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Implementation of the EU Bioeconomy Monitoring System dashboards

*Status and technical
description as of December
2021*

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Abstract

This document describes the progress made in 2021 for the development of the EU Bioeconomy Monitoring System. It contains an overview of the purpose of the system, its current status and future outlook for 2022. Technical details of the back-end and front-end are also provided.

This is the second of an annual reporting scheme to document and inform the public of the progress in building the EU Bioeconomy Monitoring System.

The EU Bioeconomy Monitoring System: Summary of progress

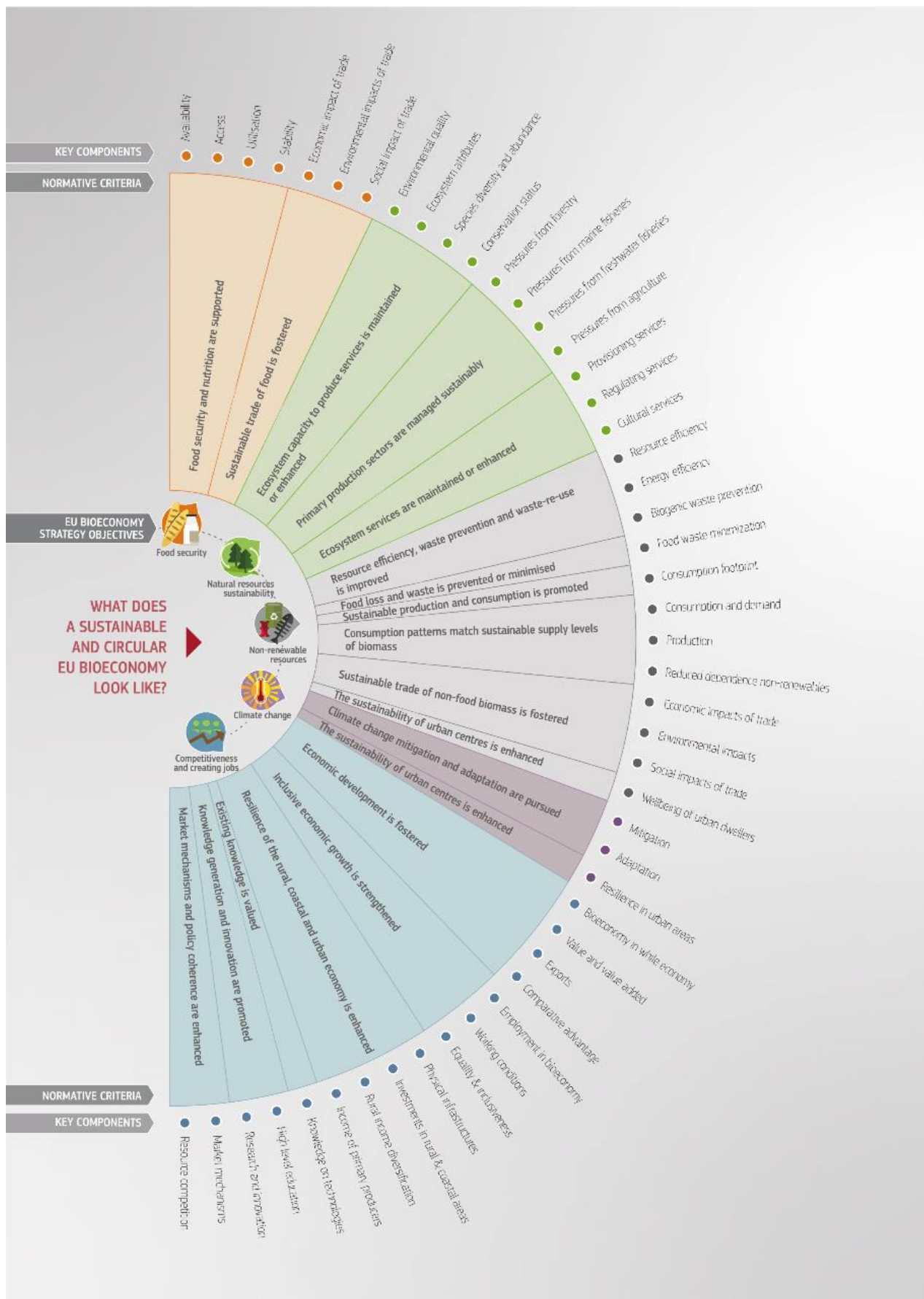
The development of the EU Bioeconomy Monitoring System is pursuant to the Action 3.3.2 of the EU Bioeconomy Strategy (COM/2018/673). It addresses the need for a comprehensive monitoring system by establishing a mechanism to measure the progress of the EU bioeconomy towards the five strategic objectives it tackles. It defines and implements a comprehensive monitoring framework for the EU bioeconomy, which covers environmental, social and economic dimensions of sustainability and relates to the overarching Sustainable Development Goals (SDGs) context.

The EU Bioeconomy Monitoring System was officially launched in November 2020 on the occasion of the Global Bioeconomy Summit. This document describes the back-end and front-end system design as well as the content of the EU Bioeconomy Monitoring System dashboards embedded in the Knowledge Centre for Bioeconomy (KCB) at the location <https://knowledge4policy.ec.europa.eu/bioeconomy/monitoring>. It reports on the status as of December 2021.

In this early stage of the lifetime of the dashboards, the progress of its development is measured by the number of indicators published with respect to the number of planned indicators within the Bioeconomy Monitoring System framework.

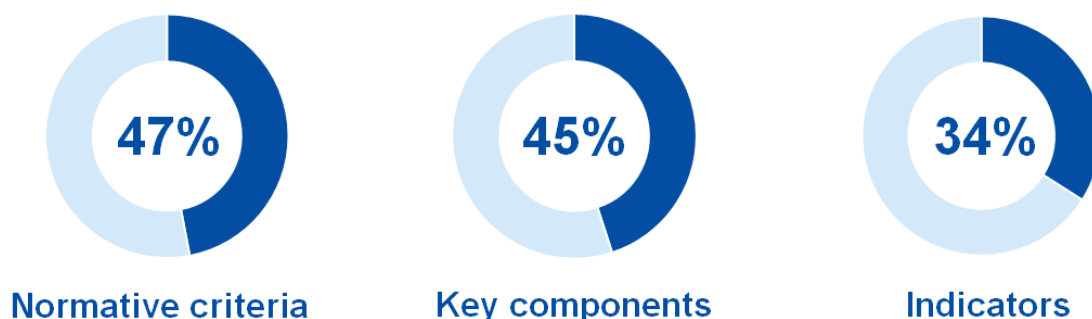
The framework consists of four levels. As shown in Figure 1, the highest level is that of the EU Bioeconomy Strategy objectives themselves. Each of these is broken down into normative criteria, which in turn, is broken down into key components. The indicators are then assigned to the level of the key components. This hierarchical design allows for a logical aggregation of indicators for higher-level indicators to be developed.

Figure 1. Conceptual framework of the EU Bioeconomy Monitoring System



As of the end of 2021, the dashboards contain 34% of the indicators that were originally intended to be included, covering 45% of all key components and 47% of all normative criteria (Figure 2).

Figure 2. Summary of coverage of published indicators, key components and normative criteria



What is new in 2021

When the EU Bioeconomy Monitoring System was launched in November 2020 during the Global Bioeconomy Summit, nineteen indicators were included in the dashboards. One year later, the dashboards contain nineteen more indicators (Figure 3), closing seven gaps at the level of key components, and one at the level of normative criteria.

Figure 3. Breakdown of the nineteen new indicators published in 2021 by EU Bioeconomy Strategy objectives



The new indicators included in 2021 are summarised in Table 1. As a general rule, each time a group of indicators was published, a Science Update was published in the JRC Science Hub. An exception occurred in December for three indicators added to objective 2.

Table 1. Summary of new indicators published in 2021 and respective JRC Science Update publication headline

Indicator id	Indicator	Science update publication
2.1.b.9	Forest and other wooded land growing stock	25 Mar 2021 EU Bioeconomy Monitoring System extended with new indicators
2.1.d.1	Bird and butterfly indices EU aggregate (common farmland bird Index, common forest bird index, grassland butterfly index)	
2.1.e.1	Surface of marine and terrestrial sites designated under NATURA 2000	

3.1.a.2	Material Footprint (Biomass)	
3.4.a.4	Share of woody biomass used for energy	
4.1.b.3	Water exploitation index (WEI)	
5.1.a.2	Value Added per sector / Bioeconomy value added	
5.1.a.5	Gross value added per person employed in bioeconomy	
5.1.b.1	Turnover in bioeconomy per sector	
3.1.c.1	Cascading factor of wood resources	02 Aug 2021 European Green Deal and SDGs mapped to the EU Bioeconomy indicators
3.1.c.5	Biowaste generated by source	
3.1.c.6	Biowaste recovered by source	
3.1.c.4	Recycling rate of municipal waste	21 Oct 2021 JRC Food waste indicators now reported in the EU Bioeconomy Monitoring System
3.2.a.1	Food waste along supply chain - mass balance approach	
3.2.a.2	Food waste by food category - mass balance approach	
3.4.c.1	Share of renewables for transport, electricity and heating & cooling	19 Dec 2021 (no science update)
2.1.a.1	Biochemical oxygen demand in rivers	
2.1.a.2	Phosphate in rivers	
2.1.a.4	Nitrate in groundwater	

Two new tools were added to the EU Bioeconomy Monitoring System during the summer of 2021: mapping to the SDGs and mapping to the EU Green Deal. The highest number of indicators are associated with the Green Deal priorities (1) Mobilising industry for a clean and circular economy, (2) From Farm to Fork: designing a fair, healthy and environmentally friendly food system and (3) Preserving and restoring ecosystems and biodiversity (Figure 4, Table 2). Indicators can be associated with different Green Deal priorities, but contrary to the bioeconomy, there is no conceptual framework to define how the indicators are measuring the Green Deal priorities, only that they are topically associated in some way. This means that these indicators should not be considered as an exhaustive means to measure progress towards the Green Deal or any of its priorities.

Figure 4. The indicators in the EU Bioeconomy Monitoring System are mapped to the EU Green Deal priorities (image shows entry point to the dashboards by Green Deal priorities)



Table 2. The EU Green Deal priorities and associated number of indicators within the EU Bioeconomy Monitoring System

2.1.1. Increasing the EU's climate ambition for 2030 and 2050	33
2.1.2. Supplying clean, affordable and secure energy	20
2.1.3. Mobilising industry for a clean and circular economy	68
2.1.4. Building and renovating in an energy and resource efficient way	8
2.1.5. Accelerating the shift to sustainable and smart mobility	8
2.1.6. From 'Farm to Fork': designing a fair, healthy and environmentally-friendly food system	66
2.1.7. Preserving and restoring ecosystems and biodiversity	61
2.1.8. A zero pollution ambition for a toxic-free environment	16
2.2.1. Pursuing green finance and investment and ensuring a just transition	2
2.2.2. Greening national budgets and sending the right price signals	2

2.2.3. Mobilising research and fostering innovation	7
2.2.4. Activating education and training	3
2.2.5. A green oath: 'do no harm'	0

Furthermore, starting from 2021, the EU Bioeconomy Monitoring System is supported by the KCB data service that stores and feeds the data shown in the dashboards. This back-end solution replaced the previous approach of publishing the data in JSON files on the Knowledge4Policy (K4P) platform that was implemented at the launch of the EU Bioeconomy Monitoring System. The data service also supports the editing of the associated metadata through a custom editor.

The EU Bioeconomy Monitoring System: An Internationally recognised example

In 2021 a Guidance Note was jointly published by the FAO and the JRC. This report describes why and how bioeconomy monitoring systems could be developed and uses the EU Bioeconomy Monitoring System as an example. It is available here: <https://www.fao.org/documents/card/en/c/cb7437en>.

1 Introduction

This document describes the user interface of the EU Bioeconomy Monitoring System as it is nested within the Knowledge Centre for Bioeconomy (KCB): https://knowledge4policy.ec.europa.eu/bioeconomy/monitoring_en. A list of indicators that are published in the EU Bioeconomy Monitoring System dashboards in 2021, as well as the full list of indicators to be included in the coming years, are also described in this document. The conceptual framework and methodology are further described elsewhere (Giuntoli et al., 2020; Robert et al., 2020). Furthermore, a description of the methods behind each indicator is published on the data owner's websites.

In the first section of this report, we describe the EU Bioeconomy Monitoring System's objectives and scope. We then walk the reader through the user interface, describing the features developed up to the time of writing, followed by a description of the back-end and front-end technologies. Finally, the relevance of creating metadata sheets for each indicator is presented. All the indicators are listed and the metadata of the ones that are included in the EU Bioeconomy Monitoring System dashboards are given in the annexes.

Action 3.3.2 in the 2018 Bioeconomy Strategy related to the development of an EU Bioeconomy Monitoring System as described in COM/2018/673, states the need to increase observation, measurement, monitoring and reporting capabilities and build an EU-wide, internationally coherent monitoring system to track economic, environmental and social progress towards a sustainable bioeconomy, which addresses the need for a comprehensive mechanism by which to measure the progress of the EU Bioeconomy towards its five strategic objectives. A comprehensive monitoring framework for the EU bioeconomy should, according to the description in this action, address environmental, social and economic dimensions of sustainability and relate to the overarching Sustainable Development Goals (SDGs) context. The development and the implementation of the monitoring framework are based on a set of indicators that were selected in a participatory process to provide information on the condition, performance and trajectory of the bioeconomy as a whole—including ecosystems and their services, primary production sectors (forestry, agriculture, aquaculture and fisheries) and bio-based industries—at different levels (systemic and sectorial). See, for example, KCB (2019) and KCB (2020).

Since the time of its release on the occasion of the Global Bioeconomy Summit on November 18, 2020, the EU Bioeconomy Monitoring System provides information on trends and changes over time at the EU-27 (not including the UK), EU-28 (including the UK) and Member State levels for a subset of selected indicators. These do not necessarily provide an explanation for the trends or changes, nor do they imply causal links, however they are the first step in a monitoring system. The full list of indicators planned to be included in the EU Bioeconomy Monitoring System dashboards are listed in Annex 3.

In 2022, the JRC will further develop the EU Bioeconomy Monitoring System by adding indicators defined in Annex 3 for which data are available. Furthermore, there will be a focus on headline indicators in order to provide a comprehensive view of the EU's progress towards sustainable bioeconomy. Furthermore, the scientific team will work towards tracing the environmental footprint of trade and consumption. As a result, new visualisations will be developed and embedded in the dashboards. Finally, technical improvements will be implemented to enhance the extensibility and sustainability of the project.

The consistency, stability and availability of the EU Bioeconomy Monitoring System dashboards will be guaranteed by the KCB and will be reviewed periodically.

1.1 Objectives of the EU Bioeconomy Monitoring System

- To provide robust indicators whose numbers can be trusted as a reference for bioeconomy-related policy formulation, assessment and evaluation;
- To ensure a flexible monitoring system that is conducive to modifications as new data and information become available;
- To coordinate with other monitoring frameworks, in the Member States and international organisations (e.g., FAO, OECD);
- To identify relevant indicators to gauge the progress and sustainability of the EU bioeconomy both within and outside of the EU;
- To minimise reporting burdens on all data providers;
- To improve data collection exercises in order to close identified gaps;
- To review the framework periodically to ensure it is fit for purpose;

- To disseminate the information in a user-friendly way, through dashboards and other dynamic visualisations in the KCB;
- To provide underlying data and assumptions behind the indicators, ensuring reproducibility to the best extent possible.

1.2 Expected impacts/outcomes of the EU Bioeconomy Monitoring System

- The design of this monitoring framework to monitor the sustainability of bioeconomy in a holistic way could serve as an example for other regions;
- The Monitoring System offers a single entry point for harmonised indicators that are relevant to the EU bioeconomy;
- The action, while monitoring the support of the bioeconomy to the five objectives of the Strategy, will indirectly support the preparation and the evaluation of the mentioned related EU policies/legislations/instruments that also contribute to addressing similar or shared objectives;
- Monitoring the progress of the EU bioeconomy in a consistent way across the EU will enable better coordination and cooperation at different policy levels, including regional and local scales, thus, the impact of the monitoring framework may be an improved and consistent basis for better policy decisions at different policy levels;
- Dissemination of the information provided by the monitoring framework will better inform policy and public debates.

2 General description

The EU Bioeconomy Monitoring System is a series of dashboards showing trends in indicators that were selected based on their relevance to the overall EU bioeconomy monitoring conceptual framework, as described in Giuntoli et al. (2020) and Robert et al. (2020), in collaboration with external partners, including experts from the Member States and international organisations through the Community of Practice on Bioeconomy (managed by the KCB) through workshops and online discussions (KCB, 2019; KCB, 2020).

So far, the indicators that are translated to dashboards are there to highlight temporal trends and comparisons between the Member States and regional averages. They measure the state or condition of sectors and systems that rely on biological resources, their functions and principles and the pressures that might exist on them (so-called output indicators). They consist of a set of indicators to show trends in specific themes that are noteworthy. This layer of indicators includes basic indicators (measurements and indicators from other sources), processed indicators (e.g., special treatment of bio-based sectors within NACE processed by the JRC) and system-level indicators (e.g., LCA, footprint processed by the JRC).

2.1 Editorial committee

The responsible person for the content in the EU Bioeconomy Monitoring System is Sarah Mubareka, JRC D.1. The KCB oversees the overall quality of the content. Any new content of the EU Bioeconomy Monitoring System must be pushed through, and therefore approved by the editorial team of the KCB.

2.2 URL

The EC hosts a permanent URL for the KCB. The EU Bioeconomy Monitoring System is embedded in that at https://knowledge4policy.ec.europa.eu/bioeconomy/monitoring_en. The breadcrumb is European Commission > Knowledge for policy > Bioeconomy > EU Bioeconomy Monitoring System.

2.3 Security

The JRC Local Informatics Security Officer (LISO) has performed a series of security controls to ensure that the level of security of the data service of the dashboards complies with the EC security policies. Risks and impact assessment for this information system has been successfully passed at the beginning of 2021. This is further described in the Section Back-end technologies.

2.4 Content

Several actors have approved the content before it was put online. The main actors are the JRC webmaster and DG COMM. The controllers have given a first opinion of the EU Bioeconomy Monitoring System components within the KCB and the changes they have recommended have been implemented.

2.5 Target user audience

The primary users of the EU Bioeconomy Monitoring System are policymakers at the EU level. This category of users might benefit from the information that is aggregated and interpreted using the scientific knowledge and familiarity of EU policy in the JRC. We also target policymakers at national and regional levels. Other users are EU Agencies, researchers and the bio-based industry. The Monitoring System should also cater to EU citizens by providing useful information on consumer footprint and the life cycle assessment of selected products in order to help citizens ponder the choices they make. The Monitoring System should provide useful information for each of these categories of users.

2.6 Main menu items

The main menu items are the following: “Headline Indicators”, “EU Bioeconomy Objectives”, “Bioeconomy and SDGs” and “Bioeconomy and Green Deal”. The main menu of the EU Bioeconomy Monitoring System dashboards is always present as the KCB frames it (Figure 5).

2.7 Description of pages

1. **Headline Indicators** This menu option leads to the main page of the EU Bioeconomy Monitoring System dashboards. The users are immediately presented with the visualizations of the selected indicators that cover different facets of the EU bioeconomy. This page is meant as an entry point to the more detailed datasets in the Monitoring System. It is designed to encourage users with different interests in the targeted audience group (see the Section Target user audience) to go deeper into the indicators of the Monitoring System. This page shows a variety of numbers, sometimes combined so that the users can see the related indicators next to one another. For example, the indicator for biomass uses for food is under objective 1 of the EU Bioeconomy Monitoring System, while the indicators for biomass uses for energy and materials are under objective 3. In the main dashboard, we see these indicators in the same area chart so that the users can compare trends in biomass uses among the three of them. The choice of the few indicators shown on this first page was based on the following criteria: covering all 5 objectives and including aggregated or value-added indicators computed by the JRC or other DGs and Agencies of the European Commission. Each visualization within the dashboard has a button with the text ‘Find out more’ that leads the users to a more detailed dashboard about that indicator. See Figure 6 and Annex 2 for details on the headline indicators.
 - 1.1. Employment and value-added indicators summarise the overall employment in and value-added of the EU bioeconomy. When clicked on one of the two buttons, the user is taken to a page where more details, divided by sector and each Member State, are shown. (objective 5)
 - 1.2. The indicators in the GHG emissions section show emissions from the agriculture and LULUCF sectors. When the user clicks on any of the buttons, they are taken to their respective detailed page. (objective 4)
 - 1.3. There is a stacked area chart showing the trends in biomass uses from 2009 to 2015 at the centre of the dashboard. When the user clicks on one of the three buttons under the chart they are brought to the detailed indicator page that corresponds to the clicked button. (objectives 1 & 3)
 - 1.4. Pressures from production systems indicators are a selection to show the pressures from forestry on forests, fisheries on fresh and marine water systems and agriculture on agroecosystems. Although many indicators compose the pressures series of indicators, we have selected one per primary production system. For forestry, long term ratio of annual fellings to net annual increment; for fisheries, fishing mortality of commercially exploited fish and shellfish exceeding fishing mortality at maximum sustainable yield; for agriculture, intensification of farming. (objective 2)

Figure 5. Framing of EU Bioeconomy Monitoring System is Knowledge Centre for Bioeconomy

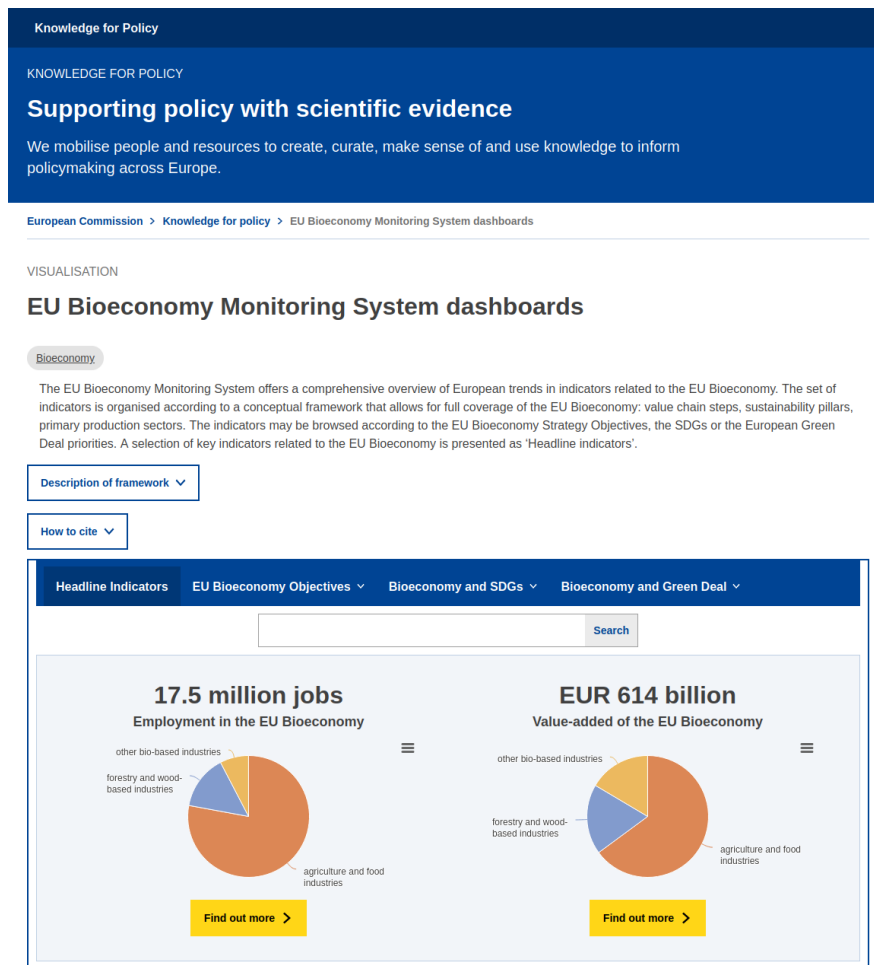
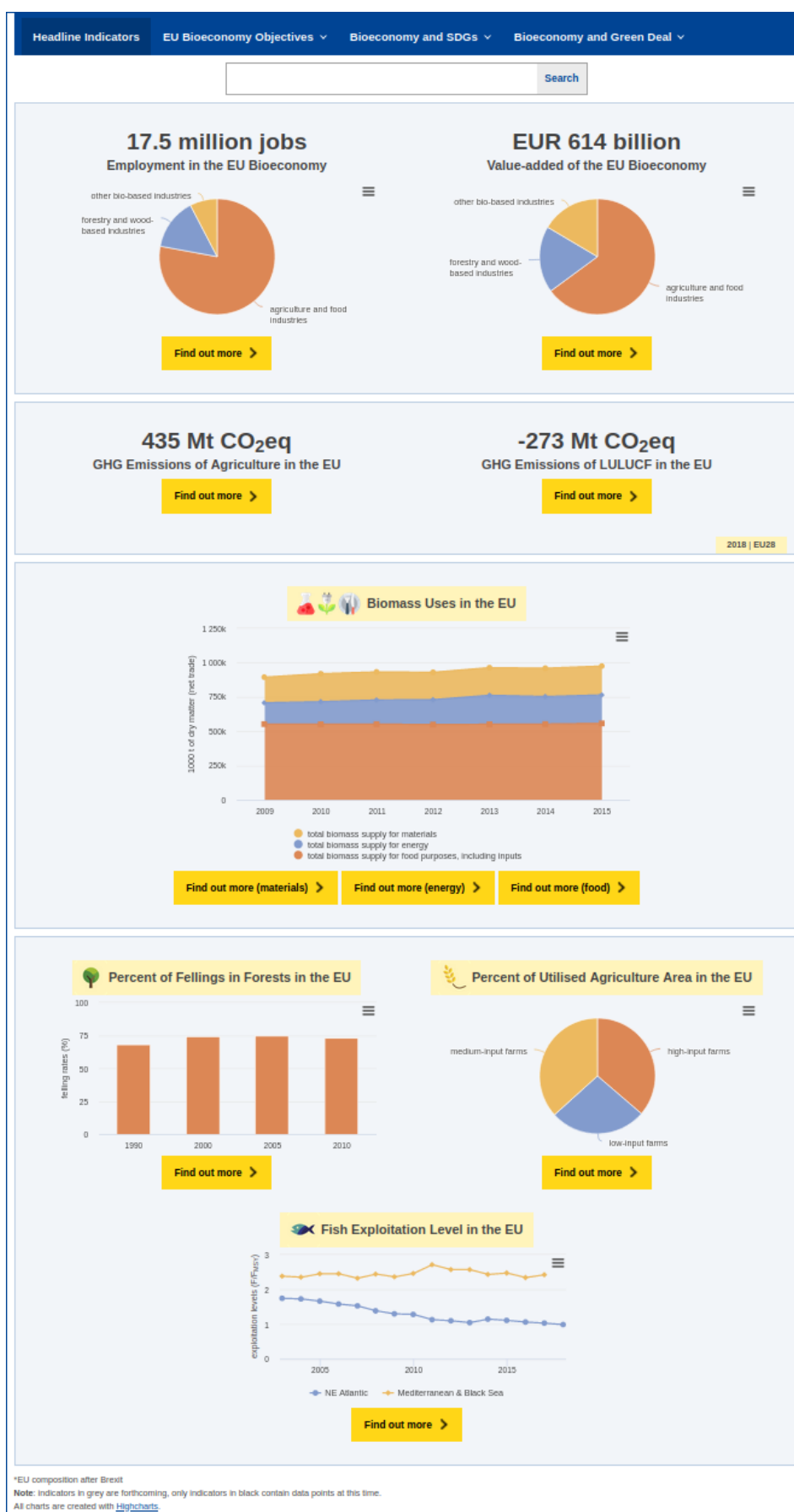


Figure 6. Landing page of the EU Bioeconomy Monitoring System dashboards



2. **EU Bioeconomy Objectives** The Bioeconomy Strategy objectives are shown in five hexagons representing each of the objectives (Figure 7). The hexagons contain the icons produced for this purpose by the JRC Communications Unit. When the user hovers over a hexagon, the icon is transformed into the EU bioeconomy objective text.
 - 2.1. User clicks on an objective. Then, they are taken to a subpage where all the indicators related to the selected objective are listed.
 - 2.2. A filter composed of two steps is presented on the page. The first step is the selection of a (a) normative criterion, (b) key component, (c) value chain step or (d) primary production sector.
 - 2.3. When the user makes a selection, the second step of the filter is activated. The second step provides the user with a list of items that are related to the first selection and the selected objective. Once the user completes the second step of the filtering, the list of indicators is updated.
 - 2.4. When the user selects an indicator, a dashboard appears in three panes. Pane 1 is a clickable choropleth map showing the relative differences between the Member States based on a quantile classification method that best highlights differences between the countries. Pane 2 is a column chart showing the same information as in the map but in a column chart in order to facilitate comparability among the Member States. Pane 3 is a line chart showing the trend for the indicator over time. By default, the chart shows the EU aggregate. Below the line chart, there is a list of clickable Member States so the user may overlay the Member States of interest. The choropleth map and the line chart are linked so that if a Member State is selected on the map, it is also shown in the line chart. Only in the case of intensive indicators, the Member States are compared with EU-27 and EU-28 in pane 2, whereas they are always compared with EU-27 and EU-28 in pane 3 if data are available. Some indicators also contain shares, in which case these are represented in all the panes. All three panes are equipped with a mouse-over feature, whereby the exact numbers are shown for the point of interest (i.e., where the mouse is located). For the first two panes, there is a timeline slider. The user may visualise the map or column chart for any point in time along the timeline. The default is the latest year in the available data (Figure 8). Furthermore, some of the metadata of the selected indicator can be accessed by clicking on the information button next to the indicator's name (Figure 9).

Figure 7. Layout for selection of indicators by EU Bioeconomy Strategy objectives



Figure 8. Example of three panes in the dashboards

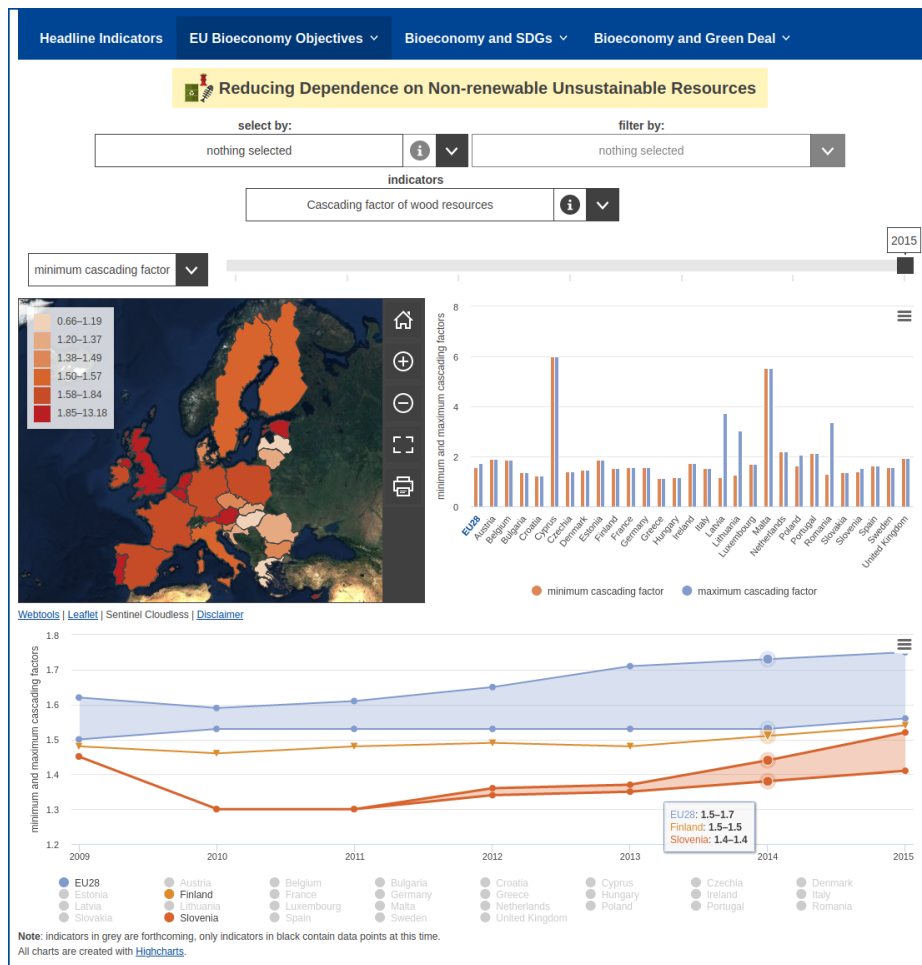
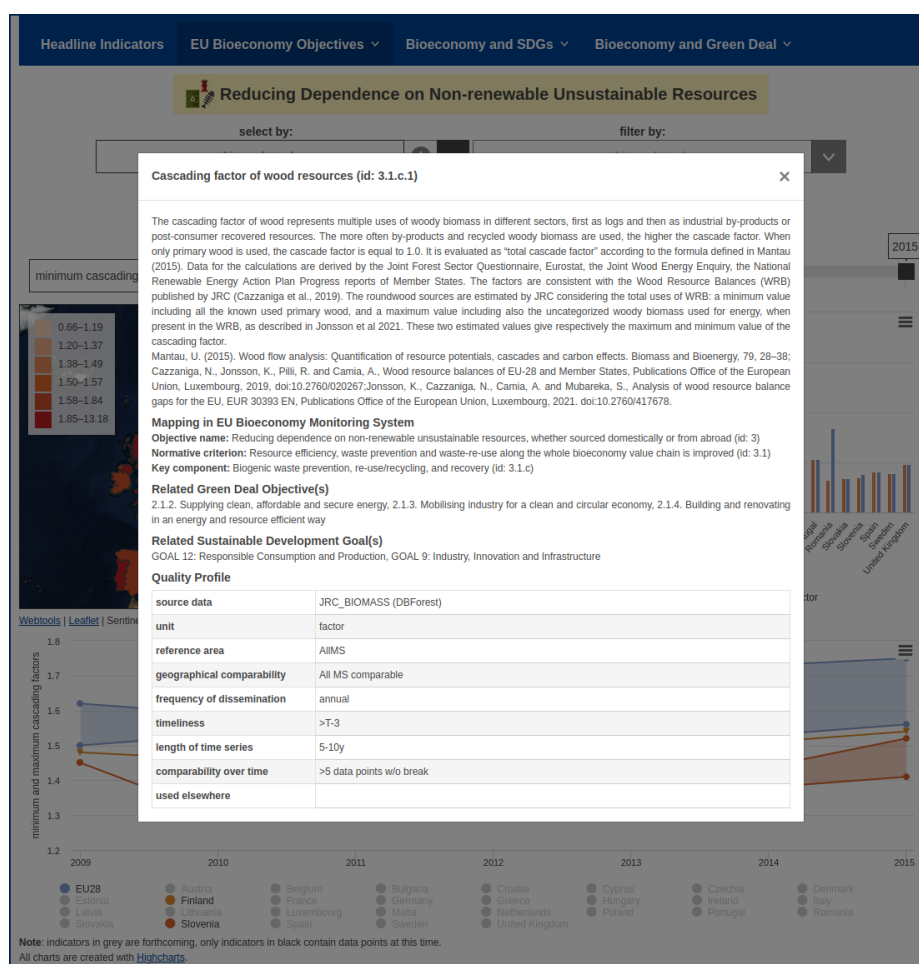


Figure 9. Metadata of an indicator



3. **Bioeconomy and SDGs** This menu item takes the user to a page showing the SDGs in seventeen hexagons representing each of the SDGs (Figure 10). If none of the indicators related to an SDG is added to the dashboards so far or there is not an indicator related to an SDG in the Monitoring System, its corresponding hexagon is greyed out and disabled. As more indicators are added to the dashboards, some of the disabled hexagons will be enabled. When the user clicks on one of the enabled hexagons, they are presented with a list of indicators that are related to that SDG. This option was developed and activated in July 2021.

Figure 10. Layout for selection of indicators by SDGs



4. **Bioeconomy and Green Deal** This menu item takes the user to a page showing the Green Deal priorities via a structure of hexagons (Figure 11). On this page, only the Green Deal priorities that currently have indicators added to the dashboards are displayed. As such, in the future more hexagons representing the rest of the Green Deal priorities mapped to indicators will be added. When the user clicks on one of the priorities, they are presented with a list of related bioeconomy indicators. This option was developed and activated in July 2021.

Figure 11. Layout for selection of indicators by Green Deal priorities



2.8 Indicator coverage in the conceptual framework

The indicators in the EU Bioeconomy Monitoring System were selected according to whether they could tell us something meaningful about the blueprint we have set out to achieve a sustainable and circular bioeconomy. This blueprint is the conceptual framework of the whole system. The main bounding box is the five EU Bioeconomy Strategy objectives. Each of these objectives is broken down into guiding principles, which we call normative criteria to describe a direction of what we should achieve with a sustainable and circular bioeconomy. The normative criteria are further broken down into key components. This is a manageable categorisation that gives more detail to the broader aspirational normative criteria. With this structure, the indicators are directly relevant to the whole system.

The drawback of such an approach is that there may be no indicator available for a given key component we wish to measure. These are gaps in the system. The JRC is responsible for filling these gaps.

Table 3 shows the current status of the Monitoring System. In some cases, there are no indicators published yet for a given key component. These key components are highlighted in grey in the last two columns. In other cases, there are no indicators published yet for all key components within a normative criterion. This is the case where the last four columns are highlighted in grey and occur in two of the five objectives. Key components in bold red show gaps filled in 2021.

Table 3. Summary of coverage of indicators within the conceptual framework

Objective id	Objective name	Normative criterion id	Normative criterion name	Key component id	Key component name
1	Ensuring Food and Nutrition Security	1.1	Food security and nutrition are supported	1.1.a	Availability
1	Ensuring Food and Nutrition Security	1.1	Food security and nutrition are supported	1.1.b	Access
1	Ensuring Food and Nutrition Security	1.1	Food security and nutrition are supported	1.1.c	Utilisation
1	Ensuring Food and Nutrition Security	1.1	Food security and nutrition are supported	1.1.d	Stability
1	Ensuring Food and Nutrition Security	1.2	Local economies, societies and environmental conditions of countries exporting food to the EU are not hampered but rather harnessed by the trade of raw and processed biomass and related technologies	1.2.a	Economic impact of trade in exporting countries of food (to EU)
1	Ensuring Food and Nutrition Security	1.2	Local economies, societies and environmental conditions of countries exporting food to the EU are not hampered but rather harnessed by the trade of raw and processed biomass and related technologies	1.2.b	Environmental footprints in exporting countries of food (to EU)
1	Ensuring Food and Nutrition Security	1.2	Local economies, societies and environmental conditions of countries exporting food to the EU are not	1.2.c	Social impact of trade in exporting countries of food (to EU)

			hampered but rather harnessed by the trade of raw and processed biomass and related technologies		
2	Managing Natural Resources Sustainably	2.1	Ecosystem capacity to produce services is maintained or enhanced	2.1.a	Environmental quality
2	Managing Natural Resources Sustainably	2.1	Ecosystem capacity to produce services is maintained or enhanced	2.1.b	Structural and functional ecosystem attributes
2	Managing Natural Resources Sustainably	2.1	Ecosystem capacity to produce services is maintained or enhanced	2.1.d	Species diversity and abundance
2	Managing Natural Resources Sustainably	2.1	Ecosystem capacity to produce services is maintained or enhanced	2.1.e	Conservation status of habitats and species
2	Managing Natural Resources Sustainably	2.2	Primary production sectors are managed sustainably	2.2.a	Pressures from Forest Management
2	Managing Natural Resources Sustainably	2.2	Primary production sectors are managed sustainably	2.2.b	Pressures from marine fisheries & aquaculture management
2	Managing Natural Resources Sustainably	2.2	Primary production sectors are managed sustainably	2.2.c	Pressures from freshwater fisheries & aquaculture management
2	Managing Natural Resources Sustainably	2.2	Primary production sectors are managed sustainably	2.2.d	Pressures from agroecosystems
2	Managing Natural Resources Sustainably	2.3	Ecosystem services contribution to human well-being is maintained or enhanced	2.3.a	Provisioning services

2	Managing Natural Resources Sustainably	2.3	Ecosystem services contribution to human well-being is maintained or enhanced	2.3.b	Regulating services
2	Managing Natural Resources Sustainably	2.3	Ecosystem services contribution to human well-being is maintained or enhanced	2.3.c	Cultural services
3	Reducing dependence on non-renewable unsustainable resources, whether sourced domestically or from abroad	3.1	Resource efficiency, waste prevention and waste-re-use along the whole bioeconomy value chain is improved	3.1.a	Resource efficiency (Material footprint)
3	Reducing dependence on non-renewable unsustainable resources, whether sourced domestically or from abroad	3.1	Resource efficiency, waste prevention and waste-re-use along the whole bioeconomy value chain is improved	3.1.b	Energy efficiency
3	Reducing dependence on non-renewable unsustainable resources, whether sourced domestically or from abroad	3.1	Resource efficiency, waste prevention and waste-re-use along the whole bioeconomy value chain is improved	3.1.c	Biogenic waste prevention, re-use/recycling, and recovery
3	Reducing dependence on non-renewable unsustainable resources, whether sourced domestically or from abroad	3.2	Food loss and waste is minimised and, when unavoidable, its biomass is reused or recycled	3.2.a	Food loss and waste minimization
3	Reducing dependence on non-renewable unsustainable resources, whether sourced domestically or from abroad	3.3	Bioeconomy should promote sustainable production and consumption of biomass and bio-based products (within EU)	3.3.a	Bio-based products environmental impacts

3	Reducing dependence on non-renewable unsustainable resources, whether sourced domestically or from abroad	3.4	Consumption patterns of bioeconomy goods match sustainable supply levels of biomass	3.4.a	Consumption and demand for biomass and bio-based products
3	Reducing dependence on non-renewable unsustainable resources, whether sourced domestically or from abroad	3.4	Consumption patterns of bioeconomy goods match sustainable supply levels of biomass	3.4.b	Production of bio-based products
3	Reducing dependence on non-renewable unsustainable resources, whether sourced domestically or from abroad	3.4	Consumption patterns of bioeconomy goods match sustainable supply levels of biomass	3.4.c	Reduced dependence on non-renewable resources
3	Reducing dependence on non-renewable unsustainable resources, whether sourced domestically or from abroad	3.5	Local economies of countries exporting non-food commodities to the EU are not hampered but rather harnessed by the trade of raw and processed biomass and related technologies	3.5.a	Economic impact of trade in exporting countries of non-food (to EU)
3	Reducing dependence on non-renewable unsustainable resources, whether sourced domestically or from abroad	3.5	Local economies of countries exporting non-food commodities to the EU are not hampered but rather harnessed by the trade of raw and processed biomass and related technologies	3.5.b	Environmental footprints in exporting countries of non-food (to EU)
3	Reducing dependence on non-renewable unsustainable resources, whether sourced domestically or from abroad	3.5	Local economies of countries exporting non-food commodities to the EU are not hampered but rather harnessed by the trade of raw and processed biomass and related technologies	3.5.c	Social impact of trade in exporting countries of non-food (to EU)
3	Reducing dependence on non-renewable unsustainable resources,	3.6	The sustainability of urban centres is enhanced	3.6.a	Enhanced well-being and health of urban dwellers

	whether sourced domestically or from abroad				
4	Mitigating and adapting to climate change	4.1	Climate change mitigation and adaptation are pursued	4.1.a	Climate change mitigation
4	Mitigating and adapting to climate change	4.1	Climate change mitigation and adaptation are pursued	4.1.b	Climate change adaptation
4	Mitigating and adapting to climate change	4.2	The sustainability of urban centres is enhanced	4.2.a	Enhanced resilience/adaptation to climate change for urban areas
5	Strengthening European competitiveness and creating jobs	5.1	Economic development is fostered	5.1.a	Contribution of bioeconomy to economic development
5	Strengthening European competitiveness and creating jobs	5.1	Economic development is fostered	5.1.b	Value of raw and processed biomass, value added in bioeconomy sectors
5	Strengthening European competitiveness and creating jobs	5.1	Economic development is fostered	5.1.c	Exports of EU food and non-food biomass, processed goods and/or related technologies
5	Strengthening European competitiveness and creating jobs	5.1	Economic development is fostered	5.1.d	Comparative advantage
5	Strengthening European competitiveness and creating jobs	5.2	Inclusive economic growth is strengthened	5.2.a	Employment in bioeconomy
5	Strengthening European competitiveness and creating jobs	5.2	Inclusive economic growth is strengthened	5.2.b	Working conditions related to bioeconomy
5	Strengthening European competitiveness and creating jobs	5.2	Inclusive economic growth is strengthened	5.2.c	Equality & inclusiveness in bioeconomy sectors

5	Strengthening European competitiveness and creating jobs	5.3	Resilience of the rural, coastal and urban economy is enhanced	5.3.a	Physical infrastructure (accessibility, services)
5	Strengthening European competitiveness and creating jobs	5.3	Resilience of the rural, coastal and urban economy is enhanced	5.3.c	Bioeconomy investments in rural & coastal areas
5	Strengthening European competitiveness and creating jobs	5.3	Resilience of the rural, coastal and urban economy is enhanced	5.3.d	Rural income diversification
5	Strengthening European competitiveness and creating jobs	5.3	Resilience of the rural, coastal and urban economy is enhanced	5.3.e	Income of primary producers
5	Strengthening European competitiveness and creating jobs	5.4	Existing knowledge is adequately valued and proven sound technologies are fostered	5.4.a	Existing knowledge on bioeconomy technologies
5	Strengthening European competitiveness and creating jobs	5.5	Knowledge generation and innovation are promoted	5.5.a	Knowledge generation/ (high level) education
5	Strengthening European competitiveness and creating jobs	5.5	Knowledge generation and innovation are promoted	5.5.b	Research and innovation
5	Strengthening European competitiveness and creating jobs	5.6	Demand and supply-side market mechanisms and policy coherence between supply and demand of food and non-food goods are enhanced	5.6.a	Market mechanisms (e.g. prices, consumer awareness)
5	Strengthening European competitiveness and creating jobs	5.6	Demand and supply-side market mechanisms and policy coherence between supply and demand of food and non-food goods are enhanced	5.6.c	Resource competition among sectors of the bioeconomy and Biomass demand for new value chains

3 Back-end technologies

The Monitoring System is supported by the KCB data service, set up in 2021, to store and feed the data shown in the dashboards integrated into the web platform of the KCB. This back-end solution replaced the previous approach of publishing the data in JSON files on the Knowledge4Policy (K4P) platform that was implemented at the launch of the Monitoring System. The data service also supports the editing of the associated metadata through a custom editor.

3.1 Architecture

The KCB data service is a web service (served by Apache web servers) for storing data in a database, developed in Python 3 programming language on top of the Django web framework.

It consists of an administrative module named Web Administrative Interface (WAI) and a programmatic module named Application Programming Interface (API):

- The WAI module allows authorised users to control the status of the data service, through a Graphical User Interface (GUI). It includes functionalities to administer the user access to the WAI, reserved to users with administrator rights, as well as functionalities to manage the data served through the API for users with editor rights.
- The API module allows machine-to-machine unauthenticated interactions and allows the dashboards to retrieve the data stored in the database for rendering them in the dashboards. The API module is made of read-only endpoints for various sections accessible by URLs. One of the sections is dedicated to the EU Bioeconomy Monitoring system.

Both the WAI and API have access to the same database, the API in read-only mode.

3.2 Infrastructure

The KCB data service is a project made of two Django applications, one for each of the two modules, installed in two dedicated environments:

- An external one, called Production, for the API that is exposed to the Internet and can be queried by the dashboards;
- An internal one, called Staging, for the WAI and can be accessed only from the JRC's network.

Both environments host the Python code and the web servers, but not the database server (PostgreSQL) that runs in a shared environment managed by JRC D.1.

3.3 Data publication

The data service stores two types of datasets: geographical datasets and thematic datasets. The thematic datasets are the data shown in charts, while geographical datasets contain geographical information (e.g., latitude and longitude, ISO 2 countries identifier). The data in every thematic dataset needs to be associated with the data in a geographical dataset in order to assign the thematic data to a location and make it visible through selection in maps.

In order to upload data through the WAI module in the data service, the data needs to be saved in files created from a template provided, in XLSX or ODF file format, which also explains how the data need to be organised.

Geographical datasets can be reused for different thematic datasets that use the same geographic coordinates. Thematic datasets are versioned using a timestamp and need to be enabled explicitly in order to be published through the API. The API returns only the latest enabled version of a thematic dataset.

3.4 The metadata editor

The metadata is attributes of a dataset, and they are not currently exposed on the Internet through the API but managed by the data service through a dedicated section in the WAI. Similar to the thematic and geographical datasets, a specific template (using XLSX or ODF formats) needs to be used in order to import them into the data service. It has a single sheet where each row is dedicated to the metadata of a dataset that should be indicated in a specific column.

Once imported, they can be edited and then exported in the same file format. The metadata editor allows editing of all the metadata of a dataset at once, after selecting the correct section and dataset identifier.

3.5 The data of the EU Bioeconomy Monitoring System

The data of the EU Bioeconomy Monitoring System are generated using Python 3 in CSV format. The input data may be in a spreadsheet/CSV file or may be requested from an online source. Currently, only from Eurostat servers and DBForest data are requested but, in the future, more sources will be used. The CSV files are converted to XLSX format using a Python script that sets the expected content and then uploaded to the database using the WAI.

3.6 The API of the EU Bioeconomy Monitoring System

The front-end makes a request to the API via a URL and the API returns the requested data to the client in JSON format. A URL expects the values of three parameters: indicator id, type and visualization type. Initially, the API queries the database and returns the data of the indicator of interest. Then, the data are filtered and reformatted according to the other two parameters. The types of an indicator typically denote the components that make up the whole dataset of an indicator. For instance, the indicator 'Intensification of farming (share of high, medium and low input farms in UAA)' with indicator id 2.2.d.5 has three types: low-input farms, medium-input farms and high-input farms. Finally, the visualization types are line chart or area range chart, column chart that may be unstacked or stacked and choropleth map. The JSON files are formatted according to the format the visualization libraries expect.

4 Front-end technologies

The platform follows the client-server paradigm. The client is hosted on an Apache2 server during development. It is then transferred to the Drupal 8 content management system (CMS) for enabling global and public access. The client is a web application that has been developed on a Linux operating system using the Atom text editor. The front-end is written in HTML, CSS and JavaScript, making use of multiple libraries, which are Highcharts for creating data visualizations (such as line, area range and column charts), Webtools which uses Leaflet for creating choropleth maps, jQuery for accelerating the coding process, jQuery UI for adding a search bar with autocomplete, Bootstrap for some visual components and Europa Component Library (ECL) for the rest of the visual components and building responsive dashboards.

The transition to ECL from other libraries has been completed in 2021, however since ECL does not provide all the necessary components, other libraries had to be used in some cases. ECL is used for creating buttons, search bars, icons, labels and messages that are shown as a response to invalid search text. The headline indicators page was constructed using the facts and figures component of ECL. Moreover, the responsiveness, thus mobile-friendliness was ensured using the grid layout utility of ECL. In this way, the content on the interface gets reorganized and the dashboards can be explored on extra small (phone), small (phone), medium (tablet), large (small laptop) and extra large (laptop and monitor) screens. Finally, the navigation menu that enables site-wide navigation and offers an alternative to the navigation via the structures of hexagons was implemented using ECL.

In 2021, besides integrating ECL to the front-end, two new pages were developed: Bioeconomy and SDGs and Bioeconomy and Green Deal. These pages enable exploring the indicators from the perspective of the SDGs and Green Deal priorities.

5 Metadata of indicators

The aim of the EU Bioeconomy Monitoring System is to provide policymakers and other stakeholders with reliable and harmonised data and knowledge about the bioeconomy throughout the years. The indicators were chosen and computed based on the interaction with national and international experts through several workshops and exchanges.

Despite the high number of different data sources and the wide range of technical expertise required, the JRC must provide sound and up-to-date indicators. To ensure the update and reproducibility of each indicator yearly, metadata sheets are created detailing the meaning of the indicators and the input data used (Annex 4).

Increasing the transparency on the interpretation, data and methodologies of the basic, processed and system-level indicators will also make the construction and use of composite indicators easier in the future.

Disseminating methodological information together with numerical results is the precursor to ensure that the indicator is understood and reproducible or retraceable. It will also set the base for improvements in the future.

6 Dissemination & way forward

In this document, we discuss the technical implementation of the EU Bioeconomy Monitoring System and not the theoretical developments, although the two are clearly related. Whereas the scientific team is responsible for the further development of the concepts behind the Monitoring System, the technical team is responsible for the implementation of the back- and front-end of the Monitoring System. The following section discusses the technical aspects only.

7 Implementation plan

In the first years of the technical implementation of the EU Bioeconomy Monitoring System, the JRC will rely on an Administrative Agreement with RTD to ensure the development of the system evolves according to the expectations of the Core DG group responsible for the implementation of the EU Bioeconomy Strategy. The JRC estimates that the final stable Monitoring System as described as our aspirations and outlined in Giuntoli et al. (2020) and Robert et al. (2020) will be fully in place by the end of 2022.

7.1 Implementation team

The implementation team is composed of a back-end developer and a front-end developer. The back-end developer is also the KCB developer and is responsible for the KCB data service. The second figure interacts with the scientific team to understand the expectations in data visualisation and implements these data visualisations according to the criteria set out by DG COMM for website development. She also generates the data of the indicators using the input data given to her, uploads them to the database and writes the API code to serve the data to the dashboards in the expected way. In 2022, another back-end developer will join the team and will be responsible for updating the data already generated and will take the responsibility of generating the data of the indicators from the front-end developer. The fourth member of the team is the team leader who oversees the process. Needless to say, there are numerous scientific collaborators who are producing data and knowledge used in the specific indicators.

7.2 Post-implementation plan

Once the EU Bioeconomy Monitoring System is fully implemented (expected at the end of 2022), it may be considered an operational tool. Under normal circumstances the JRC does not maintain operational tools and perform redundant tasks, however in this particular case, because of the nesting of the Monitoring System within the KCB and the KCB being under the responsibility of the JRC, the Monitoring System will also likely remain under the responsibility of the JRC. This is desirable because we know that the bioeconomy is evolving very quickly and new research needs will arise. Thus, new features and requirements will certainly appear in the coming decade.

7.3 Daily management of the system

The JRC has a scientific production mandate with high data management requirements and can therefore guarantee a constant presence of staff with competences in the web development domain. Furthermore, as a tool embedded in the KCB, so long as the Knowledge for Policy Centres exist, there will be competent staff to maintain them.

8 Way forward

8.1 Next tools

In 2022, the Python project that generates the data of the indicators will be extended for new indicators and the front-end will display the data of these indicators; a major change is not expected in both projects. However, the libraries used for developing the front-end should be upgraded to their latest version and necessary adjustments should be implemented. Furthermore, the API code should be improved structurally to improve its extensibility for the new indicators and speed.

In 2022, the dashboards will incorporate more of the basic, processed and system-level indicators and as composite indicators will be created by the scientific team, the page dedicated to headline indicators may be

extended or replaced by the visualizations of these new indicators or a new page or pages dedicated to them may be created. Furthermore, the relation between basic and processed indicators may be demonstrated by developing tools that are designed for this purpose.

The scientific team will work towards tracing the environmental footprint of trade and consumption and visualizations best suited for revealing the footprint of such activities will be created.

8.2 Link to Science for Policy reports

The JRC plans to initiate a series of Science for Policy reports at the end of 2022 in a cross-unit collaboration, in which the EU Bioeconomy Monitoring System will play a key role in providing the data behind the reports. The reports are planned to go beyond the data in the Monitoring System, offering added intellectual value through the interpretations of the trends, as well as ad hoc studies to go deeper into the drivers behind the indicators, with an expert-based analysis on specific themes that could also be defined by an ad hoc steering committee that should be extended.

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Annexes

Annex 1. Glossary

Indicator	In general terms, an indicator is a quantitative or a qualitative measure derived from a series of observed facts that can reveal relative positions (e.g., of a country) in a given area. When evaluated at regular intervals, an indicator can point out the direction of change across different units and through time. In the context of policy analysis, indicators are useful in identifying trends and drawing attention to particular issues. They can also be helpful in setting policy priorities and in benchmarking or monitoring performance (Nardo et al., 2008).
Headline indicator	Headline indicators are indicators that were chosen to be emphasized for various reasons, particularly to cover all the EU Bioeconomy Strategy objectives and to emphasize the value-added of the JRC knowledge.
Output indicator	Output indicators measure the state or condition of sectors and systems.
Input indicator	Input indicators correspond to drivers, such as governance.
Basic indicator	Basic indicators are a collection of indicators that are not necessarily harmonised among themselves. Each indicator in this group has its own specific purpose. The basic indicators are often borrowed from European or international reporting systems that are used to gauge EU policy or produced ad hoc to monitor a specific facet of the EU bioeconomy (Giuntoli et al., 2020).
Processed indicator	Processed indicators are more sophisticated than basic indicators in that a certain level of harmonisation, computation and interpretation is made to generate these indicators. These are more useful indicators with respect to basic indicators because although they may be sector-specific, value-chain-specific, objective-specific etc., their meaning is interpreted within the context of the EU bioeconomy (Giuntoli et al., 2020).
System-level indicator	System-level indicators are those that require a higher level of judgment with respect to basic and processed indicators in their compilation given a higher level of complexity of the questions the indicators are addressing (Giuntoli et al., 2020).
Composite indicator	A composite indicator is formed when individual indicators are compiled into a single index on the basis of an underlying model. The composite indicator should ideally measure multi-dimensional concepts which cannot be captured by a single indicator (Nardo et al., 2008).
Intensive (indicator type)	An intensive variable does not depend on system size (such as temperature, pressure or density). For example, if a country would clone itself into double its size, the per cent of the studied factor would remain the same. In this way, the studied factor can be compared to small and big countries alike.
Extensive (indicator type)	An extensive variable depends on system size (such as mass or volume).
Positive directionality	An indicator with a positive directionality indicates that an increasing trend is indicative of a desired state or response (e.g., an indicator of the number of employed people has positive directionality).
Negative directionality	An indicator with a negative directionality indicates that a decreasing trend is indicative of a desired state or response (e.g., an indicator of the number of alien species has negative directionality).

Annex 2. Headline indicators

The headline indicators are indicators that are already present within the list of the indicators published under the 'EU Bioeconomy Objectives', 'Bioeconomy and SDGs' and 'Bioeconomy and Green Deal' pages, but which we wish to highlight for various reasons. The criteria for including an indicator as a headline indicator are primarily covering all the EU Bioeconomy Strategy objectives and emphasising the value-added of the JRC knowledge (where possible). The reasons are further explained in the table below. For details on the meaning of each indicator, the reader is referred to Annex 3, where all the indicators to be included in the EU Bioeconomy Monitoring System are listed and Annex 4, where the metadata of all the indicators included in the dashboards is given.

Indicator id	Indicator name	Reasons for inclusion as headline
1.1.a.4	Total biomass supply for food purposes, including inputs	To emphasize the value-added of the JRC knowledge, to complete biomass uses stacked area chart, to cover objective 1 JRC indicator from Biomass mandate Produced by JRC D.2 and JRC D.4
2.2.a.1	Long term ratio of annual fellings (m3/ha/year) to net annual increment (m3/ha/year)	To emphasize the value-added of the JRC knowledge, to cover objective 2 JRC indicator from Biomass mandate Produced by JRC D.1
2.2.b.2	Fishing mortality of commercially exploited fish and shellfish exceeding fishing mortality at maximum sustainable yield	To emphasize the value-added of the JRC knowledge, to cover objective 2 F/F _{MSY} , data behind the STECF-Adhoc-20-01 Produced by JRC D.2
2.2.d.5	Intensification of farming (share of high, medium and low input farms in UAA)	To cover objective 2 Percent UAA under the three management categories Produced for CAP and retrieved from Eurostat
3.4.a.2	Total biomass consumed for energy	To emphasize the value-added of the JRC knowledge, to complete biomass uses stacked area chart, to cover objective 3 JRC indicator from Biomass mandate Produced by JRC D.1, JRC D.2 and JRC D.4
3.4.a.3	Total biomass consumed for materials	To emphasize the value-added of the JRC knowledge, to complete biomass uses stacked area chart, to cover objective 3 JRC indicator from Biomass mandate Produced by JRC D.1, JRC D.2 and JRC D.4
4.1.a.3	Net GHG emissions (emissions and removals) from agriculture	To cover objective 4 Climate change mitigation indicator Data retrieved from Eurostat
4.1.a.6	Net GHG emissions (emissions and removals) from LULUCF	To cover objective 4 Climate change mitigation indicator

		Data retrieved from Eurostat
5.1.b.2	Value-added per sector	<p>To emphasize the value-added of the JRC knowledge, to cover objective 5</p> <p>Novel approach to calculate the value-added of bio-based industries in NACE classification</p> <p>Produced by JRC D.4</p>
5.2.a.1	Persons employed per bioeconomy sectors	<p>To emphasize the value-added of the JRC knowledge, to cover objective 5</p> <p>Novel approach to infer employment in bio-based sectors in NACE classification</p> <p>Produced by JRC D.4</p>

Annex 3. All indicators

The full list of indicators and some of their attributes are given below. The colour in the first column indicates whether data are available for the indicator (green), data may be available for the indicator (orange) or there are no known data for the indicator (red).

Indicator id	Indicator name	Objective name	Normative criterion name	Key component name	Unit
1.1.a.1	Agricultural factor income per annual work unit (AWU)	Ensuring Food and Nutrition Security	Food security and nutrition are supported	Availability	index (2010=100)
1.1.a.2	New food products (by sector)	Ensuring Food and Nutrition Security	Food security and nutrition are supported	Availability	kg
1.1.a.3	New food value chains (by sector)	Ensuring Food and Nutrition Security	Food security and nutrition are supported	Availability	
1.1.a.4	Total biomass supply for food purposes, including inputs	Ensuring Food and Nutrition Security	Food security and nutrition are supported	Availability	1000 tonnes dry matter
1.1.a.5	Biomass directly consumed by humans by source (animal, fish, plant-based, algae)	Ensuring Food and Nutrition Security	Food security and nutrition are supported	Availability	1000 tonnes dry matter
1.1.b.1	Prevalence of moderate or severe food insecurity in the total population, yearly estimates	Ensuring Food and Nutrition Security	Food security and nutrition are supported	Access	percent
1.1.b.2	Average dietary energy supply adequacy	Ensuring Food and Nutrition Security	Food security and nutrition are supported	Access	percent
1.1.b.3	Food purchasing power	Ensuring Food and Nutrition Security	Food security and nutrition are supported	Access	Index
1.1.c.1	Daily calorie supply per capita by source	Ensuring Food and Nutrition Security	Food security and nutrition are supported	Utilisation	kcal/capita/d and %
1.1.c.2	Indicator concerning food quality, or food safety	Ensuring Food and Nutrition Security	Food security and nutrition are supported	Utilisation	
1.1.c.3	Animal welfare	Ensuring Food and Nutrition Security	Food security and nutrition are supported	Utilisation	
1.1.d.1	Government support to research and development (by sector)	Ensuring Food and Nutrition Security	Food security and nutrition are supported	Stability	eur / GDP
1.1.d.2	EU's self-sufficiency rate on protein for feed	Ensuring Food and Nutrition Security	Food security and nutrition are supported	Stability	
1.1.d.3	Import dependency ratio of food (import/domestic production)	Ensuring Food and Nutrition Security	Food security and nutrition are supported	Stability	

1.1.d.4	Value of food imports over total merchandise exports	Ensuring Food and Nutrition Security	Food security and nutrition are supported	Stability	
1.2.a.1	Economic impact of trade in exporting countries of food (to EU)	Ensuring Food and Nutrition Security	Local economies, societies and environmental conditions of countries exporting food to the EU are not hampered but rather harnessed by the trade of raw and processed biomass and related technologies	Economic impact of trade in exporting countries of food (to EU)	
1.2.b.1	Environmental footprints in exporting countries of food (to EU)	Ensuring Food and Nutrition Security	Local economies, societies and environmental conditions of countries exporting food to the EU are not hampered but rather harnessed by the trade of raw and processed biomass and related technologies	Environmental footprints in exporting countries of food (to EU)	ha
1.2.c.1	Social impact of trade in exporting countries of food (to EU)	Ensuring Food and Nutrition Security	Local economies, societies and environmental conditions of countries exporting food to the EU are not hampered but rather harnessed by the trade of raw and processed biomass and related technologies	Social impact of trade in exporting countries of food (to EU)	
2.1.a.1	Biochemical oxygen demand in rivers	Managing Natural Resources Sustainably	Ecosystem capacity to produce services is maintained or enhanced	Environmental quality	mg O2 per litre
2.1.a.2	Phosphate in rivers	Managing Natural Resources Sustainably	Ecosystem capacity to produce services is maintained or enhanced	Environmental quality	mg PO4/l
2.1.a.3	Phosphorus in lakes	Managing Natural Resources Sustainably	Ecosystem capacity to produce services is maintained or enhanced	Environmental quality	mg P/l
2.1.a.4	Nitrate in groundwater	Managing Natural Resources Sustainably	Ecosystem capacity to produce services is maintained or enhanced	Environmental quality	mg NO3/l
2.1.a.5	Nitrate in rivers	Managing Natural Resources Sustainably	Ecosystem capacity to produce services is maintained or enhanced	Environmental quality	mg NO3-N/l
2.1.a.6	Nutrients in transitional, coastal and marine waters	Managing Natural Resources Sustainably	Ecosystem capacity to produce services is maintained or enhanced	Environmental quality	µmol/l
2.1.a.7	Exposure of forest area to ozone	Managing Natural Resources Sustainably	Ecosystem capacity to produce services is maintained or enhanced	Environmental quality	µg/m-3/hr

2.1.a.8	Exceedance of air quality standards in urban areas	Managing Natural Resources Sustainably	Ecosystem capacity to produce services is maintained or enhanced	Environmental quality	ug.m-3 O3
2.1.b.1	Percentage area of urban green space (or percentage of natural area within the city boundaries)	Managing Natural Resources Sustainably	Ecosystem capacity to produce services is maintained or enhanced	Structural and functional ecosystem attributes	
2.1.b.2	Landscape fragmentation Index	Managing Natural Resources Sustainably	Ecosystem capacity to produce services is maintained or enhanced	Structural and functional ecosystem attributes	index
2.1.b.3	Share of High Nature Value farmland in agricultural area	Managing Natural Resources Sustainably	Ecosystem capacity to produce services is maintained or enhanced	Structural and functional ecosystem attributes	percent of UAA
2.1.b.4	Share of organic farming in utilised agricultural area	Managing Natural Resources Sustainably	Ecosystem capacity to produce services is maintained or enhanced	Structural and functional ecosystem attributes	percent of UAA
2.1.b.5	Livestock density index	Managing Natural Resources Sustainably	Ecosystem capacity to produce services is maintained or enhanced	Structural and functional ecosystem attributes	unit per ha
2.1.b.6	Forest fragmentation and connectivity index	Managing Natural Resources Sustainably	Ecosystem capacity to produce services is maintained or enhanced	Structural and functional ecosystem attributes	percent
2.1.b.7	Deadwood	Managing Natural Resources Sustainably	Ecosystem capacity to produce services is maintained or enhanced	Structural and functional ecosystem attributes	m3 per ha
2.1.b.8	Share of forest area	Managing Natural Resources Sustainably	Ecosystem capacity to produce services is maintained or enhanced	Structural and functional ecosystem attributes	percent tot land area
2.1.b.9	Forest and other wooded land growing stock	Managing Natural Resources Sustainably	Ecosystem capacity to produce services is maintained or enhanced	Structural and functional ecosystem attributes	1000m3
2.1.b.10	Ecological status of European waters	Managing Natural Resources Sustainably	Ecosystem capacity to produce services is maintained or enhanced	Structural and functional ecosystem attributes	categorical
2.1.b.11	Fish stock biomass in NE Atlantic & Mediterranean	Managing Natural Resources Sustainably	Ecosystem capacity to produce services is maintained or enhanced	Structural and functional ecosystem attributes	Fish stock biomass – index 2003 = 100
2.1.d.1	Bird and butterfly indices EU aggregate (common farmland bird Index, common forest bird index, grassland butterfly index)	Managing Natural Resources Sustainably	Ecosystem capacity to produce services is maintained or enhanced	Species diversity and abundance	index rel to 1990 or 2000
2.1.d.2	Age and size distribution of commercially-exploited fish species	Managing Natural Resources Sustainably	Ecosystem capacity to produce services is maintained or enhanced	Species diversity and abundance	% or number or cm
2.1.e.1	Surface of marine and terrestrial sites designated under NATURA 2000	Managing Natural Resources Sustainably	Ecosystem capacity to produce services is maintained or enhanced	Conservation status of habitats and species	percent land area

2.1.e.2	Conservation Status of European Habitats	Managing Natural Resources Sustainably	Ecosystem capacity to produce services is maintained or enhanced	Conservation status of habitats and species	categorical
2.1.e.3	Conservation status of grassland	Managing Natural Resources Sustainably	Ecosystem capacity to produce services is maintained or enhanced	Conservation status of habitats and species	percent of assessments of habitats
2.1.e.4	Threatened tree species in forests	Managing Natural Resources Sustainably	Ecosystem capacity to produce services is maintained or enhanced	Conservation status of habitats and species	
2.2.a.1	Long term ratio of annual fellings (m ³ /ha/year) to net annual increment (m ³ /ha/year)	Managing Natural Resources Sustainably	Primary production sectors are managed sustainably	Pressures from Forest Management	percent
2.2.a.2	Fraction of primary residues remaining in forest	Managing Natural Resources Sustainably	Primary production sectors are managed sustainably	Pressures from Forest Management	percent
2.2.a.3	Change in ecosystems extent: Forest and woodland	Managing Natural Resources Sustainably	Primary production sectors are managed sustainably	Pressures from Forest Management	ha
2.2.a.4	Land use / land cover type taken over by forest	Managing Natural Resources Sustainably	Primary production sectors are managed sustainably	Pressures from Forest Management	ha
2.2.a.5	Number of annual introductions of invasive alien species in forests	Managing Natural Resources Sustainably	Primary production sectors are managed sustainably	Pressures from Forest Management	number/y
2.2.a.6	Certified forests	Managing Natural Resources Sustainably	Primary production sectors are managed sustainably	Pressures from Forest Management	
2.2.b.1	Nutrient discharge from fisheries aquaculture	Managing Natural Resources Sustainably	Primary production sectors are managed sustainably	Pressures from marine fisheries & aquaculture management	
2.2.b.2	Fishing mortality of commercially exploited fish and shellfish exceeding fishing mortality at maximum sustainable yield	Managing Natural Resources Sustainably	Primary production sectors are managed sustainably	Pressures from marine fisheries & aquaculture management	F/FSMY
2.2.b.3	Number of annual introductions of invasive alien species in marine waters	Managing Natural Resources Sustainably	Primary production sectors are managed sustainably	Pressures from marine fisheries & aquaculture management	number/a
2.2.c.1	Number of annual introductions of invasive alien species in freshwater	Managing Natural Resources Sustainably	Primary production sectors are managed sustainably	Pressures from freshwater fisheries & aquaculture management	number/a
2.2.c.2	Size of aquaculture production units	Managing Natural Resources Sustainably	Primary production sectors are managed sustainably	Pressures from freshwater fisheries & aquaculture management	

2.2.c.3	Number of integrated multi-trophic aquaculture production units	Managing Natural Resources Sustainably	Primary production sectors are managed sustainably	Pressures from freshwater fisheries & aquaculture management	count
2.2.d.1	Ammonia emissions from agriculture	Managing Natural Resources Sustainably	Primary production sectors are managed sustainably	Pressures from agroecosystems	kg/ha
2.2.d.2	Land use / land cover type taken over by agricultural land	Managing Natural Resources Sustainably	Primary production sectors are managed sustainably	Pressures from agroecosystems	ha
2.2.d.3	Change in ecosystems extent: cropland & grassland	Managing Natural Resources Sustainably	Primary production sectors are managed sustainably	Pressures from agroecosystems	ha
2.2.d.4	Number of annual introductions of invasive alien species in agroecosystems	Managing Natural Resources Sustainably	Primary production sectors are managed sustainably	Pressures from agroecosystems	number/a
2.2.d.5	Intensification of farming (share of high, medium and low input farms in UAA)	Managing Natural Resources Sustainably	Primary production sectors are managed sustainably	Pressures from agroecosystems	percent
2.2.d.6	Sales of pesticides	Managing Natural Resources Sustainably	Primary production sectors are managed sustainably	Pressures from agroecosystems	kg of active ingredient
2.3.a.1	Biomass production in EU from primary production sectors (agriculture, forests, fisheries, algae, waste)	Managing Natural Resources Sustainably	Ecosystem services contribution to human well-being is maintained or enhanced	Provisioning services	sector-specific units
2.3.a.2	Roundwood removals	Managing Natural Resources Sustainably	Ecosystem services contribution to human well-being is maintained or enhanced	Provisioning services	m3 o.b.
2.3.b.1	Flood regulation (flood control, flow, demand, potential, unmet demand, monetary values)	Managing Natural Resources Sustainably	Ecosystem services contribution to human well-being is maintained or enhanced	Regulating services	
2.3.b.2	Air quality	Managing Natural Resources Sustainably	Ecosystem services contribution to human well-being is maintained or enhanced	Regulating services	
2.3.b.3	Net ecosystem productivity	Managing Natural Resources Sustainably	Ecosystem services contribution to human well-being is maintained or enhanced	Regulating services	coefficient 0 to 1
2.3.c.1	Aesthetics considerations of nature	Managing Natural Resources Sustainably	Ecosystem services contribution to human well-being is maintained or enhanced	Cultural services	

2.3.c.2	Recreational services (recreation, flow, demand, potential)	Managing Natural Resources Sustainably	Ecosystem services contribution to human well-being is maintained or enhanced	Cultural services	mln eur/y
3.1.a.1	Domestic Material Consumption (Biomass)	Reducing dependence on non-renewable unsustainable resources, whether sourced domestically or from abroad	Resource efficiency, waste prevention and waste-re-use along the whole bioeconomy value chain is improved	Resource efficiency (Material footprint)	1000 tonnes
3.1.a.2	Material Footprint (Biomass)	Reducing dependence on non-renewable unsustainable resources, whether sourced domestically or from abroad	Resource efficiency, waste prevention and waste-re-use along the whole bioeconomy value chain is improved	Resource efficiency (Material footprint)	tonne / capita
3.1.a.3	Land footprint IN EU of EU consumption (for non-food&feed)	Reducing dependence on non-renewable unsustainable resources, whether sourced domestically or from abroad	Resource efficiency, waste prevention and waste-re-use along the whole bioeconomy value chain is improved	Resource efficiency (Material footprint)	
3.1.b.1	Energy productivity	Reducing dependence on non-renewable unsustainable resources, whether sourced domestically or from abroad	Resource efficiency, waste prevention and waste-re-use along the whole bioeconomy value chain is improved	Energy efficiency	eur / kgoe
3.1.b.2	Share of renewable energy in gross final energy consumption	Reducing dependence on non-renewable unsustainable resources, whether sourced domestically or from abroad	Resource efficiency, waste prevention and waste-re-use along the whole bioeconomy value chain is improved	Energy efficiency	%
3.1.b.3	Share of renewable energy in gross final energy consumption of bio based industries or bioenergy industries	Reducing dependence on non-renewable unsustainable resources, whether sourced domestically or from abroad	Resource efficiency, waste prevention and waste-re-use along the whole bioeconomy value chain is improved	Energy efficiency	
3.1.c.1	Cascading factor of wood resources	Reducing dependence on non-renewable unsustainable resources, whether sourced domestically or from abroad	Resource efficiency, waste prevention and waste-re-use along the whole bioeconomy value chain is improved	Biogenic waste prevention, re-use/recycling, and recovery	factor
3.1.c.2	Circular material rate	Reducing dependence on non-renewable unsustainable resources, whether sourced domestically or from abroad	Resource efficiency, waste prevention and waste-re-use along the whole bioeconomy value chain is improved	Biogenic waste prevention, re-use/recycling, and recovery	%
3.1.c.3	Final Energy Consumption from renewable municipal waste	Reducing dependence on non-renewable unsustainable resources, whether sourced domestically or from abroad	Resource efficiency, waste prevention and waste-re-use along the whole bioeconomy value chain is improved	Biogenic waste prevention, re-use/recycling, and recovery	Thousand tonnes of oil equivalent

3.1.c.4	Recycling rate of municipal waste	Reducing dependence on non-renewable unsustainable resources, whether sourced domestically or from abroad	Resource efficiency, waste prevention and waste-re-use along the whole bioeconomy value chain is improved	Biogenic waste prevention, re-use/recycling, and recovery	%
3.1.c.5	Biowaste generated by source	Reducing dependence on non-renewable unsustainable resources, whether sourced domestically or from abroad	Resource efficiency, waste prevention and waste-re-use along the whole bioeconomy value chain is improved	Biogenic waste prevention, re-use/recycling, and recovery	kT wet mass, kT dry mass
3.1.c.6	Biowaste recovered by source	Reducing dependence on non-renewable unsustainable resources, whether sourced domestically or from abroad	Resource efficiency, waste prevention and waste-re-use along the whole bioeconomy value chain is improved	Biogenic waste prevention, re-use/recycling, and recovery	kT wet mass (per waste source)
3.2.a.1	Food waste along supply chain - mass balance approach	Reducing dependence on non-renewable unsustainable resources, whether sourced domestically or from abroad	Food loss and waste is minimised and, when unavoidable, its biomass is reused or recycled	Food loss and waste minimization	Ktoe
3.2.a.2	Food waste by food category - mass balance approach	Reducing dependence on non-renewable unsustainable resources, whether sourced domestically or from abroad	Food loss and waste is minimised and, when unavoidable, its biomass is reused or recycled	Food loss and waste minimization	Ktoe
3.3.a.3	Environmental impacts based on product-based LCA and basket of representative products of the bioeconomy	Reducing dependence on non-renewable unsustainable resources, whether sourced domestically or from abroad	Bioeconomy should promote sustainable production and consumption of biomass and bio-based products (within EU)	Bio-based products environmental impacts	
3.4.a.1	Import dependencies for energy (wood,biofuels, bioenergy)	Reducing dependence on non-renewable unsustainable resources, whether sourced domestically or from abroad	Consumption patterns of bioeconomy goods match sustainable supply levels of biomass	Consumption and demand for biomass and bio-based products	%
3.4.a.2	Total biomass consumed for energy	Reducing dependence on non-renewable unsustainable resources, whether sourced domestically or from abroad	Consumption patterns of bioeconomy goods match sustainable supply levels of biomass	Consumption and demand for biomass and bio-based products	1000 tonnes dry matter
3.4.a.3	Total biomass consumed for materials	Reducing dependence on non-renewable unsustainable resources, whether sourced domestically or from abroad	Consumption patterns of bioeconomy goods match sustainable supply levels of biomass	Consumption and demand for biomass and bio-based products	1000 tonnes dry matter
3.4.a.4	Share of woody biomass used for energy	Reducing dependence on non-renewable unsustainable resources,	Consumption patterns of bioeconomy goods match	Consumption and demand for biomass and bio-based products	%

		whether sourced domestically or from abroad	sustainable supply levels of biomass		
3.4.b.1	Liquid biofuels production (bioethanol, pure biogasoline, biodiesel, bio jet kerosene and other liquid biofuels)	Reducing dependence on non-renewable unsustainable resources, whether sourced domestically or from abroad	Consumption patterns of bioeconomy goods match sustainable supply levels of biomass	Production of bio-based products	1000 tonnes
3.4.b.2	Biogasses (indigenous) production	Reducing dependence on non-renewable unsustainable resources, whether sourced domestically or from abroad	Consumption patterns of bioeconomy goods match sustainable supply levels of biomass	Production of bio-based products	TJ
3.4.b.3	Production of bio-based materials (plastics, textiles, chemicals)	Reducing dependence on non-renewable unsustainable resources, whether sourced domestically or from abroad	Consumption patterns of bioeconomy goods match sustainable supply levels of biomass	Production of bio-based products	tonnes
3.4.b.4	Advanced biofuels production	Reducing dependence on non-renewable unsustainable resources, whether sourced domestically or from abroad	Consumption patterns of bioeconomy goods match sustainable supply levels of biomass	Production of bio-based products	ktoe
3.4.c.1	Share of renewables for transport, electricity and heating & cooling	Reducing dependence on non-renewable unsustainable resources, whether sourced domestically or from abroad	Consumption patterns of bioeconomy goods match sustainable supply levels of biomass	Reduced dependence on non-renewable resources	%
3.4.c.2	Total consumption of energy, including fossil-based	Reducing dependence on non-renewable unsustainable resources, whether sourced domestically or from abroad	Consumption patterns of bioeconomy goods match sustainable supply levels of biomass	Reduced dependence on non-renewable resources	ktoe
3.4.c.3	Share of wood-based constructions	Reducing dependence on non-renewable unsustainable resources, whether sourced domestically or from abroad	Consumption patterns of bioeconomy goods match sustainable supply levels of biomass	Reduced dependence on non-renewable resources	%
3.4.c.4	Share of consumption of bio-based plastics, textiles and chemicals	Reducing dependence on non-renewable unsustainable resources, whether sourced domestically or from abroad	Consumption patterns of bioeconomy goods match sustainable supply levels of biomass	Reduced dependence on non-renewable resources	%
3.5.a.1	Economic impact of trade in exporting countries of non-food (to EU)	Reducing dependence on non-renewable unsustainable resources, whether sourced domestically or from abroad	Local economies of countries exporting non-food commodities to the EU are not hampered but rather harnessed by the trade of	Economic impact of trade in exporting countries of non-food (to EU)	

			raw and processed biomass and related technologies		
3.5.b.1	Environmental footprints in exporting countries of non-food (to EU)	Reducing dependence on non-renewable unsustainable resources, whether sourced domestically or from abroad	Local economies of countries exporting non-food commodities to the EU are not hampered but rather harnessed by the trade of raw and processed biomass and related technologies	Environmental footprints in exporting countries of non-food (to EU)	
3.5.c.1	Social impact of trade in exporting countries of non-food (to EU)	Reducing dependence on non-renewable unsustainable resources, whether sourced domestically or from abroad	Local economies of countries exporting non-food commodities to the EU are not hampered but rather harnessed by the trade of raw and processed biomass and related technologies	Social impact of trade in exporting countries of non-food (to EU)	
3.6.a.1	Self-assessed satisfaction with recreational and green areas	Reducing dependence on non-renewable unsustainable resources, whether sourced domestically or from abroad	The sustainability of urban centres is enhanced	Enhanced well-being and health of urban dwellers	%
3.6.a.2	Self-assessed satisfaction with living environment	Reducing dependence on non-renewable unsustainable resources, whether sourced domestically or from abroad	The sustainability of urban centres is enhanced	Enhanced well-being and health of urban dwellers	%
3.6.a.3	Self-assessed overall life satisfaction	Reducing dependence on non-renewable unsustainable resources, whether sourced domestically or from abroad	The sustainability of urban centres is enhanced	Enhanced well-being and health of urban dwellers	%
4.1.a.1	net GHG emissions (emissions and removals) from bioenergy (absolute and relative vs. total sector emissions)	Mitigating and adapting to climate change	Climate change mitigation and adaptation are pursued	Climate change mitigation	tCO2e and %
4.1.a.2	net GHG emissions (emissions and removals) from BBI (absolute and relative vs. total industrial emissions)	Mitigating and adapting to climate change	Climate change mitigation and adaptation are pursued	Climate change mitigation	tCO2e and %
4.1.a.3	net GHG emissions (emissions and removals) from agriculture	Mitigating and adapting to climate change	Climate change mitigation and adaptation are pursued	Climate change mitigation	tCO2e
4.1.a.4	net GHG emissions (emissions and removals) from bio-waste (absolute and relative vs. total waste emissions)	Mitigating and adapting to climate change	Climate change mitigation and adaptation are pursued	Climate change mitigation	tCO2e and %
4.1.a.5	GHG emissions from fishing and aquaculture	Mitigating and adapting to climate change	Climate change mitigation and adaptation are pursued	Climate change mitigation	1000 tCO2e

4.1.a.6	net GHG emissions (emissions and removals) from LULUCF	Mitigating and adapting to climate change	Climate change mitigation and adaptation are pursued	Climate change mitigation	1000 tCO2e
4.1.a.7	Financial support to bio-based sectors (climate action)	Mitigating and adapting to climate change	Climate change mitigation and adaptation are pursued	Climate change mitigation	Euro/pc
4.1.b.1	Climate change indices (country level precipitation and temp)	Mitigating and adapting to climate change	Climate change mitigation and adaptation are pursued	Climate change adaptation	TBC rain and temp units
4.1.b.2	Crop yield (3 main crops)	Mitigating and adapting to climate change	Climate change mitigation and adaptation are pursued	Climate change adaptation	tonne/ha
4.1.b.3	Water exploitation index (WEI)	Mitigating and adapting to climate change	Climate change mitigation and adaptation are pursued	Climate change adaptation	%
4.1.b.4	Soil moisture (seasonal average)	Mitigating and adapting to climate change	Climate change mitigation and adaptation are pursued	Climate change adaptation	%
4.1.b.5	Soil erosion / desertification	Mitigating and adapting to climate change	Climate change mitigation and adaptation are pursued	Climate change adaptation	Tg C/y
4.1.b.6	Soil organic carbon content	Mitigating and adapting to climate change	Climate change mitigation and adaptation are pursued	Climate change adaptation	percent
4.1.b.7	Adaptation in agriculture, share of farmers with CAP risk management tools (insurance)	Mitigating and adapting to climate change	Climate change mitigation and adaptation are pursued	Climate change adaptation	%
4.1.b.8	Adaptation in agriculture, share of agricultural land under commitments to improve adaptation (ha)	Mitigating and adapting to climate change	Climate change mitigation and adaptation are pursued	Climate change adaptation	%
4.1.b.9	Adaptation in agriculture, unsustainable water use: share of irrigated land under commitments to improve water balance	Mitigating and adapting to climate change	Climate change mitigation and adaptation are pursued	Climate change adaptation	%
4.1.b.10	Adaptation in forest, # fire instances	Mitigating and adapting to climate change	Climate change mitigation and adaptation are pursued	Climate change adaptation	#
4.1.b.11	Adaptation in forest, Burnt area	Mitigating and adapting to climate change	Climate change mitigation and adaptation are pursued	Climate change adaptation	ha
4.1.b.12	Adaptation in forest, Damages due to storm events (forests)	Mitigating and adapting to climate change	Climate change mitigation and adaptation are pursued	Climate change adaptation	
4.1.b.13	Adaptation in fisheries, potential catch	Mitigating and adapting to climate change	Climate change mitigation and adaptation are pursued	Climate change adaptation	tons
4.1.b.14	MS Preparedness - Year of adoption of the National Adaptation strategy/Plan (NAS/NAP)	Mitigating and adapting to climate change	Climate change mitigation and adaptation are pursued	Climate change adaptation	#

4.1.b.15	Adaptation, International Transboundaries effects - loss in GDP	Mitigating and adapting to climate change	Climate change mitigation and adaptation are pursued	Climate change adaptation	%
4.2.a.1	City preparedness - # cities signatories of COM - Adaptation	Mitigating and adapting to climate change	The sustainability of urban centres is enhanced	Enhanced resilience/adaptation to climate change for urban areas	#
4.2.a.2	Investments in urban adaptation through nature-based infrastructures or EBA	Mitigating and adapting to climate change	The sustainability of urban centres is enhanced	Enhanced resilience/adaptation to climate change for urban areas	Euro/pc
5.1.a.1	Contribution of the Bioeconomy to GDP	Strengthening European competitiveness and creating jobs	Economic development is fostered	Contribution of bioeconomy to economic development	%
5.1.a.2	Value Added per sector / Bioeconomy value added	Strengthening European competitiveness and creating jobs	Economic development is fostered	Contribution of bioeconomy to economic development	%
5.1.a.3	GVA to turnover ratio	Strengthening European competitiveness and creating jobs	Economic development is fostered	Contribution of bioeconomy to economic development	ratio
5.1.a.4	Economic productivity (GVA/unit of biomass)	Strengthening European competitiveness and creating jobs	Economic development is fostered	Contribution of bioeconomy to economic development	GVA/unit biomass / sector
5.1.a.5	Gross value added per person employed in bioeconomy	Strengthening European competitiveness and creating jobs	Economic development is fostered	Contribution of bioeconomy to economic development	1000 EUR per worker
5.1.b.1	Turnover in bioeconomy per sector	Strengthening European competitiveness and creating jobs	Economic development is fostered	Value of raw and processed biomass, value added in bioeconomy sectors	Million EUR
5.1.b.2	Value-added per sector	Strengthening European competitiveness and creating jobs	Economic development is fostered	Value of raw and processed biomass, value added in bioeconomy sectors	Million EUR
5.1.c.1	Export value	Strengthening European competitiveness and creating jobs	Economic development is fostered	Exports of EU food and non-food biomass, processed goods and/or related technologies	EUR
5.1.c.2	Trade balance (net export)	Strengthening European competitiveness and creating jobs	Economic development is fostered	Exports of EU food and non-food biomass, processed goods and/or related technologies	EUR
5.1.d.1	Terms-of-Trade of biomass (export/import)	Strengthening European competitiveness and creating jobs	Economic development is fostered	Comparative advantage	ratio
5.1.d.2	Revealed comparative advantage of biomass (Balassa index)	Strengthening European competitiveness and creating jobs	Economic development is fostered	Comparative advantage	index
5.1.d.3	Number of enterprises in bioeconomy	Strengthening European competitiveness and creating jobs	Economic development is fostered	Comparative advantage	number

5.1.d.4	Bioeconomy SME birth & death rates	Strengthening European competitiveness and creating jobs	Economic development is fostered	Comparative advantage	%
5.2.a.1	Persons employed per bioeconomy sectors	Strengthening European competitiveness and creating jobs	Inclusive economic growth is strengthened	Employment in bioeconomy	person
5.2.b.1	Occupation health and safety in bioeconomy sectors	Strengthening European competitiveness and creating jobs	Inclusive economic growth is strengthened	Working conditions related to bioeconomy	
5.2.c.1	Employment by age in bioeconomy sectors	Strengthening European competitiveness and creating jobs	Inclusive economic growth is strengthened	Equality & inclusiveness in bioeconomy sectors	person
5.2.c.2	Employment by educational level in bioeconomy sectors	Strengthening European competitiveness and creating jobs	Inclusive economic growth is strengthened	Equality & inclusiveness in bioeconomy sectors	person
5.2.c.3	Employment by gender in bioeconomy sectors	Strengthening European competitiveness and creating jobs	Inclusive economic growth is strengthened	Equality & inclusiveness in bioeconomy sectors	person
5.2.c.4	Income by gender by sector	Strengthening European competitiveness and creating jobs	Inclusive economic growth is strengthened	Equality & inclusiveness in bioeconomy sectors	EUR
5.2.c.5	Income distribution along bioeconomy value chains	Strengthening European competitiveness and creating jobs	Inclusive economic growth is strengthened	Equality & inclusiveness in bioeconomy sectors	EUR per step in the value chain
5.3.a.1	Distance to logistics hubs (territorial dimension)	Strengthening European competitiveness and creating jobs	Resilience of the rural, coastal and urban economy is enhanced	Physical infrastructure (accessibility, services)	km
5.3.b.1	Bioeconomy investments in rural and coastal areas	Strengthening European competitiveness and creating jobs	Resilience of the rural, coastal and urban economy is enhanced	Bioeconomy investments in rural & coastal areas	EUR
5.3.b.2	Number of bioeconomy businesses developed with policy support	Strengthening European competitiveness and creating jobs	Resilience of the rural, coastal and urban economy is enhanced	Bioeconomy investments in rural & coastal areas	number
5.3.c.1	Transformation of biomass at farm (or coop) level	Strengthening European competitiveness and creating jobs	Resilience of the rural, coastal and urban economy is enhanced	Rural income diversification	Tonnes??
5.3.c.2	Income diversification in rural areas, by farmer age for production and transformation at farm or coop level.	Strengthening European competitiveness and creating jobs	Resilience of the rural, coastal and urban economy is enhanced	Rural income diversification	?
5.3.c.3	Income diversification of rural and coastal biomass producers (other than agriculture)	Strengthening European competitiveness and creating jobs	Resilience of the rural, coastal and urban economy is enhanced	Rural income diversification	?
5.3.d.1	Income of primary producers (fish & seafood landing income, agriculture households, forest owners)	Strengthening European competitiveness and creating jobs	Resilience of the rural, coastal and urban economy is enhanced	Income of primary producers	EUR
5.4.a.1	Adoption of new bioeconomy technology by primary producers for	Strengthening European competitiveness and creating jobs	Existing knowledge is adequately valued and proven sound technologies are fostered	Existing knowledge on bioeconomy technologies	?

	both production and transformation levels				
5.4.a.2	Rolling-out of pilot projects	Strengthening European competitiveness and creating jobs	Existing knowledge is adequately valued and proven sound technologies are fostered	Existing knowledge on bioeconomy technologies	number
5.4.a.3	Investment in TRL8-9 bio-based products	Strengthening European competitiveness and creating jobs	Existing knowledge is adequately valued and proven sound technologies are fostered	Existing knowledge on bioeconomy technologies	EUR
5.5.a.1	% persons employed with 3 ^o education in bioeconomy sectors	Strengthening European competitiveness and creating jobs	Knowledge generation and innovation are promoted	Knowledge generation/ (high level) education	%
5.5.a.2	Changes in University curricula (number)	Strengthening European competitiveness and creating jobs	Knowledge generation and innovation are promoted	Knowledge generation/ (high level) education	number
5.5.a.3	Investment in higher education related to bioeconomy	Strengthening European competitiveness and creating jobs	Knowledge generation and innovation are promoted	Knowledge generation/ (high level) education	EUR
5.5.b.1	Number of patents by bioeconomy sectors	Strengthening European competitiveness and creating jobs	Knowledge generation and innovation are promoted	Research and innovation	number
5.5.b.2	Investment in research and innovation (1000 eur)	Strengthening European competitiveness and creating jobs	Knowledge generation and innovation are promoted	Research and innovation	1000 EUR
5.5.b.3	Open innovation	Strengthening European competitiveness and creating jobs	Knowledge generation and innovation are promoted	Research and innovation	?
5.5.b.4	New non-food products produced from primary sources	Strengthening European competitiveness and creating jobs	Knowledge generation and innovation are promoted	Research and innovation	number?
5.5.b.5	Number of research outputs in the field of bioeconomy	Strengthening European competitiveness and creating jobs	Knowledge generation and innovation are promoted	Research and innovation	number
5.6.a.1	Market or consumers acceptance	Strengthening European competitiveness and creating jobs	Demand and supply-side market mechanisms and policy coherence between supply and demand of food and non-food goods are enhanced	Market mechanisms (e.g. prices, consumer awareness)	?
5.6.a.2	Number of labelled or certified bio-based products	Strengthening European competitiveness and creating jobs	Demand and supply-side market mechanisms and policy coherence between supply and demand of food and non-food goods are enhanced	Market mechanisms (e.g. prices, consumer awareness)	number
5.6.b.1	Share biomass uses by primary sector	Strengthening European competitiveness and creating jobs	Demand and supply-side market mechanisms and policy coherence between supply and demand of	Resource competition among sectors of the bioeconomy and Biomass demand for new value chains	percent

			food and non-food goods are enhanced		
5.6.b.2	Producer prices per primary production sector	Strengthening European competitiveness and creating jobs	Demand and supply-side market mechanisms and policy coherence between supply and demand of food and non-food goods are enhanced	Resource competition among sectors of the bioeconomy and Biomass demand for new value chains	EUR/tonne?

Annex 4. Metadata of indicators

Agricultural factor income per annual work unit (AWU)

Publication year	2020
Indicator id	1.1.a.1
Objective id	1
Objective name	Ensuring Food and Nutrition Security
Normative criterion id	1.1
Normative criterion name	Food security and nutrition are supported
Key component id	1.1.a
Key component name	Availability
SDGs	GOAL 2: Zero Hunger, GOAL 8: Decent Work and Economic Growth
Green Deal priorities	2.1.3. Mobilising industry for a clean and circular economy 2.1.6. From 'Farm to Fork': designing a fair, healthy and environmentally-friendly food system
Description	(source: Eurostat) The indicator is a partial labour productivity measure of the agricultural sector. Agricultural factor income measures the income generated by farming, which is used to remunerate borrowed or rented factors of production (capital, wages and land rents) as well as own production factors (own labour, capital and land). Factor income corresponds to the deflated (real) net value added at factor cost of agriculture. The implicit price index of GDP is used as deflator. Annual work units (AWUs) are defined as full-time equivalent employment (corresponding to the number of full-time equivalent jobs), i.e. as total hours worked divided by the average annual number of hours worked in full-time jobs within the economic territory
References	n/a
Unit	index (2010=100)
Unit's description	n/a
Intensive/extensive	intensive
Directionality	pos
Source	ESTAT
Link	https://ec.europa.eu/eurostat/databrowser/view/sdg_02_20/default/table?lang=en
Geographic coverage	AllMS
Frequency	annual
Timeliness	T-1
Length of time series	>10y
Comparability over time	>5 data points w/o break
Accessibility	most FAIR
Used elsewhere	SDG_02_20
Link used elsewhere	https://ec.europa.eu/eurostat/cache/metadata/en/sdg_02_20_esmsip2.htm

Total biomass supply for food purposes, including inputs

Publication year	2020
Indicator id	1.1.a.4
Objective id	1
Objective name	Ensuring Food and Nutrition Security
Normative criterion id	1.1
Normative criterion name	Food security and nutrition are supported
Key component id	1.1.a
Key component name	Availability
SDGs	GOAL 2: Zero Hunger
Green Deal priorities	2.1.6. From 'Farm to Fork': designing a fair, healthy and environmentally-friendly food system
Description	(source: JRC-BIOMASS) The indicator reveals the total primary biomass used annually for food purposes. This includes plant-based food, the total plant biomass and primary fish biomass used to feed and bedding of animals or fish for food consumption.
References	Gurria Albusac, P., Gonzalez Hermoso, H., Ronzon, T., Tamosiunas, S., Lopez Lozano, R., Garcia Condado, S., Ronchetti, G., Guillen Garcia, J., Banja, M., Fiore, G. and M`barek, R., Biomass flows in the European Union, EUR 30454 EN, Publications Office of the European Union, Luxembourg, 2020, ISBN 978-92-76-25378-5, doi:10.2760/14342, JRC122379.
Unit	1000 tonnes dry matter
Unit's description	n/a
Intensive/extensive	extensive
Directionality	pos
Source	JRC EU BIOMASS FLOWS
Link	https://datam.jrc.ec.europa.eu/datam/mashup/BIOMASS_FLOWS
Geographic coverage	ALLMS
Frequency	>triennial
Timeliness	T-3
Length of time series	>10y
Comparability over time	>5 data points w/o break
Accessibility	most FAIR
Used elsewhere	n/a
Link used elsewhere	n/a

Prevalence of moderate or severe food insecurity in the total population, yearly estimates

Publication year	2020
Indicator id	1.1.b.1
Objective id	1
Objective name	Ensuring Food and Nutrition Security
Normative criterion id	1.1
Normative criterion name	Food security and nutrition are supported
Key component id	1.1.b
Key component name	Access
SDGs	GOAL 1: No Poverty, GOAL 2: Zero Hunger
Green Deal priorities	2.1.6. From 'Farm to Fork': designing a fair, healthy and environmentally-friendly food system
Description	An estimate of the percentage of a country's population that faces difficulties in accessing enough safe and nutritious food for normal growth and development and an active and healthy life. The data is collected through direct interviews by asking people about experiences associated with constrained access to food. For details see http://www.fao.org/hunger/en/
References	n/a
Unit	percent
Unit's description	n/a
Intensive/extensive	intensive
Directionality	neg
Source	FAO
Link	https://sdic.fao.org/artifactory/fao-sdg-releases/2.1.2/2.1.2_March_2020.xlsx
Geographic coverage	AllMS
Frequency	annual
Timeliness	>T-3
Length of time series	5-10y
Comparability over time	3-5 data points w/o break
Accessibility	most FAIR
Used elsewhere	FAO SDG 2
Link used elsewhere	http://www.fao.org/sustainable-development-goals/indicators/212/en/

Daily calorie supply per capita by source

Publication year	2020
Indicator id	1.1.c.1
Objective id	1
Objective name	Ensuring Food and Nutrition Security
Normative criterion id	1.1
Normative criterion name	Food security and nutrition are supported
Key component id	1.1.c
Key component name	Utilisation
SDGs	GOAL 2: Zero Hunger, GOAL 3: Good Health and Well-being
Green Deal priorities	2.1.6. From 'Farm to Fork': designing a fair, healthy and environmentally-friendly food system
Description	<p>(source: Eurostat) The indicator shows the total daily calorie supply per capita and the split into calories from animal products and vegetal products. It should not be confused with the per capita consumption of those products (calorie consumption) as calorie supply includes also losses through food distribution and mismanagement. The supply data are based on the food balance sheets (FBS) available at FAOSTAT. Data sources are primarily FAO questionnaires, national publications available in the ESS Library and Country visits by statisticians involving discussions with national experts. The food balance sheet shows the availability for human consumption for each food item i.e., each primary commodity, which corresponds to the sources of supply and its utilisation. The total quantity of all foodstuffs produced in a country added to the total quantity imported and adjusted to any change in stocks that may have occurred since the beginning of the reference period, gives the supply available during that period. Data on per capita food supplies are expressed in terms of quantity and by applying appropriate food composition factors for all primary and processed products. The data for this indicator can also be expressed in terms of its energy value.</p>
References	n/a
Unit	kcal/capita/d and %
Unit's description	n/a
Intensive/extensive	intensive
Directionality	descriptive
Source	Eurostat
Link	https://ec.europa.eu/eurostat/databrowser/view/t2020_rk100/default/table?lang=en
Geographic coverage	AllMS
Frequency	annual
Timeliness	>T-3
Length of time series	>10y
Comparability over time	>5 data points w/o break
Accessibility	most FAIR
Used elsewhere	n/a

Biochemical oxygen demand in rivers

Publication year	2021
Indicator id	2.1.a.1
Objective id	2
Objective name	Managing Natural Resources Sustainably
Normative criterion id	2.1
Normative criterion name	Ecosystem capacity to produce services is maintained or enhanced
Key component id	2.1.a
Key component name	Environmental quality
SDGs	GOAL 14: Life Below Water, GOAL 15: Life on Land, GOAL 6: Clean Water and Sanitation
Green Deal priorities	2.1.7. Preserving and restoring ecosystems and biodiversity 2.1.8. A zero pollution ambition for a toxic-free environment
Description	(source: Eurostat) An indicator from the EEA. Biochemical oxygen demand (BOD) is used to measure water quality. The cleanest rivers have BOD5 values of less than 1 mg O2/L, moderately and heavily polluted rivers show values ranging from 2 to 8 mg O2/L.
References	n/a
Unit	mg O2 per litre
Unit's description	amount of oxygen required by aerobic microorganisms to decompose organic substances in a water sample over a period of five days in the dark at 20°C. High levels mean organic pollution.
Intensive/extensive	intensive
Directionality	neg
Source	EEA / ESTAT
Link	https://ec.europa.eu/eurostat/databrowser/view/sdg_06_30/default/table?lang=en
Geographic coverage	50-74%MS
Frequency	annual
Timeliness	T-3
Length of time series	>10y
Comparability over time	>5 data points w/o break
Accessibility	most FAIR
Used elsewhere	SDG_06_30
Link used elsewhere	https://ec.europa.eu/eurostat/databrowser/view/sdg_06_30/default/table?lang=en

Phosphate in rivers

Publication year	2021
Indicator id	2.1.a.2
Objective id	2
Objective name	Managing Natural Resources Sustainably
Normative criterion id	2.1
Normative criterion name	Ecosystem capacity to produce services is maintained or enhanced
Key component id	2.1.a
Key component name	Environmental quality
SDGs	GOAL 14: Life Below Water, GOAL 15: Life on Land, GOAL 6: Clean Water and Sanitation
Green Deal priorities	2.1.7. Preserving and restoring ecosystems and biodiversity 2.1.8. A zero pollution ambition for a toxic-free environment
Description	(source: Eurostat) An indicator from the EEA. Refers to concentration of phosphate (PO ₄) in the dissolved phase of water samples. At high levels, phosphate can cause water quality problems, such as eutrophication, by triggering the growth of macrophytes and algae.
References	n/a
Unit	mg PO ₄ /l
Unit's description	concentration of phosphate (PO ₄) in the dissolved phase of water samples
Intensive/extensive	intensive
Directionality	neg
Source	EEA / ESTAT
Link	https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=sdg_06_50&lang=en
Geographic coverage	50-74%MS
Frequency	annual
Timeliness	T-3
Length of time series	>10y
Comparability over time	>5 data points w/o break
Accessibility	most FAIR
Used elsewhere	SDG_06_50
Link used elsewhere	https://ec.europa.eu/eurostat/cache/metadata/EN/sdg_06_50_esmsip2.htm

Nitrate in groundwater

Publication year	2021
Indicator id	2.1.a.4
Objective id	2
Objective name	Managing Natural Resources Sustainably
Normative criterion id	2.1
Normative criterion name	Ecosystem capacity to produce services is maintained or enhanced
Key component id	2.1.a
Key component name	Environmental quality
SDGs	GOAL 14: Life Below Water, GOAL 15: Life on Land, GOAL 6: Clean Water and Sanitation
Green Deal priorities	2.1.7. Preserving and restoring ecosystems and biodiversity 2.1.8. A zero pollution ambition for a toxic-free environment
Description	(source: Eurostat) An indicator from the EEA. Indicator refers to concentrations of nitrate (NO ₃) in groundwater. According to the Drinking Water Directive, a maximum concentration of 50 mg/L of nitrate in groundwater that is used for drinking water is allowed.
References	n/a
Unit	mg NO ₃ /l
Unit's description	concentrations of nitrate (NO ₃) in groundwater
Intensive/extensive	intensive
Directionality	neg
Source	EEA
Link	http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=sdg_06_40&lang=en
Geographic coverage	EUaggr
Frequency	annual
Timeliness	T-3
Length of time series	>10y
Comparability over time	>5 data points w/o break
Accessibility	most FAIR
Used elsewhere	EEA
Link used elsewhere	https://www.eea.europa.eu/data-and-maps/daviz/rivers-nutrient-trend-3#tab-chart_1

Share of organic farming in utilised agricultural area

Publication year	2020
Indicator id	2.1.b.4
Objective id	2
Objective name	Managing Natural Resources Sustainably
Normative criterion id	2.1
Normative criterion name	Ecosystem capacity to produce services is maintained or enhanced
Key component id	2.1.b
Key component name	Structural and functional ecosystem attributes
SDGs	GOAL 3: Good Health and Well-being, GOAL 15: Life on Land
Green Deal priorities	2.1.7. Preserving and restoring ecosystems and biodiversity 2.1.6. From 'Farm to Fork': designing a fair, healthy and environmentally-friendly food system
Description	(source: Eurostat) The indicator measures the share of total utilised agricultural area (UAA) occupied by organic farming (existing organically-farmed areas and areas in process of conversion). Farming is recognised to be organic if it complies with Council Regulation (EC) No 834/2007, which has set up a comprehensive framework for the organic production of crops and livestock and for the labelling, processing and marketing of organic products, as well as for governing imports of organic products into the EU. The detailed rules for the implementation of this Regulation are laid down in Commission Regulation (EC) No 889/2008.
References	n/a
Unit	percent of UAA
Unit's description	n/a
Intensive/extensive	intensive
Directionality	pos
Source	ESTAT
Link	https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=org_cropar&lang=en
Geographic coverage	ALLMS
Frequency	annual
Timeliness	T-2
Length of time series	5-10y
Comparability over time	>5 data points w/o break
Accessibility	most FAIR
Used elsewhere	SDG_02_40
Link used elsewhere	https://ec.europa.eu/eurostat/cache/metadata/en/sdg_02_40_esmsip2.htm

Forest and other wooded land growing stock

Publication year	2021
Indicator id	2.1.b.9
Objective id	2
Objective name	Managing Natural Resources Sustainably
Normative criterion id	2.1
Normative criterion name	Ecosystem capacity to produce services is maintained or enhanced
Key component id	2.1.b
Key component name	Structural and functional ecosystem attributes
SDGs	GOAL 15: Life on Land
Green Deal priorities	2.1.7. Preserving and restoring ecosystems and biodiversity
Description	(source: FAO - FE) Growing stock in forests and on other wooded land. One indicator of Eurostat's 'Forest resources and environmental functions', where growing stock follows the FAO FRA definition "Volume over bark of all living trees with a minimum diameter of 10 cm at breast height (or above buttress if these are higher). Includes the stem from ground level up to a top diameter of 0 cm, excluding branches".
References	n/a
Unit	1000m3
Unit's description	n/a
Intensive/extensive	extensive
Directionality	pos
Source	ESTAT
Link	https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=for_vol&lang=en
Geographic coverage	AllMS
Frequency	>triennial
Timeliness	>T-3
Length of time series	>10y
Comparability over time	>5 data points w/o break
Accessibility	most FAIR
Used elsewhere	SEBI_017
Link used elsewhere	https://biodiversity.europa.eu/topics/sebi-indicators

Bird and butterfly indices EU aggregate (common farmland bird Index, common forest bird index, grassland butterfly index)

Publication year	2021
Indicator id	2.1.d.1
Objective id	2
Objective name	Managing Natural Resources Sustainably
Normative criterion id	2.1
Normative criterion name	Ecosystem capacity to produce services is maintained or enhanced
Key component id	2.1.d
Key component name	Species diversity and abundance
SDGs	GOAL 15: Life on Land
Green Deal priorities	2.1.7. Preserving and restoring ecosystems and biodiversity
Description	<p>(source: Eurostat) Common bird index by type of species - EU aggregate (source: EBCC). online data code: SDG_15_60. The indicator shows the abundance and diversity of a selection of common bird species and is presented as Index 2000 = 100 and Index 1990 = 100. Three groups of bird species are represented: common farmland species (39 species), common forest species (34 species), all common bird species (167 species) which include the farmland species, the forest species and a further 94 common species (generalists, as opposed to the farmland and forest specialists). Rare species are excluded, although some species common in certain Member States may be considered rare in others. The species covered under the common farmland and common forest indices are deemed to be dependent on that particular kind of habitat for feeding and nesting. Each of the three indices is a composite, multispecies index calculated using Monte Carlo simulations as described in Soldaat et al. (2017) and an R-script developed by Statistics Netherlands. The indices are presented for EU-aggregates only and with smoothed values. The indices draw from data produced by the European Bird Census Council and its Pan-European Common Bird Monitoring Scheme programme. The data source comprises EBCC/RSPB/BirdLife/Czech Society for Ornithology. Data coverage has increased from 9 to 22 EU Member States over the period 1990 to 2010, with 25 countries covered as of the reference year 2011.</p>
References	n/a
Unit	index rel to 1990 or 2000
Unit's description	n/a
Intensive/extensive	intensive
Directionality	pos
Source	ESTAT
Link	https://ec.europa.eu/eurostat/databrowser/view/sdg_15_60/default/table?lang=en & https://ec.europa.eu/eurostat/databrowser/view/sdg_15_61/default/table?lang=en
Geographic coverage	EUaggr
Frequency	annual
Timeliness	T-2
Length of time series	>10y
Comparability over time	>5 data points w/o break

Accessibility	most FAIR
Used elsewhere	SDG_15_60
Link used elsewhere	https://ec.europa.eu/eurostat/cache/metadata/EN/sdg_15_60_esmsip2.htm

Surface of marine and terrestrial sites designated under NATURA 2000

Publication year	2021
Indicator id	2.1.e.1
Objective id	2
Objective name	Managing Natural Resources Sustainably
Normative criterion id	2.1
Normative criterion name	Ecosystem capacity to produce services is maintained or enhanced
Key component id	2.1.e
Key component name	Conservation status of habitats and species
SDGs	GOAL 14: Life Below Water, GOAL 15: Life on Land
Green Deal priorities	2.1.7. Preserving and restoring ecosystems and biodiversity
Description	(source: DG ENV, EEA) Online data code: SDG_15_20. The indicator measures the surface of terrestrial sites designated under Natura 2000. The Natura 2000 network comprises both marine and terrestrial protected areas designated under the EU Habitats and Birds Directives with the goal to maintain or restore a favourable conservation status for habitat types and species of EU interest. Each country is required to fill in a standard data form where sites designated under the Directives are reported in detail, included the size of the site in km2, the existing habitats and species and their percentage cover of the site. A thorough typology has been developed to support precise reporting.
References	n/a
Unit	percent land area
Unit's description	n/a
Intensive/extensive	intensive
Directionality	pos
Source	ESTAT
Link	https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=env_bio1&lang=en
Geographic coverage	ALLMS
Frequency	annual
Timeliness	T-1
Length of time series	5-10y
Comparability over time	>5 data points w/o break
Accessibility	most FAIR
Used elsewhere	SDG_15_20
Link used elsewhere	https://ec.europa.eu/eurostat/cache/metadata/EN/sdg_15_20_esmsip2.htm

Long term ratio of annual fellings (m³/ha/year) to net annual increment (m³/ha/year)

Publication year	2020
Indicator id	2.2.a.1
Objective id	2
Objective name	Managing Natural Resources Sustainably
Normative criterion id	2.2
Normative criterion name	Primary production sectors are managed sustainably
Key component id	2.2.a
Key component name	Pressures from Forest Management
SDGs	GOAL 15: Life on Land
Green Deal priorities	2.1.7. Preserving and restoring ecosystems and biodiversity
Description	(source: SOEF) Total fellings as a fraction of the net annual increment. Reference is FOREST EUROPE, 2015, State of Europe's Forests 2015, indicator 3.1 "Fellings as percent of net annual increment".
References	n/a
Unit	percent
Unit's description	[annual fellings (m ³ /ha/a)/net annual increment (m ³ /ha/a)]
Intensive/extensive	intensive
Directionality	neg
Source	SOEF
Link	https://foresteurope.org/state-europes-forests-2015-report/
Geographic coverage	ALLMS
Frequency	>triennial
Timeliness	>T-3
Length of time series	>10y
Comparability over time	3-5 data points w/o break
Accessibility	most FAIR
Used elsewhere	n/a
Link used elsewhere	n/a

Fishing mortality of commercially exploited fish and shellfish exceeding fishing mortality at maximum sustainable yield

Publication year	2020
Indicator id	2.2.b.2
Objective id	2
Objective name	Managing Natural Resources Sustainably
Normative criterion id	2.2
Normative criterion name	Primary production sectors are managed sustainably
Key component id	2.2.b
Key component name	Pressures from marine fisheries & aquaculture management
SDGs	GOAL 14: Life Below Water
Green Deal priorities	2.1.7. Preserving and restoring ecosystems and biodiversity 2.1.6. From 'Farm to Fork': designing a fair, healthy and environmentally-friendly food system
Description	(source: JRC-STEFCF) The trends shown here are for European stocks although there are some stocks which are shared between European and non-European waters. The indicator shows the model-based trend over time of fish stock biomass relative to 2003 in the EU waters of the North-East Atlantic and adjacent seas (FAO area 27) and the Mediterranean and Black seas (FAO area 37). It is presented as Index 2003 = 100. The indicator is computed based on single species quantitative stock assessments. The time series are annually updated, sometimes including new stocks due to newly available quantitative assessments, which can result in small differences between annual versions of the indicator.
References	n/a
Unit	F/FSMY
Unit's description	n/a
Intensive/extensive	intensive
Directionality	neg
Source	JRC_STECF
Link	https://stecf.jrc.ec.europa.eu
Geographic coverage	all EU
Frequency	annual
Timeliness	T-2
Length of time series	>10y
Comparability over time	>5 data points w/o break
Accessibility	unFAIR
Used elsewhere	MSCG_D3C1
Link used elsewhere	https://circabc.europa.eu/sd/a/ac936d86-7a3c-4102-be28-74e155aef3eb/MSCG_22-2018-03_MSFD2018ReportingGuidance_v5.pdf

Intensification of farming (share of high, medium and low input farms in UAA)

Publication year	2020
Indicator id	2.2.d.5
Objective id	2
Objective name	Managing Natural Resources Sustainably
Normative criterion id	2.2
Normative criterion name	Primary production sectors are managed sustainably
Key component id	2.2.d
Key component name	Pressures from agroecosystems
SDGs	GOAL 15: Life on Land
Green Deal priorities	2.1.7. Preserving and restoring ecosystems and biodiversity 2.1.6. From 'Farm to Fork': designing a fair, healthy and environmentally-friendly food system 2.1.8. A zero pollution ambition for a toxic-free environment
Description	(source: FADN) Percentage of utilised agricultural area (UAA) managed by low-, medium- and high-input farms and the number of hectares of UAA per category of farms. Each farm is classified according to the level of input use per hectare, which is calculated on the basis of the spending (in constant euros) on purchased inputs per hectare of UAA. The inputs considered here are purchased fertilisers and soil improvers, pesticides (plant protection products), other means for protection such as traps and baits, bird scarers, anti-hail shells, frost protection and purchased feed. Important details available here https://ec.europa.eu/eurostat/cache/metadata/en/aei_ps_inp_esms.htm
References	n/a
Unit	percent
Unit's description	n/a
Intensive/extensive	intensive
Directionality	neg
Source	ESTAT
Link	https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=aei_ps_inp&lang=en
Geographic coverage	All MS
Frequency	annual
Timeliness	>T-3
Length of time series	>10y
Comparability over time	>5 data points w/o break
Accessibility	most FAIR
Used elsewhere	CAP_AEI
Link used elsewhere	https://ec.europa.eu/info/sites/info/files/food-farming-fisheries/farming/documents/cap-indicators-doc-c33_2018_en.pdf

Roundwood removals

Publication year	2020
Indicator id	2.3.a.2
Objective id	2
Objective name	Managing Natural Resources Sustainably
Normative criterion id	2.3
Normative criterion name	Ecosystem services contribution to human well-being is maintained or enhanced
Key component id	2.3.a
Key component name	Provisioning services
SDGs	GOAL 15: Life on Land
Green Deal priorities	2.1.7. Preserving and restoring ecosystems and biodiversity
Description	(source: JRC-BIOMASS) Total removals over bark, derived from the last available JFSQ (published August 2019). Conversion to over bark using conversion factors from UNECE/FAO (2010), Forest products conversion factors for the UNECE region.
References	n/a
Unit	m3 o.b.
Unit's description	n/a
Intensive/extensive	extensive
Directionality	pos
Source	JRC_BIOMASS
Link	DBForest
Geographic coverage	ALLMS
Frequency	annual
Timeliness	T-2
Length of time series	>10y
Comparability over time	>5 data points w/o break
Accessibility	most FAIR
Used elsewhere	n/a
Link used elsewhere	n/a

Domestic Material Consumption (Biomass)

Publication year	2020
Indicator id	3.1.a.1
Objective id	3
Objective name	Reducing dependence on non-renewable unsustainable resources, whether sourced domestically or from abroad
Normative criterion id	3.1
Normative criterion name	Resource efficiency, waste prevention and waste-re-use along the whole bioeconomy value chain is improved
Key component id	3.1.a
Key component name	Resource efficiency (Material footprint)
SDGs	GOAL 12: Responsible Consumption and Production
Green Deal priorities	<p>2.1.2. Supplying clean, affordable and secure energy</p> <p>2.1.4. Building and renovating in an energy and resource efficient way</p> <p>2.1.5. Accelerating the shift to sustainable and smart mobility</p> <p>2.1.3. Mobilising industry for a clean and circular economy</p> <p>2.1.6. From 'Farm to Fork': designing a fair, healthy and environmentally-friendly food system</p>
Description	(source: Eurostat) This indicates the total amount of material actually consumed domestically by resident units. DMC is part of Eurostat's 'Economy-wide material flow accounts (EW-MFA)', which provide an aggregate overview of the material flows into and out of an economy.
References	n/a
Unit	1000 tonnes
Unit's description	n/a
Intensive/extensive	intensive
Directionality	neg
Source	ESTAT
Link	https://appsso.eurostat.ec.europa.eu/nui/show.do?query=BOOKMARK_DS-075779_QID_138D22EA_UID_-3F171EB0&layout=TIME,C,X,O;GEO,L,Y,O;UNIT,L,Z,O;MATERIAL,L,Z,1;INDIC_ENV,L,Z,2;INDICATORS,C,Z,3;&zSelection=DS-075779MATERIAL,MF1;DS-075779INDICATORS,OBS_FLAG;DS-075779INDIC_ENV,DMC;DS-075779UNIT,THS_T;&rankName1=INDIC-ENV_1_2_-1_2&rankName2=MATERIAL_1_2_-1_2&rankName3=UNIT_1_2_-1_2&rankName4=INDICATORS_1_2_-1_2&rankName5=TIME_1_0_0_0&rankName6=GEO_1_2_0_1&sortC=ASC_-1_FIRST&rStp=&cStp=&rDCh=&cDCh=&rDM=true&cDM=true&footnes=false&empty=false&wai=false&time_mode=ROLLING&time_most_recent=true&lang=EN&cfo=%23%23%23%2C%23%23%23.%23%23%23
Geographic coverage	AllMS
Frequency	annual

Timeliness	T-1
Length of time series	5-10y
Comparability over time	>5 data points w/o break
Accessibility	most FAIR
Used elsewhere	UN SDG 12.2.2 / 8.4.2
Link used elsewhere	https://unstats.un.org/sdgs/report/2019/goal-12/

Material Footprint (Biomass)

Publication year	2021
Indicator id	3.1.a.2
Objective id	3
Objective name	Reducing dependence on non-renewable unsustainable resources, whether sourced domestically or from abroad
Normative criterion id	3.1
Normative criterion name	Resource efficiency, waste prevention and waste-re-use along the whole bioeconomy value chain is improved
Key component id	3.1.a
Key component name	Resource efficiency (Material footprint)
SDGs	GOAL 12: Responsible Consumption and Production
Green Deal priorities	<p>2.1.2. Supplying clean, affordable and secure energy</p> <p>2.1.4. Building and renovating in an energy and resource efficient way</p> <p>2.1.5. Accelerating the shift to sustainable and smart mobility</p> <p>2.1.3. Mobilising industry for a clean and circular economy</p> <p>2.1.6. From 'Farm to Fork': designing a fair, healthy and environmentally-friendly food system</p>
Description	(source: UN). Total amount of raw materials extracted to meet final consumption demands. It is one indication of the pressures placed on the environment to support economic growth and to satisfy the material needs of people. For more details, see https://unstats.un.org/sdgs/report/2019/goal-12/
References	n/a
Unit	tonne / capita
Unit's description	n/a
Intensive/extensive	intensive
Directionality	neg
Source	UNEP
Link	https://uneplive.unep.org/media/docs/statistics/indicators/12_2_1.xlsx
Geographic coverage	AllMS
Frequency	annual
Timeliness	>T-3
Length of time series	>10y
Comparability over time	>5 data points w/o break
Accessibility	somewhat FAIR
Used elsewhere	UN SDG 12.2.1 / 8.4.1

Link used elsewhere	https://unstats.un.org/sdgs/report/2019/goal-12/
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Energy productivity

Publication year	2020
Indicator id	3.1.b.1
Objective id	3
Objective name	Reducing dependence on non-renewable unsustainable resources, whether sourced domestically or from abroad
Normative criterion id	3.1
Normative criterion name	Resource efficiency, waste prevention and waste-re-use along the whole bioeconomy value chain is improved
Key component id	3.1.b
Key component name	Energy efficiency
SDGs	GOAL 7: Affordable and Clean Energy
Green Deal priorities	2.1.2. Supplying clean, affordable and secure energy
Description	(source: Eurostat) The indicator results from the division of the gross domestic product (GDP) by the gross available energy for a given calendar year. It measures the productivity of energy consumption and provides a picture of the degree of decoupling of energy use from growth in GDP
References	n/a
Unit	eur / kgoe
Unit's description	n/a
Intensive/extensive	intensive
Directionality	pos
Source	ESTAT
Link	http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=t2020_rd310&lang=en
Geographic coverage	ALLMS
Frequency	annual
Timeliness	T-2
Length of time series	5-10y
Comparability over time	>5 data points w/o break
Accessibility	most FAIR
Used elsewhere	UN SDG 7.3.1
Link used elsewhere	https://unstats.un.org/sdgs/report/2019/goal-07/

Share of renewable energy in gross final energy consumption

Publication year	2020
Indicator id	3.1.b.2
Objective id	3
Objective name	Reducing dependence on non-renewable unsustainable resources, whether sourced domestically or from abroad
Normative criterion id	3.1
Normative criterion name	Resource efficiency, waste prevention and waste-re-use along the whole bioeconomy value chain is improved
Key component id	3.1.b
Key component name	Energy efficiency
SDGs	GOAL 7: Affordable and Clean Energy, GOAL 12: Responsible Consumption and Production, GOAL 13: Climate Action
Green Deal priorities	2.1.2. Supplying clean, affordable and secure energy
Description	(source: Eurostat) The indicator measures the share of renewable energy consumption in gross final energy consumption according to the Renewable Energy Directive (the gross final energy consumption is the energy used by end-consumers -final energy consumption- plus grid losses and self-consumption of power plants)
References	n/a
Unit	%
Unit's description	n/a
Intensive/extensive	intensive
Directionality	pos
Source	ESTAT
Link	http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=t2020_31&lang=en
Geographic coverage	ALLMS
Frequency	annual
Timeliness	T-2
Length of time series	5-10y
Comparability over time	>5 data points w/o break
Accessibility	most FAIR
Used elsewhere	UN SDG 7.2.1
Link used elsewhere	https://unstats.un.org/sdgs/report/2019/goal-07/

Cascading factor of wood resources

Publication year	2021
Indicator id	3.1.c.1
Objective id	3
Objective name	Reducing dependence on non-renewable unsustainable resources, whether sourced domestically or from abroad
Normative criterion id	3.1
Normative criterion name	Resource efficiency, waste prevention and waste-re-use along the whole bioeconomy value chain is improved
Key component id	3.1.c
Key component name	Biogenic waste prevention, re-use/recycling, and recovery
SDGs	GOAL 12: Responsible Consumption and Production, GOAL 9: Industry, Innovation and Infrastructure
Green Deal priorities	2.1.2. Supplying clean, affordable and secure energy 2.1.3. Mobilising industry for a clean and circular economy 2.1.4. Building and renovating in an energy and resource efficient way
Description	(source: JRC) The cascading factor of wood represents multiple uses of woody biomass in different sectors, first as logs and then as industrial by-products or post-consumer recovered resources. The more often by-products and recycled woody biomass are used, the higher the cascade factor. When only primary wood is used, the cascade factor is equal to 1.0. It is evaluated as "total cascade factor" according to the formula defined in Mantau (2015). Data for the calculations are derived by the Joint Forest Sector Questionnaire, Eurostat, the Joint Wood Energy Enquiry, the National Renewable Energy Action Plan Progress reports of Member States. The factors are consistent with the Wood Resource Balances (WRB) published by JRC (Cazzaniga et al., 2019). The roundwood sources are estimated by JRC considering the total uses of WRB: a minimum value including all the known used primary wood, and a maximum value including also the uncategorized woody biomass used for energy, when present in the WRB, as described in Jonsson et al 2021. These two estimated values give respectively the maximum and minimum value of the cascading factor.
References	Mantau, U. (2015). Wood flow analysis: Quantification of resource potentials, cascades and carbon effects. Biomass and Bioenergy, 79, 28–38; Cazzaniga, N., Jonsson, K., Pilli, R. and Camia, A., Wood resource balances of EU-28 and Member States, Publications Office of the European Union, Luxembourg, 2019, doi:10.2760/020267; Jonsson, K., Cazzaniga, N., Camia, A. and Mubareka, S., Analysis of wood resource balance gaps for the EU, EUR 30393 EN, Publications Office of the European Union, Luxembourg, 2021. doi:10.2760/417678.
Unit	factor
Unit's description	n/a
Intensive/extensive	intensive
Directionality	pos
Source	JRC_BIOMASS
Link	DBForest
Geographic coverage	AllMS

Frequency	annual
Timeliness	>T-3
Length of time series	5-10y
Comparability over time	>5 data points w/o break
Accessibility	unFAIR
Used elsewhere	n/a
Link used elsewhere	n/a

Circular material rate

Publication year	2020
Indicator id	3.1.c.2
Objective id	3
Objective name	Reducing dependence on non-renewable unsustainable resources, whether sourced domestically or from abroad
Normative criterion id	3.1
Normative criterion name	Resource efficiency, waste prevention and waste-re-use along the whole bioeconomy value chain is improved
Key component id	3.1.c
Key component name	Biogenic waste prevention, re-use/recycling, and recovery
SDGs	GOAL 12: Responsible Consumption and Production, GOAL 9: Industry, Innovation and Infrastructure
Green Deal priorities	2.1.2. Supplying clean, affordable and secure energy 2.1.3. Mobilising industry for a clean and circular economy 2.1.4. Building and renovating in an energy and resource efficient way
Description	<p>(source: Eurostat) The indicator measures the share of material recovered and fed back into the economy – thus saving extraction of primary raw materials – in overall material use. The circular material use, also known as circularity rate is defined as the ratio of the circular use of materials to the overall material use. The overall material use is measured by summing up the aggregate domestic material consumption (DMC) and the circular use of materials. DMC is defined in economy-wide material flow accounts. The circular use of materials is approximated by the amount of waste recycled in domestic recovery plants minus imported waste destined for recovery plus exported waste destined for recovery abroad. Waste recycled in domestic recovery plants comprises the recovery operations R2 to R11 – as defined in the Waste Framework Directive 75/442/EEC. The imports and exports of waste destined for recycling – i.e. the amount of imported and exported waste bound for recovery are approximated from the European statistics on international trade in goods. A higher circularity rate value indicates means that more secondary materials substitute for primary raw materials thus reducing the environmental impacts of extracting primary material.</p>
References	n/a
Unit	%
Unit's description	n/a
Intensive/extensive	intensive
Directionality	pos
Source	Eurostat
Link	https://ec.europa.eu/eurostat/databrowser/view/cei_srm030/default/table?lang=en
Geographic coverage	AllMS
Frequency	annual
Timeliness	T-2

Length of time series	5-10y
Comparability over time	>5 data points w/o break
Accessibility	most FAIR
Used elsewhere	sdg_12_41
Link used elsewhere	https://ec.europa.eu/eurostat/cache/metadata/EN/sdg_12_41_esmsip2.htm

Recycling rate of municipal waste

Publication year	2021
Indicator id	3.1.c.4
Objective id	3
Objective name	Reducing dependence on non-renewable unsustainable resources, whether sourced domestically or from abroad
Normative criterion id	3.1
Normative criterion name	Resource efficiency, waste prevention and waste-re-use along the whole bioeconomy value chain is improved
Key component id	3.1.c
Key component name	Biogenic waste prevention, re-use/recycling, and recovery
SDGs	GOAL 12: Responsible Consumption and Production, GOAL 9: Industry, Innovation and Infrastructure
Green Deal priorities	2.1.3. Mobilising industry for a clean and circular economy
Description	(source: Eurostat) The share of recycled municipal waste in the total municipal waste generation
References	n/a
Unit	%
Unit's description	n/a
Intensive/extensive	intensive
Directionality	pos
Source	ESTAT
Link	https://ec.europa.eu/eurostat/databrowser/view/t2020_rt120/default/table?lang=en
Geographic coverage	75-99%MS
Frequency	annual
Timeliness	T-2
Length of time series	>10y
Comparability over time	>5 data points w/o break
Accessibility	most FAIR
Used elsewhere	ESTAT - Circular Economy
Link used elsewhere	https://ec.europa.eu/eurostat/web/circular-economy/indicators/monitoring-framework

Biowaste generated by source

Publication year	2021
Indicator id	3.1.c.5
Objective id	3
Objective name	Reducing dependence on non-renewable unsustainable resources, whether sourced domestically or from abroad
Normative criterion id	3.1
Normative criterion name	Resource efficiency, waste prevention and waste-re-use along the whole bioeconomy value chain is improved
Key component id	3.1.c
Key component name	Biogenic waste prevention, re-use/recycling, and recovery
SDGs	GOAL 12: Responsible Consumption and Production
Green Deal priorities	2.1.3. Mobilising industry for a clean and circular economy
Description	(source: JRC) Biowaste generated by households and industry. Data on waste generation is collected from EU MS in Waste Statistics Regulation framework and published by Eurostat. This data includes a mix of organic and inorganic wastes generated from various economic activities (including households). JRC has developed a methodology to differentiate the biodegradable component in the different waste categories using empirical evidence. Statistics on waste generation are provided through a matrix which consists of different waste categories and the activities/source of the waste generation. Relevant data on waste categories that contain biodegradable matter and the source of waste generation (NACE activities) were chosen and are reported in the following sections. The calculations were done for agricultural and industrial biowaste and household biowaste. More detailed indicators on food waste are shown in indicators "Food waste along supply chain - mass balance approach"; and "Food waste by food category - mass balance approach".
References	n/a
Unit	kT wet mass, kT dry mass
Unit's description	per waste type
Intensive/extensive	extensive
Directionality	neg
Source	JRC_BIOMASS
Link	https://github.com/xapple/waste_flow/
Geographic coverage	AllMS
Frequency	biennial
Timeliness	>T-3
Length of time series	>10y
Comparability over time	>5 data points w/o break
Accessibility	most FAIR
Used elsewhere	n/a

Biowaste recovered by source

Publication year	2021
Indicator id	3.1.c.6
Objective id	3
Objective name	Reducing dependence on non-renewable unsustainable resources, whether sourced domestically or from abroad
Normative criterion id	3.1
Normative criterion name	Resource efficiency, waste prevention and waste-re-use along the whole bioeconomy value chain is improved
Key component id	3.1.c
Key component name	Biogenic waste prevention, re-use/recycling, and recovery
SDGs	GOAL 12: Responsible Consumption and Production
Green Deal priorities	2.1.3. Mobilising industry for a clean and circular economy
Description	(source: JRC) Biowaste recovered from household and industrial biowaste. The amount of each type of biowaste differentiated by waste treatment option is provided in the Eurostat database [env_wastrt].Based on the values reported, coefficients expressing the share of waste going to each destination were determined. The coefficients were then multiplied by the amount of the respective stream of biowaste.
References	n/a
Unit	kT wet mass (per waste source)
Unit's description	n/a
Intensive/extensive	extensive
Directionality	pos
Source	JRC_BIOMASS
Link	https://github.com/xapple/waste_flow/
Geographic coverage	ALLMS
Frequency	biennial
Timeliness	>T-3
Length of time series	>10y
Comparability over time	>5 data points w/o break
Accessibility	most FAIR
Used elsewhere	n/a
Link used elsewhere	n/a

Food waste along supply chain - mass balance approach

Publication year	2021
Indicator id	3.2.a.1
Objective id	3
Objective name	Reducing dependence on non-renewable unsustainable resources, whether sourced domestically or from abroad
Normative criterion id	3.2
Normative criterion name	Food loss and waste is minimised and, when unavoidable, its biomass is reused or recycled
Key component id	3.2.a
Key component name	Food loss and waste minimization
SDGs	GOAL 12: Responsible Consumption and Production
Green Deal priorities	2.1.3. Mobilising industry for a clean and circular economy 2.1.6. From 'Farm to Fork': designing a fair, healthy and environmentally-friendly food system
Description	(source: JRC) Food waste generated per year in EU MS by stage of the food supply chain. The model was developed in the JRC and provides results for the years 2000 – 2017 for EU27 MS.
References	De Laurentiis, V., Caldeira, C., Sala, S., Building a balancing system for food waste accounting at National Level, EUR 30685 EN, Publications Office of the European Union, Luxembourg, 2021, ISBN 978-92-76-37275-2, doi:10.2760/316306
Unit	Ktoe
Unit's description	n/a
Intensive/extensive	extensive
Directionality	neg
Source	JRC
Link	manually retrieved from JRC.D3
Geographic coverage	AllMS
Frequency	annual
Timeliness	>T-3
Length of time series	1y
Comparability over time	no data points w/o break
Accessibility	n/a
Used elsewhere	will be soon used by ESTAT for Waste Framework Directive (2008/98/EC)
Link used elsewhere	n/a

Food waste by food category - mass balance approach

Publication year	2021
Indicator id	3.2.a.2
Objective id	3
Objective name	Reducing dependence on non-renewable unsustainable resources, whether sourced domestically or from abroad
Normative criterion id	3.2
Normative criterion name	Food loss and waste is minimised and, when unavoidable, its biomass is reused or recycled
Key component id	3.2.a
Key component name	Food loss and waste minimization
SDGs	GOAL 12: Responsible Consumption and Production
Green Deal priorities	2.1.3. Mobilising industry for a clean and circular economy 2.1.6. From 'Farm to Fork': designing a fair, healthy and environmentally-friendly food system
Description	(source: JRC) Food waste generated per year in EU MS by food type category. The model was developed in the JRC and provides results for the years 2000 – 2017 for EU27 MS.
References	De Laurentiis, V., Caldeira, C., Sala, S., Building a balancing system for food waste accounting at National Level, EUR 30685 EN, Publications Office of the European Union, Luxembourg, 2021, ISBN 978-92-76-37275-2, doi:10.2760/316306
Unit	Ktoe
Unit's description	n/a
Intensive/extensive	extensive
Directionality	neg
Source	JRC
Link	manually retrieved from JRC.D4
Geographic coverage	AllMS
Frequency	annual
Timeliness	>T-4
Length of time series	1y
Comparability over time	no data points w/o break
Accessibility	n/a
Used elsewhere	will be soon used by ESTAT for Waste Framework Directive (2008/98/EC)
Link used elsewhere	n/a

Total biomass consumed for energy

Publication year	2020
Indicator id	3.4.a.2
Objective id	3
Objective name	Reducing dependence on non-renewable unsustainable resources, whether sourced domestically or from abroad
Normative criterion id	3.4
Normative criterion name	Consumption patterns of bioeconomy goods match sustainable supply levels of biomass
Key component id	3.4.a
Key component name	Consumption and demand for biomass and bio-based products
SDGs	GOAL 7: Affordable and Clean Energy, GOAL 12: Responsible Consumption and Production
Green Deal priorities	2.1.2. Supplying clean, affordable and secure energy 2.1.3. Mobilising industry for a clean and circular economy
Description	(source: JRC-BIOMASS) The indicator shows the total biomass of agricultural and woody origin consumed annually in the production of energy.
References	Gurria Albusac, P., Gonzalez Hermoso, H., Ronzon, T., Tamosiunas, S., Lopez Lozano, R., Garcia Condado, S., Ronchetti, G., Guillen Garcia, J., Banja, M., Fiore, G. and M`barek, R., Biomass flows in the European Union, EUR 30454 EN, Publications Office of the European Union, Luxembourg, 2020, ISBN 978-92-76-25378-5, doi:10.2760/14342, JRC122379.
Unit	1000 tonnes dry matter
Unit's description	n/a
Intensive/extensive	extensive
Directionality	descriptive
Source	JRC EU BIOMASS FLOWS
Link	https://datam.jrc.ec.europa.eu/datam/mashup/BIOMASS_FLOWS
Geographic coverage	AllMS
Frequency	annual
Timeliness	>T-3
Length of time series	5-10y
Comparability over time	>5 data points w/o break
Accessibility	don't know
Used elsewhere	n/a
Link used elsewhere	n/a

Total biomass consumed for materials

Publication year	2020
Indicator id	3.4.a.3
Objective id	3
Objective name	Reducing dependence on non-renewable unsustainable resources, whether sourced domestically or from abroad
Normative criterion id	3.4
Normative criterion name	Consumption patterns of bioeconomy goods match sustainable supply levels of biomass
Key component id	3.4.a
Key component name	Consumption and demand for biomass and bio-based products
SDGs	GOAL 7: Affordable and Clean Energy, GOAL 12: Responsible Consumption and Production
Green Deal priorities	2.1.3. Mobilising industry for a clean and circular economy 2.1.1. Increasing the EU's climate ambition for 2030 and 2050
Description	(source: JRC-BIOMASS) The indicator shows the total biomass of agricultural and woody origin consumed annually in the production of materials.
References	Gurria Albusac, P., Gonzalez Hermoso, H., Ronzon, T., Tamosiunas, S., Lopez Lozano, R., Garcia Condado, S., Ronchetti, G., Guillen Garcia, J., Banja, M., Fiore, G. and M`barek, R., Biomass flows in the European Union, EUR 30454 EN, Publications Office of the European Union, Luxembourg, 2020, ISBN 978-92-76-25378-5, doi:10.2760/14342, JRC122379.
Unit	1000 tonnes dry matter
Unit's description	n/a
Intensive/extensive	extensive
Directionality	descriptive
Source	JRC EU BIOMASS FLOWS
Link	https://datam.jrc.ec.europa.eu/datam/mashup/BIOMASS_FLOWS
Geographic coverage	AllMS
Frequency	annual
Timeliness	>T-3
Length of time series	5-10y
Comparability over time	>5 data points w/o break
Accessibility	don't know
Used elsewhere	n/a
Link used elsewhere	n/a

Share of woody biomass used for energy

Publication year	2021
Indicator id	3.4.a.4
Objective id	3
Objective name	Reducing dependence on non-renewable unsustainable resources, whether sourced domestically or from abroad
Normative criterion id	3.4
Normative criterion name	Consumption patterns of bioeconomy goods match sustainable supply levels of biomass
Key component id	3.4.a
Key component name	Consumption and demand for biomass and bio-based products
SDGs	GOAL 7: Affordable and Clean Energy, GOAL 12: Responsible Consumption and Production
Green Deal priorities	2.1.2. Supplying clean, affordable and secure energy 2.1.3. Mobilising industry for a clean and circular economy
Description	(source: JRC-BIOMASS) The indicator shows the total biomass of agricultural and woody origin consumed annually in the production of energy.
References	n/a
Unit	%
Unit's description	n/a
Intensive/extensive	intensive
Directionality	descriptive
Source	JRC_BIOMASS
Link	DBForest
Geographic coverage	ALLMS
Frequency	annual
Timeliness	>T-3
Length of time series	5-10y
Comparability over time	>5 data points w/o break
Accessibility	don't know
Used elsewhere	KCB
Link used elsewhere	https://ec.europa.eu/jrc/en/publication/sankey-diagrams-woody-biomass-flows-eu-28

Share of renewables for transport, electricity and heating & cooling

Publication year	2021
Indicator id	3.4.c.1
Objective id	3
Objective name	Reducing dependence on non-renewable unsustainable resources, whether sourced domestically or from abroad
Normative criterion id	3.4
Normative criterion name	Consumption patterns of bioeconomy goods match sustainable supply levels of biomass
Key component id	3.4.c
Key component name	Reduced dependence on non-renewable resources
SDGs	GOAL 7: Affordable and Clean Energy, GOAL 12: Responsible Consumption and Production, GOAL 9: Industry, Innovation and Infrastructure
Green Deal priorities	2.1.2. Supplying clean, affordable and secure energy 2.1.3. Mobilising industry for a clean and circular economy 2.1.5. Accelerating the shift to sustainable and smart mobility
Description	(source: Eurostat) This indicator is based on data collected by Eurostat in the framework of Regulation (EC) No 1099/2008 on energy statistics and complemented by specific supplementary data transmitted by national administrations to Eurostat. More detailed information is available at https://ec.europa.eu/eurostat/cache/metadata/en/nrg_ind_share_esms.htm
References	n/a
Unit	%
Unit's description	n/a
Intensive/extensive	intensive
Directionality	pos
Source	ESTAT
Link	https://ec.europa.eu/eurostat/databrowser/view/NRG_IND_REN_custom_1260675/default/table?lang=en
Geographic coverage	ALLMS
Frequency	annual
Timeliness	T-2
Length of time series	>10y
Comparability over time	>5 data points w/o break
Accessibility	not very FAIR
Used elsewhere	RED
Link used elsewhere	https://ec.europa.eu/energy/topics/renewable-energy_en

Net GHG emissions (emissions and removals) from agriculture

Publication year	2020
Indicator id	4.1.a.3
Objective id	4
Objective name	Mitigating and adapting to climate change
Normative criterion id	4.1
Normative criterion name	Climate change mitigation and adaptation are pursued
Key component id	4.1.a
Key component name	Climate change mitigation
SDGs	GOAL 13: Climate Action
Green Deal priorities	2.1.1. Increasing the EU's climate ambition for 2030 and 2050 2.1.6. From 'Farm to Fork': designing a fair, healthy and environmentally-friendly food system
Description	(source: Eurostat) Agriculture emissions (mostly methane CH ₄ and nitrous oxide N ₂ O) are mainly related to the management of agricultural soils (e.g. fertiliser and lime application), enteric fermentation by ruminant animals and manure management and , to a lesser extent, to rice cultivation and crop residue burning.
References	n/a
Unit	tCO ₂ e
Unit's description	n/a
Intensive/extensive	extensive
Directionality	neg
Source	ESTAT
Link	https://ec.europa.eu/eurostat/databrowser/view/tai08/default/table?lang=en
Geographic coverage	AllMS
Frequency	annual
Timeliness	T-2
Length of time series	>10y
Comparability over time	>5 data points w/o break
Accessibility	most FAIR
Used elsewhere	n/a
Link used elsewhere	n/a

Net GHG emissions (emissions and removals) from LULUCF

Publication year	2020
Indicator id	4.1.a.6
Objective id	4
Objective name	Mitigating and adapting to climate change
Normative criterion id	4.1
Normative criterion name	Climate change mitigation and adaptation are pursued
Key component id	4.1.a
Key component name	Climate change mitigation
SDGs	GOAL 13: Climate Action
Green Deal priorities	2.1.1. Increasing the EU's climate ambition for 2030 and 2050 2.1.2. Supplying clean, affordable and secure energy 2.1.4. Building and renovating in an energy and resource efficient way
Description	(source: Eurostat) LULUCF covers emissions and removals (mainly CO ₂) in "managed lands" (forest land, cropland, grassland, wetlands, settlements, other lands) from the following pools: Living biomass (above and below-ground values); Dead organic matter (deadwood and litter); Soil organic carbon (mineral and organic). Harvested wood products such as timber used in construction or furniture are reported as an additional pool.
References	n/a
Unit	1000 tCO ₂ e
Unit's description	n/a
Intensive/extensive	extensive
Directionality	neg
Source	ESTAT
Link	https://appsso.eurostat.ec.europa.eu/nui/show.do?query=BOOKMARK_DS-089165_QID_31E68B61_UID_-3F171EB0&layout=TIME.C.X.O:GEO.L.Y.O:UNIT.L.Z.O:AIRPOL.L.Z.1:SRC_CRF.L.Z.2:INDICAT.ORS.C.Z.3:&zSelection=DS-089165UNIT.THS_T:DS-089165AIRPOL.GHG:DS-089165SRC_CRF.CRF4:DS-089165INDICATORS.OBS_FLAG:&rankName1=SRC-CRF_1_2_-1_2&rankName2=UNIT_1_2_-1_2&rankName3=AIRPOL_1_2_-1_2&rankName4=INDICATORS_1_2_-1_2&rankName5=TIME_1_0_0_0&rankName6=GEO_1_2_0_1&sortC=ASC_-1_FIRST&rStp=&cStp=&rDCh=&cDCh=&rDM=true&cDM=true&footnes=false&empty=false&wai=false&time_mode=NONE&time_most_recent=false&lang=EN&cfo=%23%23%23%2C%23%23%23%23%23%23%23%23
Geographic coverage	AllMS
Frequency	annual
Timeliness	T-2
Length of time series	>10y
Comparability over time	>5 data points w/o break

Accessibility	most FAIR
Used elsewhere	eea
Link used elsewhere	https://www.eea.europa.eu/publications/european-union-greenhouse-gas-inventory-2019

Crop yield (3 main crops)

Publication year	2021
Indicator id	4.1.b.2
Objective id	4
Objective name	Mitigating and adapting to climate change
Normative criterion id	4.1
Normative criterion name	Climate change mitigation and adaptation are pursued
Key component id	4.1.b
Key component name	Climate change adaptation
SDGs	GOAL 2: Zero Hunger, GOAL 13: Climate Action
Green Deal priorities	2.1.1. Increasing the EU's climate ambition for 2030 and 2050 2.1.6. From 'Farm to Fork': designing a fair, healthy and environmentally-friendly food system
Description	(source: Eurostat) Climate change can measurably affect crop productivity, food security and agriculture competitiveness. Annual productivity (tonnes/ha yr) of three crops that are sensitive to climate change: Winter wheat, summer wheat and corn.
References	n/a
Unit	tonne/ha
Unit's description	n/a
Intensive/extensive	intensive
Directionality	pos
Source	ESTAT
Link	https://appsso.eurostat.ec.europa.eu/nui/show.do?query=BOOKMARK_DS-905455_QID_-9F26998_UID_-3F171EB0&layout=STRUCPRO.L.X.0:TIME.C.X.1:CROPS.L.Y.0:GEO.L.Y.1:INDICATORS.C.Z.0:&zSelection=DS-905455CROPS.C0000:DS-905455INDICATORS.OBS_FLAG:&rankName1=INDICATORS_1_2_-1_2&rankName2=STRUCPRO_1_2_0_0&rankName3=TIME_1_0_1_0&rankName4=CROPS_1_2_0_1&rankName5=GEO_1_2_1_1&rStp=&cStp=&rDCh=&cDCh=&rDM=true&cDM=true&footnes=false&empty=false&wai=false&time_mode=ROLLING&time_most_recent=true&lang=EN&cfo=%23%23%23%2C%23%23%23%23%23%23%23%23
Geographic coverage	AllMS
Frequency	annual
Timeliness	T-1
Length of time series	5-10y
Comparability over time	>5 data points w/o break
Accessibility	most FAIR
Used elsewhere	n/a
Link used elsewhere	n/a

Water exploitation index (WEI)

Publication year	2021
Indicator id	4.1.b.3
Objective id	4
Objective name	Mitigating and adapting to climate change
Normative criterion id	4.1
Normative criterion name	Climate change mitigation and adaptation are pursued
Key component id	4.1.b
Key component name	Climate change adaptation
SDGs	GOAL 6: Clean Water and Sanitation, GOAL 13: Climate Action
Green Deal priorities	2.1.1. Increasing the EU's climate ambition for 2030 and 2050 2.1.7. Preserving and restoring ecosystems and biodiversity
Description	(source: Eurostat) Climate change can lead to longer and more frequent droughts across the EU, affecting both the demand and availability of water for, e.g., agriculture irrigation. Annual total water use – i.e., the difference between water abstraction and return after use – can be expressed as a percentage of the available renewable freshwater resources (groundwater and surface water) at given time. The higher the percentage, the higher pressure on renewable water resources due to water demand and the more vulnerable the system is. On average, values above 20% indicate situations of water scarcity, while values above 40% point to severe water scarcity and unsustainable use of water resources.
References	n/a
Unit	%
Unit's description	n/a
Intensive/extensive	intensive
Directionality	neg
Source	ESTAT
Link	http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=sdg_06_60&lang=en
Geographic coverage	ALLMS
Frequency	annual
Timeliness	T-3
Length of time series	>10y
Comparability over time	>5 data points w/o break
Accessibility	most FAIR
Used elsewhere	n/a
Link used elsewhere	n/a

Value Added per sector / Bioeconomy value added

Publication year	2021
Indicator id	5.1.a.2
Objective id	5
Objective name	Strengthening European competitiveness and creating jobs
Normative criterion id	5.1
Normative criterion name	Economic development is fostered
Key component id	5.1.a
Key component name	Contribution of bioeconomy to economic development
SDGs	GOAL 8: Decent Work and Economic Growth, GOAL 9: Industry, Innovation and Infrastructure
Green Deal priorities	2.1.3. Mobilising industry for a clean and circular economy 2.1.6. From 'Farm to Fork': designing a fair, healthy and environmentally-friendly food system
Description	(source: DataM) The ratio of the value added of a sector on the total bioeconomy value added reflects the contribution of that sector to bioeconomy wealth generation. Value added refers to the value added at factor costs. It is the gross income from operating activities after adjusting for operating subsidies and indirect taxes. Value adjustments (such as depreciation) are not subtracted.
References	n/a
Unit	%
Unit's description	n/a
Intensive/extensive	intensive
Directionality	pos
Source	DataM
Link	https://datam.jrc.ec.europa.eu/datam/mashup/BIOECONOMICS
Geographic coverage	AllMS
Frequency	annual
Timeliness	T-3
Length of time series	5-10y
Comparability over time	>5 data points w/o break
Accessibility	most FAIR
Used elsewhere	n/a
Link used elsewhere	n/a

Gross value added per person employed in bioeconomy

Publication year	2021
Indicator id	5.1.a.5
Objective id	5
Objective name	Strengthening European competitiveness and creating jobs
Normative criterion id	5.1
Normative criterion name	Economic development is fostered
Key component id	5.1.a
Key component name	Contribution of bioeconomy to economic development
SDGs	GOAL 8: Decent Work and Economic Growth, GOAL 9: Industry, Innovation and Infrastructure
Green Deal priorities	2.1.3. Mobilising industry for a clean and circular economy 2.1.6. From 'Farm to Fork': designing a fair, healthy and environmentally-friendly food system
Description	The value added at factor costs divided by the number of persons employed in a given sector measures the "Apparent labour productivity" of that sector.
References	n/a
Unit	1000 EUR per worker
Unit's description	n/a
Intensive/extensive	intensive
Directionality	pos
Source	DataM
Link	https://datam.jrc.ec.europa.eu/datam/mashup/BIOECONOMICS
Geographic coverage	AllMS
Frequency	annual
Timeliness	T-3
Length of time series	5-10y
Comparability over time	>5 data points w/o break
Accessibility	most FAIR
Used elsewhere	n/a
Link used elsewhere	n/a

Turnover in bioeconomy per sector

Publication year	2021
Indicator id	5.1.b.1
Objective id	5
Objective name	Strengthening European competitiveness and creating jobs
Normative criterion id	5.1
Normative criterion name	Economic development is fostered
Key component id	5.1.b
Key component name	Value of raw and processed biomass, value added in bioeconomy sectors
SDGs	GOAL 8: Decent Work and Economic Growth, GOAL 9: Industry, Innovation and Infrastructure
Green Deal priorities	2.1.3. Mobilising industry for a clean and circular economy 2.1.6. From 'Farm to Fork': designing a fair, healthy and environmentally-friendly food system
Description	(source: DataM) Turnover comprises the totals invoiced by the observation unit during the reference period, and this corresponds to market sales of goods or services supplied to third parties.
References	n/a
Unit	Million EUR
Unit's description	n/a
Intensive/extensive	extensive
Directionality	pos
Source	DataM, JRC.D2 for algae
Link	https://datam.jrc.ec.europa.eu/datam/mashup/BIOECONOMICS
Geographic coverage	AllMS
Frequency	annual
Timeliness	T-3
Length of time series	5-10y
Comparability over time	>5 data points w/o break
Accessibility	most FAIR
Used elsewhere	EU Bioeconomy strategy
Link used elsewhere	https://ec.europa.eu/research/bioeconomy/pdf/ec_bioeconomy_strategy_2018.pdf#view=fit&pagemode=none

Value-added per sector

Publication year	2020
Indicator id	5.1.b.2
Objective id	5
Objective name	Strengthening European competitiveness and creating jobs
Normative criterion id	5.1
Normative criterion name	Economic development is fostered
Key component id	5.1.b
Key component name	Value of raw and processed biomass, value added in bioeconomy sectors
SDGs	GOAL 8: Decent Work and Economic Growth, GOAL 9: Industry, Innovation and Infrastructure
Green Deal priorities	2.1.3. Mobilising industry for a clean and circular economy 2.1.6. From 'Farm to Fork': designing a fair, healthy and environmentally-friendly food system
Description	(source: DataM) Value added refers to the value added at factor costs. It is the gross income from operating activities after adjusting for operating subsidies and indirect taxes. Value adjustments (such as depreciation) are not subtracted.
References	Ronzon, T., Piotrowski, S., Tamosiunas, S., Dammer, L., Carus, M., M'barek, R., 2020. Developments of economic growth and employment in bioeconomy sectors across the eu. Sustainability 12, 4507. 10.3390/su12114507. (https://www.mdpi.com/2071-1050/12/11/4507)
Unit	Million EUR
Unit's description	n/a
Intensive/extensive	extensive
Directionality	pos
Source	DataM
Link	https://datam.jrc.ec.europa.eu/datam/mashup/BIOECONOMICS/index.html
Geographic coverage	AllMS
Frequency	annual
Timeliness	T-3
Length of time series	5-10y
Comparability over time	>5 data points w/o break
Accessibility	most FAIR
Used elsewhere	Action plan of the EU Bioeconomy strategy
Link used elsewhere	https://ec.europa.eu/research/bioeconomy/pdf/ec_bioeconomy_strategy_2018.pdf#view=fit&pagemode=none

Persons employed per bioeconomy sectors

Publication year	2020
Indicator id	5.2.a.1
Objective id	5
Objective name	Strengthening European competitiveness and creating jobs
Normative criterion id	5.2
Normative criterion name	Inclusive economic growth is strengthened
Key component id	5.2.a
Key component name	Employment in bioeconomy
SDGs	GOAL 8: Decent Work and Economic Growth, GOAL 9: Industry, Innovation and Infrastructure
Green Deal priorities	2.1.3. Mobilising industry for a clean and circular economy 2.1.6. From 'Farm to Fork': designing a fair, healthy and environmentally-friendly food system
Description	(source: DataM) The number of persons employed is defined as the total number of persons who work in the observation unit, as well as persons who work outside the unit who belong to it and are paid by it. For Algae: Data collected and curated by JRC.D2 Water and Marine Resources. Note that the employment data under fishing and aquaculture includes also algae gathering
References	Ronzon, T., Piotrowski, S., Tamosiunas, S., Dammer, L., Carus, M., M'barek, R., 2020. Developments of economic growth and employment in bioeconomy sectors across the eu. Sustainability 12, 4507. 10.3390/su12114507. (https://www.mdpi.com/2071-1050/12/11/4507)
Unit	person
Unit's description	n/a
Intensive/extensive	extensive
Directionality	pos
Source	DataM, JRC.D2 for algae
Link	https://datam.jrc.ec.europa.eu/datam/mashup/BIOECONOMICS/index.html
Geographic coverage	AllMS
Frequency	annual
Timeliness	T-3
Length of time series	5-10y
Comparability over time	3-5 data points w/o break
Accessibility	most FAIR
Used elsewhere	n/a
Link used elsewhere	Action plan of the EU Bioeconomy strategy

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