The Status of Regional Bioeconomy: Developing a Multi-Criteria Assessment (MCA) Framework to Evaluate Regional Potential in the EU of 27

Panos Kalimeris[1,2], Georgios Maroulis[1,2], Panagiotis Koronaios[1,2], Antonios Rovolis[1,2]

1. Department of Economic and Regional Development, Panteion University of Athens, Greece.
2. Institute of Urban Environment and Human Resources, Panteion University of Athens, Greece

Extended Abstract

Bioeconomy is presented as a promising alternative framework towards a more efficient and greener economy based on the replacement of non-renewable and fossil resources with renewable ones. In a nutshell bioeconomy, based on the European perception of the term, could be described as an economic framework operating with the use of biomass as an input to fulfil the economy's needs, such as food, feed, materials and energy (Proestou et al., 2024). The transition to a circular and sustainable bioeconomy is a key priority for the European Union which identifies bioeconomy as the vehicle towards achieving the European Green Deal. As a result, the first European Bioeconomy Strategy established in 2012, aimed to harmonize economic with environmental and social related goals (European Commission, 2012). In 2018, the European Bioeconomy Strategy was updated by adding new parameters in the framework and emphasizing the cross section of bioeconomy with circular economy, as well as the environmental related topics and the importance of the regions (European Commission, 2018).

The importance of regions in the implementation of European Union's bioeconomy strategy remains crucial for the transformational process of the linear economy (European Commission, 2022). The transformation process could be challenging, especially in regions with carbon-intensive economic activities, such as coal mining, intensive agriculture, forestry, and fishery sectors. Towards this direction, the Horizon Europe "BIO2REG" project (https://bio2reg.eu/) funded by the European Union, aspires to design and implement a region-specific blueprint for assessing the EU's regional transition to bioeconomy. Towards this objective, a Multi-Criteria Assessment (MCA) framework was designed to identify the status of bioeconomy in the EU regions. The presented study is based on the methodology followed in a prior effort to classify the status of the regions of the 8 countries participating in the "BIO2REG" project and is further extending the analysis by including the total 244 NUTS II (Nomenclature of Territorial Units for Statistics) regions of the EU-27.

Methodology

An extensive literature review took place to examine the current state of knowledge on bioeconomy, structured around four main pillars:

1. Academic and scientific research on bioeconomy indicators.
2. Reports from international organizations and bioeconomy strategies of non-EU countries.
3. EU research institutions and bioeconomy strategies of the EU member states.
4. Past and ongoing projects on bioeconomy indicators and monitoring, assessed for adaptable methodologies to support the proposed Multi-Criteria Assessment (MCA).

During the review process, widely recognized bioeconomy indicators were identified and classified into three categories namely, economy, society, and environment. This process led into the identification of 897 bioeconomy indicators. In the initial stage of the MCA, the Traffic Light Assessment (TLA) method was applied to categorize the indicators into four groups: green (accepted), orange (potential/currently rejected), red (rejected), and grey (other/currently rejected). This classification helped refine the selection, resulting in a final set of 41 quantifiable indicators relevant NUTS II regional level.

Moreover, two qualitative indicators were also included and considered positively related to regional bioeconomy status. The first is the existence/or not of a national bioeconomy strategy in the country where the regions belongs, as well as the presence/or not of any regional bioeconomy strategies.

Finally, a MCA was performed using the TOPSIS methodology to evaluate and prioritize the selected indicators. The study compares three (3) different scenarios of ranking:

1. **The base scenario**. Initial equally weights ranking by using TOPSIS. In this scenario all indicators have equal importance in the ranking process.
2. **The weights' ranking scenario.** This scenario is based on the modified TOPSIS ranking, where the estimated weights were generated automatically by the dataset itself, by using the Shannon entropy weighting technique.
3. **The experts' weights ranking scenario:** The third scenario is using estimated weights based on the opinions of the BIO2REG consortium, provided during an internal collaboration session, took place in the 1st annual meeting in Germany, in February 2025.

Furthermore, since a disaggregated approach seems more proper for identifying more case-specific characteristics of regional bioeconomy performance, we apply all the three scenarios in specified rankings considering the next groups and sub-groups of the total bioeconomy indicators:

- **Economy group**: Ranking is performed into three sub-groups, namely:
  1. Pure economy indicators ranking
  2. Bioeconomy & innovation indicators ranking
  3. Sectoral bioeconomy indicators ranking (All sectors)
- **Society group**: Group ranking is performed as it is.
- **Environment**: Group ranking is performed as it is.
- **Bioeconomy per sector**: A more targeted ranking per sector (8 sectors[1])
- **Total Bioeconomy Indicators**: The total aggregated dataset of indicators

Concluding remarks

The analysis indicates the state of regional bioeconomy across 244 European regions (NUTS II) of the total EU-27 group of countries. As a result, a detailed ranking of all regions, based on the three scenarios applied into different groups and sub-groups of

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[1] Following NACE Rev. 2 statistical classification of economic activities in the European Community, the sectors are: A01 Agriculture, A02 Forestry, A03 Fishing & Aquaculture, C10-C12 Food, Beverage & Tobacco, C13-C15 Bio-based textiles, C16-C31 Wood products & furniture, C17 Paper, C20-C22 Bio-based chemicals, pharma, plastics & rubber.

indicators, will be presented to the conference. Emphasizing in each distinct scenario, we identify hidden sectoral patterns, as well as strengths and weaknesses of the regions in each thematic area, leading to comparisons among regions and revealing the best performing (champion) regions. Identifying the champion regions, for specific groups of bioeconomy indicators, could further support the transfer of best practices and know-how, from the strongest to the weakest regions and, thus, function as an instrument for shaping future regional bioeconomy policies.

Acknowledgements

References

European Commission (2012). Directorate-General for Research and Innovation, Innovating for sustainable growth – A bioeconomy for Europe, Publications Office, 2012, https://data.europa.eu/doi/10.2777/6462

European Commission (2022). Directorate-General for Research and Innovation, European bioeconomy policy – Stocktaking and future developments – Report from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, Publications Office of the European Union, 2022, https://data.europa.eu/doi/10.2777/997651

European Commission: Directorate-General for Research and Innovation. (2018). A sustainable bioeconomy for Europe: strengthening the connection between economy, society and the environment: updated bioeconomy strategy. Publications Office. https://data.europa.eu/doi/10.2777/792130.

Proestou, M., Schulz, N., & Feindt, P. H. (2024). A global analysis of bioeconomy visions in governmental bioeconomy strategies. Ambio, 53(3), 376–388. https://doi.org/10.1007/s13280-023-01958-6