biomonitor

POLICY BRIEF #2

Relevance of current modelling tools for offering policy insights for the creation of a vibrant European Bioeconomy by 2030 and 2050

Abstract

The BioMonitor project aims to understand the status of current modelling tools for offering policy insights for the creation of a vibrant European Bioeconomy by 2030 and 2050 and to provide recommendations based on improved modelling capacity within the BioMonitor Model Toolbox (Infopack #1).
The research performed in the project evaluates the alignment of a selective mix of current modelling capacities (Varacca et al., 2020) with a need of assessment of policy interventions relevant to the EU bioeconomy including their capabilities to address the five core objectives of the European Bioeconomy Strategy.
Existing gaps are highlighted with respect to surrounding policy goals inadequately answered or modelled, as well as bioeconomy sectors, value chains, and indicators that are insufficiently captured. Underlining the barriers between modelling research and policy-making groups will facilitate better collaboration of future policy agendas and strategies through openness and transparency, data development, and targeted interventions for value chain-based challenges.

Key points

BioMonitor analysis on the current modelling capacity for assessment of policies related to bioeconomy shows:

- **No single model is able to sufficiently cover all areas of the bioeconomy; a mix of modelling tools is required.**
- **The inadequate or missing representation of bio-based products and their respective value chains remains a key challenge.**
- **Further integration of indicators for the assessment of bioeconomy developments in modelling tools is needed.**

Introduction

The EU has set up the Bioeconomy Strategy as part of the Circular Economy Action Plan and the Green Deal (European Commission, 2019), to steer the use of biomass in several sectors and to achieve multiple policy goals that will aid in the transition to a more sustainable economy by 2050. The Strategy sets five core objectives: i) ensuring food and security, ii) managing natural resources sustainably, iii) reducing dependence on non-renewable resources, iv) mitigating and adapting to climate change, and v) creating jobs and strengthening European competitiveness.
These objectives mirror the Sustainable Development Goals (SDGs) which target sustainability and growth. As such, they require robust integration among new policies and coordinated research and industry developments that go hand-in-hand with regulatory frameworks for bio-based products and markets (European Commission, 2018).
There is, however, limited guidance available for decision-makers on which model(s) to select for policy planning (Allen et al., 2016). Given the bioeconomy's eclectic mix of sectors and topics, from land management to biotechnological or biochemical refining, there is no single 'one-size-fits-all' model with this degree of coverage. Instead, the landscape is fragmented into models of different classifications and foci. This, in turn, complicates the selection of the 'right' model(s) for the right policy, an issue on which this project seeks to shed light.
BioMonitor will evaluate the alignment of a selective mix of current modelling capacities and policy interventions relevant to the EU bioeconomy and the five objectives of the Strategy.

Overview of initial research findings

Our initial findings show that some models can provide cross-sectoral and cross-value chain insights, linking a more aggregated definition of economic sectors (e.g. across agriculture, energy, industry, etc.) and policies with environmental impacts, land use dynamics, or final consumption patterns. Other models, however, focus solely on specific sectors/products, value chains and policies, but go into more detail.

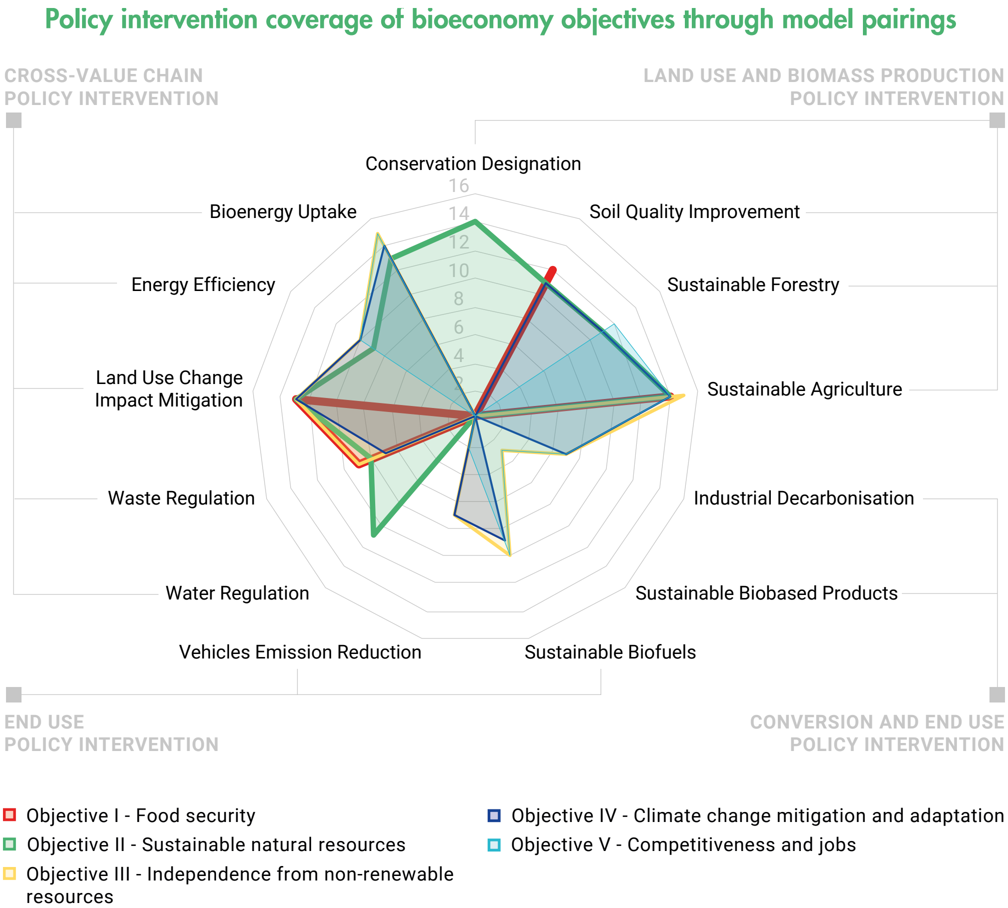
An exercise that cross references models with policies has been applied to illustrate how models jointly address the bioeconomy objectives, where there are gaps as well as the opportunity for the former to inform on the broader impact of the latter. For each value chain stage, individual policies currently addressed by the models were grouped under the following categories:

- Land use and biomass production: policies dealing with land use and biomass production including conservation designation, soil quality improvement, and sustainable agriculture and forestry.
- Conversion and end use: policies dealing with industrial decarbonisation and sustainable bio-based products.
- End use: policies dealing with sustainable biobased products, biofuels and vehicle emissions reduction.
- Cross-value chain: policies dealing with water and waste regulation, land use change impact mitigation, energy efficiency and bioenergy uptake.

The majority of these policies are focused on environmental sustainability drivers, for instance among policies aimed at supporting the conversion stage, most are largely emissions focused (e.g. the Medium Combustion Plant Directive (European Union, 2015) within the industrial decarbonisation policy intervention). As such, it is crucial to identify which models can tie economic drivers with environmental ones (e.g. farm incomes with environmental issues like soil quality, etc.).

Figure 1 below illustrates the number of models paired with policy interventions and the bioeconomy objectives these jointly address.

Figure 1: Cross referencing thirty-two models (see list in Annex) with policy interventions for relevance with bioeconomy objectives



Overall, models and policies are most synergetic in addressing objectives II and IV, followed closely by objectives III and V. The former is due to a high number of environmental model output indicators and environmentally focused policies.

Objective I has a lower representation here since nine out of thirteen policy interventions do not directly target food security and as such, the modelling focus is largely on energy, industry, forestry or environment.

In terms of cross-sustainability insights, the land use impact mitigation policy intervention, largely focused on environmental sustainability, is strongly tied to objective I and III, both encompassing economic growth factors.

Agriculture and biomass from energy are highly synergistic with models, though the latter is limited for objective I.

Waste regulation is aligned with around half of models (sixteen out of thirty-two) and as such cuts across four objectives. This is due in part to the assumption that models have the capacity to translate new input creation into alternative biomass or integrated soil fertility management. In the following pairing sub-framework, further analytical scrutiny is applied using economic sectors.

The sustainable bio-based products policy intervention, which explicitly targets the growth of the bioeconomy, has limited modelling support as only three models have the capacity to simulate the market uptake of such products.

Policies supporting sustainable biofuels are aligned with a higher number of models (10) to address most bioeconomy objectives, while those explicitly tying all value chain stages have a much stronger coherence across bioeconomy objectives through modelling support, including bioenergy uptake and land use change impact mitigation (with at least four bioeconomy objectives and between thirteen and fifteen models).

Conclusions and Policy Recommendations

The multi-sectoral, cross-value chain and multi-dimensional sustainability representation of the EU bioeconomy across the pairing framework illustrates a challenge for modellers and policymakers, who must collaboratively assemble its numerous and distinct components and generate a clear support plan for its objectives.

There are both considerable limitations and opportunities on how modelling capacities and policy goals are aligned, the former include a lack of representation of ecosystem indicators, conversion value chain stage, bio-based industry and waste sectors.

A crucial message from this analysis is the wide, available range of bioeconomy products, including biopharmaceuticals, fine biochemicals, bioplastics, and bulk materials (Stegmann et al., 2020) which remain underreported in modelling studies. This could be due to their highly variable impact measurements (Briassoulis et al., 2020) or a lack of cross-value chain insights tying end-products with their land footprint within model capacities. Models and policies should use established research and legislation surrounding bio-based energy to encapsulate further a broader set of bioeconomy innovations. One of the main challenges that lies ahead is the need to harmonise biophysical and environmental constraints with market and consumer behaviour factors. Since models are not designed in an ideological silo (Kolkman, 2020), or expected to single-handedly answer to all five objectives, optimising knowledge exchange with the policy-making arena is a crucial part of this way forward. The focus should be on how efficiently modellers and academics can collaborate with policy-makers, consultants, lobbies and think-tanks to pursue data collection and software capacity development tailored to the Bioeconomy Strategy.

Increasing relevance within high-level EU consortia and support from interdisciplinary networks can match the potentially highly demanding skillset of combined models, which ultimately lead to a higher capacity linking economic drivers and biophysical dynamics.

Meanwhile, openness and transparency can lead to decreasing time lags between policy formulation and modelling development, while improving the knowledge exchange on specific challenges for each value chain stage.

Annex – Model(s) analysed

InVEST[1]

G4M[2], CBM-CFS3[3], EFDM[4] & EFISCEN[5]

PRISM-ELM[6] & EPIC[7]

MAgPIE[8]

MITERRA[9]

CLUMondo[10] & Dyna-CLUE[11]

FARMIS[12]

BeWhere[13]

MESSAGE[14], TIMES[15] & MARKAL[16]

GCAM[17]

REMIND[18]

IMAGE[19]

BIOSAMs[20]

MAGNET[21], MIRAGE[22] & GTAP[23]

GLOBIOM[24]

AGMEMOD[25], ESIM[26], CAPRI[27] & AgLink-COSIMO[28]

GFTM[29], GFPM[30] & EFI-GTM[31]

IMPACT[32]

Notes

1 https://naturalcapitalproject.stanford.edu/software/invest

2 https://iiasa.ac.at/web/home/research/researchPrograms/EcosystemsServicesandManagement/G4M.en.html

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14 https://docs.messageix.org/en/stable/; https://iiasa.ac.at/web/home/research/researchPrograms/Energy/MESSAGE.en.html

15 https://iea-etsap.org/index.php/etsap-tools/model-generators/times

16 https://iea-etsap.org/index.php/etsaptool/model-generators/markal

17 http://jgcri.github.io/gcam-doc/overview.html

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