



**Circular
Bio-based
Europe**
Joint Undertaking

CBE JU

Key Performance Indicators handbook

v.1 - 07/2022

KPIs handbook rationale and objectives

The purpose of this document is to provide further (non-legally binding) guidance to applicants and beneficiaries to support the interpretation and subsequent reporting of the CBE JU key performance indicators (KPIs) from all types of actions (IAs, including Flagships, RIAs and CSAs).

The information provided in this document is based on and is intended to complement the information provided on the KPIs in the CBE JU [SRIA](#). If different interpretations would be found, the information provided in the SRIA always prevails. This document also supports the CBE JU Annual Work Programmes for what concerns the KPIs interpretation and the preparation of its Annual Activity Reports.

This document will be updated on a yearly basis to include further clarifications and examples as required.

In case of any question, please contact the CBE JU Programme Office info@cbe.europa.eu

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KPI 1 - Strategic participation and integration of feedstock producers and suppliers towards large-scale valorisation of sustainable biomass

Links with CBE Specific Objectives and SRIA Strategic Priorities:

CBE Specific Objective	SRIA Strategic Priority
1.1: Increase the intensity of cross-disciplinary research and innovation activities	1.1.1: Ensure the availability and quality of sustainable bio-based feedstock
1.2: Increase and integrate the research and innovation capacity of stakeholders across the Union	1.2.1: Stimulate research activities in countries and regions with underdeveloped R&I capacity for bio-based systems
2.1: Reinforce the integration of bio-based research and innovation in the Union bio-based industry and increase the involvement of R&I actors including feedstock providers in the bio-based value chains	2.1.1: Demonstrate the sustainable supply of bio-based feedstock
3: Ensure a high level of environmental performance of bio-based industrial systems	3.1.2: Incorporate the environmental sustainability and circularity criteria in bio-based systems

1.1. Number of primary producers, involved as project beneficiaries and/or engaged in value chains at project level

This KPI aims at monitoring the number of primary producers actively involved in the CBE JU funded projects. Involvement of these actors should be in line with the principles highlighted in the multi-actor approach,¹ i.e. ensuring genuine and sufficient involvement over the whole course of the project. Contributions are mainly expected from IAs and RIAs, but they should also be reported by CSAs if relevant.

Primary producers	
Definition	Primary and/or secondary, residual biomass feedstock producers and suppliers from: agriculture, forestry, fisheries, and aquaculture/marine sectors.
Examples	<ul style="list-style-type: none"> - Cooperatives (first and second degree) - Individual farms/farmers/aquatic feedstock producers/suppliers - Biomass producers' organisations - Farmers'/aquatic feedstock/foresters' associations - Local Action Groups
Types of involvement and engagement at project level ²	
Beneficiaries	Beneficiaries (article 7 of the MGA)
	Affiliated Entities (article 8 of the MGA)
Third parties giving in-kind contributions to the action	Associated partners (article 9.1 of the MGA)
	Third parties giving in-kind contributions to the action (article 9.2 of the MGA), e.g. member of advisory board
	Subcontractors (article 9.3 of the MGA), e.g. long term agreements signed

¹ For further information on the Multi-Actor Approach, please refer to the 'Additional Requirements' outlined in the [CBE JU Annual Work Programme 2022](#)

² [general-mga_horizon-euratom_en.pdf \(europa.eu\)](#)

1.2. Number of (bio)waste management actors, involved as project beneficiaries and/or engaged in value chains at project level

This KPI aims at monitoring the number of waste management actors in the CBE JU funded projects. Involvement of these actors should be in line with the principles highlighted in the multi-actor approach³, i.e. ensuring their genuine and sufficient involvement over the whole course of the project. Contributions are mainly expected from IAs and RIAs, but they should also be reported by CSAs if relevant.

Waste management actors	
Definition	Private companies or municipalities involved in the collection, sorting, treatment, and/or recycling of municipal or industrial waste.
Examples	Actors engaged in, for example: <ul style="list-style-type: none"> - Industrial composting - Recycling - Waste collection, sorting and/or treatment For examples of 'industrial and municipal bio-based residues and waste' as well as other types of biowaste, please refer to the SRIA. ⁴
Types of involvement and engagement at project level ⁵	
Beneficiaries	Beneficiaries (article 7 of the MGA)
	Affiliated Entities (article 8 of the MGA)
Third parties giving in-kind contributions to the action	Associated partners (article 9.1 of the MGA)
	Third parties giving in-kind contributions to the action (article 9.2 of the MGA)
	Subcontractors (article 9.3 of the MGA)

³ For further information, please refer to the 'Additional Requirements' outlined in the [CBE JU Annual Work Programme 2022](#)

⁴ See [SRIA](#) (Annex V. Table V.1: Potential feedstock for the bio-based industry)

⁵ [general-mga_horizon-euratom_en.pdf \(europa.eu\)](#)

KPI 2 - Unlock sustainable and circular bio-based feedstock for the industry

Links with CBE Specific Objectives and SRIA Strategic Priorities:

CBE Specific Objective	SRIA Strategic Priority
1.1: Increase the intensity of cross-disciplinary research and innovation activities	1.1.1: Ensure the availability and quality of sustainable bio-based feedstock
	1.1.2: Develop innovative production systems in the bio-based industry
	1.1.3: Develop innovative bio-based products
2.1: Reinforce the integration of bio-based research and innovation in the Union bio-based industry and increase the involvement of R&I actors including feedstock providers in the bio-based value chains	2.1.1: Demonstrate the sustainable supply of bio-based feedstock
	2.1.2: Deploy innovative production technologies

2. Number of innovative bio-based value chains created or enabled based on sustainably-sourced biomass

This KPI aims at monitoring the innovative bio-based value chains created or enabled through CBE JU funded projects. The value chains should be strictly based on sustainably-sourced and used biomass, including primary, secondary, residual or waste biomass. Contributions should be reported by RIAs (value chains enabled) and IAs (value chains created).

Innovative bio-based value chains	
Definition	New bio-based value chains, ones created or enabled, with at least one element of novelty/innovation across the value chain.
Additional definitions	Novel/Innovative value chain = a value chain applying new, emerging technologies or technologies which have been, so far, not developed or deployed in comparable existing value chain(s). This could be to provide benefits (advanced functional properties and/or environmental performance) versus existing benchmarks (where available) for existing or new market segments.
Examples	Novelty/innovation across the value chain can refer to one or more of the following: <ul style="list-style-type: none"> - Type of sustainably-sourced feedstock - Bio-based processes applied - Bio-based outputs/products - Applications of bio-based solutions
Sustainably-sourced biomass	
Definition	Biomass sourced in a manner that enhances and creates benefits for the environment, economy, and society. Where applicable, and wherever possible,

	<p>the sustainability of sourced biomass should be certified by a relevant independent third party.</p> <p>In the context of environmental sustainability, feedstock must also comply with the environmental requirements, including the DNSH principle⁶, as set in the CBE Annual Work Programme.</p>
Additional definitions	<p>Secondary biomass: refers to bio-based feedstock, being waste or residues, that can be recycled in a circular economy context, therefore getting 'injected' back into the economy as secondary raw materials. In this context, secondary bio-based feedstock is residual or waste biomass that can be valorised in bio-based processes.⁷</p>
Examples	<ul style="list-style-type: none"> - Forest-based biomass originating from sustainably managed forests, as certified by FSC/PEFC - Bio-waste complying with the Regulation (EU) 2019/1009 ('Fertilising products regulation'; i.e. "<i>bio-waste within the meaning of Directive 2008/98/EC resulting from separate bio-waste collection at source</i>")

⁶ [programme-guide_horizon_en.pdf \(europa.eu\)](#)

⁷ See [EU Biorefinery Outlook to 2030](#) for classifications of feedstock.

KPI 3 - Ensure environmental sustainability of feedstock

Links with CBE Specific Objectives and SRIA Strategic Priorities:

CBE Specific Objective	SRIA Strategic Priority
1.3: Increase the research and innovation capacity for addressing environmental challenges and development of more sustainable bio-based innovations	1.3.1: Protect and enhance biodiversity and ecosystem services in bio-based feedstock supply systems
3.1: Ensure the integration of circularity and environmental sustainability requirements, contribution to climate neutrality and zero pollution ambition in the development and implementation of bio-based research and innovation and facilitate societal acceptance.	3.1.1: Set effective and robust environmental sustainability and circularity criteria for bio-based systems
	3.1.2: Incorporate the environmental sustainability and circularity criteria in bio-based systems

3.1 Number of projects using feedstock generated with practices that contribute to enhance biodiversity

This KPI aims at monitoring the number of CBE JU funded projects which contribute to the enhancement of biodiversity. Projects can deliver via the development or improvement of (integrated) practices, and/or methodologies, and/or tools to enhance biodiversity within the provision of feedstock⁸ to bio-based systems; for example, production, collection and supply (including any feedstock pre-processing prior to storage and transportation). Contributions should be reported by IAs and RIAs.

Practices, methodologies & tools that contribute to enhance biodiversity	
Definition	<p>Innovative practices refer to primary and/or secondary biomass feedstock production and supply (including any feedstock pre-processing prior to storage and transportation), eventually also contributing to the EU Biodiversity strategy⁹ targets by enhancing biodiversity, preventing ecosystems degradation and restoring terrestrial as well as aquatic ecosystems, in rural, coastal and (peri)urban settings.</p> <p>Development or improvement of methodologies and/or tools:</p> <ul style="list-style-type: none"> - Projects may contribute via improving knowledge on the sustainable management of biotic resources and related ecosystems and/or knowledge on the causes of biodiversity loss and ecosystems degradation, related to bio-based systems. - Within the scope of CBE specific objective 3.1, and especially strategic priority 3.1.1, projects may also contribute via improving on metrics, science-based methodologies and tools to assess the ecosystem functions

⁸ For examples of potential feedstock for the bio-based industry, please refer to Annex V. Table V.1 in the SRIA: <https://www.cbe.europa.eu/strategic-research-and-innovation-agenda-sria>. In the context of environmental sustainability, feedstock must comply with the environmental requirements as set in the CBE Annual Work Programme.

⁹ [Biodiversity strategy for 2030 \(europa.eu\)](#) including the key commitments by 2030. Also, [The EU NatureRestoration Law \(europa.eu\)](#) proposal may be considered.

	and impacts on biodiversity from bio-based systems and based on different types of feedstock.
Additional definitions	Biodiversity enhancement ¹⁰ refers to reporting practices, methodologies and tool improvements relevant to the integration, assessment and improvement of biodiversity aspects related to bio-based systems (coming on top of the mandatory requirement of biodiversity protection ¹¹).
Examples	<ul style="list-style-type: none"> - Remediation of contaminated soils - Pollinator-friendly crops and agronomic systems - Marine multifunctional biomass systems - Harmonized methodologies to better integrate the assessment and monitoring of any potential (reversible or irreversible) impacts on biodiversity from bio-based systems, together with assessing the potential of enhancing biodiversity. - Utilisation of paludicrops from rewetted areas for high value applications, or other nature-positive supply chains. <p>Further examples could be found under</p> <ul style="list-style-type: none"> - The Commission Delegated Acts to the EU Taxonomy regulation¹² - The Platform on Sustainable Finance reports¹³

3.2 Number of projects using feedstock generated with practices aiming at zero-pollution (soil, water, air) and/or at reducing water consumption

This KPI aims at monitoring the number of CBE JU funded projects which reduce pollution (soil, water, air) and/or water consumption due to improved feedstock¹⁴ production and supply practices (including any feedstock pre-processing prior to storage and transportation). Contributions should be reported by IAs and RIAs.

Practices aiming at zero-pollution (soil, water, air)	
Definition	Biomass feedstock production and supply practices (including any feedstock pre-processing prior to storage and transportation) which contribute to the EU Zero Pollution and toxic-free environment ambitions ¹⁵ by reducing the pollution of soil, water and air.
Examples	<ul style="list-style-type: none"> - Reduce excessive fertiliser loads on soil and losses of N- and P-based fertilisers into water bodies.

¹⁰ Restoring EU's ecosystems will help to increase biodiversity, mitigate and adapt to climate change, and prevent and reduce the impacts of natural disasters.

¹¹ Biodiversity protection is further described as part of the mandatory environmental requirements, set in the CBE Annual Work Programmes

¹² [EU taxonomy for sustainable activities | European Commission \(europa.eu\)](https://ec.europa.eu/euro-observatory/en/eu-taxonomy-for-sustainable-activities)

¹³ [Platform on Sustainable Finance: Technical working group - Methodological report \(europa.eu\)](https://ec.europa.eu/euro-observatory/en/platform-on-sustainable-finance-technical-working-group-methodological-report)

¹⁴ In the context of environmental sustainability, feedstock must comply with the environmental requirements as set in the CBE Annual Work Programmes. For examples of potential feedstock for the bio-based industry, please refer to Annex V. Table V.1 in the SRIA: <https://www.cbe.europa.eu/strategic-research-and-innovation-agenda-sria>

¹⁵ On 12 May 2021, the European Commission adopted the [EU Action Plan: "Towards a Zero Pollution for Air, Water and Soil"](https://ec.europa.eu/euro-observatory/en/eu-action-plan-towards-a-zero-pollution-for-air-water-and-soil). The action plan aims to strengthen the EU green, digital and economic leadership, whilst creating a healthier, socially fairer Europe and planet. It provides a compass to mainstream pollution prevention in all relevant EU policies, to step up implementation of the relevant EU legislation and to identify possible gaps.

	<ul style="list-style-type: none"> - Conversion of cropland to fallow or permanent grassland & respective sustainable biomass supply - Restoration of peatlands and wetlands combined with biomass generation (paludiculture) <p>For more examples relevant to climate change mitigation, refer also to:</p> <ul style="list-style-type: none"> - The Carbon Farming initiative and the Handbook¹⁹ (Setting up and implementing result-based carbon farming mechanisms in the EU Technical guidance handbook) - The Sustainable carbon cycles Communication²⁰
Practices contributing to climate change adaptation	
Definition	<p>Climate change adaptation is the process of adapting to climate change, taking action to prepare for and adjust to both the current effects of climate change the predicted impacts in the future.</p> <p>For example, adaptation aims to moderate or avoid harm in humans' life, whereas humans may intervene to help adjustment and increase the resilience of ecosystems to climate change-related events (drought, temperature fluctuations, extreme weather conditions).</p>
Examples	<ul style="list-style-type: none"> - Breeding of more resistant biomass varieties - Cultivating low input crops <p>For more examples relevant to climate adaptation, refer also to:</p> <ul style="list-style-type: none"> - The Carbon Farming initiative and the Handbook (<i>Setting up and implementing result-based carbon farming mechanisms in the EU Technical guidance handbook</i>)¹⁹ - The Sustainable carbon cycles Communication²⁰

¹⁹ [Setting up and implementing result-based carbon farming mechanisms in the EU - Publications Office of the EU \(europa.eu\)](https://ec.europa.eu/europa.eu)

²⁰ https://ec.europa.eu/clima/system/files/2021-12/com_2021_800_en_0.pdf

KPI 4 - Improve environmental sustainability of bio-based production processes and value chains

Links with CBE Specific Objectives and SRIA Strategic Priorities:

CBE Specific Objective	SRIA Strategic Priority
1.1: Increase the intensity of cross-disciplinary research and innovation activities	1.1.2: Enhance production systems for bio-based chemicals, materials and products
1.3: Increase the research and innovation capacity for addressing environmental challenges and development of more sustainable bio-based innovations	1.3.2: Improve environmental performances of bio-based processes and products
2.1: Reinforce the integration of bio-based research and innovation throughout industrial bio-based systems and increase the involvement of R&I actors including feedstock providers in the bio-based value chains	2.1.2: Deploy innovative production technologies
3: Ensure a high level of environmental performance of bio-based industrial systems	3.1.1: Set effective and robust environmental sustainability and circularity criteria for bio-based systems
	3.1.2: Incorporate the environmental sustainability and circularity criteria in bio-based systems

4.1 Number of projects with innovative & sustainable processes that contribute to GHGs emissions reduction

This KPI aims at monitoring the number of CBE JU funded projects which develop, demonstrate or scale-up bio-based processes with a reduced carbon footprint compared to the current benchmark(s). Contributions should be reported by IAs and RIAs.

Innovative & sustainable processes	
Definition	A bio-based process may be considered innovative if it applies technologies (novel or existing but yet not applied in the context in scope) for the conversion of a particular bio-based feedstock or intermediate and at the targeted scale. The process is considered as sustainable if it enhances and creates benefits for the environment, society and the economy.
Contribute to GHGs emissions reduction ²¹	
Definition	A process offering reduced direct GHGs emissions compared to current benchmark(s). The benchmark may be a process using fossil-based inputs and/or an existing process converting bio-based feedstock.
Additional definitions	GHG emissions = GHGs comprise carbon dioxide (CO ₂), nitrous oxide (N ₂ O), methane (CH ₄) and fluorinated gases. In general, there are direct and indirect emissions that need to be monitored and addressed, hereby we are especially focusing on scope 1, direct/process emissions.
Examples	- Demonstrating a process incorporating bio-catalysis for the production of a group of drop-in platform chemicals, reducing direct CO ₂ emissions per kg of product, compared to the state-of-the-art benchmark.

²¹ Targets (% reduction) and baselines defined at project level with appropriate benchmarks.

	<ul style="list-style-type: none"> - Demonstrating significantly improved capture, purification of gaseous streams and catalysis concepts for bio-based processes implementing Carbon Capture and Use (CCU), based on gaseous biogenic carbon <p>Further examples could be found under</p> <ul style="list-style-type: none"> - the Commission Delegated Acts to the EU Taxonomy regulation²² the Platform on Sustainable Finance reports²³
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4.2 Number of projects developing innovative & sustainable processes that improve on resource efficiency and zero-waste

This KPI aims at monitoring the number of CBE JU funded projects which develop, demonstrate or scale-up bio-based processes which are more resource efficient and produce less waste than the current benchmark(s). Contributions should be reported by IAs and RIAs.

Improve resource efficiency (for bio-based processes) ²⁴	
Definition	<p>Resource efficiency means using the Earth's limited resources sustainably, allowing to create more with less and deliver greater value with less input while minimising impacts on the environment. Improved resource efficiency can address technoeconomic feasibility along with environmental sustainability aspects.</p> <p>Using secondary raw materials and energy efficiency are also linked with the resource efficiency concept (see also KPI 4.4).</p>
Examples	<ul style="list-style-type: none"> - Use of secondary raw materials, including all streams of waste - More efficient: <ul style="list-style-type: none"> o biomass feedstock valorisation (improving pre-treatment, conversion and downstream purification efficiency) o water/solvent/(bio)catalyst (re)use (reduce waste/product ratio)
Zero-waste	
Definition	<p>Zero-waste ambition refers to significantly reducing/eliminating waste and by-products during production processes and making full use of input biomass as well as other process agents, thus also preserving natural resources.</p>
Examples	<ul style="list-style-type: none"> - Applying the cascading use of biomass approach to fully valorise all biomass fractions - Recirculate any process streams back in the production processes - Industrial or industrial-urban symbiosis making use of each other's side and waste streams - Applying circularity to feed process biomass residues or waste back in a bio-based value chain - Optimisation, control and monitoring of bio-based processes by applying digitalisation concepts to improve on and ensure high process standards of resource efficiency and environmental protection.

²² [EU taxonomy for sustainable activities | European Commission \(europa.eu\)](https://ec.europa.eu/euro-observatory/en/eu-taxonomy-for-sustainable-activities)

²³ [Platform on Sustainable Finance | European Commission \(europa.eu\)](https://ec.europa.eu/euro-observatory/en/platform-on-sustainable-finance)

²³ [Platform on Sustainable Finance: Technical working group - Methodological report \(europa.eu\)](https://ec.europa.eu/euro-observatory/en/platform-on-sustainable-finance-technical-working-group-methodological-report) For examples of potential feedstock for the bio-based industry, please refer to Annex V. Table V.1 in the SRIA: <https://www.cbe.europa.eu/strategic-research-and-innovation-agenda-sria>

²⁴ Targets (% reduction) and baselines defined at project level with appropriate benchmarks.

4.3 Number of projects developing innovative & sustainable processes enabling to address zero pollution

This KPI aims at monitoring the number of CBE JU funded projects which develop, demonstrate or scale-up bio-based processes which are contributing to zero pollution ambition. Contributions should be reported by IAs and RIAs.

Address zero pollution	
Definition	Contributing to the zero-pollution vision for 2050 ²⁵ by addressing the key 2030 targets to reduce air, water and soil pollution to levels no longer considered harmful to human health and ecosystems and that respect the planetary boundaries.
Examples	<ul style="list-style-type: none"> - Reducing exhaust flows from bio-based processes through innovative technologies of extraction, recirculation, fractionation and conversion of such flows, thus reducing pollutants' emissions. - Reducing noise emissions - Replacing hazardous substances used in industrial processes with safe(r) and more sustainable bio-based ones

4.4 Number of projects with innovative & sustainable processes with improved energy efficiency

This KPI aims at monitoring the number of CBE JU funded projects which develop, demonstrate or scale-up bio-based processes which are more energy efficient than current processes (the benchmark(s) may be addressing fossil- or bio-based feedstock). Contributions should be reported by IAs and RIAs.

Improved energy efficiency ²⁶	
Definition	Reduced energy input while maintaining an equivalent level of an activity with regards to providing products and services. Improved energy efficiency can address technoeconomic feasibility along with environmental sustainability aspects.
Examples	<ul style="list-style-type: none"> - A process occurring at milder conditions (e.g. catalyst optimisation to reduce required temperatures or pressures), thus lowering its energy consumption - A process using waste heat recovery to lower its overall energy consumption - Low carbon energy integration/electrification of bio-based processes

4.5 Number of products with improved life cycle environmental performance

This KPI aims at monitoring the number of bio-based products developed, demonstrated or scaled-up within CBE JU funded projects that improve environmental performance compared to the current (fossil- and/or bio-based) benchmarks. Contributions should be reported by IAs.

²⁵ See [Zero pollution action plan \(europa.eu\)](https://europea.eu).

²⁶ Targets (% reduction) and baselines defined at project level with appropriate benchmarks.

Products²⁷	
Definition	Outputs of bio-based value chains (including B2B and B2C products)
Examples	<ul style="list-style-type: none"> - Bio-based chemicals (e.g. platform chemicals, additives, solvents, surfactants) - Bio-based polymers and materials - Other bio-based end products
Improved life cycle environmental performance	
Definition	<p>The product life cycle assessment (LCA) indicates improvements in at least one environmental impact category, with no negative impacts on other impact categories and while fulfilling all environmental sustainability requirements set out in the relevant Annual Work Programme.²⁸</p> <p>The main references for LCA methodologies are the international standards ISO 14040 and ISO 14044. Environmental LCA is complemented by life cycle costing assessment (LCCA), which aims to assess the economic impacts of a product/process/service, and by social life cycle assessment (S-LCA), which aims to evaluate social implications of a product/process/service.</p> <p>In the context of SRIA 2030 and CBE Annual Work Programme, depending on the type of impacts to be assessed, LCA methodologies can refer to:</p> <ul style="list-style-type: none"> - Life cycle assessment (LCA) to evaluate environmental impacts. - Life cycle costing (LCC) to evaluate economic impacts. - Social life cycle assessment (S-LCA) to evaluate social impacts.
Examples	<ul style="list-style-type: none"> - Bio-based products that show a carbon removal capacity (according with the forthcoming regulation on the certification of carbon removals) - climate change impacts (decreased global warming potential) - reduced pollution (e.g. acidification, eutrophication) - improved land/water use

²⁷ Please refer to the [EU Biorefinery Outlook to 2030 | European Commission \(europa.eu\)](https://ec.europa.eu/biobased-economy/) for product classifications.

²⁸ Targets (% reduction) and baselines defined at project level with appropriate benchmarks. [CBE JU Annual Work Programme 2022](#).

KPI 5 - Expand circularity in bio-based value chains

Links with CBE Specific Objectives and SRIA Strategic Priorities:

CBE Specific Objective	SRIA Strategic Priority
1.1: Increase the intensity of cross-disciplinary research and innovation activities	1.1.3: Develop innovative bio-based products
2.1: Reinforce the integration of bio-based research and innovation throughout industrial bio-based systems and increase the involvement of R&I actors including feedstock providers in the bio-based value chains	2.1.3: Scale up production and market uptake of innovative bio-based products
3.1: Ensure that circularity and environmental considerations, including contributions to climate neutrality and zero pollution objectives, are taken into account in the development and implementation of research and innovation bio-based projects and facilitate societal acceptance	3.1.1: Set effective and robust environmental sustainability and circularity criteria for bio-based systems
	3.1.2: Incorporate the environmental sustainability and circularity criteria in bio-based systems

5.1 Number of innovative products that are biodegradable, compostable, recyclable, reused or upcycled (circular-by-design)

This KPI aims at monitoring the number of bio-based products developed (RIA), demonstrated (low TRL IA), or upscaled to precommercial scale (high TRL IA) within CBE JU funded projects and with improved end-of-life options compared to the current fossil and/or bio-based benchmarks.

Innovative products	
Definition	Materials and/or chemicals with advanced properties or enhancements (including improved circularity-by-design) compared to existing benchmarks.
Examples	<ul style="list-style-type: none"> - Materials and/or chemicals exploiting the natural variety and chemical functionality of bio-based molecules to confer unprecedented technical performance properties to the final products - Active ingredients with new functional characteristics
Biodegradable products	
Definition	<p>A material or product is biodegradable if it can undergo biodegradation, which is the breakdown of an organic compound by microorganisms in the presence of oxygen into carbon dioxide, water and mineral salts of any other elements present (mineralization) and new biomass (EN 17033).</p> <p>The ultimate aerobic biodegradation occurs under specific environmental conditions.</p>
Examples	<ul style="list-style-type: none"> - Mulching tarps biodegrading under the right environmental conditions and also serving as soil nutrients after use. - Design for programmed biodegradation for bio-based plastics, improving on end-of-life and microplastics release.

Compostable products	
Definition	Compostable bio-based materials or products able (and certified) to biodegrade under specific conditions in industrial composting plants (e.g. compostable packaging following the standard EN 13432) and/or home composting (an EU home composting standard does not exist, yet, but some MSs have it).
Examples	<ul style="list-style-type: none"> - Bio-based smart food packaging to reduce waste by monitoring and extending shelf-life, while being compostable.
Recyclable products	
Definition	Recycling means any recovery operation by which waste materials are reprocessed into products, materials or substances whether for the original or other purposes. It includes the reprocessing of organic material but does not include energy recovery and the reprocessing into materials that are to be used as fuels or for backfilling operations. ²⁹
Examples	<ul style="list-style-type: none"> - Bio-based plastic that is mechanically recyclable; either by the conventional plastic recycling routes (for PET, PP, LDPE, etc) or in dedicated recycling facilities - Cellulose-based products compatible with paper recycling streams
Reused products	
Definition	Products which are designed for re-use, without any pre-processing beyond cleaning/repairing operations.
Examples	<ul style="list-style-type: none"> - Bio-based bottles/packaging designed for reuse - Improving the durability/reparability of bio-based products
Upcycled products	
Definition	Products which can be converted into new ones with a higher value, including environmental value.
Examples	<ul style="list-style-type: none"> - Creating garments from recycled fabric, including from mixed bio-based fibers - Design furniture from scrap wood composites
Circular-by-design	
Definition	Including circular economy considerations at the design stage of a product and/or business model considering their lifecycle. It aims to minimise resource consumption intensity, waste generation, extend the lifetime of products and optimise production and logistics.
Examples	<ul style="list-style-type: none"> - Modular products allowing easy disassembly and reassembly. - Materials designed with safer and more sustainable additives, facilitating recycling. - Improved bio-based materials' design to limit the number of materials (e.g., in multi-layered materials) and the need of chemical additives incorporated in the final product.

²⁹ See [Waste Framework Directive](#).

5.2 Number of projects developing circular production practices (incl. industrial & industrial urban symbiosis)

This KPI aims at monitoring the number of CBE JU funded projects which are developing bio-based value chains which close the circle from the feedstock inputs to the end-of-life of the bio-based products (cradle-to-cradle).

Circular production practices	
Definition	Circular production processes minimise resources input requirements (e.g. feedstock, process auxiliaries etc) and consumption as well as waste generation (outputs) of production processes. See also KPIs 4.2-4.4
Additional definitions	Circular bio-based system = a full operational system, from feedstock intake through market application of resultant bio-based products, and their end-of-life handling to close the circle (cradle-to-cradle).
Industrial symbiosis/ Industrial-urban symbiosis	
Definition	<p>This concept covers both material and energy flows and can contribute to circular (bio)economy. It refers, partly, to a process by which waste or by-products of an industrial process or (peri)urban setting become the raw material or input for (another) industrial process.</p> <p>Industrial symbiosis creates an interconnected network, even between different sectors, within which energy and materials cycles operate in a continuous mode, minimising waste products. Deploying industrial and/or industrial-urban symbiosis solutions for energy, water and waste and other by-products can also contribute to the regional development of circular bio-based systems.</p>
Examples	<ul style="list-style-type: none"> - Biogenic gaseous carbon CCU deploying symbiosis networks - A biorefinery producing lactic acid fed by the by-products for the dairy industry (whey permeate/de-lactosed whey permeate) - A biorefinery recovering high added value from urban waste streams

KPI 6 - Increase innovative bio-based outputs and products

Links with CBE Specific Objectives and SRIA Strategic Priorities:

CBE Specific Objective	SRIA Strategic Priority
1.1: Increase the intensity of cross-disciplinary research and innovation activities	1.1.3: Develop innovative bio-based products
2.1: Reinforce the integration of bio-based research and innovation throughout industrial bio-based systems and increase the involvement of R&I actors including feedstock providers in the bio-based value chains	2.1.3: Scale up production and market uptake of innovative bio-based products
3: Ensure a high level of environmental performance of bio-based industrial systems	3.1.2: Incorporate the environmental sustainability and circularity criteria in bio-based systems

6.1 Number of innovative bio-based dedicated outputs, with novel or significantly improved properties vs relevant alternatives

This KPI aims at monitoring the number of dedicated outputs developed (RIA), demonstrated (low TRL IA), or upscaled to precommercial scale (high TRL IA) within CBE JU funded projects. Contributions should be reported by IAs and RIAs.

Dedicated outputs with novel or significantly improved properties	
Definition	Dedicated outputs here refer to bio-based outputs that are produced via a dedicated pathway and do not have an identical fossil-based counterpart. As such, they can be used for products that cannot be obtained through traditional chemical reactions and which may offer unique and superior properties that are unattainable with fossil-based alternatives. ³⁰
Additional Definition	Outputs refer to the following product categories: <ul style="list-style-type: none"> - Chemicals (platform chemicals, additives, solvents, surfactants...) - Polymers and materials - other products related with end use.
Examples	<ul style="list-style-type: none"> - Furan dicarboxylic acid (FDCA) for polyethylene furanoate (PEF) - Polylactic acid (PLA) - Polyhydroxyalkanoates (PHA) - 5-Hydroxymethylfurfural (5-HMF) for phenolic (PF) resins
Relevant alternatives	
Definition	Bio- or fossil-based benchmarks currently used for the same or similar application(s).
Examples	<ul style="list-style-type: none"> - Phthalic acid for polyethylene terephthalate (PET) - Formaldehyde for resins applications

³⁰ Definition adapted from the one of dedicated chemicals found in the 'Roadmap for the Chemical Industry in Europe towards a Bioeconomy': [RoadToBio_Drop-in_paper.pdf](#)

6.2 Number of innovative bio-based drop-in outputs meeting applications requirements

This KPI aims at monitoring the number of drop-in outputs developed (RIA), demonstrated (low TRL IAs), or upscaled to precommercial scale (high TRL IAs) within CBE JU funded projects. Contributions should be reported by IAs and RIAs.

Drop in outputs	
Definition	Drop-ins (including smart drop-ins) are bio-based versions of existing petrochemicals which have established markets. They are chemically identical to existing fossil-based outputs. ³¹
Additional Definitions	<p>Smart drop-ins: A sub-group of drop-in chemicals. They are also chemically identical to existing chemicals based on fossil hydrocarbons, but their bio-based pathways provide advantages compared to the conventional pathways. Drop-in chemicals are 'smart drop-ins' if at least two of the following criteria apply: 1) the Biomass Utilization Efficiency from feedstock to product is significantly higher compared to other drop-ins. 2) Their production requires significantly less energy compared to other production alternatives. 3) Time-to-product is shorter due to shorter and less complex production pathways compared to the fossil-based counterpart or other drop-ins. 4) Fewer toxic chemicals are used or occur as by-products during their production process compared to the fossil-based counterpart or other drop-ins³⁴.</p> <p>Outputs refers to the following product categories:</p> <ul style="list-style-type: none"> - Chemicals (platform chemicals, additives, solvents, surfactants...) - Polymers and materials - other products related with end use
Examples	<ul style="list-style-type: none"> - C2-C4 small molecules (e.g. bio-isobutene) - Alcohols (e.g. 1,4-butanediol as a smart drop-in) - Carboxylic acids (e.g. succinic acid, adipic acid) and esters - (Bio)-polyurethane (smart drop-in) - (Bio)-polymethyl methacrylate – (bio)-PMMA (smart drop-in)
Meeting applications requirements	
Definition	The bio-based solutions should be compliant with the specifications determined by the relevant end users and should perform comparably with regards to their functional performance and with an improved environmental performance than the current alternatives (bio- and/or fossil-based) in the same or similar applications.
Examples	<ul style="list-style-type: none"> - Chemical/physical properties suitable for application, including applications with stringent requirements. - Cost performance in line with applications. - Sensory properties meet expectations. <p><i>Note: For all the above examples, meeting the additional requirement of an improved environmental performance vs state-of-the-art benchmarks.</i></p>

³¹ Definition adapted from the one of drop-in chemicals found in the 'Roadmap for the Chemical Industry in Europe towards a Bioeconomy': [RoadToBio Drop-in paper.pdf](#)

KPI 7 - Improve the market uptake of bio-based products

Links with CBE Specific Objectives and SRIA Strategic Priorities:

CBE Specific Objective	SRIA Strategic Priority
2.1: Reinforce the integration of bio-based research and innovation in the Union bio-based industry and increase the involvement of R&I actors including feedstock providers in the bio-based value chains	2.1.3: Scale up production and market uptake of innovative bio-based products
	2.1.4: Build policy makers' awareness and acceptance of bio-based solutions

Number of brand owners involved as project partners and/or engaged with other mechanisms

This KPI aims at monitoring the number of brand owners involved in CBE JU funded projects, either as project partners or as a third party. Their involvement is a tool to increase consumers' awareness and uptake of bio-based products. Involvement of these actors should be in line with the principles highlighted in the multi-actor approach,³² i.e., ensuring genuine and sufficient involvement over the whole course of the project. Contributions should be reported by RIAs, IAs and CSAs.

Brand owners	
Definition	Refers to industrial stakeholders selling commodities under a registered brand. They may be existing or new stakeholders of bio-based value chains, contributing to the market uptake of bio-based products.
Examples	Brand owners may include, for example: <ul style="list-style-type: none"> - Fast-moving consumer goods (FMCG) - Textiles - Novel food ingredients - Retail chains Examples of types of involvement include: <ul style="list-style-type: none"> - Production of prototype consumer products in industrially relevant/operational environments - Providing specifications/requirements to materials producers
Project partners and/or engaged with other mechanisms at project level ³³	
Beneficiaries	Beneficiaries (article 7 of the MGA)
	Affiliated Entities (article 8 of the MGA)
Third parties giving in-kind contributions to the action	Associated partners (article 9.1 of the MGA)
	Third parties giving in-kind contributions to the action (article 9.2 of the MGA) e.g. member of advisory board
	Subcontractors (article 9.3 of the MGA)

³² For further information, please refer to the 'Additional Requirements' outlined in the [CBE JU Annual Work Programme 2022](#)

³³ [general-mga_horizon-euratom_en.pdf \(europa.eu\)](#)

KPI 8 - Attract investment on the bio-based sector

Links with CBE Specific Objectives and SRIA Strategic Priorities:

CBE Specific Objective	SRIA Strategic Priority
2.2: Reduce the risk for research and innovation investment in bio-based companies and projects	2.2.2: Develop investment tools and approaches that mitigate the investment risk in bio-based systems

Number of actions implemented at project level to attract investment and/or to create awareness in the investment/funding community

This KPI aims at monitoring the activities within CBE JU funded projects which are contributing to increased awareness of opportunities in the bio-based sector and/or increased investment into the bio-based sector. Contributions should be reported by all types of action and especially CSAs.

Actions implemented at project level to attract investment and/or to create awareness	
Definition	Actions which facilitate the engagement of investors and/or funding bodies with the bio-based sector.
Examples	<ul style="list-style-type: none"> - Participate in or deliver events (e.g. pitch competitions) and/or open platforms, related with investment, increasing networking and funding opportunities - Campaigns to increase awareness of the investment/funding community about the opportunities and applications of innovative bio-based solutions - Events/platforms to exchange on best practices to attract investment and improve on scaling up innovation, replicability and market uptake.
Investment/funding community	
Definition	Institutions, private investors and investment products with a potential interest in financing the bio-based sector.
Examples	<ul style="list-style-type: none"> - Financial institutions (public or private) - Venture Capitals/Business Angels/Investment banks - Private investment funds - Funding agencies and public procurement actors

KPI 9 - Increase resilience and capacity in the bio-based sector

Links with CBE Specific Objectives and SRIA Strategic Priorities:

CBE Specific Objective	SRIA Strategic Priority
1.2: Increase and integrate the research and innovation capacity of stakeholders across the Union	1.2.2: Increase the awareness and capacity of national and regional research support agencies for industrial bio-based systems
	1.2.3: Facilitate the development of expertise in bio-based fields by improving higher education and skills development
2.2: Reduce the risk for research and innovation investment in bio-based companies and projects	2.2.1: Improve risk profile of bio-based projects
3.1: Ensure the integration of circularity and environmental sustainability requirements, contribution to climate neutrality and zero pollution ambition in the development and implementation of bio-based research and innovation and facilitate societal acceptance.	3.1.3: Facilitate social acceptance of bio-based applications

Number of projects contributing to develop the skills and capacity needed by the EU bio-based sector

This KPI aims at monitoring the number of CBE JU funded projects which are strengthening the EU bio-based sector through activities which contribute to skills and capacity building. Contributions should be reported by all types of action (IAs, RIAs and CSAs).

Develop skills and capacity needed by the EU bio-based sector	
Definition	<p>Activities oriented to improve expertise and competences to meet current and future professionals profiles' needs for the development and deployment of the bio-based sector.</p> <p>Moreover, bio-based capacity extends from R&I capacity and skills to awareness, policies and other capacity necessary to establish and expand the bio-based sector.</p>
Examples	<ul style="list-style-type: none"> - Educational programmes (higher education, including PhD, summer schools etc.) - Vocational programmes and traineeships - Platforms and ecosystems, connecting bio-based value chain stakeholders, and allowing for sharing knowledge and skills-related tools - Academia –industry exchange programmes - Training and mutual learning addressed to regional or national policy makers and governance actors - Harmonisation of bio-based systems-related standards and certifications

KPI 10 - Improve participation of regions and countries with high unexploited potential and strategic interest to develop it

Links with CBE Specific Objectives and SRIA Strategic Priorities:

CBE Specific Objective	SRIA Strategic Priority
1.2: Increase and integrate the research and innovation capacity of stakeholders across the Union	1.2.1: Stimulate research activities in countries and regions with underdeveloped R&I capacity for bio-based systems
	1.2.2: Increase awareness and capacity of national and regional research support agencies for industrial bio-based systems.
2.1: Reinforce the integration of bio-based research and innovation throughout industrial bio-based systems and increase the involvement of R&I actors including feedstock providers in the bio-based value chains	2.1.4: Build policy makers' awareness and acceptance of bio-based solutions

10.1 Number of participants from the underrepresented EU countries and regions³⁴

This KPI aims at monitoring the involvement in CBE JU funded projects of EU countries and regions which have been underrepresented in the bio-based sector, so far. Contributions should be reported by all types of action (IAs, RIAs and CSAs).

Participants at project level	
Definition	<ul style="list-style-type: none"> - Beneficiaries (article 7 of the MGA) - Affiliated Entities (article 8 of the MGA)
Underrepresented countries	
Definition	Refers to Member States and Associated Countries which have been underrepresented in terms of participation (funded project(s) numbers and of budget) in the calls of the preceding Joint Undertaking (BBI JU) (see Annex I) and/or have low geographical coverage of biorefineries (for bio-based chemicals/materials production) in the EU. ³⁵
Examples	<ul style="list-style-type: none"> - Below average participation considering the population normalized number of participations and/or budget contribution at country level in BBI JU projects funded (see Annex I) - EU countries with a lower-than-average coverage of biorefineries³⁵
Underrepresented regions	
Definition	Refers to EU regions at NUTS 1 level (major socio-economic regions ³⁶) which have been underrepresented in the bio-based sector so far, but have the potential as well as strategic interest in the bio-based sector. For instance, such

³⁴ Further references and improvement for the definition of this sub-KPI will be included in the next revision of the handbook

³⁵ Please refer to JRCKBC dashboard on [Chemical and material biorefineries in the EU | Knowledge for policy \(europa.eu\)](https://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&plugin=1)

³⁶ [NUTS - Nomenclature of territorial units for statistics - Eurostat \(europa.eu\)](https://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&plugin=1)

	<p>strategic interest to improve representation can be demonstrated via being part of one or more of the following initiatives:</p> <ul style="list-style-type: none"> i) Bioeconomy Strategy development in EU regions³⁷ ii) Participation in the BIC regional platform³⁸ iii) Inclusion of bio-based sectors into other relevant policy initiatives at regional level (e.g., smart specialisation strategy³⁹, regional operational plan etc).
Examples	- EU regions with a lower-than-average coverage of biorefineries ³⁶

10.2 Number of regional hubs, established and operated to process bio-based feedstock, and other cooperation aspects

This KPI aims at monitoring the number of regional hubs established through CBE JU funded projects. Contributions are mainly expected from IAs and RIAs, but should also be reported by CSAs if relevant.

Regional hubs	
Definition	Regional Hubs are platforms for cooperation, information and collaboration, and bridging sectoral and bio-based value chain stakeholders as well as the civil society.
Examples	<ul style="list-style-type: none"> - Large-scale infrastructures such as biorefineries, established to implement industrial cooperation and economy of scale, at regional level - Regional logistics units to connect biomass suppliers to biorefineries - Platforms for cooperation, information and collaboration, and bridging sectoral and value chain stakeholders as well as the civil society⁴⁰

10.3 Number of projects with synergies with other funding programmes at EU, national or regional level

This KPI aims at monitoring the number of CBE JU funded projects which benefit from complementary funding invested at the EU, national or regional level such as funding for regional infrastructure/facilities. Contributions are mainly expected from IAs and RIAs, but should also be reported by CSAs if relevant.

Synergies with other funding programmes	
Definition	Synergy = working together to create a greater combined contribution/ effect than could be achieved independently, confirmed by any formal arrangement (e.g. MoU or joint financing plan).
Examples	<p>Project cofunded with other funding programmes:</p> <ul style="list-style-type: none"> - EU (e.g. ECBF, EIB, EBRD, CAP, CFP) - National (e.g. NextGenerationEU)

³⁷ See [JRC Publications Repository - Bioeconomy strategy development in EU regions \(europa.eu\)](#)

³⁸ <https://www.bioeconomy-regions.eu/project/regional-funding-database/new/regional-funding-database/>

³⁹ [Home - Smart Specialisation Platform \(europa.eu\)](#)

⁴⁰ [POWER4BIO_D5.3_Summaries-of-5-new-regional-bioeconomy-strategies_20201111_FV.pdf](#)

	<ul style="list-style-type: none">- Regional level (e.g. cohesion and structural funds)⁴¹- European Forest Institute- Joint programming activities (e.g. with local/regional funding)
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⁴¹ [Staff Working Document \(europa.eu\)](#) on 'Synergies between Horizon Europe and ERDF programmes'

Annex I

Country	Budget Contribution	Number of participations*	Participation per million population
Average	€23,240,997.19	53	3.75
AT	€14,006,237.58	41	4.59
BE	€58,748,806.00	132	11.42
BG	€417,046.25	6	0.87
CY	€1,038,175.00	4	4.46
CZ	€3,028,511.04	9	0.84
DE	€55,136,381.04	156	1.88
DK	€12,298,798.72	31	5.31
EE	€18,781,644.26	13	9.77
EL	€5,810,663.68	26	2.43
ES	€100,640,835.71	293	6.18
FI	€26,736,341.72	62	11.20
FR	€90,738,808.59	158	2.34
HR	€3,327,272.40	15	3.72
HU	€571,242.10	4	0.41
IE	€24,235,032.45	32	6.39
IT	€76,776,289.92	183	3.09
LT	€368,335.00	1	0.36
LU	€114,975.00	1	1.58
LV	€8,841,491.11	4	2.11
MT	€0.00	0	0.00
NL	€60,416,188.95	130	7.44
PL	€7,827,006.29	27	0.71
PT	€12,408,618.51	38	3.69
RO	€902,988.00	4	0.21
SE	€11,224,633.40	30	2.89
SI	€4,591,311.94	11	5.22
SK	€19,284,529.90	16	2.93

Table 1: Requested budget and participation per EU country in BBI JU projects in absolute numbers and scaled to population* (Call 2014-2020).

*2021 population data was obtained from Eurostat:

http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=demo_r_d2jan