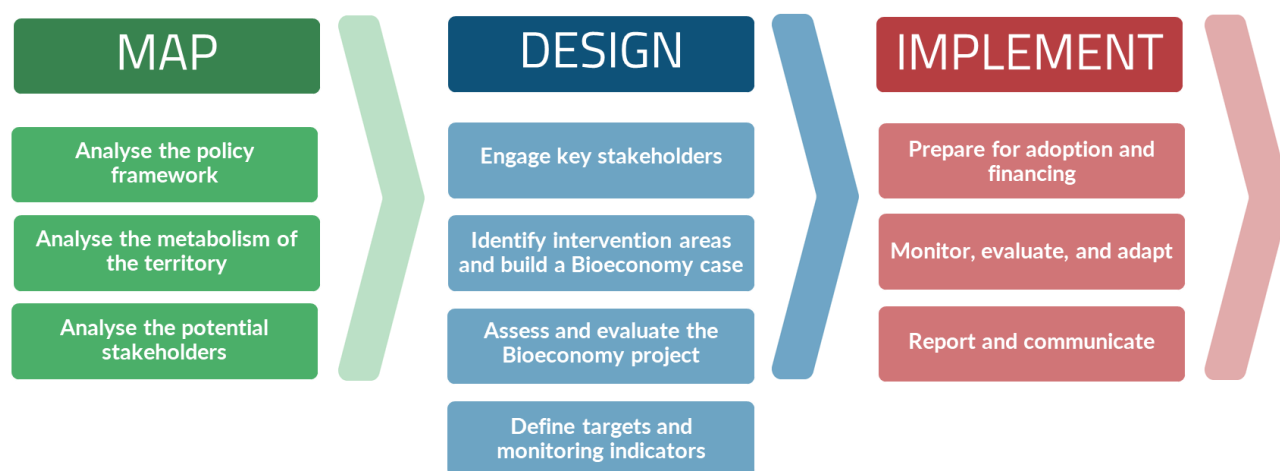


Figure 19. CCRI Methodology overview.⁵⁰

1. Map

Effective circular solutions are built on a solid understanding of the local environment. Since the circular economy and bioeconomy largely focus on material flows and stocks, devoting time and resources to obtaining a thorough understanding of the local metabolism will help define a bioeconomy solution later on and ensure its successful implementation. To guarantee that a bioeconomy solution is in line with general local goals, it's crucial to accurately analyse local development policies in addition to the examination of material flows and stocks, as well as analysing all potential stakeholders that need to be engaged to successfully implement the solution.

This section summarises the key objectives, activities, and outcomes described in the CCRI Methodology, to read in more detail about the different steps please refer to their Guideline.⁵⁰

1. MAP			
PHASE	OBJECTIVES	TASKS	OUTCOMES
Analyse the policy framework	Generate a broad understanding of the landscape of existing CE related policies and financing opportunities.	Review of existing policy, regulation and institutional landscape. Find out about the current circular activities and initiatives by stakeholders in the city and who is involved.	Local strategies and policies affecting the project development identified. Regulatory barriers and policy gaps identified.
Analyse the metabolism of the territory	Assess the baseline circularity of the territory (resource consumption and waste generation flows). Gain a systemic understanding of circularity perspectives at the local level.	Analysis of the territory: map the socio-economic context and the urban metabolism, collect historical data on material/waste to represent and grasp the spatial and volumetric realities of the territory.	Database of quantified material flows, waste generation and treatment streams based on production activity and geo-localised.
Analyse the potential stakeholders	Map key stakeholders, including civil society, and start defining a regional stakeholder group.	Stakeholder mapping: identify key stakeholders related to the material/waste flows. Assess needs, challenges, problems and potential engagement mechanisms. Determine how they can participate in the project and provide their knowledge.	List of stakeholders to be engaged, identification of their interests and roles, and specific engagement strategies. Synergies, barriers, and enablers evaluated

Figure 20. Phase I – Objectives, tasks, and outcomes for mapping policies, resources, and stakeholders in the region. Based on CCRI Methodology.⁵⁰

1.1. Policy framework analysis

Understanding the current policy landscape's advantages and potential growth areas enables more focused identification of pertinent policy interventions and early involvement of stakeholders in a discussion to determine which general categories of policy interventions might be appropriate for the city or region. Such a conversation can make clear potential future policy adjustments, which are crucial to take into account when creating new policy interventions.

To determine the objectives and measures from public administrations that could be taken into consideration to support circular economy projects, an evaluation of the current regional and/or local policy and institutional situation is required. On the other hand, a policy framework analysis can aid in identifying policy goals that may restrict or impede possible bioeconomy and circular economy activities that need to be taken into consideration.

To analyse the policy landscape the following six policy intervention categories can be studied, taking into consideration if there are potential additional interventions can complement/improve the existing ones, or if new interventions should be anticipated to address particular policy areas.⁵⁰

- i. Education, information, and awareness: integration of circular economy and bioeconomy into university and schools' curricula, public communication and awareness campaigns.
- ii. Collaboration platforms: public-private partnerships with business, promotion of industry collaboration platforms, cross-sectoral initiatives, promoting R&D programmes.
- iii. Business support schemes: financial support to business, technical support, advisory, capacity building and demonstration of best practices,
- iv. Public procurement and infrastructure: green public procurement, sustainable finance.
- v. Regulatory framework: regional strategies, associated targets on resource productivity, decarbonisation, and circular economy. Product and waste regulations.
- vi. Fiscal framework: VAT or excise duty reduction for circular products and services.

The main policy sectors to be analysed where there is potential to introduce direct public interventions related to bioeconomy initiatives are the following: land use and spatial planning, built environment and construction, water and waste management, and transportation and mobility.

In particular for the BioBoost Project during the first 12 months of the project (June 2022 to May 2023) the Catalan Bioeconomy ecosystem is being analysed, as well as the legal and regulatory barriers to bioeconomy in Catalonia. The first report (D1.2) will include the finding of research related to the bioeconomy in Catalonia, covering features, stakeholders, policies, case studies and financial instruments, and the second report (D1.3) will include the legal and regulatory barrier/challenges to bioeconomy development in Catalonia. Therefore, the BioBoost Bioeconomy Project Accelerator will analyse, implement, and complement all activities being currently performed.

This in-depth analysis of the bioeconomy environment in the Catalonia Region will be used for all the projects to which BioBoost will provide the PDA services, and when necessary, a more specific analysis will be conducted for more specific topics if the project has more specific barriers.

1.2. Territorial metabolism analysis

First of all, it is important to try to quantify the baseline levels of the city or regions where the bioeconomy project is taking place. The CCRI Methodology, in line with the EC Circular Economy monitoring framework, classifies the indicators into six circularity areas (see also Annex I for more detailed description and examples of the indicators):⁵⁰

- i. Production and consumption: municipal and industrial waste generation, virgin material extraction per capita, energy consumption, share of renewable energy, GHG emissions by sector, food losses, resources productivity, etc.
- ii. Waste management: recycling, incineration, and landfill rate, etc.
- iii. Secondary raw materials: circular material use rate, end-of-life recycling input rates, trade in secondary raw materials, etc.
- iv. Competitiveness and innovation: direct jobs, value added generation by sector, related patents.
- v. Socio-economic characterisation: GDP per capita, population density, economic structure, etc.
- vi. Indicators that inform on the state of implementation of the bioeconomy or circular economy solution.

Afterwards, for each project a material and energy flow analysis are necessary. The flows of materials entering the system (such as imports of materials from other areas or withdrawals from the natural environment), as well as how they are consumed (such as energy, biomass), transformed (from raw materials to manufactured goods), accumulated (such as buildings), or discarded (i.e., waste) in the studied system.⁵⁰ At the BioBoost Project Accelerator Office this will be done with the [SYNER Platform](#), that Symbiosis has developed, to identify resources and build industrial synergies in the studies region.

The key objectives are the following:

- provide scientific-based evidence for identifying the key material streams which should be addressed in the design phase.
- identifies 'hidden' flows which are often disregarded.
- supports the creation of future scenarios for evaluating and prioritizing.
- supports the identification of key stakeholders, as it provides a systematic way of mapping and organizing stakeholders.

1.3. Stakeholder's analysis

In the context of the CCRI, stakeholders refer to "people and organisations having a direct or indirect interest in circular systemic solutions and participating in activities making these possible". Due to the systemic nature of circular and bioeconomy solutions, decision-makers involved in project design and implementation must push themselves to include as many actors as possible in the decision-making

process to provide public policies with a variety of viewpoints. This will help to establish the foundation for public accountability and ensure an interdisciplinary dialogue between disciplines and sectors.⁵⁰

Prior to direct engagement, which in the CCRI Methodology represents the first step in the Design phase, key stakeholders should be identified by answering strategic 'who', 'what', 'how' and 'when' political questions related to the reasons why each stakeholder is important for the project and, at the same time, the benefits stakeholders could gain from collaborating in the project activities. This would make it possible to become aware of the interest of the stakeholders and, therefore, to guarantee an active and constant involvement of the interested parties.⁵⁰

The primary objective of the stakeholder analysis is to begin developing a stakeholders' engagement plan (SEP), a living document that is constantly updated throughout the project and defines and monitors the governance of the stakeholders' engagement process in terms of planning, managing, and monitoring of the activities and commitments of interested parties. To define the SEP, three processes can serve as the foundation to make it easier to identify and choose the key involved parties:

- i. preliminary mapping of stakeholder's actors
- ii. analysis of stakeholder's initiatives, interests, and power
- iii. selection of key stakeholders and definitions of mechanisms to engage

For a more detailed description on how to identify stakeholders and characterise them, please refer to the CCRI Methodology.⁵⁰

2. Design

The Design phase mostly relies on the information generated in the mapping phase where a database informing on the metabolism of the territory should have been created. On the basis of this, additional ad-hoc and detailed evaluations of particular material flows or value chains will be performed. Overall, the Design phase's activities are intended to produce the data and knowledge needed for an **Action Plan**, which should elaborate on the specific steps that will be taken to achieve the goals set by the involved stakeholders. Therefore, the main goal of this phase is to develop an Action Plan that includes:⁵⁰

- the ambitions (objectives) of the city or region;
- actions needed to address each objective;
- how CE actions (or the CSS) fulfil strategic objectives;
- the timeline for the action's implementation;
- who will be responsible for actions implementation;
- expected impacts of the actions;
- a KPIs scoreboard that allows to monitor CSS implementation.

2. DESIGN			
PHASE	OBJECTIVES	TASKS	OUTCOMES
Engage key stakeholders	Consolidate stakeholders' group. Develop Stakeholder Engagement Plan.	Stakeholders' engagement actions: advisory sessions, capacity building initiatives, agreements, collaborations, workshops, interviews, newsletters, presentations, etc.	Stakeholder Engagement Plan – including commitments and roles, the agenda of stakeholders' events and the engagement mechanisms agreed.
Identify intervention areas and build a Bioeconomy case	Identify key intervention areas considering drivers, risks, and barriers, and establish mechanisms to overcome them.	Identification of intervention areas aims to solidify what actions can be implemented considering the drivers, barriers and priorities of the local territory.	Definition of the Bioeconomy case – choose sectors and areas of intervention, list of actions to be implemented. Development of an Action Plan specifying objectives, actions, responsible actors, impacts, and KPIs scoreboard.
Assess and evaluate the Bioeconomy project	Build a CSS in conjunction with stakeholders, assess and evaluate CSS economic, social and environmental impacts.	Assessment and evaluation of the project to ensure it is viable as a whole and that the expected impacts (economic, environmental and social) are positive. Scenarios' assessment to define medium and long-term goals.	Assessment and evaluation of the project, including viability and life cycle based expected impacts.
Define targets and monitoring indicators	Develop an action plan to get the CSS in motion, including the schedule of required activities, clear objectives and performance indicators.	Definition of a set of KPIs to be monitored.	The definition of a KPIs system is the last step of the Design phase and it aims to define a monitoring framework for the evaluation of the CSS over time.

Figure 21. Phase II – Objectives, tasks, and outcomes to design the bioeconomy solution and engage stakeholders. Based on CCRI Methodology.⁵⁰

2.1. Stakeholders' engagement

The systemic nature of the shift to circular bioeconomies in cities and regions necessitates the work and participation of numerous stakeholders who talk, argue, collaborate, and establish the framework requirements and incentives for creating synergies. This variety of stakeholders represents a source of thoughts, viewpoints, and effort that must be utilized. However, it's crucial to remember that the various parties participating in circular bioeconomy solutions typically have a variety of, and sometimes conflicting, interests and objectives. Determining the processes or dynamics that will best include each group of stakeholders is crucial from the outset. In order to carry out joint collaboration efforts and ensure the participation formulation of new policy actions, including the identification of more pertinent and demanding opportunities, effective and active engagement will be necessary.⁵⁰

Activities to engage stakeholders in the development of a circular economy initiative aim to provide a basis for informed decision-making by offering chances for communication between the individuals and/or organisations executing the initiative and its stakeholders. There are numerous ways to involve stakeholders, and each project developer should investigate and choose the best options for their particular situation. Salvioni and Alici (2020) provide a classification of engagement forms based on the intended level of engagement (low, medium, high), and the kind of relationship as a viable framework to determine the precise stakeholder engagement approach for circular economy activities (short, medium or long-term). Figure 22, Stakeholders' Engagement Methods, summarizes this.⁵⁰ It is also important to choose the most adequate engagement method for each stakeholder group (local authority, industry, business, academia, civil society), and the level of influence and interest of each stakeholder. For each group, a set of communication channels and engagement mechanisms will be determined in the SEP.

The SEP should clearly define the following items:⁵⁰

- Stakeholder list, including contact person and preferred communication channel.
- Project phase: the identified stakeholders for each CSS project phase.
- Interest level: the stakes identified for each stakeholder. It highlights how the stakeholders' interests overlap with the CSS project, their goals and why they are interested.

- Influence level: the power to stop, change or accelerate the CSS.
- Engagement approach: the strategies for engaging each stakeholder. It should describe the frequency and forms of communication – e.g., daily, weekly, or monthly emails, phone calls, or face- to-face meetings. Additionally, the content of the communication – e.g., design information and project progress – should also be highlighted.

	Short-term nature	Medium-term nature	Long-term nature
Low engagement level	Passive engagement (communications through the media, newsletters and project websites)	Monitor (communications and advice from certain stakeholder, for example, through targeted interviews)	Advocate (continuous advocacy efforts to certain stakeholders)
Medium engagement level	Inform (direct communication with the stakeholder, including through conferences and presentations)	Transact (medium-term engagement through specific agreements and collaborations)	Consult (regular consultations on key issues through focus groups, meetings and workshops)
High engagement level	Negotiate (punctual engagement on a specific issue to reach a consensus)	Involve (joint learning and advice through forums, advisory sessions and consensus-building initiatives)	Collaborate and empower (joint learning and decision-making, the stakeholder plays critical role in shaping the initiative)

Figure 22. Stakeholders' Engagement Methods. From CCRI Methodology.⁵⁰

2.2. Identify intervention areas and build a Bioeconomy solution

A value-chain approach enables the identification of hotspots and the tailoring of associated actions based on already known information and data. It offers a framework that can be used to many industries, goods, and geographic scales and aids in the identification of the factors that influence how various industries' value chains function.

Over the past years several approaches have been proposed to identify and prioritise intervention areas for circular solutions, and the CCRI Methodology has proposed an approach for the selection of key intervention areas based on a **value-chain approach** promoted by the Circular Economy Action Plan and the United Nations Environment Programme. See Annex III for more information on existing approaches and tools to identify intervention / opportunities areas.⁵⁰

A value chain is a collection of economic activities, including the procurement and supply of raw materials, the production of the product during its useful service life, and its distribution and consumption, that add value to or receive value from the design, manufacture, distribution, retail, and consumption of a good. In this view, the value chain includes all phases of a product's life cycle, from the provision of raw materials through disposal following usage, as well as the pursuit of value-adding activities like business strategies, financial investments, and legislative oversight. The actors carrying out the activities and the stakeholders who potentially affect the activities are also included in the value chain. Thus, the value chain includes not only the physical activities, such as farms and industries, but also the business models and the methods used in the creation, marketing, and distribution of the products.⁵⁰

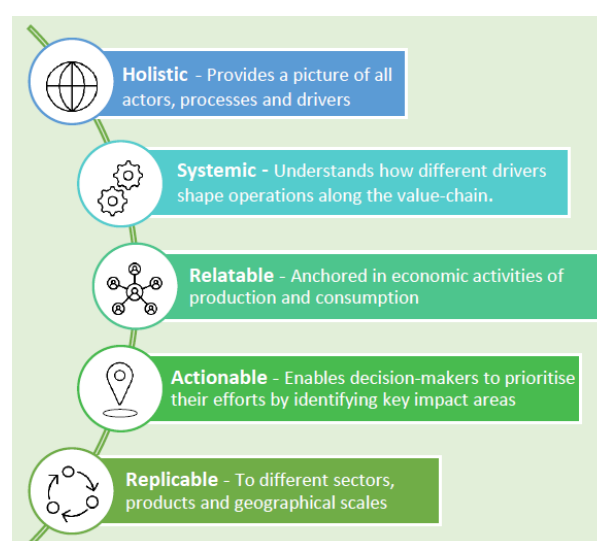


Figure 23. Five value-adding features of the value-chain approach. From the CCRI methodology.⁵⁰

The value chain approach uses a systems perspective to identify the factors and constraints that affect how value chains in various industries function, taking into consideration the complicated factors and feedback loops that determine and affect the actions and behaviours of actors along the value chain. The value-chain method finds the most promising solutions and establishes a clear agenda for concerted efforts that can transform the system by including all actors along the value-chain.⁵⁰

The value-chain method determines where the biggest potential for improvement exist and shapes appropriate actions by building on the knowledge already present and the data already available.⁵⁰

By using a value-chain approach, it is possible to locate hotspots and create actions based on knowledge already in existence and information already at hand. In this instance, the analysis of the territory, including resource and waste flows, major stakeholders, and regional policies, will serve as the primary source of data and information. In other words, it promotes the comprehension of the systematic drivers and barriers along the value-chain by analysing the available data and information through the lens of value-chain economic operations. For instance, the first phase – to Map - may have revealed the value-chain segments where the majority of the impacts and uses of natural resources take place. It does not follow, however, that the solutions can only be sought in those industries. Applying a systems lens is crucial to get above silos and isolated analysis and toward understanding how several forces might collaborate to create a bioeconomy solution along the value chain and across various economic activities. Institutions, rules, markets, technology, and other socioeconomic and cultural factors are Circular Systemic Solution (CSS) and bioeconomy solutions drivers that also affect how value-chain processes are carried out.⁵⁰

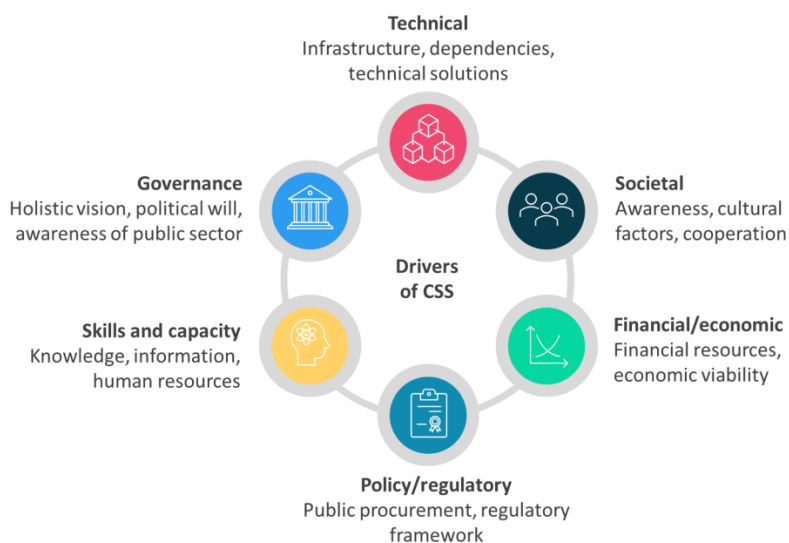


Figure 24. CSS and bioeconomy solutions drivers. From the CCRI methodology.⁵⁰

The value chain's drivers and value chain structure affect an actor's amount of influence, power, and contribution to CSS and bioeconomy solutions. Each of the drivers has an impact on how the solution is shaped, how players behave throughout the value chain, and what options are open to them. Additionally, each of these factors represents a potential area for intervention to favorably influence the sector's operations and the actions of value-chain participants. The data produced by the Map phase should be analyzed and discussed in this phase in accordance with three essential steps:⁵⁰

- i. Understanding and selecting main product value-chains in the territory (following criteria of opportunities and/or criteria of risks/challenges).
- ii. Prioritising sectors and intervention areas.
- iii. Identifying bioeconomy actions to build a circular systemic solution case.

Using a (product) value-chain lens can help to better understand: 1) what is happening at different stages of the value-chain; 2) what are the main economic activities of relevance and how they operate as part of the whole system; and 3) what are the associated environmental and socio-economic impacts. This is in contrast to existing approaches, which adopt a rather sectoral perspective. The ultimate goal is for all stakeholders to be guided by a shared agenda toward the holistic implementation of the intended solution. It is crucial that stakeholders are actively involved in all three of the phases that are listed above. For more information on how to implement these three steps please refer to the CCRI Methodology sections 2.2.1, 2.2.2, and 2.2.3.⁵⁰

2.3. Assess and define the bioeconomy solution

To translate potential actions into workable and executable CSS, it is important to determine their feasibility and potential impacts. Prioritising areas of action that produce the greatest local impact is key to ensuring stakeholder consensus and ultimately the effective deployment of CSS.

After the list of potential actions has been identified, it is necessary to determine what can be done to set the CSS in motion. It will probably be unclear what the impacts of these actions are, whether they are feasible and what it takes to carry them out. That is why the potential activities need to be evaluated. It is important that, unlike the scanning of opportunities, here the selection of activities must be based on direct feedback from the engaged stakeholders of their compromise to collaborate.

Therefore, the intention of this phase is to move from concepts (or first sets of solutions) to specific, operationalised, assessable solutions, which respond to stakeholders' identified needs. This, on the one hand, will facilitate the assessment of the economic, social and environmental impacts of CSSs, including their feasibility analysis and, on the other hand, will ensure the commitment of stakeholders.

The CCRI Methodology identifies three key tasks to be taken into account in order to accomplish this:⁵⁰

- i. Setting the bioeconomy or CSS solution ambitions;
 - What (value-chain/need) does the CSS address?
 - How much the CSS should improve the status quo?
 - When the goals should be achieved?
- ii. Analysing the bioeconomy solution feasibility – drivers and barriers analysis

This task aims at a comprehensive analysis of the CE actions identified in Section 2.2 in order to determine: 1) the adoption of CSS drivers and obstacles factors; and 2) the potential consequences that the CSS would have on the territorial metabolism. The analysis should cover the following key questions:

- What is the relevance of the CSS according to emerging trends in the territory?
- How the CSS will be developed and implemented?
- Does the CSS tackle the real needs of cities?
- Do the available resources (financial, technical, human) match the ambitions of the stakeholders?
- What are the results expected by the CSS?

The analytic frameworks PESTEL (Political, Economic, Social, Technological, Environmental and Legal) and SWOT (Strengths, Weaknesses, Opportunities, Threats) can be used at this point to organize the data gathered during the mapping phase across the identified intervention areas.

PESTEL study supports the definition of a CSS in two ways. The first is that it enables the CSS's operating environment, including the primary drivers and barriers, to be identified. The information it gives can be used to create future scenarios that can then be further examined using quantitative methods in order to predict the events and circumstances that cities and regions may experience in the future (see CSS scenario and impacts assessment). In this situation, applying the PESTEL framework can help stakeholders comprehend the "overall picture" of how a CSS runs and help them choose which CE actions should be prioritized.⁵⁰ For instance, the PESTEL analysis was utilized in the [REPAiR project](#) to better comprehend the difficulties associated with adopting new forms of governance in metropolitan areas that utilize circular systems (Obersteg et al., 2019).⁵⁰

The SWOT analysis distinguishes the factors by taking into account whether they represent Strengths, Weaknesses, Opportunities, and Threats, in contrast to the PESTEL analysis, which arranges the key factors by thematic areas.

For more information on tools to identify and address potential barriers and drivers of CSS, refer to the CCRI Methodology section 2.3.2.⁵⁰

iii. Assessing the CSS impacts

Scenarios modelling and impact analysis are particularly necessary when the proposed solutions represent a radical change from the baseline and are systemic in nature, thus affecting different sectors/stakeholders.

The CCRI Methodology refers to: 1) scenarios as 'representations of possible futures events, used to analyse potential responses to new and upcoming CSSs'; and 2) simulations as quantified scenarios generated with models that are simplified representations of reality. The creation and quantification of scenarios with mathematical simulation models allows for the creation of quantitative estimates for various scenarios that can be used to inform the policymaking process (e.g., on implementing or not implementing a proposed CSS).

There are two main types of scenarios:⁵⁰

- Baseline scenarios: elaborated to define the trends to assess performance against (e.g., waste generation, GHG emission, food demand trends). This is also known as business-as-usual because it considers the likely future path without the implementation of CE actions under consideration, and it is based on the analysis performed in the mapping phase.
- CSS scenarios: generated to determine how the performance of a system is affected by the implementation of a CSS (e.g., a CSS focusing on Circular Buildings).

The majority of methods for scenario modelling are based on the concepts of urban metabolism and associated accounting techniques because the circular economy largely focuses on material flows and inventories, including garbage. Table X lists some of the most current instruments created to do assessments of urban metabolism along with their key characteristics. The CCRI Methodology provides more details for each tool.⁵⁰

Project	Urban metabolism tool	Method approach/main features	Comments
REPAiR	Geodesign Decision Support Environment (GDSE)	Activity-Based Material Flow Analysis (MFA). It can include environmental (LCA) and social impacts. It offers spatial/geo-localised	The method is made operative through an open-access software. However, an expert in the tool may be required due to its complexity. The tool can be used to guide the overall process of CSS

		visualisation of material flows.	definition, since the very early stages of decision-making.
UrbanWINS	Urban Metabolism Analyst (UMAn)	Eurostat's Economic-Wide Material Flow Analysis (EW-MFA), possibility to include environmental impacts by integrating LCA.	The method does not have a software tool associated. It mainly relies on EW-MFA accounting and generates local estimates through downscaling techniques.
CITYLOOPS	Urban Circularity Assessment (UCA)	Eurostat's EW-MFA. It also considers stock of material (besides flows). It offers spatial/geo-localised visualisation.	The method does not have a software tool associated. It mainly relies on EW-MFA accounting and generates local estimates through downscaling techniques. It also offers the possibility to monitor the 'stocks' of material.
REFLOW	Urban metabolism	MFA	

Table 2. An overview of urban metabolism assessment approaches employed in recent EU projects. From CCRI Methodology.⁵⁰

It is important to keep in mind when evaluating CSSs that enhancing circularity ultimately aims to lessen the negative environmental, social, and economic effects of resource extraction and material consumption while enhancing societal benefits. As a result, CSS analyses that concentrate on material weight, whether for flows or for stocks, do not provide the complete picture. Going a step further, one could want to discuss the effects of material use. Material flow data and life cycle impact assessment (LCIA) procedures (ISO, 2006) are typically needed for a more thorough measurement of numerous impacts.⁵⁰ The UMAn and GDSE, for example, use a set of "plug-in" databases to enable more in-depth analysis of material flows, including a thorough description of environmental impacts. However, in general, an LCA should be conducted in parallel to compare the sustainability performance of the CSSs with its counterpart "Status Quo." Impacts on many different factors can be classified into midpoint impact categories (such as eutrophication, acidification, climate change, ozone depletion, human toxicity, etc.) and then aggregated into areas of protection at the endpoint level, such as human health and well-being, ecosystem health and natural resources, and economic prosperity. LCA-based impact indicators could be used to guide KPIs and goal setting in addition to evaluating a CSS, but it will be more difficult to include them in the monitoring framework because they can never be quantified directly and always call for supplementary approaches to be evaluated (Moraga et al., 2019).⁵⁰

A more detailed report on how to define and quantify KPIs for bioeconomy projects will be prepared in the BioBoost "Accelerator Operational and Monitoring Plan" Report that will be published in February 2023.

2.4. KPIs and targets definition

Definition of KPIs and targets is crucial to any project and shouldn't be overlooked. To guarantee that information is used to support decision-making, make necessary corrections, and report to stakeholders and decision-makers, it is imperative to choose KPIs carefully. Monitoring activities and resources run the danger of being viewed as a resource drain and abandoned if there is no obvious connection between KPIs and decision-making.

The goal of the assessment framework is to track the development of a CSS using a small number of important KPIs that accurately reflect the key components of the circular solution. Additionally, this will allow for the identification of potential areas in need of additional attention (see phase 3.2). Ideally, compatibility with the EC's framework for monitoring the circular economy should also be taken into account. Indicators should be coordinated whenever possible to improve comparability and prevent indicator proliferation.⁵⁰

KPIs should include output and outcome indicators, and may also include impacts indicators:⁵⁰

- Output indicators inform on the implementation of the planned actions – e.g., has a stakeholder platform been built? Have circular criteria been introduced in public procurement?
- Outcome indicators inform on the expected direct –measurable– impacts generated by the implementation of a CSS – e.g., has the generation of waste reduced? Has employment been generated?
- Impact indicators inform on the expected indirect – measurable through ancillary approaches, e.g., LCA – impacts generated by the outcome or output of the CSS – e.g., have GHG emissions been reduced?

As monitoring is often expensive and neglected, it is important to select the right indicators to support the assessment. In this context, an adapted version of SMART framework can be a useful way to identify quality indicators. SMART indicators are Specific, Measurable, Achievable, Repeatable, Relevant and Timely.⁵⁰

- **Specific** – Indicators need to be easily understood and meaningful for those who seek to use the information they provide. There is little point in collecting complex information if there is no capacity to analyse it or no intent to use it in the review of CSS progress.
- **Measurable** – Indicators should be measurable, with consideration given to the repeatability of assessment, the precision required for measurement and the resources (funding, time) needed for measurement.
- **Action-orientated** – It should be considered how measurement information is likely to be used and adjust the scope of monitoring appropriately. Additional depth and scope of measurement may be useful where there are management sensitivities. For example, a municipality making decisions about a food waste management may consider the level of food waste as well as business activity in hospitality sectors.
- **Repeatable** – Indicators should be framed in a way that enables comparison over time. Where appropriate, indicators should be similar to what others use in similar contexts to enable comparison, e.g., carbon emissions per GDP or per capita is used as part of climate impacts comparisons.
- **Relevant** – Indicators and associated measures need to be relevant to the CE strategies at hand. They also need to adequately reflect progress towards desired long-term outcomes.
- **Timely** – Indicators need to be sensitive to time-related factors. For example, some variables are slow to show a trend and can vary significantly across years (e.g., waste generation), meaning that progress towards outcomes can be difficult to assess over the short-term. In these situations, it is helpful to identify intermediate outcomes/outputs that lead towards long-term outcomes (e.g., launch of an awareness campaign).

One option for quantitative KPIs is the EU Circular Economy Monitoring Framework (see annex I). environmental issues, resource conservation, waste management, industrial planning, and sustainable development objectives.

The decrease (or increase) of important components of the CSS, such as waste generation, material consumption, employment creation, or gross value added, is typically the focus of outcome KPI targets (and, eventually, impact KPI targets). These can be specified as an absolute amount, such as a home waste generation of 100 kg per capita, or as a percentage, such as a reduction of XX% when compared to the baseline scenario.

For further information on the role of digitalisation for the monitoring of the circular economy, please refer also the EEA briefing "[Monitoring the circular economy using emerging data streams](#)" and the OECD Working Paper "[Digitalization for the transition to a resource efficient and circular economy](#)".

Through the CCRI Methodology Self-Assessment Tool (SAT), the KPIs and objectives definition can become operational. Specific KPIs are provided in Module 2 "Defining the Framework for Specific Targets" which is based on the CE major areas to which the CSS references. There are five important areas that have been identified: i) governance and capacity building, ii) production and consumption, iii) waste management, iv) secondary raw materials, and v) competitiveness and innovation.⁵⁰

3. Implement

Implementing **Bioeconomy Systemic Solution** is the main goal of this phase. This entails putting Circular Economy actions into motion in accordance with the laid out action plan and the agreed upon distribution of roles, which includes creating a workable CSS business model (including a CSS ownership model), securing funding, forming partnerships, and ensuring engagement occurs throughout. Additionally, it is crucial to make sure that money is available for CSS's start-up phase because it is highly possible that they won't be competitive on the market at first. It is crucial to assess the CSS implementation and inform internal and external stakeholders of its progress.

As a result, the main focus of this phase is creating a business strategy for the CSS that will guarantee stakeholder and organizational support and make it easier to access the necessary financial resources. There should never be a need for additional analysis (assuming the preceding steps of the technique have been adequately handled). Instead, it will be necessary to organize the data created up to this point and begin putting the decisions made into motion. Once the CSS is in place, it will be equally important to keep a consolidated and proactive monitoring framework in place by talking about the potential for taking corrective actions when the KPIs deviate from the established objectives and regularly updating stakeholders on CSS progress to increase political and societal support.⁵⁰

3. IMPLEMENT			
PHASE	OBJECTIVES	TASKS	OUTCOMES
Prepare for adoption and financing	Build a business case for implementing bioeconomy project. Attracting funds or finance for actions. Stablish collaborations and partnerships to support project implementation.	Definition of financial needs and identification of public and private funding opportunities. Development of business plan.	Defined business case and business plan. Defined financial needs and financial resources found.
Monitor, evaluate, and adapt	Measure and evaluate projects to be accountable and determine which actions are not achieving desired outcomes and need to be changed. Identify when an action is no longer effective, and a new action or suite of actions is required.	Reflect on planning process, helping identify when adjustments are required. Monitoring of ongoing project through selected KPIs. Update of stakeholder engagement plan Update of action plan.	Indicators measured for each action to achieve outputs and outcomes that can be measured to assess performance. Processes established to evaluate and update the project plan at regular intervals.
Report and Communicate	Communication of project results when completing project development lifecycle to enhance and support other cities, regions, and future projects.	The reporting to interested parties and knowledge sharing with other cities and regions	Results and lessons learnt associated with the implementation plan successfully reported to stakeholders, cities, and regions.

Figure 25. Phase III – Objectives, tasks, and outcomes for implementing the bioeconomy solution. Based on CCRI Methodology.⁵⁰

3.1. Prepare for adopting and financing

The creation of a business case for a CSS should show its long-term financial viability by describing the following: the CSS customer(s) and the problems/needs they seek to address; the CSS value proposition outlining how the suggested CSS will solve these problems and produce additional benefits; the CSS

owner/provider, key CSS actors and suppliers, and the key resources and activities that are required from their sides to implement and maintain the CSS; costs and expenses; and the CSS value proposition.

To identify suitable funding or financing instruments it is necessary to develop a Circular Economy Investment Plan (CEIP), a document that identifies concrete investment opportunities to implement the respective CSS (or its elements) and CEAP. To help ensure the upscaling and replication of successful CSSs, a critical mass of public and private investments should be made accessible. Funding opportunities can take many forms (e.g., grants, debt, equity, guarantees, etc.) – see section Bioeconomy Financing Programmes.

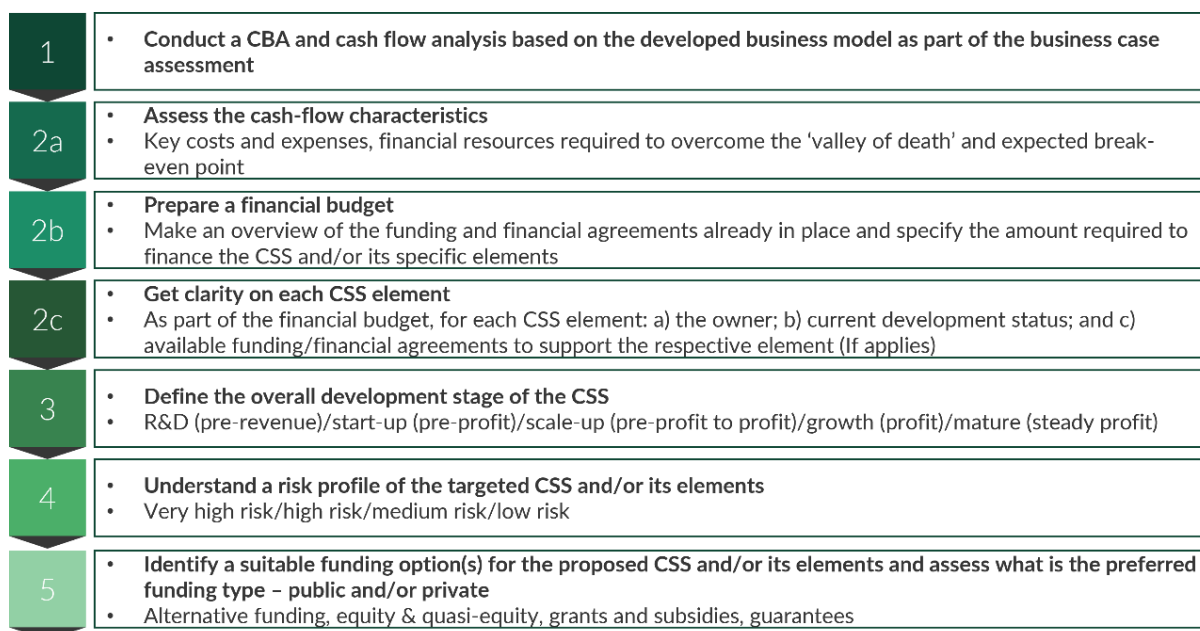


Figure 26. Steps to develop the Investment Plan. Adapted from the CCRI Methodology.⁵⁰

For further guidance on each of the steps please refer to the CCRI methodology Guideline⁵⁰

3.2. Monitor, evaluate, and adapt CSS

At this point in the CSS planning cycle, formalizing an evaluation and review process allows for reflection on implementation progress and lessons learned. This is crucial since CSS implementation best practices are always changing as new information becomes available and practitioners gain expertise. It's crucial to keep in mind that monitoring and evaluation marks not the conclusion of the CSS strategy but rather a fresh start.⁵⁰

The ability to assess whether the CSS is progressing effectively (or not) and to learn from the entire CSS deployment process in order to improve it is made possible by monitoring data. In order to achieve the desired CSS results, such learning (both good and negative) might assist in improving the current planning and execution processes.⁵⁰

Cities and regions are strongly encouraged to undertake assessments and compare the actual results with the anticipated ones - previously specified in the phase 2.4 - to ensure an effective development towards more sustainable production and consumption systems. Understanding the numerous social, economic, and environmental changes that have taken place in the area and comparing them to those that were expected before to implementation would be greatly aided by an ex-post impact assessment.⁵⁰

To do this, a simple logic framework approach that is in line with the kind of KPIs discussed in phase 2.4 can make it easier to structure a scoreboard for KPIs. A logic framework (Figure 27) involves determining the following: i) the inputs, such as the resources (such as funding, expert knowledge,

information, etc.), that are required to accomplish a CSS Action Plan; ii) the outputs, or the activities that the plan undertakes (e.g., events, research, capacity building, etc.); iii) the outcomes that are produced through the activities (e.g., the reduction in food waste generation, increase of employment in repairing activities, reduction of extraction of primary material, etc.); and iv) the impacts of the outcomes - i.e., intended and unintended short and medium-term effects of CSSs (environmental, social and economic impacts, etc.).⁵⁰



Figure 27. Logical framework to structure a KPIs scoreboard for monitoring and evaluating CSS implementation. From CCRI Methodology.⁵⁰

The CCRI Methodology Self-Assessment Tool's third module can help with the monitoring and assessment of the CSS. In fact, the SAT tracks the chosen KPIs over time (ideally, the assessment is carried out annually), indicating whether goals have been attained or the amount of progress made toward achieving them. Additionally, the SAT will provide an easy-to-read summary of the overall accomplishments and the degree to which the targets have been met through a comprehensive dashboard that summarizes the results.⁵⁰

3.3. Report to stakeholders and communicate lessons learnt

It is crucial to update these groups on the progress and adaption measures after engaging with stakeholders and the community throughout the process. Building societal and political support for CE and CSS projects depends on this. Both internal and external stakeholders should be involved in this process. Internal stakeholders, or those who will be directly impacted by the CSS, should be kept in the loop regarding any plan modifications and their justifications. To facilitate the spread and duplicability of CSSs, regions and cities should organize or take part in knowledge transfer (KT) events for external stakeholders.⁵⁰

The purpose of KT events is to demonstrate transferable CSSs (through CSS cards and/or CSS posters), discuss the possibilities for their adoption elsewhere, and possibly suggest revisions to better fit the context of the "receiving" region. In a KT event, various stakeholders from various areas and countries will get together to learn about, discuss, and exchange information about the CSS, from best governance practices to technical concerns. It will be addressed whether the practices seen in the various fields are appropriate in other contexts.⁵⁰

Best Practices and Key Challenges in Bioeconomy Project Development

Analysis of European Bioeconomy Case Studies

The following gives a brief summary of some projects of relevance for the bioeconomy covering a wide range of topics addressing different issues over a number of bioeconomy sectors or challenges that the bioeconomy can help address. The examples have been summarised and adapted from the Bioeconomy Strategy Progress Report,² the CCRI Methodology,⁵⁰ and the Biomonitor Project's leaflet "BioMonitor: past and future of the bioeconomy".⁵³

The BioBoost Bioeconomy Project Accelerator will analyse their progress and results to replicate them in the Catalonia Region.

Bioeconomy Projects Best Practices	
BioMonitor Horizon 2020	BioMonitor addresses the information gap in bioeconomy research by re-structuring its existing data and modelling framework. The ultimate goal of the project is to get a clearer picture of how bioeconomy affects our lives. Examples of case studies, datasets, policy briefs, bioeconomy-related publications, webinars, reports, etc.
HOOP Horizon 2020	The HOOP project supports 8 lighthouse cities and regions in developing large-scale urban circular bioeconomy initiatives that will focus on recovering valuable resources from urban biowaste and wastewater to make bio-based products.
EcoeFISHent Horizon 2020	Demonstrates a replicable systemic and sustainable cluster for territorial deployment of the climate neutral circular economy by creating six multilevel and synergic circular value chains (CVC) interconnecting blue and green-economies to reconcile human industrial and economic activities with marine ecosystems and marine protected areas
Agro2Circular Horizon 2020	A2C is EU project boosting the upcycling of agri-food wastes (from F&V and MPF) through innovative routes of valorisation, leading to high extraction yields, bioactives with the purity and stability required to be used for the production of new food, cosmetic and nutraceutical formulation.
FRONTSH1P Horizon 2020	Demonstrating four Circular Systemic Solutions. Each circular systemic solution targets an economic sector that is aiming towards decarbonisation: Wood Packaging, Food & Feed, Water & Nutrients, and Plastic & Rubber Waste
CIRCULAR FOAM Horizon 2020	Develop and demonstrate all technological steps required to achieve circularity of plastics in post-consumer applications, using the example of rigid PU foams used as insulation in refrigerators and construction. The CIRCULAR FOAM consortium is composed of all actors required to close the circular value chain (process industries, manufacturing, waste management, technology providers, incl. also research partners, logistics, social scientists and economists working with the public sector and citizens).
REPAiR Horizon 2020	REPAiR – REsource Management in Peri-urban Areas: Going Beyond Urban Metabolism Geodesign Decision Support Environment (GDSE) Tool. The GDSE is an online and open-access software designed for workshop sessions where small groups of participants cooperatively develop strategies for a more circular economy with a special focus on waste and resource management. The GDSE relies on the activity- based spatial material flow analysis (ASMFA), and it allows visualising the flows using classic Sankey diagrams as well as map representations.
URBAN WINS Horizon 2020	Innovative strategic plans for urban waste reduction and management. UrbanWINS Toolkit Guidelines for the selection and implementation of adequate stakeholder engagement techniques Driving forces-Pressures-State-Impact-Response model (DPSIR) Understanding CSS barriers and drivers The DPSIR model can be used for a preliminary understanding and investigation of the causal

⁵³ [BioMonitor: past and future of the bioeconomy \(2022\).](#)

	relationships between different factors (economic, social and environmental) that shape the urban metabolism of a city and influence the design of the CSS. The Urban Metabolism Analyst (UMAn) tool offers a methodology for the computation of material flow accounts at urban scale. The UMAN approach is derived from the Economy- Wide Material Flow Analysis (EW-MFA) methodology, though the UMAn model adapts this methodology to be used for a smaller spatial unit, such as the urban scale
Built-In-Wood Horizon 2020	Sustainable multi- storey wooden buildings. Developing a sustainable and innovative wood value chain for the construction of multi-storey wooden buildings. The project goal is to drastically increase the proportion of timber construction. The challenge is to offer high-quality, affordable and environmentally friendly housing.
GLOPACK Horizon 2020	Aiming to food packaging with no environmental footprint. The project is developing home-compostable, biodegradable packaging made from agro-food residues. It is investigating food packaging with no environmental footprint and the ability to extend the shelf life of food products.
HEREWEAR Horizon 2020	Locally-produced bio- based textiles. Project aims to establish EU market for locally-produced textiles made from locally-sourced bio-based materials (e.g. three novel waste streams: seaweed, straw, lignin from wood). The bio-based material solutions will build further on the latest bio-based polyester and cellulose developments.
FUSILLI Horizon 2020	Developing new urban food plans Its' core are the 12 Living Labs in 12 different cities, whose main objective it is to develop urban food plans within their local contexts to achieve an integrated and safe holistic transition towards healthy, sustainable, secure, inclusive and cost-efficient food systems. Via an open knowledge community, cities will be empowered to implement innovative and personalized policies and actions, placing citizens in the heart of the process.
The Crop Diversification Cluster Horizon 2020	The crop diversification cluster brings together research projects which operate in countries across Europe to increase the impact of crop diversification research. The cluster encourages sustained uptake of diversification measures by European farmers and through innovations across the agri-value chain. The diversification of crops through rotation, multiple cropping and species mixtures can allow farming systems to become more resource-efficient with fewer agronomic inputs. Diversified systems can help meet the needs of end users for food, feed and industrial products and simultaneously deliver other ecosystem services and public goods.
RES URBIS Horizon 2020	Designs facilities to turn bio-waste generated in our cities – by homes, restaurants and shops – into bioplastic and a number of related products. RES URBIS uses not only food and kitchen waste but also sludge from the treatment of waste-water, residue from gardens and parks, as well as nappies.
RESYNTEX H2020	RESYNTEX demonstrates how to avoid the incineration and landfilling of textile waste through chemical recycling of unwearable blends in a textile recycling pilot plant.
SABANA H2020	SABANA will develop a large-scale integrated microalgae-based biorefinery for the production of biostimulants, biopesticides and feed additives, in addition to biofertilisers and aquafeed, using only marine water and nutrients from wastewaters.
POWERSTEP H2020	POWERSTEP focused on converting sewage treatment plants in power production facilities while still achieving a high effluent quality for the treated wastewater. It showcased that state-of-the-art plants can either power themselves or feed surplus (upgraded) biogas into the gas grid, therefore turning WWTPs into producers of renewable or “green” energy. SYSTEMIC has 5 large-scale demonstration plants that aim at a transition towards a more circular economy and closed nutrient cycles by recycling nutrients from organic waste streams (manure, sewage sludge, food waste) and turning them into bio-based fertilisers.
SSUCHY Bio-Based Industries JU	Developing advanced bio-based composites. Sustainable structural and multifunctional bio-composites from hybrid natural fibres and bio-based polymers. Project develops bio-based aircraft wings to address plastic pollution. Trees, crops and even organic waste can be transformed into a bewildering array of plastics to use in products ranging from single-use bags to heavy-duty aeroplane wings.

<u>AGRICHEMWEY</u> Bio-Based Industries JU	Develops the world's first integrated biorefinery for converting by-products of the dairy industry into products such as bio-based fertilisers and mineral supplements for human nutrition.
<u>CIRCULAR BIOCARBON</u> Bio-Based Industries JU	The project will develop a first-of-its-kind flagship biorefinery to valorise the organic fraction of municipal solid waste into four value-added products and a range of other intermediate products. It will do this through a biorefinery, organised through a pool of cascading technologies. This will treat mixed urban waste streams, including the organic fraction of municipal solid waste and sewage sludge, in order to demonstrate that the process is capable of handling all the biowaste produced by a medium-sized city.
<u>BEESPOKE</u> Interreg North Sea Region	Increase levels of pollinators and crop pollination at local and landscape scales by providing land managers and policy makers with new expertise, tools and financial knowledge to create more sustainable and resilient agroecosystems. Pollination is an important ecosystem service, a key to more sustainable and resilient agroecosystems.
<u>MUNTER</u> European Innovation Partnership (EIP-AGRI)	Integrating nature conservation, crop production and livestock farming. Project integrates objectives for water, soil and flood protection with broader objectives such as climate protection, biodiversity and animal welfare. For the first time, farmers, municipalities, water managers, nature conservationists and authorities worked out new multi-use concepts and implemented them together.
<u>Bioökonomie REVIER</u> National funding	The project in which the conversion of the traditional fossil based economy into a sustainable bioeconomy is adapted to the local conditions and future prospects. The project is implemented in the Rhineland region, where structured phase-out of lignite mining is done to gain a new profile by expanding and establishing novel options for creating value. The projects aims at identity, secure jobs and prosperity in the area to achieve quality life. The area once reliant on lignite mining, is to be transformed into a bioeconomy region in order to create a lighthouse project for sustainable and circular bioeconomy for Germany, Europe, and the whole world.
<u>WOODIO</u> EIC Accelerator	An eco-design and material technology company whose signature material is the world's first 100% waterproof solid wood composite with a minimal carbon footprint. The company manufactures easy to clean, durable bathroom furniture to provide an alternative to CO2 high ceramic industry. Products are made of wood and resin based adhesives.
<u>FISH4FISH</u> European Maritime and Fisheries Fund (EMFF)	FISH4FISH project closes the circle between waste and consumption. FISH4FISH is developing a novel active polymeric material based on chitin from crustaceans combined with lignin waste for the fish packaging sector. Such packaging enhances shelf-life and, once it is has been used, could be processed completely in a home composting system and used as fertilizer and microbial preservatives for plants.
<u>BIOGEARS</u> EMFF	BIOGEARS project aims to develop innovative bio- based ropes for mussels and seaweed to contribute to a more sustainable aquaculture sector. The goal is to obtain a plastic that does not decompose at sea, but instead turns into compost, when it is no longer of use.
<u>BE-RURAL</u>	Bio-based strategies and roadmaps for enhanced rural and regional development in the EU (BE-Rural).
<u>BIOEAST</u>	The Central-Eastern European Initiative for Knowledge-based Agriculture, Aquaculture and Forestry in the Bioeconomy – BIOEAST – offers a common political commitment and shared strategic research and innovation framework for working towards sustainable bioeconomies in the Central and Eastern European (CEE) countries: Bulgaria, Czechia, Estonia, Croatia, Hungary, Lithuania, Latvia, Poland, Romania, Slovenia and Slovakia.
<u>MIRACLES</u> Knowledge-based bioeconomy	Multi-product Integrated bioRefinery of Algae: from Carbon dioxide and Light Energy to high-value Specialties

Specific examples of best practices

In this section a closer look is given to some of the initiatives listed on the previous section. Given the fact that some of the European projects mentioned have not yet finalised, the best practices examples haven been extracted from the public resources available in the respective websites, not precluding that other good practices might be implemented after the present document publication.

BioMonitor

BioMonitor is a Horizon 2020 project that aims to address the information gap in bioeconomy research by re-structuring its existing data and modelling framework. To do so, the project makes available a long list of case studies, datasets, policy briefs, bioeconomy-related publications, webinars, reports.

In particular, the list of case studies, provides a valuable insight into diverse sectors regarding their readiness level, impact into economy and society and monitoring status. At the end of each case study a list of recommendations and lessons learnt are provided to the reader to support future analysis. Here below are provided the links to some of the case studies available in their website “Technical insights” section.

Description / Link

[D8.2: Report on case study “New wood-based products”](#)

[D8.3: Case study “Bio-refineries sector”](#)

[D8.4: Case study “Chemical industry”](#)

[D8.5: Case study “Dynamics in the bioeconomy: from infant products to largescale production”](#)

[D8.6: Case study “Circularity in the bio-based packaging industry”](#)

[D8.8: Report on case study “The Bioeconomy Pilot from the Vanguard Initiative”](#)

Hoop

Hoop is another Horizon 2020 project that supports 8 lighthouse cities and regions in developing large-scale urban circular bioeconomy initiatives. This support is given through different PDA services (Project Development Assistance) providing technical, economic, financial, and legal expertise to develop concrete investments. In this context, the Hoop project has developed different financial tools that have been provided and tested during the PDA to the 8 lighthouses to increase their maturity and bankability. The list of tools can be found in the article:

[D.R. Silva, et al. Hoop financial tools to provide technical assistance for urban circular bioeconomy projects from biowaste and wastewater sludge, 6th International Conference, September 2023](#)

REPAiR

REPAiR focuses on how the design of physical structures and their social and urban metabolisms are affected by material flows. Specifically, the project has developed an [on-line handbook](#) to share the PULL (Peri-urban Living Labs) methodology widely, and to transfer it to researchers, public institutions, and private parties, interested in implementing an Urban Living Lab. The online handbook is available on their website.

GLOPACK

The project GLOPACK had the aim to investigate food packaging alternatives with no environmental footprint and the ability to extend the shelf life of food products. The project has developed home-compostable, biodegradable packaging made from agro-food residues. At its finalisation, the project had made available a [good practice guideline](#) written for food manufacturer and those who intend to

use biodegradables, active and/or intelligent packaging for food products. Thus, to facilitate the implementation of sustainable solutions that can fit in Europe's bioeconomy.

BE-RURAL

The Horizon2020 project explored the potential of regional and local bio-based economies and supported the development of bioeconomy strategies, roadmaps and business models in rural regions. To this end, BE-RURAL has made available a list a public deliverable that will be of high interest when implementing bioeconomy initiative in different regions in Europe. Here below, a few deliverables have been listed for reference.

Description / Link

[Deliverable 2.4: Business models for regional bioeconomies](#)

[Deliverable 2.5: Handbook on regional and local bio-based economies](#)

[Deliverable 4.2: Best practice guide on strategy development.](#)

[Deliverable 5.2: Summary report on small-scale bio-based business models and their market potentials](#)

BIOEAST

The Central-Eastern European Initiative for Knowledge-based Agriculture, Aquaculture and Forestry in the Bioeconomy – BIOEAST – offers a shared strategic research and innovation framework for working towards the development of a sustainable bioeconomy in the Central and Eastern European (CEE) countries. With this objective, BIOEAST has developed a series of 7 thematic studies that includes the analysis and recommendations on the interactions between bioeconomy R&I and industry specific policies, market potential, development strategies, identification of common challenges and validate common research areas, among others.

Description / Link

1 [Study Agroecology](#)

2 [Study Bioeconomy Education](#)

3 [Study Food systems](#)

4 [Study Forestry](#)

5 [Study Freshwater based bioeconomy](#)

6 [Study Bioenergy](#)

7 [Study Bio-based materials](#)

In addition, the initiative has develop a practical [Guideline](#) for the establishment of the national BIOEAST HUBs that could be replicated in other European regions.

Key Challenges

Figure 28 summarises the key challenges that can have a negative impact during the bioeconomy or circular economy project implementation. The challenges need to be defined and assessed during phase 2.3 of the project development methodology "2.3. Assess and define the bioeconomy solution".

The CCRI Methodology breaks down the possible challenges into six different categories: i) policy and regulatory; ii) financial and economic; iii) skills and capacity; iv) societal; v) technical; and vi) governance.⁵⁰

From the BioBoost Bioeconomy Project Accelerator Office we will help the regional initiatives and projects to analyse and overcome the challenges that they are facing and accelerate the project implementation.

The Accelerator Office will also serve as an interlocutor between the farmers, businesses, industry and the public administration, to transfer the detected barriers and delimiting challenges, and push for policy and regulation changes that will enable the bioeconomy projects to succeed.

In further reports we will collect the barriers found in the Catalonia region and share them with the public administration and the CCRI-CSO, as well as mitigation strategies on how to overcome them.

To overcome the barriers that will be found during the implementation of the bioeconomy systemic solutions, we will look into the best practices reports from the finished and ongoing projects, as well as being in constant communication with the CCRI-CSO and their Pilots and Fellows.

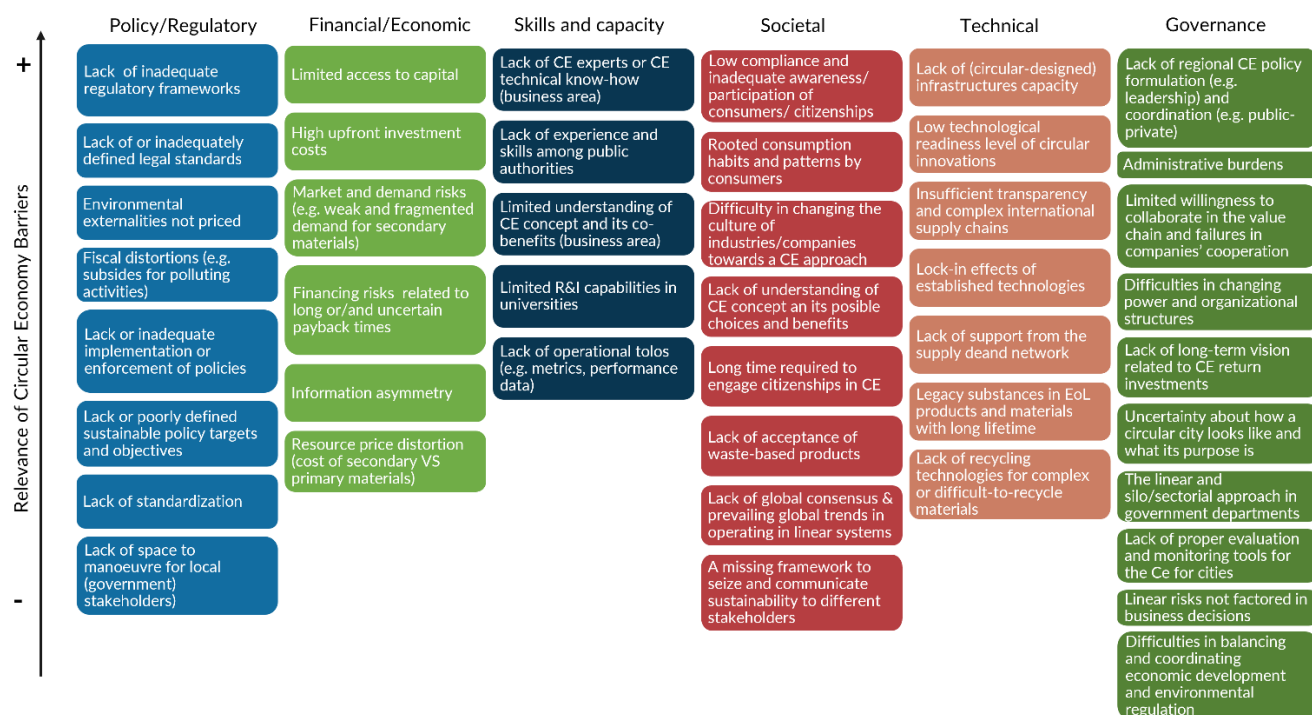


Figure 28. Key challenges for Bioeconomy and Circular Economy project implementation. Adapted from CCRI Methodology.⁵⁰



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The Role of the Bioeconomy Project Accelerator Office

03

Role of an Bioeconomy Project Accelerator

BioBoost will accelerate the implementation of bioeconomy projects in Catalonia through Project Development Assistance in four areas: i) Business and financial; ii) Circular Economy Facilitation; iii) Technical and Engineering; and iv) Legal and Administrative.

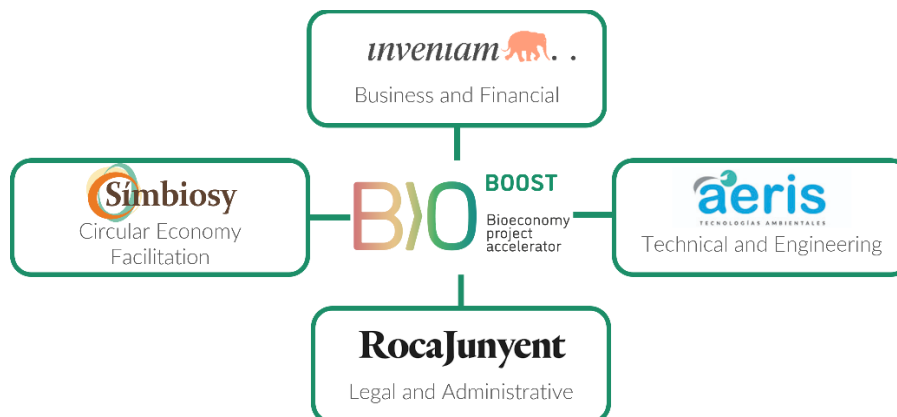


Figure 29. BioBoost's partners and services.

BioBoost aims to mobilize 30 million euros of additional investment in projects in the Catalan bioeconomy sector by 2026, and create the **Bioeconomy Project Accelerator**, a physical office where advisory services will be offered with the aim of reducing investment risk and execution time for Catalan bioeconomy projects rooted in the territory.

- Establish the physical office of the Bioeconomy Accelerator of Catalonia and offer development advisory services to Catalan bioeconomy projects, giving a boost to the economic sectors involved.
- Collaborate with the financial community to address specific and systematic barriers to investment in Bioeconomy projects and catalyze additional investment in bioeconomy projects in Catalonia.
- Contribute to the reduction of the amount of waste entering landfills and create "green" and long-term jobs in the value chains of the Bioeconomy sectors.
- Increase awareness and knowledge about the benefits of bioeconomy among EU citizens through communication and knowledge transfer activities.

From the BioBoost Bioeconomy Project Accelerator Office we will first map the Catalan ecosystem by applying the CCRI Methodology, and then we will design and implement a series of Bioeconomy System Solutions that are currently facing challenges to implement their projects.



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Annexes

04

Annex I

 Table 3. Circularity baselining: a selection of key CE metrics. From CCRI Methodology.⁵⁰

Key area	CE baseline Indicators	
	Basic	Advanced
Production and consumption	Generation of municipal waste per capita	Generation of municipal waste per capita by type of waste (including food waste) Share of food waste over total food production
	Generation of industrial waste per capita	Generation of industrial waste per capita by sector (NACE activities)
	Domestic material consumption per capita	Material footprint
	Virgin material extraction per capita	Self-sufficiency of raw material per capita
	Resource productivity	Resource productivity by type of material/sector
	Energy consumption Share of renewable energy in gross final energy consumption	CO ₂ emissions from energy generation captured and used or stored Carbon intensity of electricity generation
	Greenhouse gas (GHG) emissions by sector (NACE) activities (production-based), including transport	GHG emissions from final use of products (consumption-based) GHG emissions per unit of food production GHG emission by waste streams
		Change in land use/coverage (forest land, cropland, grassland, harvested wood products and other)
Waste management	Recycling rate of municipal waste	Recycling rate by waste streams
	Recovery rate of construction and demolition waste	
	Incineration rate	Incineration rate with (out) energy recovery
	Landfilling rate	GHG emissions by waste landfilling
	Waste intensity (tonnes/GDP)	Waste generated per material consumed (%)
Secondary raw materials		Circular material use rate (CMU)
		End-of-life recycling input rates (EOL-RIR)
		Trade in secondary raw materials
Competitiveness and innovation	Direct jobs in the circular economy	
	Value added generated by CE sectors (% of GDP)	
	CE related patents	

Annex II

Table 4. Selected indicators for circular economy state of implementation. From CCRI Methodology.⁵⁰

Key area	CE state of implementation
Awareness/ information campaigns/ events	Awareness-raising campaigns for motivating stakeholders to take up CE measures
	Level of public awareness for circular economy and waste prevention
	Initiatives/awareness campaigns at city/region level for the reduction of food waste generation
	Communication measures (campaign, provision of information, events for the public/companies) on circular transformations and waste prevention
	Number of economic operators sensitised on CE
	Number of seminars organised on the CE
	Awards for circular businesses (e.g., stamps, stickers)
	Citizens involvement
Capacity building	Number of CE courses PhDs/university courses
	Number of schools that participate in environmental education projects
	Environmental education (% per school)
	Number of people trained in CE trades
	Number of circular economy businesses offered business support
	Number of students trained in CE occupations
Regulation	CE/waste prevention criteria developed in guidelines for procurement
	Number of legislative and normative barriers identified and resolved
	Actions by the city intended to encourage the procurement of articles that use secondary raw materials
	Availability of innovative schemes for businesses at the city level, which are related to CE
	Number of legislative and normative incentives created
Funding and taxation	Budget amount allocated to calls for projects on CE and number of beneficiary companies
	Share of environmentally related tax revenue
Policy	Availability of a strategy for waste management
	Availability of a roadmap for resource management
	Availability of a circular economy strategy or CEAP at city/region level
Industry - Industrial symbiosis	Number of pilot/demonstration projects on CE
	Number of jobs (existing and new) involved in industrial symbiosis
	Number of companies involved in industrial symbiosis
	Investment in symbiosis
	Number of eco-industrial parks
	Cubic metres of water saved
	Collective annual savings across firms
	Tonnes per year in CO ₂ savings
	Million tonnes of landfill diversion
	Million tonnes of materials recovered and reused
	Billion in cost savings
	Tonnes of virgin resources saved
	Tonnes of waste turned resources
	Quantity of kg of reused items in the framework of reuse organisations
Eco-design	Activities performed by cities/regions that encourage the implementation of eco-design measures

Annex III

Table 5. Existing approaches and tools to identify CE intervention / opportunities areas. From CCRI Methodology.⁵⁰

Tools/methods/ approaches	Source	Strengths	Weaknesses
Value-chain methodology	UNEP	It favours a systemic perspective. It has been applied successfully to three value-chains: food; construction; and textiles. It links qualitative concepts and sectors to quantitative data and statistical databases.	The trade-off between the (global) value-chain perspective and the local CSS scope could make full application of this approach difficult. Not originally thought for circular economy but for Sustainable Consumption And Production.
Toolkit for policy makers	Ellen MacArthur (2015)	Step-by-step guidance. Tested on a pilot study. It links qualitative concepts and sectors to quantitative data and statistical databases.	Mainly thought for national policymakers. Systemic perspective not covered.
ReSOLVE framework approach	Ellen MacArthur, McKinsey (2015)	It encompasses a broad range of contexts and industries. It provides concrete examples of circular interventions organised by key circular strategies.	It is mainly a qualitative approach. Especially orientated to business and industries.
Urban Opportunity Framework and the Circle Scan approach	Circle Economy	It is thought for urban policymakers and organises CE opportunities according to 'urban themes.' The framework is operationalised by the Circle Scan tool, which provides CE opportunities tailored to the local context. The tool is open-access.	The Circle Scan tool is currently being tested. Its use requires registration on the web and the provision of local data.
Methodological framework for the implementation of circular economy in urban systems	Levoso et al. (2020)	It adapts the Toolkit for policy makers (Ellen MacArthur (2015)) to the regional context. Tested on a pilot. It provides a clear and good overview of the whole process.	It focuses mainly on the decision-making process but does not offer many insights into CE opportunities or actions.
Circular City Action Framework	Circle Lab for Cities programme	It provides a range of R strategies and sub-strategies along with respective case studies. The R strategies are especially thought for city actions.	It is principally descriptive and does not cover the process for identifying which R strategies apply to a specific context.
Circular Strategies Scanner	CIRCit NORDEN	It provides a comprehensive approach for identifying business strategies and/or circular business models.	The framework is mainly orientated to businesses and industries. It was only tested in manufacturing businesses.
Catalogue of circular solutions and co-benefits	NetZeroCities	It provides a catalogue of circular solutions and co-benefits. It is thought for city level.	The catalogue is not available yet. It will be made available through the NetZeroCities knowledge repository by the end of October.

Annex IV

 Table 6. Overview of EU funding schemes. From CCRI Methodology.⁵⁰

Funding scheme name	Description/Objectives	Relevance for CSS	Particularities of funding programme and how CSS can access financing
Horizon Europe: Cluster 6	This cluster aims at reducing environmental degradation, halting and reversing the decline of biodiversity on land, inland waters and sea and better managing natural resources through transformative changes of the economy and society in both urban and rural areas. Link: https://ec.europa.eu/info/research-and-innovation/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe_it	The Cluster 6 within the Horizon Europe facility could be a good opportunity for CSS focused on research, experimentation and piloting.	Horizon Europe offers grants as the main funding model, complemented with dedicated financial instruments when appropriate. The following activities are generally eligible for grants under Horizon Europe: research and innovation actions; innovation actions; coordination and support actions; programme co-funded actions; innovation and market deployment actions; and training and mobility actions.
Cohesion Fund 2021-2027	EU Cohesion Policy contributes to strengthening economic, social and territorial cohesion in the European Union. It aims to correct imbalances between countries and regions. It delivers on the EU's political priorities, especially the green and digital transition. Link https://ec.europa.eu/regional_policy/en/2021_2027/	Cohesion Policy funds, being one of the main instruments to deliver the EU's green transition, could be a good funding source for many CSSs at a regional and local level. Specifically, relevant is PO 2 – a greener, low-carbon transition towards a net-zero carbon economy and resilient Europe by promoting a clean and fair energy transition, green and blue investment, the circular economy, climate change mitigation and adaptation, risk prevention and management, and sustainable urban mobility.	Member States can use the contribution from the Cohesion Fund to provide support to beneficiaries in the form of grants, financial instruments or prizes, or a combination thereof. Financial instrument products may include loans, guarantees, equity or quasi-equity. Moreover, Member States can tailor financial products according to their needs and capabilities or structure the financial instrument based on terms and conditions provided by the European Commission for 'off-the-shelf' instruments. Projects can apply for funding under the Cohesion Fund only if you are based in a Member State with a gross national income per capita below 90 % of the EU-27 average.
Interreg	Interreg Europe is a cooperation programme, co-funded by the European Union. It helps local, regional and national governments across Europe to develop and deliver better policy, creating an environment and opportunities for sharing	Interreg Europe offers an opportunity for interregional cooperation on the field of the circular economy. CSSs could profit from an	Interreg programmes can provide support to beneficiaries in the form of grants, financial instruments or prizes, or a combination thereof. Under Interreg programmes, the most common type of

	solutions to regional development issues. It supports the exchange of good practices and policy learning among European regions in 29 countries – the EU-27, Norway and Switzerland. Budget: EUR 379 million. Link: https://www.interregeurope.eu/what-is-interreg-europe	environment of common opportunities, could learn from others and could develop common projects. Specifically relevant is PO 2 – a greener, low-carbon transition towards a net-zero carbon and resilient Europe.	support is grants. Interreg programmes support cooperation through project funding to jointly tackle common challenges and to find shared solutions. Projects funded under Interreg often address pollution problems and loss of biodiversity as these are issues that extend beyond national boundaries.
InvestEU grants	The InvestEU programme gives an additional boost to investment, innovation and job creation in Europe between 2021-27. It has the aim of triggering a new wave of EUR 372 billion in investments using an EU budget guarantee. Budget: EUR 26.2 billion Link: https://investeu.europa.eu/about-investeu_en	InvestEU constitutes a good opportunity for CSSs, not only to receive funding from the programme itself, but also to become more attractive to private investors and funnel private funds to the initiatives. Specifically, one of the policy windows includes sustainable infrastructure. This includes coverage of a key area titled 'the environment and resources' (e.g. water, waste management, the restoration of ecosystems and biodiversity, and the decarbonisation of energy production).	Financial products to be deployed under InvestEU may take the form of general products or thematic financial products. General financial products must support one or more policy areas covered under each policy window and can include either debt or equity interventions.
LIFE programme	The LIFE programme is the EU's funding instrument for the environment and climate action. Link: https://cinea.ec.europa.eu/programmes/life_en	Sub-programme number 2 concerns circular economy and quality of life. The LIFE programme is a good, and relatively easy, opportunity for CSSs to access financing, given that its focus is primarily on climate action and the environment.	The LIFE programme funds environment-specific and environment-integrated projects in the form of grants, prizes and procurement. It may also finance technical assistance for investment operations. As examples, environment-specific projects can be financed through standard action projects, whereas strategic nature projects (SNAPs) and strategic integrated projects (SIPs) have the aim of supporting the implementation of a plan or strategy required by environmental and climate

			legislation or policies. LIFE also finances projects to improve governance in support of its environmental/climate objectives. Actions under the InvestEU programme are expected to dedicate at least 30 % of the overall financial envelope of the InvestEU programme to climate objectives. However, for its sustainable infrastructure policy window, a combined climate and environmental target of 60 % has been put forward.
EIB venture debt	The EIB venture debt offers a long-term venture debt product to address the unique funding needs of fast-growing innovative companies. The financing structure includes bullet repayment and remuneration linked to the equity risk of the investees and complements existing venture capital financing. Link: https://www.eib.org/en/products/equity/venture-debt.htm	The EIB venture debt constitutes an opportunity particularly well suited for CSS initiatives pioneered by private companies and that have a strong business component.	Eligibility is for small and medium-sized enterprises (SMEs) and mid-caps, developing highly innovative technologies, solutions or platforms. The company must have already raised equity from professional investors, have a sustainable business model and business plan, and have a solid corporate governance in place.
European Angels Fund (EAF)	EAF provides equity to Business Angels and other non-institutional investors for the financing of innovative companies in the form of co-investments. EAF works hand in hand with Business Angels and helps them to increase their investment capacity by co-investing into innovative companies in the seed, early or growth stage. Budget: EUR 800 million. Link: https://www.eif.org/what_we_do/equity/eaf/index.htm	The EAF could be a good funding source for highly innovative and high-risk CSS initiatives that have a strong business component and that can promise relatively high returns if they succeed.	Instead of granting co-investments on a deal-by-deal basis, EAF enters long-term contractual relationships with Business Angels. Co-investment framework agreements (CFAs) are established through which EAF commits a predefined amount of equity for co-investments upfront to each Business Angel for future investments. For ease and speed, these CFAs are generally standardised while leaving room for adaptation to specific requirements of individual Business Angels. Such elements include timeframe, sector focus and number of investments.
Joint Initiative on Circular Economy (JICE)	JICE is a partnership between the European Union's largest national promotional banks and the EIB to invest at least EUR 10 billion in the circular economy by 2023. This will support projects that prevent and eliminate waste, increase resource efficiency and promote circular business models.	JICE is a perfectly tailored initiative for any circular economy project. Given that the programme's focus is in the circular economy, CSSs are very well suited to benefit from it.	JICE provides loans, equity investment, guarantees, innovative financing structures and technical assistance.

	Budget: EUR 10 billion. Link: https://www.eib.org/en/publications/joint-initiative-on-circular-economy#:~:text=The%20Joint%20Initiative%20on%20Circular%20Economy%20(JICE)%20is%20a%20partnership,the%20circular%20economy%20by%202023		
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