European Commission

The European Commission's Knowledge Centre for Bioeconomy

Report on the Community of Practice Workshop:

Shaping the EU Bioeconomy Monitoring System: a first discussion on indicators to include

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The workshop took place on the 18 June 2019
Venue: Joint Research Centre
Visitors' Centre– Athena/Hermes
Via Enrico Fermi 2749
21027 Ispra (VA), Italy

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JRC Science Hub
https://ec.europa.eu/jrc

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Background & objectives of the workshop

The updated EU Bioeconomy Strategy puts forward an action plan to drive a sustainable and circular bioeconomy that serves Europe's society, environment and economy. Within this plan, the European Commission commits to build an EU-wide, internationally coherent, monitoring system to track economic, environmental and social progress towards a sustainable bioeconomy.

The JRC is leading this action. A first workshop of the Community of Practice on Bioeconomy on this topic was held in Brussels in November 2018[1]. Entitled "Setting the scene for monitoring the economic, environmental and social progress of the EU Bioeconomy", it looked into existing monitoring approaches for the bioeconomy or related fields. In that event, experts illustrated the methodological background and progress achieved on various monitoring systems across the EU and shared lessons learnt and ideas for possible synergies in view of the EU's Bioeconomy Monitoring System. In this sequel event, the Community and invited experts have come together to discuss the methodological framework proposed by the JRC for the EU Bioeconomy Monitoring System as well as to discuss progress on the initial choice of specific indicators. Furthermore, the workshop provided an opportunity to learn from experts about tools and approaches to move beyond individual sector-specific indicators and for deriving indicators to monitor overall progress towards a sustainable and circular bioeconomy.

The workshop aimed to:

- Assess a first list of basic indicators with respect to their robustness and relevance to bioeconomy and to targets of Sustainable Development Goals
- Identify and quantify gaps in the set of basic indicators
- Derive recommendations on aggregate and systems-level indicators to highlight potential trade-offs related to the EU Bioeconomy
- Create new and consolidate existing networks of experts working on topics related to monitoring of the bioeconomy

[1] https://ec.europa.eu/jrc/communities/en/community/cop-bioeconomy/discussion/outcomes-cop-workshop-setting-scene-monitoring-economic

Structure and set-up of the workshop

Following the welcome of participants by the Head of the JRC Bioeconomy Unit Elisabetta Balzi, the workshop structure was presented.

The workshop was divided into two main parts. In the first half of the day, JRC scientists presented the methodological background leading up to indicators for selected thematic areas. They also gained insights from the external experts participating at the workshop during interactive discussions around posters divided by thematic areas. The second half of the day was dedicated to shaping the monitoring framework's systems-level indicators. Initial results from a survey undertaken in April-May to gather stakeholders' expectations from a bioeconomy monitoring system were reported. Colleagues from different JRC teams shared their experience about measuring synergies and trade-offs within the different objectives of the EU Bioeconomy: harmonised socioeconomic indicators, footprint and Life Cycle Assessment, Natural Capital Accounting, whilst colleagues from the Competence Centre on Composite Indicators have contributed with their expertise in monitoring EU policies and programmes using composite indicators, leading to a final plenary discussion and the closing session.

The plenary session and the parallel poster sessions were organised in the spaces of the JRC Visitors' Centre (Figure 1) around 6 thematic areas, selected based on JRC internal expertise, with the aim of discussing with the workshop participants candidate indicators for the EU bioeconomy monitoring system basic layer (see Session 1) for each thematic area.

The aim of the poster session was to assess:

1) robustness, relevance and completeness of the set of basic indicators so far identified in the different areas.
2) whether or not the indicators are also able to measure specific SDG targets and if so, to what extent.

Figure 2 shows an example of the poster template.

The participants had received copies of the posters in advance, containing the identified indicators for each area. All the additional material needed for the workshop, together with relevant publications with background information (including publications from the Knowledge Centre for Bioeconomy and the JRC), were delivered to the participants during the day.

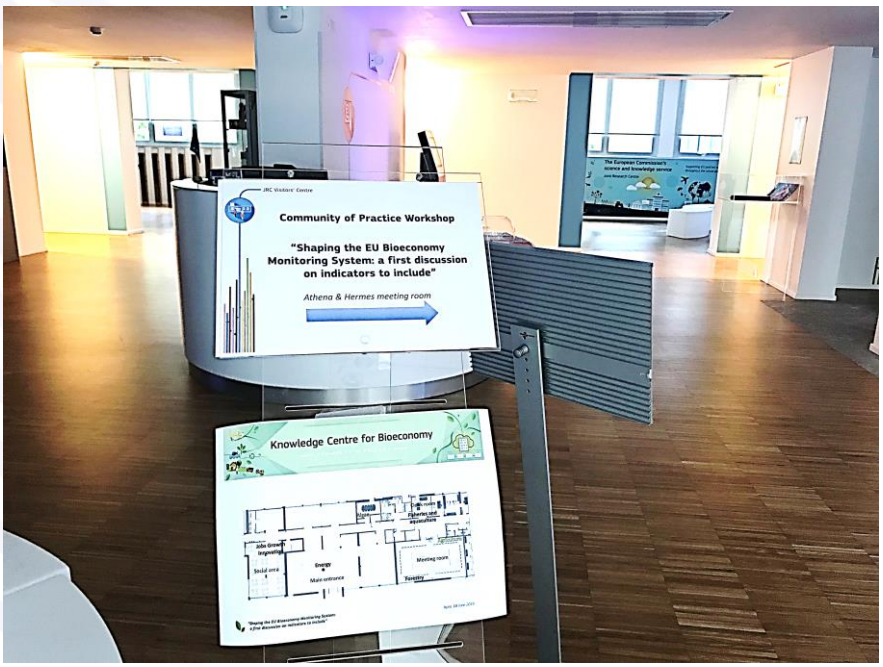


Figure 1: The workshop was organised at the JRC Visitors' Centre in Ispra

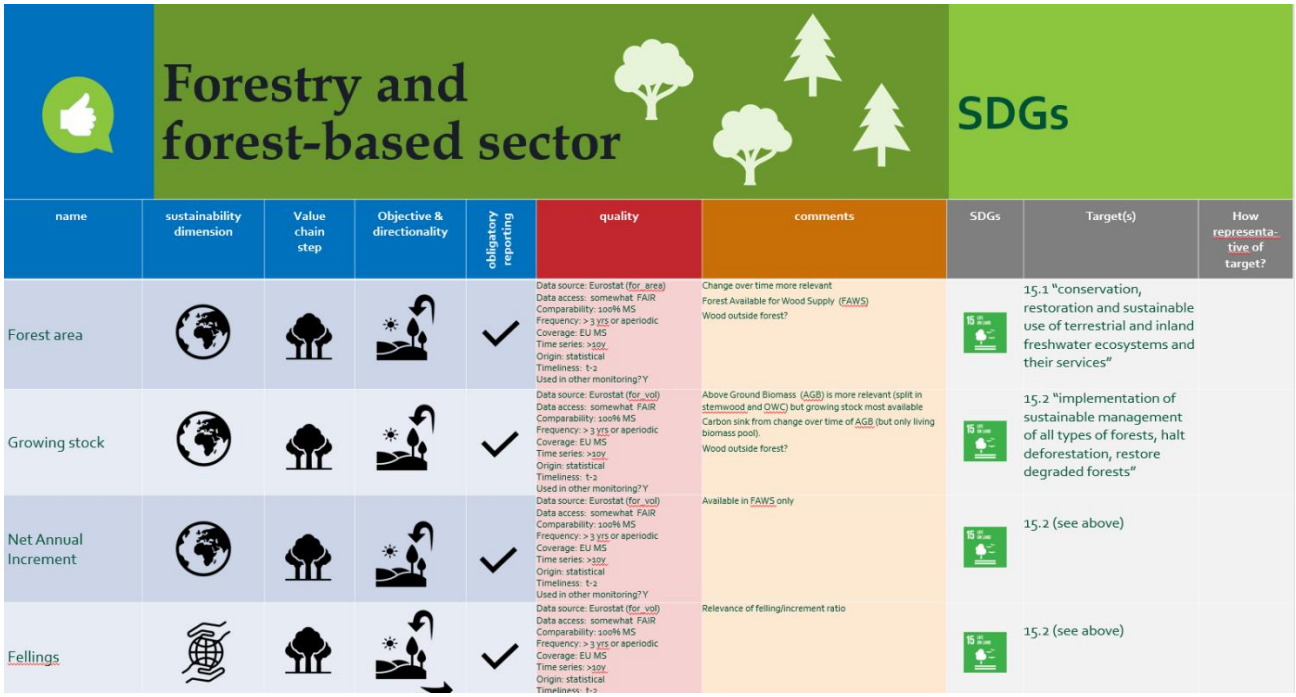


Figure 2: Poster structure: thematic area in title. Columns divided by name of the indicator, sustainability dimension, strategic objective and directionality[2], whether or not the indicator is used in obligatory reporting, quality of the indicator, comments from participants and relevance for Sustainable Development Goals and their targets

The participants were assigned to groups reflecting the different topics around the posters. The composition of the groups was arranged prior to the meeting day in order to ensure balanced expertise, both geographically and technically. Each poster discussion was managed by a presenter from the JRC, who explained the indicators and articulated the discussion while the secretariat took notes and minutes (Figure 3). The discussions were organised in a rotating configuration to allow the participants to give substantial feedback to their assigned group but also contribute to other topics of their interest (Figure 4).

Poster 1	**Presenter:** Jean Michel Terres - **Secretariat:** Javier Sanchez Lopez						
	AGRICULTURE	Santiago Guerrero	Katarzyna Biala	Stefania Bracco	Serenella Sala	Lina Mayorga	Paula Rendon Cardona
		OECD	*EEA*	*FAO*	*EC JRC*	*EC JRC*	*Leibniz Uni-Hannover*
Poster 2	**Presenter:** Andrea Camia - **Secretariat:** Nicolas Robert						
	FORESTRY	Annemarie Bastrup-Birk	Stephanie Linser	Giulia Fiorese	Alessandra La Notte	Sara Corrado	
		EEA	*EFI*	*EC JRC*	*EC JRC*	*EC JRC*	
Poster 3	**Presenter:** Claudia Bulgheroni - **Secretariat:** Jacopo Giuntoli						
	ENERGY	Uwe Fritsche	Moritz Wagner	Luisa Marelli	Marco Follador	Marco Colangeli	
		IINAS	*Hohenheim*	*EC JRC*	*EC JRC*	*FAO*	
Poster 4	**Presenter:** Gianluca Fiore - **Secretariat:** Sarah Mubareka						
	FISHERIES & AQUACULTURE	Lisa Waselikowski	Markus Lier	Jordi Guillen	Ernesto Jardim	Domenico Pisani	
		EC ESTAT	*LUKE*	*EC JRC*	*EC JRC*	*EC JRC*	
Poster 5	**Presenter:** Rita Araujo - **Secretariat:** Maria Lusser						
	ALGAE	Justus Wesseler	Vincent Egenolf	Orlaith Ni Chonchubair	Daniela Buscaglia	Joachim Kreysa	
		WUR Wageningen	*CESR Kassel*	*EC RTD*	*EC JRC*	*EC JRC*	
Poster 6	**Presenter:** Tevecia Ronzon - **Secretariat:** Maria Teresa Borzacchiello						
	JOBS, GROWTH AND INNOVATION	Stephan Piotrowski	Pilar Llorente	Elisabetta Balzi	William Becker	Robert M'Barek	Daniela Carosi
		NOVA	*BBI-JU*	*EC JRC*	*EC JRC*	*EC JRC*	*MISE, Italy*

Figure 3: Poster session topics and assignments for the first round

[2] "Directionality" refers to the positive or negative correlation between the indicator's value and the strategic objective

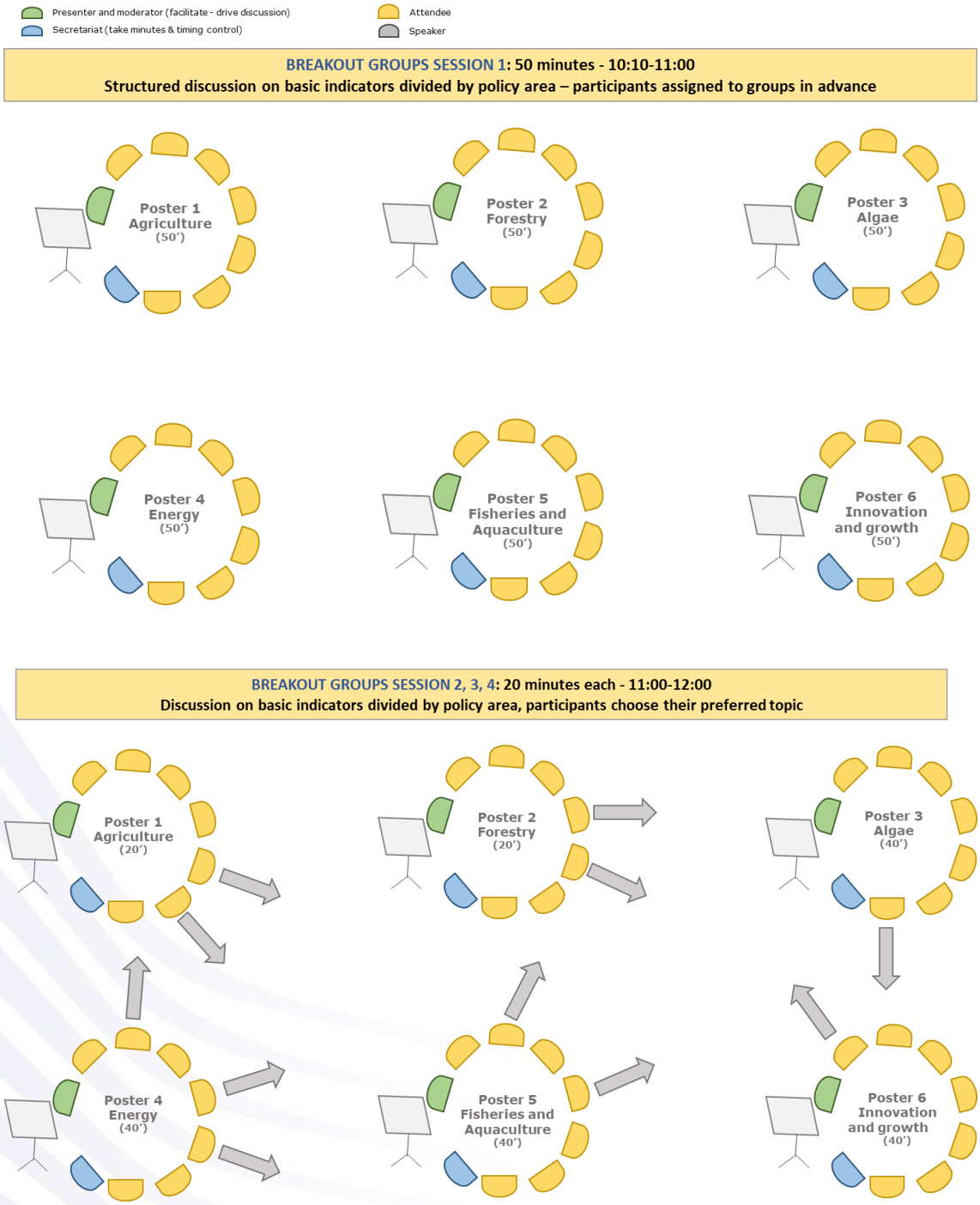


Figure 4: Breakout group discussions configuration: in the first session (first 50' discussion period) participants contributed to the topic of the assigned poster; in the following 20-minute sessions, participants moved freely to discuss the content of other posters

The specific inputs of the groups to each topic was noted down by the moderator and/or the participants and posted on the walls where the posters were displayed (Figure 5).

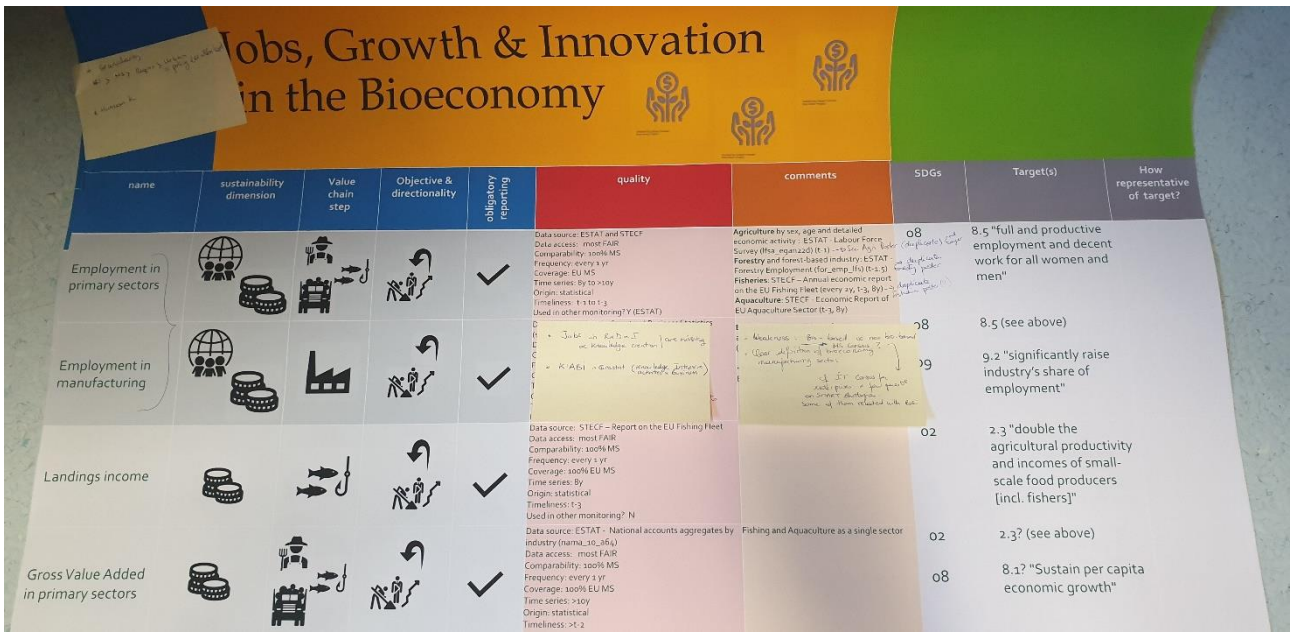


Figure 5: Sample of the input compiled from one of the poster discussions.

The plenary sessions of the workshop were also web-streamed within the Commission's internal network allowing various colleagues from the Community of Practice of Bioeconomy to follow the event remotely.

Session 1 Introduction and presentations about basic indicators

Elisabetta Balzi (Head of EC JRC Bioeconomy Unit) welcomed the participants, explaining the aims of the workshop in the context of the European Bioeconomy Strategy and global sustainability challenges. Javier Sanchez Lopez (EC Knowledge Centre for Bioeconomy) introduced the workshop structure and its expected output (see previous section), then Jacopo Giuntoli (EC JRC) gave an overview of the proposed approach to monitor the EU bioeconomy, defining a set of indicators that are measurable, purpose-dependent and with a commonly recognised link between the indicator and its interpretation. The proposed framework is designed to map the indicators across the three pillars of sustainability (economic, environmental and social) as well as the biophysical dimension upon which the other pillars depend. Further dimensions are bioeconomy sectors and different steps in the value chain (Figure 6). It was explained that this monitoring system takes into consideration lessons learned from previous monitoring experiences. It is designed to analyse progress towards the five objectives of the EU bioeconomy strategy (COM (2018) 673) and towards the achievement of the Sustainable Development Goals by 2030.

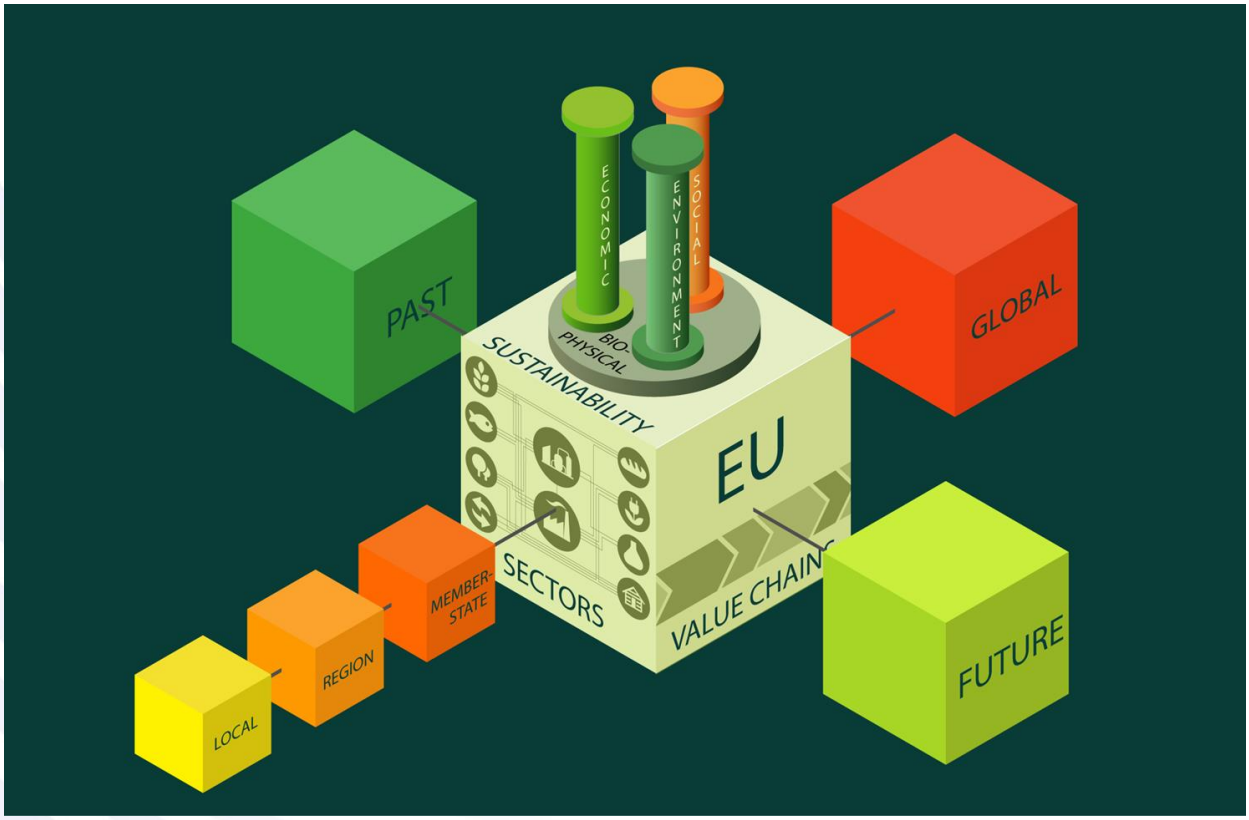
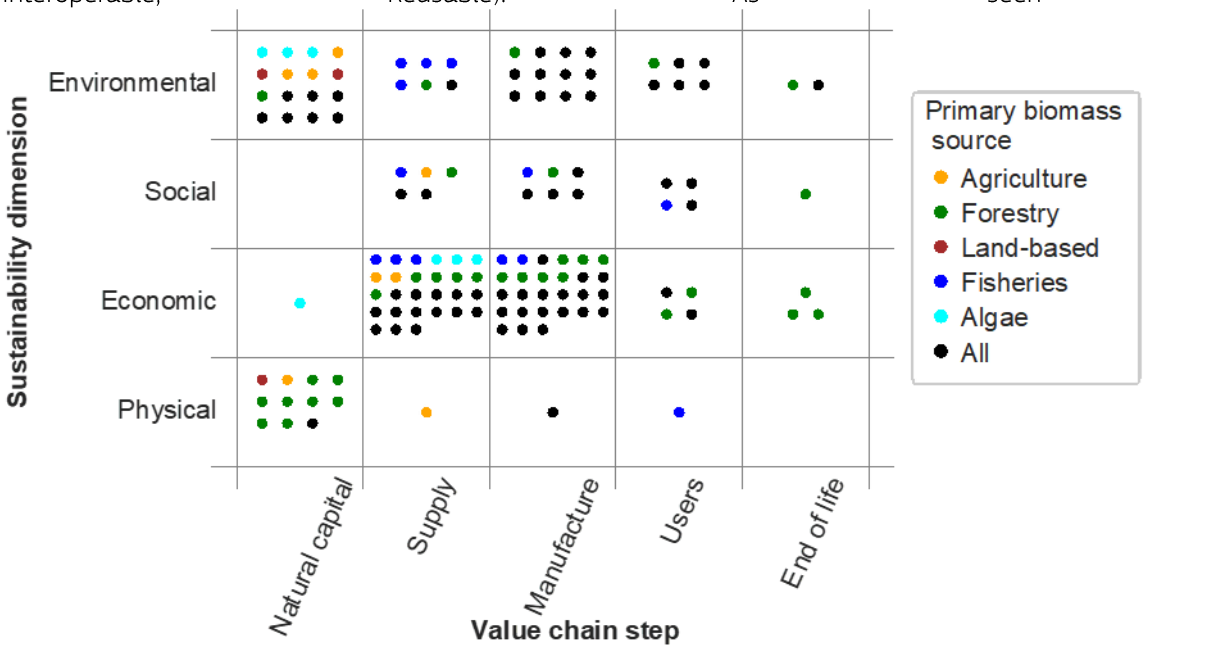


Figure 6: Proposed framework of the EU bioeconomy monitoring system

Nicolas Robert (EC JRC) showed a first attempt to map indicators proposed by JRC researchers, later presented during the poster session for discussion. He explained that existing and accepted indicators, included in other existing frameworks (when possible), were preferred, with a view to maximise EU coverage while minimising the additional reporting burden. Indicators from existing monitoring frameworks are generally accepted and, in most cases, time series exist. The proposed indicators are classified according to the length of the time series, the frequency of estimation, the confidence and their accessibility, according to the FAIR code (Findable, Accessible,

Interoperable, Reusable). As seen in Figure 7, not all the production sectors and dimensions are covered by the proposed set of indicators, therefore the participants were asked to suggest additional indicators to cover the gaps.



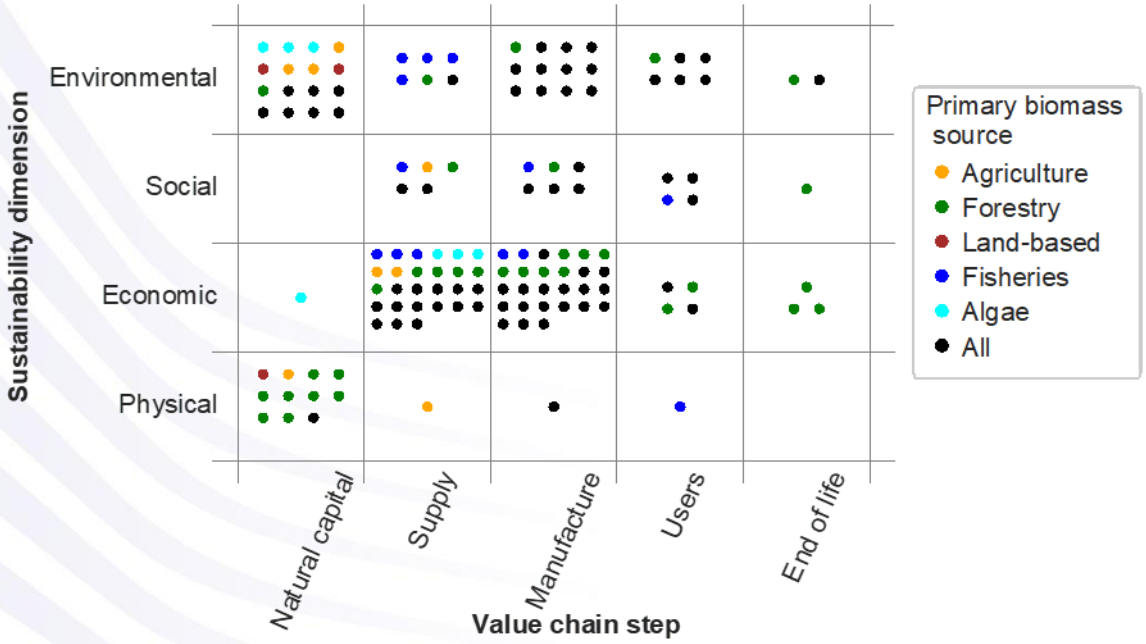


Figure 7: Coverage of the dimensions of the proposed framework by indicators identified prior to the workshop.

Participants commented on the general approach proposed by the JRC, suggesting the following:

1) clarity on whether or not this monitoring system is established to monitor the implementation of the actions of the strategy or rather the progress of the EU Bioeconomy;
2) monitoring impacts of the EU Bioeconomy on non-EU countries;
3) using citizen science to collect information for the monitoring system;
4) to look at the tertiary services sectors, including trends in education;
5) to include the five objectives of the EU bioeconomy strategy among the dimensions.

Elisabetta Balzi highlighted that we have to monitor the EU bioeconomy according to the definition of the strategy. The objectives of the 2012 strategy are still valid after the 2018 revision. She also mentioned the need

to concentrate the action on some urgent issues that represent the pillars of the action plan, such as job creation, climate mitigation and renewing the industrial landscape,

With this presentation, the introductory part of the workshop closed, and participants moved to the poster sessions. These were highly interactive. Participants took part in in-depth discussions during the first round. The agenda was adjusted to leave enough time for discussion to deal with the complexity of the indicator sets for each thematic area. Thus after roughly one hour, participants rotated to other posters if they wished. At the end of the poster session, the participants reconvened in the plenary where each presenter provided a summary of the discussions. A detailed report highlighting the main takeaways from the discussions will be prepared jointly by the JRC team working on the bioeconomy monitoring system and the workshop participants.

Parallel sessions about basic indicators – plenary wrap up summary

FOREST AND FOREST BASED

Andrea Camia (EC JRC) reported on the group discussions around the poster related to forest and forest based indicators. Main points are summarised below:

- Some indicators are cross-cutting and not univocal for forest sector, e.g. wood for energy.
- Some indicators are misleading and/or need a threshold. For example, even if it is desirable to increase the use of wood-based material, we need to make sure that the overall consumption is reduced.
- Some indicators have a different meaning in different regional contexts, e.g. the amount of deadwood. There is the need to consolidate them.
- Directionality needs to be fine-tuned because it is not always accurate.
- On employment, it would be important to define the boundaries of bioeconomy. For example, it was suggested to include ecotourism. This would also depend on data availability.
- During the plenary discussion, it was suggested to consider agroforestry and trees outside forests as a potential source for wood .
- Some indicators are part of a wish list (e.g. number of new products), as data are not yet available.
- It was suggested to use satellite imagery (e.g. Copernicus data) to close gaps and enhance the knowledge base.

JOBS, INNOVATION, AND GROWTH FOR THE BIOECONOMY

Tévécia Ronzon (EC JRC) reported on the group discussions from the poster session on indicators for jobs, innovation and growth in the bioeconomy. Main points are summarised below:

- Jobs, growth and trade are well represented, but indicators on innovation and education need to be included (e.g. what are the skills of bioeconomy workers?).
- Also indicators about investment, substitution and consumer demand are missing.
- An indicator representing the market uptake of new products is also missing.
- The use of organic waste is not represented in official data.
- Services sectors and employment in research and knowledge creation are also not covered.
- In terms of granularity, indicators at EU and Member State level must be measured, but also the regional and urban dimensions are relevant, because policies are often executed at that level.
- Normalisation is important to compare Member States. For this, it would be preferable to use intensive indicators instead of extensive indicators[3].
- Within ESTAT data for hybrid sectors[4], bio-based products are not differentiated amongst the other products of the same sector.
- Links with the smart specialisation strategy combined with bioeconomy should be considered (example of Italy).

[3] An extensive variable is one which depends on system size (like country area or population). An intensive variable is one which does not depend on system size (like GDP per capita).

[4] Sectors making use of biomass and other kinds of feedstock, e.g. textile, electricity, etc.

- It was suggested to include SDG 4 – quality education and SDG 17 – partnership for the goals as relevant for this topic.
- The plenary discussion rose several questions, in particular: which sectors shall be considered in the monitoring framework? Should we follow NACE classification? Should we include other topics such as food security? How to take into account also the rural dimension? How to consider the different geographical scale at which the bioeconomy can have an impact?
- In terms of data availability, it would be good to have an indicator about patents related to bioeconomy. However, there is no data available in this area yet.

AGRICULTURE

Jean-Michel Terres (EC JRC) reported on the group discussions from the poster session on indicators for agriculture. Main points are summarised below:

- A hybrid approach has been proposed for the workshop, isolating Agriculture from secondary sector of food processors (agro-food industry) and food retailers. This creates some confusion on the indicators to be proposed. The proposed framework shall clarify where the boundaries are. For example, food industry and beverages are not considered for the discussion under Agriculture and this create some consistency / logical issues.
- Food waste was considered an important topic, but cannot be covered under the agriculture indicators.
- Some indicators in the initial proposal have their own features and characteristics; some are meaningful only for specific geographic entities (e.g. soil erosion), some are closely linked to time scale (some are seasonal, e.g. water exploitation index, while others are very long term - e.g. soil organic carbon). Their compilation into a single matrix shall be adapted accordingly and in a meaningful manner.
- Some indicators are used in two more different sectors within the monitoring system. Duplication should be avoided.
- Amongst the new indicators proposed, some are consolidated, some represent a wish list, e.g. pollinators index.
- The concept of resilience is also missing.
- It is suggested to use for the bioeconomy already existing monitoring systems for the agricultural sector. Namely the Common Monitoring and Evaluation Framework (CMEF) which would ensure coherence for reporting on agriculture. It covers the 3 pillars of sustainability: economic, environmental - climate, social – territorial.
  In the next CAP legal proposal, this monitoring system will be extended to direct payments as well, known as Performance Monitoring and Evaluation Framework.

FISHERIES AND AQUACULTURE

Gianluca Fiore (EC JRC) reported on the group discussions from the poster session on indicators for fisheries. Main points are summarised below:

- The majority of draft indicators were well received by participants.
- There is a need to harmonise the indicators between the primary production sectors, also related to the definition of the indicators.
- The group has suggested to expand the reference of the indicators to SDGs, both by including indicators where SDGs were not associated and by expanding indicators to additional SDGs.
- The measurement units shall be mentioned for all indicators. This is particularly relevant for the job market (job positions versus full time equivalent).
- There is a need to integrate the list with indicators which could report new streams in their processing of fishery products as well as the establishment of new dedicated plants (biorefineries).

ENERGY

Claudia Bulgheroni (EC JRC) reported on the group discussions from the poster session on indicators for energy. Main points are summarised below:

- Participants deemed the discussion about SDGs not relevant. The focus of the group was on indicators themselves.
- Participants pointed out that data collection should be neutral and agnostic to the objective. Indicators should be built based on monitoring needs.
- A pre-defined dashboard, defined according to the experts' value judgement, should be the reference. In a second stage, it may be customised following policy priorities and policy makers' interests.
- Shares may be misleading in some cases. Absolute values are more meaningful. For this reason some indicators were dropped or considered only as absolute values.
- Disaggregated indicators are preferable to the aggregated indicators. The former are more versatile, as they can be aggregated further on the basis of the needs, while disaggregating aggregated indicators may not be feasible.
- A discussion on the identification of gaps was not had. Experts will be consulted further on this point.
- For the indicators about biofuels import, partner countries should be reported.
- Andrea Camia recommended that we insist asking for reporting on biomass used (and not energy content), also indicating the classification of resources.

ALGAE

Rita Araujo (EC JRC) reported on the group discussions from the poster session on indicators for algae. Main points are summarised below:

- Recommendation to disaggregate according to production method.
- Environmental dimension is weak, the indicators only measure specific impacts. Several new indicators were proposed, e.g. footprint of biomass production – for the algae sector there is the problem of quality and availability.
- Mapping of eco-friendly production was suggested.
- Patents and R&D technologies are also important in this specific field.
- Case studies could be used (to identify indicators for the source, e.g. waste water plants per country).
- It was suggested that the assessment will be easier if there are fewer indicators.
- In the plenary discussion, it was suggested to make sure that cross-cutting indicators (such as Gross Value Added) are always included for all sectors.

Session 2 - Discussions on aggregate and systems-level indicators

In the first presentation after lunch, Sarah Mubareka (leading the development of the European bioeconomy monitoring system at JRC), presented the results from a survey on stakeholder expectations from an EU Bioeconomy Monitoring system. The survey had been undertaken in April/May 2019 using a snowballing sampling technique[5], which made it possible to collect feedback from 76 participants, mostly from governmental institutions. Most respondents expect to enhance their knowledge and to understand the trends of the bioeconomy from a monitoring system, especially in order to prioritise actions and inform stakeholders. A detailed account of the survey results will be given in a separate document. In the conclusive remarks of her presentation, Sarah introduced the next steps of the work for 2019, including (i) producing mock-ups to present indicators in different ways, starting from user stories of highest-priority stakeholders (ii) interacting with stakeholders to get feedback on the mock-ups (iii) finalising the representation of basic indicators (iv) defining aggregate indicators.

Techniques to aggregate indicators were the subject of the next session in the workshop, chaired by Luisa Marelli (deputy HoU, EC JRC D1).

The first contribution from Tévécia Ronzon (EC JRC) introduced the so-called "overall approach" (pragmatic, technocratic, with a socioeconomic focus), considering the NACE sectors identified as being part of the bioeconomy, for all EU28 and individual MS, based on yearly time series, updatable and useful for stakeholders. Tévécia showed the many outputs of this work spanning from 2015 to 2019, in terms of research synthesis, policy support papers and scientific contributions, highlighting the limits and possible improvements to the approach. The methodology was developed in collaboration with Nova Institute and led to a H2020 project called Biomonitor, whose objectives, approach and initial outcomes were explained by Robert M'Barek (EC JRC). So far, this methodology has been applied to the estimation of jobs, turnover and value added in Bioeconomy sectors. As a food for thought for the future Bioenomomy monitoring system, all data is publically available online both in the form of downloadable raw data and in the form of dynamic reports from which users can compare bioeconomy indicators across sectors, countries and years.

The plenary discussion covered various topics. In particular some participants highlighted the need to harmonise EU level indicators and country level indicators. Participants again raised the issue of the diversity of definitions of the Bioeconomy in use within the EU MS. For example, the fact of including some services sectors (e.g. ecotourism, hunting, etc.) within the bioeconomy definition or to exclude them largely influence on the quantification of the number of jobs or value added generated by the bioeconomy. As a result, they recommended the JRC to consider a broad definition of the Bioeconomy and to report on the sectorial disaggregation so that comparisons can be made across different sectorial definitions of the Bioeconomy.

During the second presentation of the afternoon session William Becker (EC JRC Competence Centre on Composite Indicators and Scoreboards) introduced the concept of scoreboards (collections of indicators that are related to a common concept or theme, e.g. the social scoreboard supporting the European pillar of social rights) and composite indicators (aggregations of observable variables that aim to quantify un-measurable concepts, e.g. the sustainable development index). William outlined the ten steps to build a composite indicator, highlighting that the most important factor to build a good composite indicator is a clear objective in mind. He clarified that indicators can monitor the state of a concept/system but cannot measure the impacts of a policy intervention. The latter would require microdata and awareness of causality, to link the changes in impact variables to policy actions. It requires also a longer timeframe, usually at least 3-5 years. In the second part of his presentation William focused on state monitoring frameworks, detailing the criteria to identify suitable indicators. He stressed the importance to involve thematic experts when developing the indicators' framework, thus achieving legitimacy and quality. Regarding the choice of indicators, William clarified that composite indicators, like any model, require assumptions and subjective decisions to be made. Moreover, composite indicators are best used to make comparisons and benchmarks between countries or regions according to specific concepts, rather than absolute measurements.

Serenella Sala (EC JRC) then gave her perspectives on how to use Life Cycle Assessment (LCA) to evaluate the impacts of bio-based products. She gave a short introduction of the LCA, a quantitative method relating all

[5] In sociology and statistics research, snowball sampling (or chain-referral sampling) is a nonprobability sampling technique where primary data sources nominating another potential primary data sources to be used in the research. Thus the sample group is said to grow like a rolling snowball. Source: https://research-methodology.net/sampling-in-primary-data-collection/snowball-sampling/

emissions and impacts to a service or function provided, and recalled that in the European Bioeconomy Strategy (already in 2012, and with a clear mandate in 2018) LCA is explicitly mentioned as a method to support the calculation of environmental footprint and to support comparison between bio-based and fossil-based materials. LCA follows four main phases: (i) defining goal and scope (ii) life cycle inventory, detailing data on resources used for each stage of the product lifecycle and emissions into the environment (iii) life cycle impact assessment, based on 16 impact categories, covering impacts on the environment and human health due to emissions and resource use and (iv) interpretation of the results (including the possibility of visualising either the 16 impacts or their aggregation in terms of areas of protection: human health, ecosystem health and natural resources). These phases are corresponding to the elements of the "Driver Pressure State Impact Response" (DPSIR framework) developed by the European Environment Agency. After this introduction, Serenella showed an example of how to use LCA in support of the bioeconomy monitoring, assigning to each bioeconomy sector, representative products for which is possible to measure the impacts using the LCA method. The preliminary results show that this approach allows to put in perspective the impacts of the EU bioeconomy versus global impacts, versus planetary boundaries and versus the Sustainable Development Goals, to monitor the evolution of bioeconomy compared to other sectors, and to identify bioeconomy-related environmental hotspots (which may become more relevant in the future). However, some methodological challenges remain to be explored, such as the criteria for the selection of representative products for bioeconomy.

Participants commented on the presentation related to the use of LCA for evaluating the impacts of bio-based products:

1) Better to use less and key pressure indicators rather than many impact indicators
2) To translate the identified planetary boundaries to EU boundaries, and clarify what is the non-EU contribution to them
3) To think how to link this approach with the monitoring system and to have an idea of the change over time
4) To reflect on the feasibility of the approach, since many products and different production practices should be included in the inventories to have a representative output
5) For new emerging products, to assess the time needed for these products to be on the market so that it can be included in the evaluation
6) In monitoring the balance between human input and ecosystem contribution should be considered

The last presentation on the methods to aggregate indicators was provided by Alessandra La Notte (EC JRC), who presented an approach to account for natural capital integration in economic traditional frameworks in a systematic way (INCA project). Ecosystem services accounting is a method to consider the intersection between the ecosystem service potential and the service demand deriving from the socioeconomic systems, to obtain the actual flow of ecosystem service use, in form of "accounting tables". Although there could be different levels of complexity, the method can start with a biophysical model assessing a spatially explicit representation of the ecosystem potential interacting with the actual demand; it is then translated in monetary terms, and reported in the accounting tables for the ecosystem service. After this introduction, Alessandra explained two approaches on how ecosystem services accounting could support bioeconomy monitoring: either accounting for the changes in land use or accounting for the changes in the management practices. She provided the examples of crop provision, crop pollination, timber provision, flood control and nature-based recreation. She concluded that accounting for natural capital, and specifically for ecosystem services can support bioeconomy monitoring by systematically providing information on sustainability issues, in terms of overuse and in terms of unmet demand. In turn, the bioeconomy monitoring system can support the accounting for natural capital, and specifically for ecosystem services, by providing supporting information to set sustainability thresholds (as the medium term objective) and to measure inter-ecosystem flows (as long term objective).

The closing remarks from the workshop were provided by Sarah Mubareka (EC JRC), who concluded that expected outcome of the workshop had been ambitious, but that it was a good start. The presentations, discussions and questions raised showed a definite need for re-thinking the conceptual framework to include more clear boundaries and geographical granularity in order to effectively monitor the sustainability of the EU Bioeconomy. She outlined the main take home messages, highlighting inter alia the need to classify the indicators also according to cross-cutting themes such as food security and biodiversity, or include other sectors like the services and retail sectors, instead of considering only the traditional bioeconomy sectors. This was a recurring observation during the discussion, confirmed by the fact that many indicators were overlapping among the thematic areas presented in the poster session.

The workshop was appreciated as a starting point to build a new network of experts on the bioeconomy and for consolidating existing collaborations.

The recommendations from the experts participating to the workshop and the suggestions from the experts on systems- level indicators will be included in the reflections about the methodological approach for an EU bioeconomy monitoring system. Next steps include

1) the dissemination of the presentations to the workshop participants;
2) this report from the CoP workshop, to be publically circulated;
3) a JRC-led report describing a conceptual framework based on the outcomes of this workshop to be circulated among participants for comments and additions, whose purpose is to be used as a vehicle for discussion with policy DGs;
4) A third Bioeconomy CoP workshop on the theme of Monitoring the EU Bioeconomy, to be held on December 3 2019 in Brussels.

Evaluation of the workshop

The workshop was attended by 44 experts in total, most of them JRC scientists, plus external experts from international organisations, academia and other Commission DGs or agencies. The composition of the attendance to the workshop is shown in Figure 8.

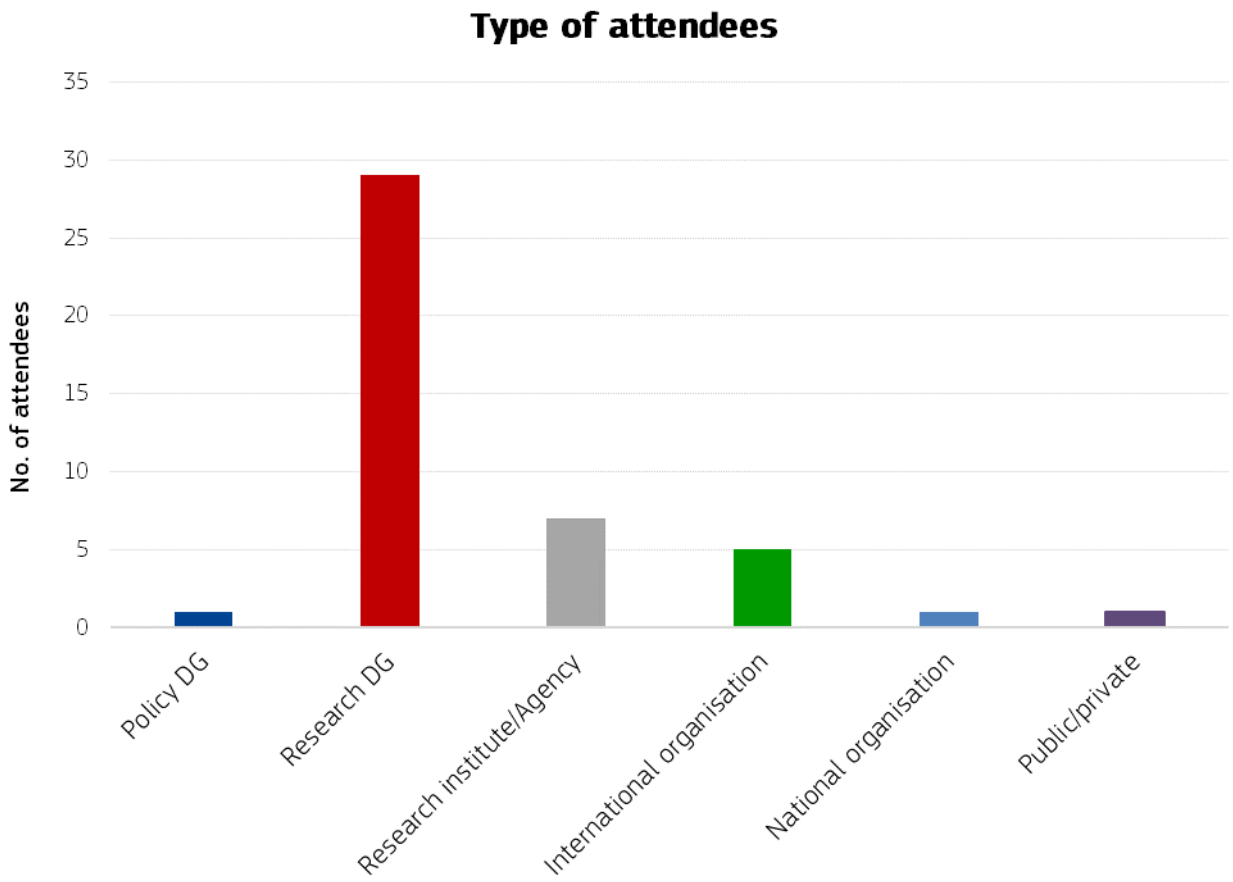


Figure 8 Attendees to the workshop by type of organisation

At the end of the event, participants were invited to give their feedback on the organisation and outcomes of the workshop following a JRC standard template. Different aspects of the workshop (e.g. agenda, speakers, documentation, facilities and services, before the event and overall outcome of the event) were assessed in a scale from 1 (completely disagree) to 5 (completely agree). The average figure obtained for each question is shown in Figure 9. Overall, the feedback was positive, but there were some lessons learnt about organisational aspects, as summarised below:

- The complexity of the bioeconomy monitoring system entailed that the workshop covered many interrelated topics. Some attendees felt they needed more background explanation about the selection of indicators in the various areas.
- The breakdown in discussion groups was welcome by participants and was effective for the discussion. A point for improvement is related to the better time keeping of the parallel sessions' discussions, and to provide better instructions to the poster presenters and secretaries, e.g. a common template for note-keeping. Given the multidisciplinarity of the topics addressed, this would have helped the post-processing of the data collected during the discussions.
- The time devoted to discussion was too limited, and the work plan a bit too dense for some of the participants. It was suggested to allocate more pauses in the programme and more time to allow experts

to contribute actively to the discussions and to take advantage of the workshop settings for networking and future collaboration.

- In terms of logistics, it would be advisable next time to have one person dedicated to the overall supervision of the event in order to take better care of the workshop organisation in case some unforeseen problem takes place, without disrupting the scientific part of the event.

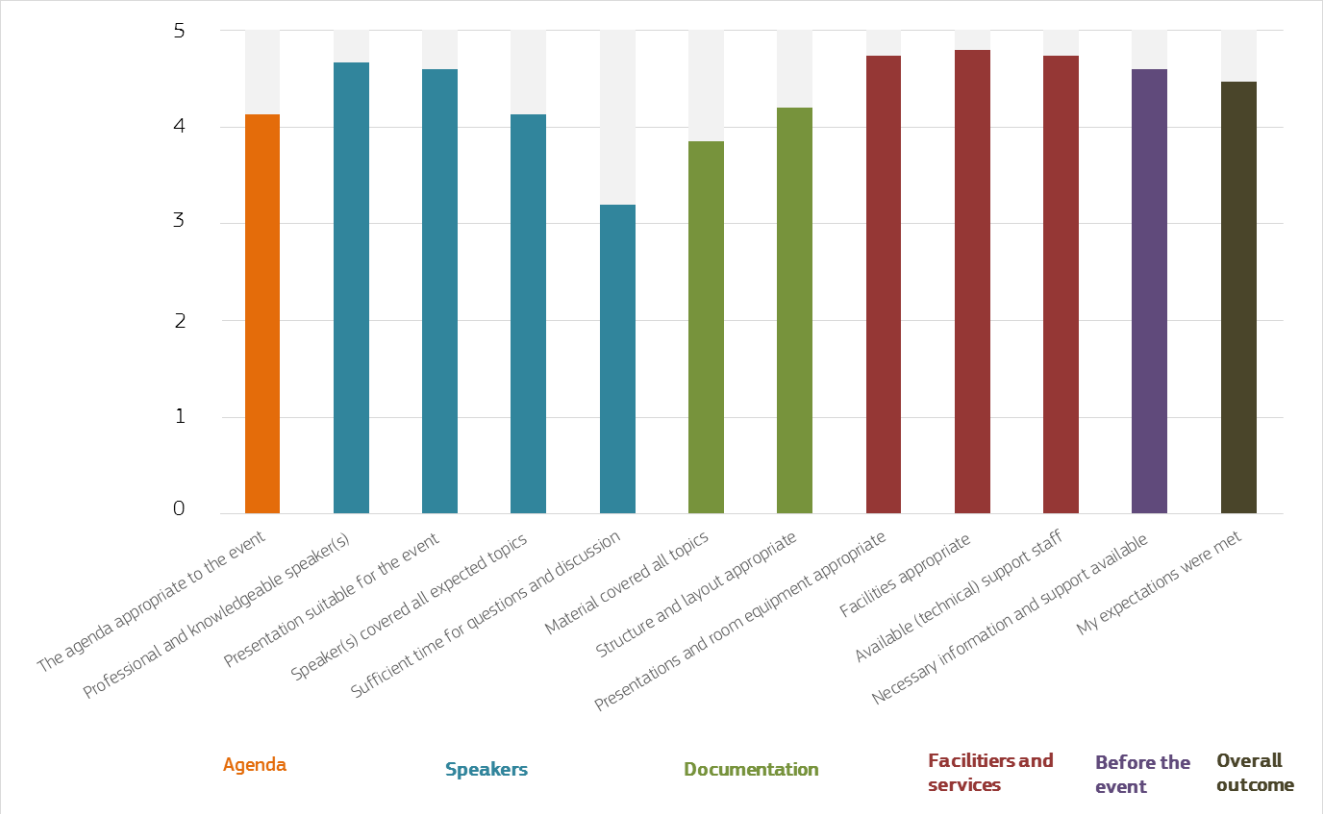


Figure 9 Assessment of different aspects of the workshop by the attendees in a scale from 1 to 5 (average values)

Annex 1 Workshop Agenda

WEBSTREAMING: from 9h00-10h00 and from 13h30- 17h30

Welcome and scene setting

Chair: Sarah Mubareka, Joint Research Centre, European Commission

09:00 - 09:10 *Welcome address*
Elisabetta Balzi, Head of Bioeconomy Unit, Joint Research Centre, European Commission

09:10 - 09:20 *Structure, objectives, expected output and follow-up of the workshop*
Javier Sanchez Lopez, EC Knowledge Centre for Bioeconomy, Joint Research Centre, European Commission

09:20 – 09:50 *Overview and discussion on proposed approach to monitor the EU Bioeconomy* Jacopo Giuntoli, Joint Research Centre, European Commission

SESSION 1: Presentation and discussion about basic indicators

09:50 -10:10 *Summary of indicators identified so far within the context of the proposed approach to monitor the EU Bioeconomy*
Nicolas Robert, Joint Research Centre, European Commission

10:10 - 12:00 *Interactive parallel sessions around posters on indicators, grouped by policy area. Main question is "Do these indicators say something about sustainability?"*
EC JRC researchers

- *Agriculture (presenter: Jean Michel Terres)*
- *Forestry and forest-based sector (presenter: Andrea Camia)*
- *Energy (presenter: Claudia Bulgheroni)*
- *Fisheries & aquaculture (presenter: Gianluca Fiore)*
- *Algae (presenter: Rita Araujo)*
- *Jobs, growth and innovation in bioeconomy sectors (presenter:Tevecia Ronzon)*

Coffee served throughout the parallel sessions

12:00 - 12:45 *Wrap up of parallel sessions*
Poster presenters

12:45 - 13:30 Lunch buffet

SESSION 2: Discussions on aggregate and systems-level indicators

Chair: Luisa Marelli (Deputy Head of Bioeconomy Unit, Joint Research Centre, European Commission)

13:30 - 13:45 *What are people expecting from an EU Bioeconomy Monitoring system & how to monitor overall progress towards a sustainable bioeconomy in a meaningful way? Results and discussion around the questionnaire on expectations*
Sarah Mubareka & Jacopo Giuntoli, Joint Research Centre, European Commission

13:45 - 14:30 *All-sectors approaches: Experiences of socio-economic indicators and H2020 BioMonitor, followed by discussion*
Tevecia Ronzon & Robert M'Barek, Joint Research Centre, European Commission

14:30 - 15:15	*Composite indicators and indicator frameworks for monitoring, followed by discussion* **William Becker**, Competence Centre on Composite Indicators and Scoreboards, Joint Research Centre, European Commission
15:15 - 15:30	Coffee
15:30 - 16:15	*Life cycle assessment to evaluate the impacts of bio-based products, a consumption-oriented perspective, followed by discussion* **Serenella Sala**, Joint Research Centre, European Commission
16:15 - 17:00	*Accounting for natural capital to penetrate economic systems in a systematic way, followed by discussion* **Alessandra La Notte**, Joint Research Centre, European Commission
17:00 – 17:15	*Summary and follow-up of the workshop, concluding remarks* **Sarah Mubareka**, Joint Research Centre, European Commission
17:30	End of workshop

Annex 2 List of participants

	Last Name	First Name	Organisation
1	BALZI	Elisabetta	EC Joint Research Centre = D1 Bioeconomy
2	BASTRUP-BIRK	Annemarie	European Environment Agency
3	BECKER	William Edward	EC Joint Research Centre – I1 Competence Centre on Composite Indicators and Scoreboards
4	BIALA	Katarzyna	European Environment Agency
5	BORZACCHIELLO	Maria Teresa	EC Joint Research Centre – D1 Bioeconomy
6	BRACCO	Stefania	Food and Agriculture Organization of the United Nations (FAO)
7	BULGHERONI	Claudia	EC Joint Research Centre – C2 Energy Efficiency and Renewables
8	BUSCAGLIA	Daniela	EC Joint Research Centre – D6 Knowledge for Sustainable Development and Food Security
9	CAMIA	Andrea	EC Joint Research Centre – D1 Bioeconomy
10	CAROSI	Daniela	Italian Ministry of Economic Development
11	COLANGELI	Marco	Food and Agriculture Organization of the United Nations (FAO)
12	CORRADO	Sara	EC Joint Research Centre = D1 Bioeconomy
13	DOS SANTOS FERNANDES DE ARAUJO	Rita	EC Joint Research Centre – D2 Water and Marine Resources
14	EGENOLF	Vincent	University of Kassel Center for Environmental Systems Research (CESR)
15	FIORE	Gianluca	EC Joint Research Centre – D2 Water and Marine Resources
16	FIORESE	Giulia	EC Joint Research Centre – D1 Bioeconomy
17	FOLLADOR	Marco	EC Joint Research Centre – D1 Bioeconomy
18	FRITSCHE	Uwe	IINAS
19	GAMITO JARDIM	José Ernesto	EC Joint Research Centre – D2 Water and Marine Resources
20	GIUNTOLI	Jacopo	EC Joint Research Centre – D1 Bioeconomy
21	GUERRERO	Santiago	Organisation for Economic Co-operation and Development
22	GUILLEN GARCIA	Jordi	EC Joint Research Centre – D2 Water and Marine Resources
23	KREYSA	Joachim	EC Joint Research Centre – JRC Adviser for Bioeconomy
24	LA NOTTE	Alessandra	EC Joint Research Centre – D3 Land Resources
25	LIER	Markus	Natural Resources Institute Finland (Luke)
26	LINSER	Stefanie	University of Natural Resources and Life Sciences, Vienna (BOKU) and European Forest Institute
27	LLORENTE RUIZ DE AZUA	Maria Pilar	BBI JU
28	LUSSER	Maria	EC Joint Research Centre = D1 Bioeconomy
29	M'BAREK	Robert	EC Joint Research Centre – D4 Economics of Agriculture
30	MARELLI	Luisa	EC Joint Research Centre – D1 Bioeconomy
31	MAYORGA DUARTE	Lina	EC Joint Research Centre – D1 Bioeconomy
32	MUBAREKA	Sarah	EC Joint Research Centre – D1 Bioeconomy
33	NI CHONCUBHAIR	Orlaith	EC DG Research and Innovation – C2 Bioeconomy & Food Systems
34	PIOTROWSKI	Stephan	nova-Institut GmbH
35	PISANI	Domenico	EC Joint Research Centre – D3 Land Resources

	Last Name	First Name	Organisation
36	RENDON CARDONA	Paula	EC Joint Research Centre – D3 Land Resources
37	ROBERT	Nicolas	EC Joint Research Centre – D1 Bioeconomy
38	RONZON	Tevecia	EC Joint Research Centre – D4 Economics of Agriculture
39	SALA	Serenella	EC Joint Research Centre – D1 Bioeconomy
40	SANCHEZ LOPEZ	Javier	EC Joint Research Centre – D1 Bioeconomy
41	TERRES	Jean-Michel	EC Joint Research Centre – Food Security
42	WAGNER	Moritz	University of Hohenheim
43	WASELIKOWSKI	Lisa	EC Eurostat – E2 Environmental statistics and accounts; sustainable development
44	WESSELER	Justus	Wageningen University & Research