

The EU BioEconomy Contribution to Sustainable Development - Measuring the Impact

Abstract

Developing a bioeconomy can make a significant contribution averting the ongoing climate crisis and to achieve sustainable development. The BioMonitor project develops and tests a monitoring and measuring framework for the EU bioeconomy. This policy brief outlines a framework for measuring the size and development of the bioeconomy. This framework considers drivers, impacts and results that depict the development of the bioeconomy. Moreover, it presents the sectors that cover the bioeconomy and includes the indicators for monitoring and measuring development. The development of new indicators concentrates on a) those describing sectors that are part of the bio-based economy and b) those describing public and private initiatives to advance the sustainable and circular bioeconomy.

Key points

There is a lack of data and statistics about emerging innovative industries in the bioeconomy: this information gap needs to be filled in to enable robust monitoring and analysis tools.

New indicators are introduced to measure the effects of public and private initiatives aimed at improving the development of the bioeconomy.

Models are developed and improved to measure the past, present, and future sustainable development of the circular bioeconomy.

Introduction

Development into a sustainable society is challenged by a number of factors like climate change, a growing and increasingly rich world population, rapid increase in urbanization, and growing inequality in income distribution. In 2018, the United Nations reaffirmed the value of sustainable development as it can bring harmony to countries' economic growth, social inclusion, and environmental protection. For the last twenty years, EU policymakers have seen the bioeconomy's important role in achieving sustainable development. This can be accomplished once the bioeconomy is tailored to meet the Sustainable Development Goals (Wesseler and von Braun 2017; Zilberman et al. 2018). The development of a sustainable and circular bioeconomy can reduce the use of petrochemicals, mitigate climate change and the dependency on imports of natural resources, and promote local economies. This commitment is reflected by the launch of policy initiatives and research programmes at EU level, like the European Bio-Based Industries Joint Undertaking (Wesseler and von Braun, 2017). The recent EC Bioeconomy

Strategy Update (European Commission, 2018a) also emphasizes how high the bioeconomy is in the political agenda. Sustainability of the circular bioeconomy is a very important aspect for a monitoring framework. It has three major dimensions: economy, society, and the environment. So far, quantifications of the bioeconomy have focused more on economic and social aspects and less on those related to the environment (European Commission, 2018b). In the BioMonitor project, we aim to quantify the bioeconomy's economic, environmental and social impacts in the EU and its Member States. We develop and test a novel statistical and modelling framework which includes a number of improvements, and in particular, linking biomass flows with economic activities; this allows a better assessment of environmental impacts. Additional improvements include the quantitative and qualitative assessment of innovations and related policies in the EU bioeconomy. The framework will identify data-gaps in measuring the emerging bio-based economy (like processing biomass into bio-based intermediate and end prod-

ucts) and develop and test strategies that will fill those data-gaps. Overall, this will aid stakeholders, and policymakers in particular, in understanding what is at stake when looking at the European bioeconomy.

Measuring the bioeconomy

The bioeconomy is inter-sectoral, international, and transdisciplinary in nature. For this reason, definitions vary depending on the stakeholders involved in the bioeconomy: scientists, policymakers, NGOs or private sector.

“The bioeconomy covers all sectors and systems that rely on biological resources (animals, plants, micro-organisms and derived biomass, including organic waste), their functions and principles. It includes and interlinks: land and marine ecosystems and the services they provide; all primary production sectors that use and produce biological resources (agriculture, forestry, fisheries and aquaculture); and all economic and industrial sectors that use biological resources and processes to produce food, feed, bio-based products, energy and services” (European Commission, 2018a, p. 4)

The Commission’s definition of the bioeconomy in its 2018 Bioeconomy Strategy Update expands on the Commission’s 2012 definition by including a wider array of products, sectors, and value chains and emphasizes even more the need for sustainability and circularity. Related to the term ‘bioeconomy’ are the overlapping terms ‘green economy’, ‘bio-based economy’, and ‘circular economy’ (Figure 1).

Several prominent European and international industry associations and research organisations use and support the concept of a ‘circular bioeconomy’ and encourage greater integration between both concepts (EuropaBio, 2017; CEPI, 2017; Hetemäki et al. 2017). Measuring and monitoring the bioeconomy helps stakeholders identify possible opportunities and constraints for increasing the circularity of the economy.

Figure 2 presents the drivers, impacts, and outcomes that depict the dynamic development of the bioeconomy. Driving forces determine the development of the bioeconomy, while policies, strategies and legislation (indicated on top) constitute the measures governments need to account for to influence it. The re(use)

Figure 1: VENN diagram of Bioeconomy, bio-based economy, green economy and circular economy

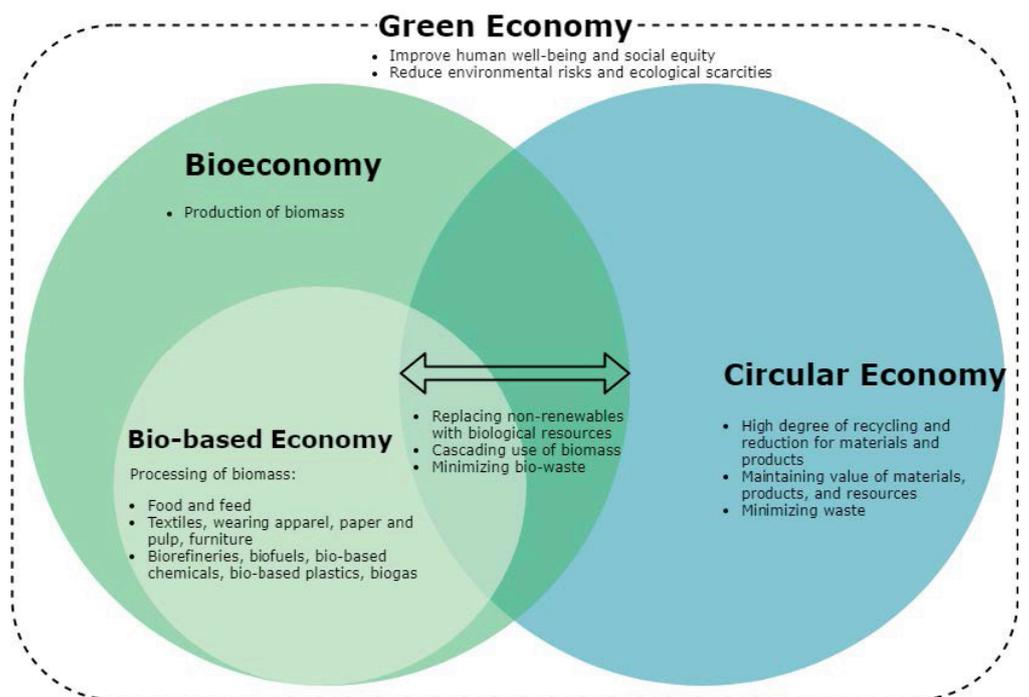
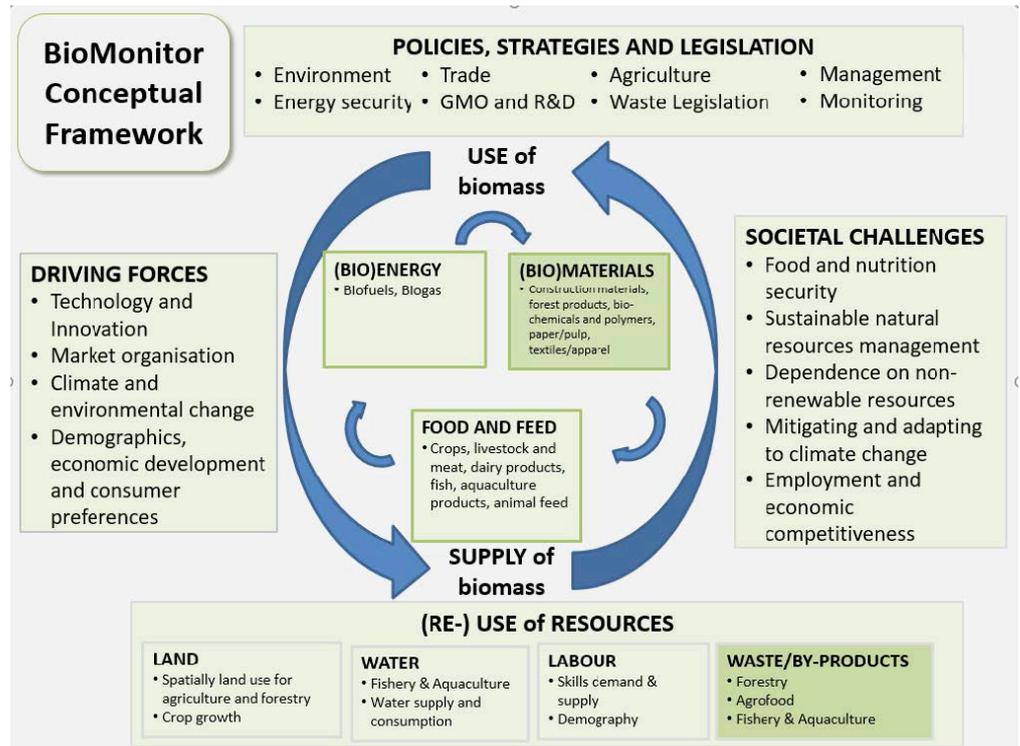


Figure 2: Overview of the relations within the bioeconomy.
 Source: Adapted from SAT-BBE (2015b)



of resources for biomass production (indicated at the bottom), like land, water, labour, and waste/by-products influences the biomass market in the centre. Altogether, they have an impact on the demand and supply of the bioeconomy, which in turn determines to what extent it will contribute to overcoming the societal challenges (indicated at the right).

To make the impacts on the societal challenges measurable, specific criteria and/or targets are needed (e.g. 'adapting to climate change' into 'reduce greenhouse gas (GHG) by 40% by 2030 as compared to 1990'). The BioMonitor model toolbox will be used to assess impacts and investigates how these are interdependent with economic, social, political and environmental elements relevant to the bioeconomy. The assessment will be based on a number of scenarios identified in collaboration with key stakeholders.

The broad definition of the bioeconomy by the European Commission asks for a list of sectors that make up the entire bioeconomy. Bioeconomy industries can be broadly assigned to i) Natural resource-based activities that directly

exploit a biological resource (e.g. the primary sectors agriculture, fishery and forestry) and provide biomass as input for other industries; ii) Conventional activities that further process biomass (e.g. food or wood processing sectors); and iii) Novel activities that further process the biomass and/or biomass residues (bioenergy or bio-based chemical sectors).

Out of these sectors, only the primary can be entirely attributed to the bioeconomy; as for the other sectors, only a part of them is fully bio-based¹. We improve previous monitoring work by developing a monitoring framework that will be more spatially explicit; this is done by including regions that cover many details on the bio-based economy. **The regional data on bio-based production will be extended. In addition, national data will be integrated using information about the investments made by the public and private sector, the patents filed, the policies monitored and the products certified. Monitoring and measuring non-traditional sectors and capturing environmental impacts are difficult and specific methods that will be developed.**

Indicators are essential in monitoring and measuring the development of the bioeconomy. These can help policymakers understand and interpret the results of our framework and let them formulate clearer targets for their policies. These can also reveal trade-offs between different policy measures that have to be taken into account. An example for such an important indicator is the impact of bio-based products on the emissions of greenhouse gases.

Table 1 presents our list of indicators, which is based on the BioMonitor project's consultation with stakeholders and a literature review. **Furthermore, we focus on the bio-based economy and**

aim to address all three dimensions of sustainability, that is environmental, social, and economic, as much as possible, although a priority is set on the economic dimension, in particular. We assign the indicators to the five societal objectives based on the EC's 2018 Bioeconomy Strategy and create Main Indicators, which can be disaggregated into Sub-Indicators.

Conclusions and Policy Recommendations

Establishing a sound monitoring system. Existing indicators and statistics for the bioeconomy have important drawbacks:

Table 1: List of indicators by societal objective for the BioMonitor Project

1. Food and nutrition security
Availability of food
Access to food
Utilization
Stability
2. Sustainable natural resource management
Sustainability threshold levels for Bioeconomy Technologies
Biodiversity
Land cover
Primary biomass production
Sustainable resource use
3. Dependence on non-renewable resources
Bio-energy replacing non-renewable energy
Bio-material replacing non-renewable resources
Biomass self-sufficiency rate
Material use efficiency
Certified bio-based products
4. Mitigating and adapting to climate change
Greenhouse gas emissions
Climate footprint
Climate change adaptation
5. Employment and economic competitiveness
Innovation
Investments
Value Added of the bioeconomy sectors
Comparative advantage
Production and consumption of non-food and feed bio-based products
Import and export of bioeconomy raw materials and products
Employment
Policies

Sustainability dimension: ■ Social ■ Environmental ■ Economic

they do not capture well the data on the current and potential future of biomass' industrial use. The current statistics rely mostly on ad hoc industry surveys and assessment by experts, and they do not sufficiently illustrate flows from raw materials to industrial end products, including bio-waste streams. Therefore, procedures to collect more precise data are needed, in particular those that feature new products. The market of new bio-based products is still very volatile as many new initiatives appear and disappear from the market and not all bio-based products can be singled out in statistics. Therefore, a selection of the products that need to be covered will be based on a sound market analysis.

Ultimately, a monitoring framework relies on the quantity and quality of data collected. The BioMonitor project will work together with public and private stakeholders to develop methodologies for collecting new and improving existing data sets to be considered by policymakers and statistical offices.

Indicators for public and private initiatives to advance the circular bioeconomy. The potential of the sustainable bioeconomy can be measured by considering indicators for innovation, supporting policies, strategies and legislation. Policy measures can be implemented at a regional, national, supranational, or

global level. These can make a significant contribution to promote the bioeconomy and often provide the foundation for establishing new bio-based industries. New spatially differentiated indicators are suggested for revealing these effects, measuring inter alia, 'Innovation' via 'Number of patents submitted by field and sub-field' and 'Innovation hurdle for different industries', and 'Policies' via 'Policy-induced investment hurdles' and 'Country level strategies'.

Indicators for the development of a sustainable and circular bioeconomy.

The three sustainability dimensions of the bioeconomy have so far been assessed mainly in isolation. BioMonitor advances in this regard by addressing all dimensions together, using a broad range of indicators. Our set of indicators measures the degree of circularity of the bioeconomy as well as its contribution to the Sustainable Development Goals. We measure, among others, 'Material use efficiency' and 'Sustainable resource use'. The specific methods to quantify these indicators will be developed within the project. They include econometric tools, which will be used to identify past and future trends, as well as economy wide and sector-specific models. These quantitative information will help stakeholders understand the different scenarios of future developments.

Notes

1 Please see Chapter 4.2.1 in BioMonitor D1.1 for a detailed list of the sectors in bioeconomy (Available at <http://biomonitor.eu/technical-insights/>).

Bibliography

- CEPI (Confederation of European Paper Industries) 2017: The forest fibre and paper industry in 2050: Investing in Europe for Industry Transformation - 2050 Roadmap to a low-carbon bioeconomy, http://pi.org/system/files/public/documents/publications/innovation/2017/roadmap_2050_v07_printable_version.pdf.
- EuropaBio (2017) Strengthening Biotechnology and the Eu Project. Available at: [http://www.europabio.org/sites/default/files/Printed version lowres.pdf](http://www.europabio.org/sites/default/files/Printed%20version%20lowres.pdf) (Accessed: 6 August 2018).
- European Commission (2018a). A sustainable bioeconomy for Europe : strengthening the connection between economy, society and the environment. Updated Bioeconomy Strategy. doi: 10.2777/478385.
- European Commission (2018b). Bio-based and applied economics. Available at: <https://datam.jrc.ec.europa.eu/datam/mashup/BIOECONOMICS/index.html> (Accessed: 3 September 2018).

- Hetemäki, L., Hanewinkel, M., Muys, B., Ollikainen, M., Palahí, M., Trasobares, A., 2017. Leading the way to a European circular bioeconomy strategy. From Science to Policy 5. European Forest Institute.
- SAT-BBE (2015) 'Systems analysis description of the bioeconomy', (March), pp. 1–40.
- Wesseler, J. and von Braun, J. (2017) 'Measuring the Bioeconomy: Economics and Policies', Annual Review of Resource Economics, 9(1), pp. 275–298. doi: 10.1146/annurev-resource-100516-053701.
- Zilberman, D., Gordon, B., Hochman, G., & Wesseler, J. (2018). Economics of sustainable development and the bioeconomy. Applied Economic Perspectives and Policy, 40(1), 22–37. <https://doi.org/10.1093/aep/ppx051>

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