Research Brief: 
**SDGs in the global MAGNET model for policy coherence analysis**

**HIGHLIGHTS**

- Adopted by 193 country members of the United Nations, the Sustainable Development Goals (SDG) provide a sound framework for analysing the coherence of simulated policy mixes.
- The MAGNET model (CGER) has been adapted for the simulation of bioeconomy scenarios towards 2030. The impacts of such scenarios can be assessed through the lens of SDGs, identifying synergies and contradictions among economic, social and environmental objectives.
- Composite indicators and correlation indices could help to handle the complexity of dealing with the multiplicity of scenarios, SDGs and regions at stake.

**Policy coherence** aims to **minimise contradictions** and **build synergies between (EU) policies.**

**The SDGs as a framework for defining areas for improvements by 2030**

- United Nations’ Sustainable Development Goals (SDGs) are universally agreed
- They provide a comprehensive list of economic, social and environmental areas of development
- The SDGs’ areas of development can be impacted by one or more sectoral or regional policy

**MAGNET, a modelling tool to analyse possible policy settings**

- The MAGNET model (Modular Applied GeNeral Equilibrium Tool) is a global general equilibrium model which is a derivative of the well-known Global Trade Analysis Project (GTAP) model.
- It is developed and applied at Wageningen Economic Research (WECR) and is also employed by the Thünen Institute (TI) and the Joint Research Centre (JRC/D).
- Its broad coverage of policies and indicators can help to identify contradictions and synergies between simulated policies.
**Applied to the Bioeconomy**, the MAGNET model gives insights into the development of various SDGs.

**MAGNET for observing the path of reference scenario:**

Between 2015 and 2030

- **GDP per capita**: GDP growth is expected in all regions of the world, peaking at +33% in Africa.

- **Food production**: Food production contracts in the EU and North America, while growing by 14% in Africa.

- **Calories p.c./day**: Food intake nearly stabilises in the EU and North America, while it keeps growing in other regions.

- **Food imports**: Increasing trade openness worldwide, is associated with more dependence on food imports in Africa.

- **CO2 emissions**: Substantial CO2 emission reductions expected in the EU28 (-26%) and the ROW (Rest Of the World) region.

Source: MAGNET – Bioeconomy scenario (forthcoming report)
**MAGNET for observing EU Member States**

Figure: Trade competitiveness of renewable energies in EU regions in 2030 (reference scenario)

Balassa index of Revealed Comparative Advantage (RCA)

- 0 to 0.5
- 0.5 to 1
- 1 to 1.5
- > 1.5
- Non EU

If RCA > 1, then region exhibits revealed comparative advantage

12 EU regions considered: France, Germany, Italy, United Kingdom, Ireland, Austria, EU Mediterranean (Spain, Greece, Portugal), Scandinavia (Sweden, Finland, Denmark), BeNeLux (Belgium, Netherlands, Luxembourg), Baltics (Latvia, Lithuania, Estonia), EU East (Poland, Czech Republic, Slovakia, Hungary, Rest EU13 (Bulgaria, Romania, Croatia, Slovenia, Cyprus, Malta)

Source: MAGNET – Bioeconomy scenario (forthcoming report)

**The SDGs as a normative framework for policy analysis related to the "Bioeconomy":**

Using the SDGs as a universal reading grid to compare different possible pathways implies crossing data for a high number of SDG-related indicators, at different regional levels and according to different possible pathways.

Heat maps can be used to visualise this complexity, as shown in the table below that presents the variation of a selection of indicators in four bioeconomy scenarios compared to the EU reference scenario in 2030 and for the EU28. The scenarios are: HT=High tech; NoM=No Mandate; RED2, BioE=only bioethanol in RED1. More details see Research Brief “Exploring bio-based futures in the EU – a MAGNET model based assessment”.

![Heat Map](image.png)

**Figure: % change of selected SDG-related indicators in four different scenarios compared to the EU reference scenario (EU region, 2030)**

<table>
<thead>
<tr>
<th>SDG</th>
<th>Indicator</th>
<th>HT</th>
<th>NoM</th>
<th>RED2</th>
<th>BioE</th>
</tr>
</thead>
<tbody>
<tr>
<td>SDG7</td>
<td>EU expenditure by primary energy on biobased feedstocks</td>
<td>-1.8</td>
<td>-18.7</td>
<td>3.7</td>
<td>-2.5</td>
</tr>
<tr>
<td>SDG7</td>
<td>EU renewable energy share in final energy consumption</td>
<td>-4.0</td>
<td>-50.2</td>
<td>7.2</td>
<td>-5.8</td>
</tr>
<tr>
<td>SDG7</td>
<td>EU real price index of fossil energies</td>
<td>-0.7</td>
<td>-4.5</td>
<td>-0.3</td>
<td>-0.7</td>
</tr>
<tr>
<td>SDG7</td>
<td>EU real price index of renewables energies</td>
<td>-2.1</td>
<td>0.1</td>
<td>0.1</td>
<td>0.3</td>
</tr>
<tr>
<td>SDG7</td>
<td>Land usage in 1st generation bioethanol</td>
<td>0.8</td>
<td>-71.3</td>
<td>-31.2</td>
<td>395.8</td>
</tr>
<tr>
<td>SDG7</td>
<td>Land usage in 1st generation biodiesel</td>
<td>0.1</td>
<td>-97.5</td>
<td>-46.8</td>
<td>-99.9</td>
</tr>
<tr>
<td>SDG8</td>
<td>EU net trade value</td>
<td>-0.5</td>
<td>0.6</td>
<td>-0.2</td>
<td>0.3</td>
</tr>
<tr>
<td>SDG8</td>
<td>EU trade competitiveness of renewable energies</td>
<td>4.4</td>
<td>-6.3</td>
<td>13.5</td>
<td>-12.1</td>
</tr>
<tr>
<td>SDG9</td>
<td>CO₂ emissions per value added in the crop sector</td>
<td>-0.7</td>
<td>-3.6</td>
<td>0.0</td>
<td>-0.7</td>
</tr>
<tr>
<td>SDG12</td>
<td>EU renewable energy share in final energy production</td>
<td>-2.3</td>
<td>-12.6</td>
<td>3.4</td>
<td>-1.1</td>
</tr>
<tr>
<td>SDG13</td>
<td>EU production cost share in value added in agriculture</td>
<td>1.4</td>
<td>0.6</td>
<td>-0.6</td>
<td>0.0</td>
</tr>
<tr>
<td>SDG13</td>
<td>EU production cost share in value added in bio-energy sectors</td>
<td>1.2</td>
<td>17.6</td>
<td>-0.3</td>
<td>4.0</td>
</tr>
</tbody>
</table>


Source: MAGNET – Bioeconomy scenario (forthcoming report)
How to assess and represent diverging scenario impacts at SDG level?

Research is on-going to objectively reduce the complexity. A possible methodological option is the elaboration of SDG correlation indices, or of composite indicators (e.g. at SDG level) after agreeing on the relative weight of each of sub-indicators.

The below table shows that sub-indicators of a given SDG can score differently, which makes difficult to attribute one single score to the SDG considered (here SDG 7).

![Figure: % change of SDG7-related indicators in four different scenarios compared to the EU reference scenarion (EU region, 2030)](image)

<table>
<thead>
<tr>
<th>Indicator</th>
<th>HT</th>
<th>NoM</th>
<th>RED2</th>
<th>BioE</th>
</tr>
</thead>
<tbody>
<tr>
<td>EU expenditure by primary energy on bio-based feedstocks</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EU renewable energy share in final energy consumption</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EU real price index of fossil energies</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EU real price index of renewables energies</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Land usage in 1st generation bioethanol</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Land usage in 1st generation biodiesel</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: MAGNET – Bioeconomy scenario (forthcoming report)

Such an approach could also help linking the SDGs (universally agreed framework) with the societal challenges defined by the European Commission. That way, science-based evidence (here model simulations) can support policy analysis by providing a synthetic view of the expected impacts of a policy option portfolio, their adequacy to pre-defined strategic orientations (e.g. SDGs or EU societal challenges) as well as potential contradictions and synergies.

In the following figure a further simplified version including different SDGs is presented. Decisions on the colour-coding are rather complex and therefore are characterised as a draft only at this stage. More (composite) indicators and a weighting system are needed for a balanced decision.

![Figure: Heat map scoring five bioeconomy scenarios with regards to SDGs and societal challenges](image)

Source: MAGNET – Bioeconomy scenario (forthcoming report)
Challenges ahead and general remarks:

- The MAGNET model has proved valid over time for scenario analysis in the fields of agriculture, trade, food nutrition and security, renewable energy and the bioeconomy. These areas relate strongly to food security (SDG 2), energy mix (SDG 7), jobs and growth (SDG 8), balanced territorial development (SDG 10), Greenhouse Gas Emissions (SDG 13) and land use (SDG 15). Thus, MAGNET can make a valuable contribution to the integrated assessment of different policy mixes in the light of the SDG framework.

- There is scope for further development of new and/or more precise SDG indicators in MAGNET that would better align with official SDG indicators. Such progress is even more interesting when a framework is concomitantly developed to handle the great complexity given by the variety of scenarios, regions, economic sectors, sustainability dimensions and indicators at stake.

- Next challenge will thus be to develop such a framework. It starts from the initial phase of designing scenarios well suited to answer specific policy questions. It also relates to the indicators themselves: weighing indicators within SDGs, building correlation indices, etc.

Acknowledgement: The work related to the further development of the MAGNET model and the SDG implementation has been co-funded by the European Commission’s Directorate General for Research and Innovation as well as the Directorate General for Agriculture and Rural Development.

Disclaimer: The scientific output expressed does not imply a policy position of the European Commission. Neither the European Commission nor any person acting on behalf of the Commission is responsible for the use that might be made of this publication.

References and further literature


Authors: SHUTES Lindsayb; PHILIPPIDIS Georgea,b,c; M’BAREK Roberta; RONZON Tévéciad; FERRARI Emanuelea; VAN MEIJLBans.1

aEuropean Commission, Joint Research Centre (JRC), Directorate for Sustainable Resources, Economics of Agriculture, Seville, Spain
bWageningen Economic Research, Wageningen University, The Hague, Netherlands.
cCentro de Investigación y Tecnología Agroalimentaria (CITA), Gobierno de Aragón, Zaragoza, Spain.

CONTACT: Robert.M’BAREK@ec.europa.eu