



The European Commission's Knowledge Centre for Bioeconomy

Upscaling bio-based chemicals and plastics in the EU

Exploratory economic modelling for bio-based pathways to 2040
2026

HIGHLIGHTS

- ▶ Taking a 2040 time horizon, this brief presents the main findings from a policy scenario [1] that focuses on the upscaling of biomass in the EU bio-based chemicals and plastics industries.
- ▶ The scenario assumes an upscaling to a bio-based share of 15% in both chemicals and plastics production, assuming 'high' levels of input-saving technological improvements and with non-food sources constituting 30% of the total biomass requirements.
- ▶ By 2040, bio-based chemicals and plastics are expected to generate a turnover of EUR 148 billion and a value added of EUR 18.2 billion in the upscaling scenario, compared with EUR 68 billion in turnover and EUR 9.2 billion in value added in the 2040 baseline.
- ▶ By 2040 the upscaling scenario would generate 210.000 additional jobs in the two upscaled sectors in comparison with the 2040 baseline, reaching approximately 360,000 jobs.
- ▶ GHG emissions in the two bio-based sectors increase slightly. However, due to the substitution of fossil technologies with bio-based alternatives, there is an overall reduction of emissions from the entire EU chemicals and plastics industries.
- ▶ Examining the consumer demand-driven footprints, land use increases because of a stronger dependence on bio-based feedstock, while emission footprints remain at similar levels.
- ▶ Overall, the results of this study indicate that such policy-driven expansion can contribute to a more sustainable growth path for the EU's bioeconomy at a small macroeconomic cost. Environmental and macroeconomic trade-offs appear limited under ambitious assumptions in terms of productivity gains derived from investments and/or targets of non-food biomass used as inputs. However, such trade-offs should be carefully evaluated under less ambitious assumptions.
- ▶ Policy coherence and the deployment of multi-instrument, bioeconomy-related interventions will be necessary to increase sustainability and competitiveness in the EU.

Background

This policy brief accompanies the JRC Technical Report **“The EU bioeconomy towards 2040: an exploratory baseline with a whole-economy, an agricultural and a bio-based industry model”** [1].

This report presents a modelling framework that integrates several enhancements and alignments to ensure its applicability to current policy discussions within the bioeconomy arena. This is particularly relevant in light of the EU Bioeconomy Strategy (2025) [2], which defined lead markets for bio-based products and technologies, as well as the upcoming Biotech Act II (2027), which will aim at developing biotechnology and biomanufacturing in the EU.

The study also presents a ‘business-as-usual’ or baseline scenario until 2040, reflecting current trends without major changes in societal behaviour or policies. It serves as a point of reference for assessing alternative bioeconomy futures against the societal challenges of the bioeconomy. The set of main assumptions is detailed in Box 1.

Box 1. Assumptions in the baseline scenario

- Following the projection from the EU Agricultural Outlook 2025-2035 [4], crop production will increase up to 2040 due to yield growth. An increase in the use of biomass for animal feed is also projected, reflecting stable preferences for animal protein.
- Biofuel use declines as electric transport grows, while crop-based biofuel feedstock shifts to material industries.
- A reduction in emissions from all sectors due to carbon pricing is also assumed; agriculture emissions rise as a share of total EU emissions.
- The bioeconomy reduces the EU’s dependence on non-renewable resources supported by reduced import dependency and a greater use of residues and renewables, although progress is constrained by limited availability of sustainable feedstock and challenges in reaching commercial scale.
- Competitiveness drives bio-industrial growth with notable expansion in biochemicals, although overall bio-industrial employment declines due to food sector contraction.

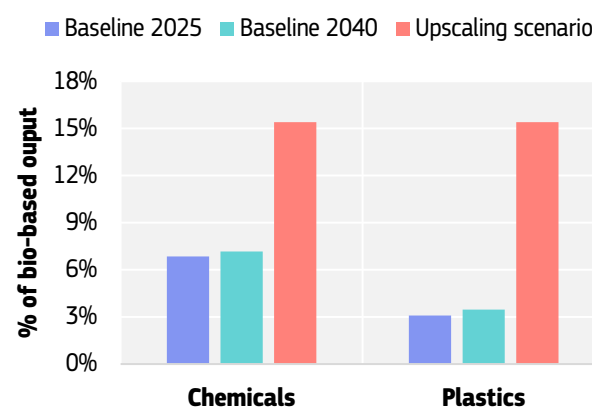
Aim and scenario design

This brief presents the **main findings of a policy scenario introducing market interventions aiming at upscaling bio-based chemicals and plastics production in the EU by 2040**. For this purpose, macro-economic and environmental impacts from the global Computable General Equilibrium model MAGNET [3] are presented, including the effects on turnover, value added, employment, GHG emissions as well as final demand-driven footprints on land and emissions. The footprint indicator encompasses the entire cradle-to-grave impacts from the use of both domestic and imported inputs to produce bio-based chemicals and plastics. Box 2 shows the main market interventions introduced under this upscaling scenario.

Box 2. Assumptions in the upscaling scenario

- Chemical and plastics sectors are assumed to commercially upscale their share of bio-based output to 15% of total chemical and plastics production from their current shares of 7% and 3%, respectively (see Figure 1).
- A higher bio-based chemicals and plastics technology growth environment, which assumes a greater rate of input-saving on non-biomass inputs.
- 30% of the demand for biomass associated with the upscaling comes from non-food sources (woody biomass and associated residues, advanced generation liquid ethanol derived from energy crops and residue sources and, to a very limited extent, composted green waste sources).

Figure 1. Share of bio-based output by sector in the EU



Source: Own elaboration.

Moreover, **results from additional simulations**, in which **only bio-based chemicals are upscaled**, are presented as a **sensitivity analysis** (see Box 3, tables 2 and 3). These comprise six additional scenarios that assess the impact of three different targets for the share of bio-based content in total EU chemical production (10%, 12.5%, and 15%), combined with two different levels of returns on investment in terms of productivity growth.

The results should be interpreted as the potential impacts under a hypothetical policy framework in which these assumptions are met. Conversely, assuming lower investment returns or the absence of biomass utilization targets would likely result in different (potentially reduced) estimated impacts.

Main results: bio-based industry¹

Turnover and value added

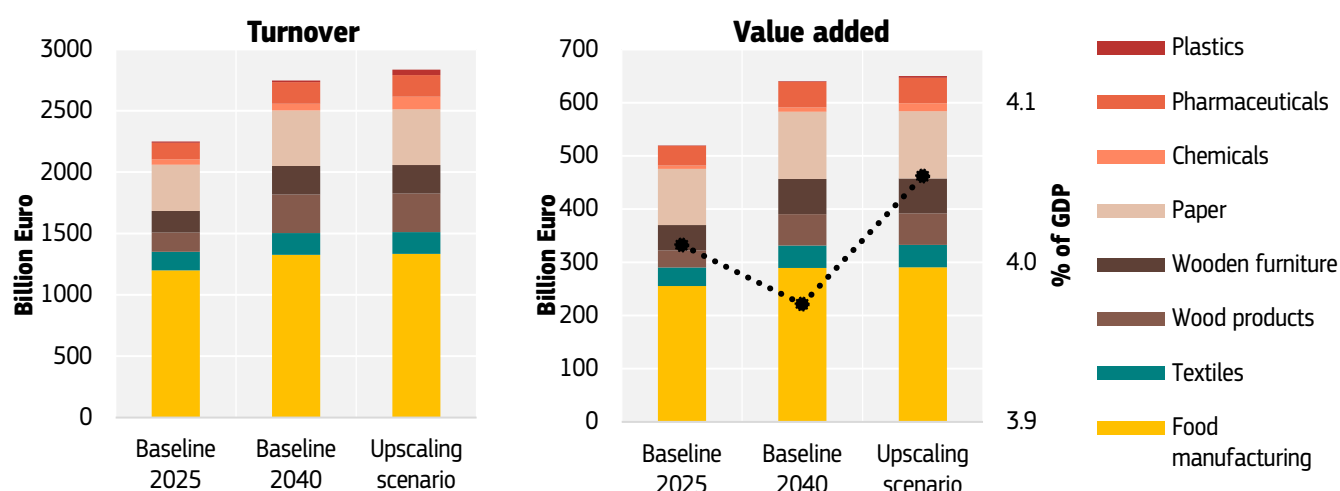
In the baseline scenario, turnover from the bio-based industry is projected to increase from EUR 2.25 trillion in 2025 to EUR 2.74 trillion in 2040. Furthermore, the value added generated by the bio-based industry is expected to grow in absolute terms from around EUR 520 billion in 2025 to EUR 640 billion in 2040 in the baseline (Figure 2). However,

this value added expressed as a share of Gross Domestic Product (GDP) would decrease in the same period from 4.01% in 2025 to 3.97% in 2040. This suggests a growth rate of the bio-based industry that is slightly below the EU's GDP during this period.

Under the upscaling scenario, turnover from bio-based manufacturing would increase to EUR 2.84 trillion in 2040 (+3.6% compared to the baseline in 2040), while value added is estimated at EUR 650 billion (+1.6% compared to the baseline). Consistent with the scenario assumptions, most of these differences are attributed to the bio-based chemicals and plastics sectors. Specifically, both activities are expected to generate a turnover of EUR 148 billion in 2040 under the upscaling scenario (of which 104 would belong to chemicals and 44 billion to plastics), compared to EUR 68 billion in the baseline in 2040 (EUR 55 from chemicals and EUR 13 billion from plastics).

As for value added, both activities would generate EUR 18.2 billion (EUR 14.8 billion from chemicals and EUR 3.4 billion from plastics) under the upscaling scenario, compared to EUR 9.2 billion (EUR 8.2 billion from chemicals and EUR 1.0 billion from plastics) in the baseline. In addition, by 2040 the bio-based industry share of GDP would increase to around 4.05% of GDP, compared with 3.97% of GDP in the baseline.

Figure 2. Turnover and value added in the EU27 bio-based industry²



Source: MAGNET simulations

¹ The term "bio-based industry" covers manufacturing activities producing food, bio-based textiles, wood products and furniture, paper, bio-based chemicals, pharmaceuticals, plastics and rubber.

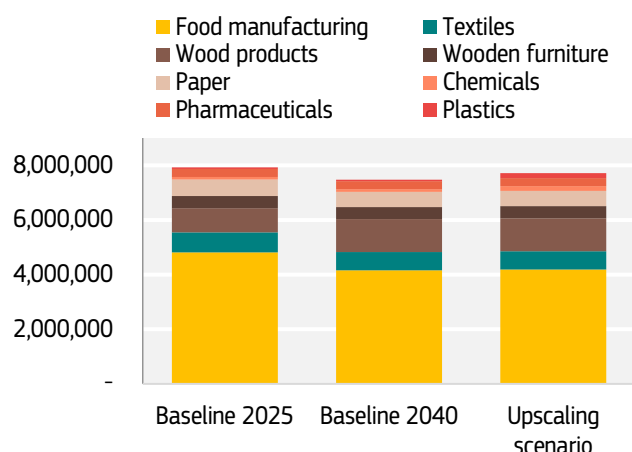
² The current version of the MAGNET model does not distinguish between bio-based and non-bio-based production for both textiles and

furniture sectors. To address this limitation, the reported values for these sectors have been adjusted using the bio-based share provided by the [Jobs and Growth in the EU Bioeconomy dataset](#) [5], which estimates bio-based production at 41.6% for textiles and 46.3% for wooden furniture.

Employment

Employment in the EU's bio-based manufacturing sectors is estimated at around 8 million jobs in the baseline in 2025, and it is projected to fall to 7.5 million jobs by 2040 (Figure 3 and Table 1). This trend is mainly driven by the food industry (-14%, -660 000 jobs), affected by overall productivity improvements on the supply side and a shrinking EU population on the demand side. However, the wood-based industry is projected to partially offset this reduction, especially employment in wood products manufacturing (+36%, 320.000 jobs). This rise reflects strong external demand for EU wood products, as slower global roundwood growth and faster economic expansion outside the EU create a supply bottleneck that boosts EU wood exports (see BioSIMs study [1] for further details).

Figure 3. Persons employed in the EU27 bio-based industry



Source: MAGNET simulations

Table 1. Employment per sector (thousand persons, 2040)

	Baseline 2025	Baseline 2040	Upscaling scenario
Food manufacturing	4 817	4 158	4190
Textiles	727	667	667
Wood products	889	1 206	1 207
Wooden furniture	443	444	442
Paper	602	555	556
Chemicals	98	99	181
Pharmaceuticals	293	292	291
Plastics	55	54	182

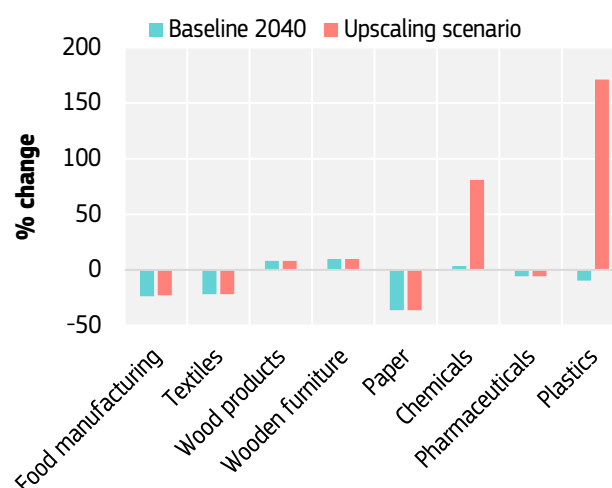
Source: MAGNET simulations

Under the upscaling scenario, the decline in employment compared with the baseline is partially offset, as the interventions in the bio-based chemicals and plastics sectors raises the total number of jobs in the bio-based industry to 7.8 million in 2040, with both targeted sectors generating 360.000 jobs (180.000 each), 210.000 more than in the baseline.

GHG emissions

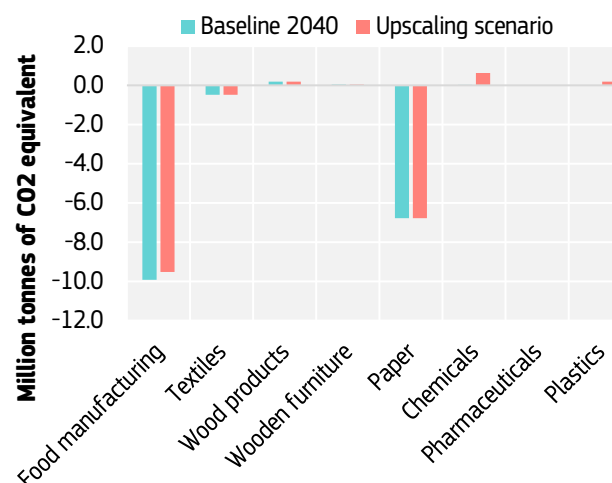
Assuming rises in carbon prices in the baseline scenario, most bio-based manufacturing activities reduce their emission levels between 2025 and 2040. The food, textiles, and paper industries show the highest reductions. It should be noted that, in absolute terms, the food industry remains the largest emitter. From a small base, the upscaling of bio-based chemicals and plastics results in a notable relative increase in GHG emissions associated with these activities (Figure 4). However, in absolute terms, this increase remains very small compared to the rest of the bio-based industries (see Figure 5). Additionally, due to the substitution of fossil-based chemical technologies with bio-based equivalents, there is an overall reduction of total emissions from all EU chemicals and plastics industries.

Figure 4. EU27 emissions change (%) of the upscaling scenario with regard to the baseline in 2025



Source: MAGNET simulations.

Figure 5. EU27 emissions change (MtCO₂e) upscaling scenario with regard to the baseline in 2025



Source: MAGNET simulations.

Focus on bio-based chemicals and plastics

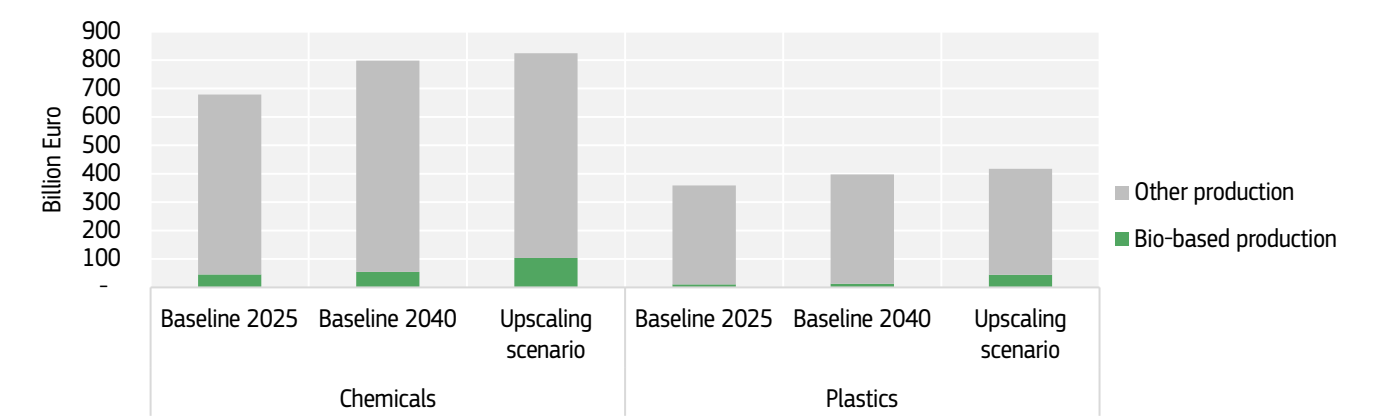
As Figure 6 shows, the upscaling of the share of bio-based chemicals and plastics to 15% of total chemicals and plastics production would increase the total turnover (using 2017 prices) of both sectors, including bio-and non-bio-based products, when compared with the baseline.

Turning to the environmental footprints (i.e. the resource impact across all stages of the bio-based chemical and plastics sectors’ value chain), in the upscaling scenario there is a rise in terms of the land footprint, driven by the increased reliance on bio-based feedstocks (Figure 7). Emission footprints in 2040 are, however, very similar in both the baseline and the upscaling scenario, showing a 14% reduction compared to 2025 (see Figure 8).

The increased emissions footprint in the upscaling scenario is offset by reductions in other bio-based industries, as well as other manufacturing and services sectors. The overall emissions footprint in the EU27 is lower, although this is also related to minor reductions in the overall level of economic activity under this scenario (with EU GDP 0.3% below the 2040 baseline level).

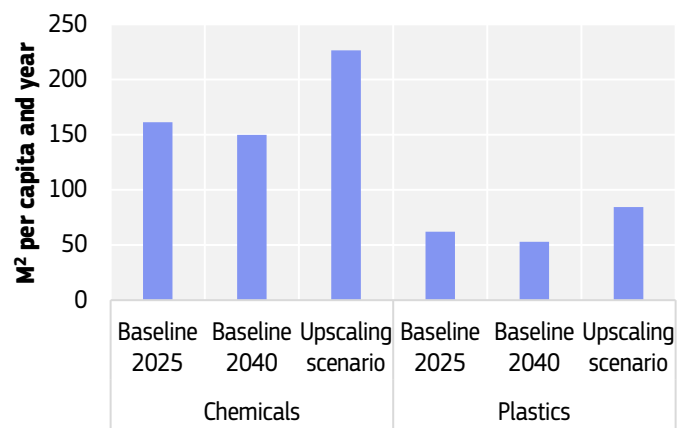
The limited-scale environmental and macroeconomic impacts compared with the baseline are largely determined by the scenario assumptions, which, as outlined in the introduction, incorporate ambitious targets for productivity improvements (i.e., input-saving technological progress) and a minimum 30% share of non-food biomass use, including by-products and residues. It should be noted that under less ambitious assumptions (i.e. lower rate of return on investments in terms of productivity gains or reduced targets for non-food biomass utilization), the environmental impacts could be more adverse.

Figure 6. Turnover (EUR million)



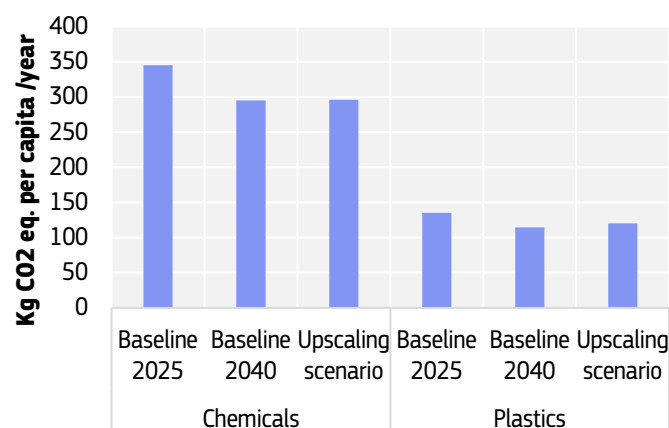
Source: MAGNET simulations.

Figure 7. EU consumer demand-driven land footprint for chemicals and plastics



Source: MAGNET simulations

Figure 8. EU consumer demand-driven emissions footprint for chemicals and plastics



Source: MAGNET simulations

Box 3. Impact of upscaling bio-based chemicals only: sensitivity analysis with different targets and pathways of technological progress

Additional analyses have been conducted considering only the upscaling of bio-based chemicals. This is relevant in the context of the EU Bioeconomy Strategy's lead market of bio-based chemicals and the upcoming Biotech Act II. As a type of sensitivity analysis, different simulations have been carried out, assuming three different targets for the quantity share of bio-based production in total chemical production (10%, 12.5%, and 15%) with the aim of measuring the impacts of different levels of policy ambition. Additionally, given the level of uncertainty associated between changes in investment and resulting technical change, a 'high' and a 'low' technological improvement pathway are explored. In the high technological progress scenarios, a higher rate-of-return is assumed, such that a 1% increase in the investment intensity yields a 0.1% gain in non-biomass input-saving productivity. In the lower technological progress scenarios, a 1% increase in investment intensity yields a lower 0.025% increase in non-biomass input saving productivity.

Table 2 shows production-related indicators for the EU chemical sector in 2040 under the baseline and the upscaling scenarios. Overall, as the target of bio-based content increases, the share of turnover generated from bio-based production is also higher, resulting in a higher sector-level turnover. Additionally, within each target, the lower-tech scenario consistently shows higher nominal turnover than the higher-tech scenario for bio-based chemicals, even if the production quantity is virtually the same in both technological pathways. The increase in the value of production should not, however, be interpreted as an increase in industry profitability, but rather as an input cost-push effect driven by a reduced efficiency in used inputs in the EU biochemical sector. This observation can be further demonstrated when calculating the average or unit costs of production (see below). The reason is the lower efficiency reached in lower-tech scenarios, which raises production costs relative to the higher-tech ones and, subsequently, the market prices of bio-based chemicals. Therefore, the same quantity is valued higher in nominal terms in the lower-tech scenarios, even though the high-tech pathways are more efficient in real terms. Lastly, emissions from chemical production decline as the bio-based target increases (from 101.6 million tonnes CO₂-eq at baseline to 97.6 million tonnes at the 15% target), as bio-based inputs substitute for non-bio ones.

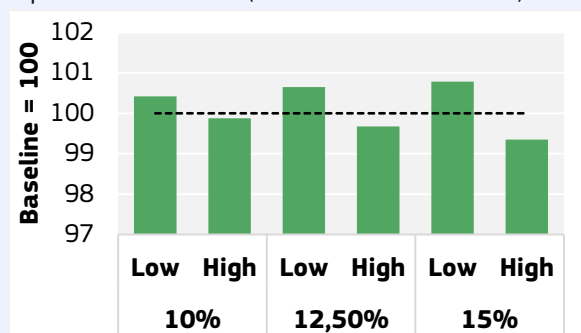
Table 2. Selected indicators for the EU chemical sector in 2040 under the baseline and different upscaling scenarios.

Target of bio-based content	Technology improvement	Turnover (billion Euro)			Production quantity index (baseline = 100)			Emissions (million tonnes of CO ₂ equivalent)
		Bio-based	Other	Total	Bio-based	Other	Total	
Baseline	n.a.	55	743	798	100.0	100.0	100.0	101.6
10%	Low tech	76	734	809	140.5	97.6	100.0	100.0
	High tech	71	734	805	140.3	97.6	100.0	100.0
12.5%	Low tech	95	726	821	176.6	95.4	100.0	98.8
	High tech	86	727	813	176.4	95.4	100.0	98.8
15%	Low tech	114	720	834	213.1	93.2	100.0	97.6
	High tech	101	721	822	212.9	93.3	100.0	97.6

Source: MAGNET simulations

The higher production efficiency is reflected in the costs of production in the chemical sector. Figure 9 shows the unit costs in each scenario with regard to the baseline. Overall, under the lower-tech scenarios, the chemical sector has higher unit costs than in the baseline. In fact, unit costs rise further as the target of bio-based content increases. The higher the target of bio-based content, the higher the unit cost. However, this effect is reversed in the higher-tech scenarios, where the higher technological efficiency in producing bio-based chemicals has a positive effect on the productivity of the sector as a whole. This highlights the role of technology in upscaling bio-based solutions.

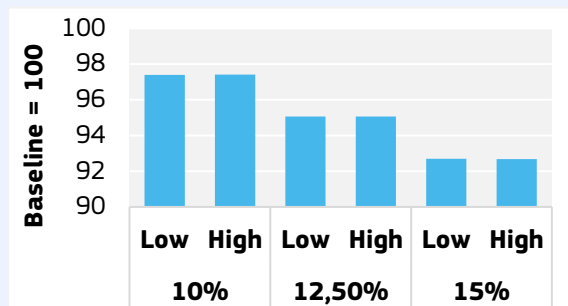
Figure 9. Unit cost index of the EU chemical production in 2040 (baseline scenario = 100)



Source: Computed from MAGNET simulations

Figure 10 presents an emissions intensity index for EU chemical production across scenarios in 2040. According to the index, emissions per unit of output decline in all scenarios. This reduction is larger as the target level of bio-based content in chemical production increases. However, the differences between low-tech and high-tech pathways are marginal for each target, suggesting that the substitution of feedstocks with bio-based alternatives is the main driver of the reduction of emissions. While there is an effect of the level of technological progress on the reduction of emissions from producing bio-based chemicals, it remains minor, as most emissions are still generated by the production of other (non-bio) chemicals.

Figure 10. Emissions intensity index of the EU chemical production in 2040 (baseline = 100)



Source: Computed from MAGNET simulations

Table 3 presents the macroeconomic and environmental footprint impacts associated with the upscaling scenarios in 2040, as a percentage change with regard to the baseline scenario. Overall, the upscaling of bio-based chemicals entails macroeconomic costs, resulting in small GDP losses, as it forces the economy to use more biomass, which becomes relatively more expensive. GDP losses become larger as the bio-based content target increases, going from around -0.06/-0.09% at the 10% target to -0.17/-0.23% at the 15% target. Within each target, the GDP impact is consistently less negative under the higher-tech scenario than under the lower-tech one, reflecting the higher efficiency (or lower competitiveness loss) of biomass-processing technology.

Table 3. Broader macroeconomic and environmental impacts in the EU (% change with regard to the baseline in 2040)

Target of bio-based content	Technology improvement	GDP	Land footprint		Emissions footprint	
			Chemicals production	Total economy	Chemicals production	Total economy
10%	Low	-0.09	13.7	0.33	0.75	-0.15
	High	-0.06	12.7	0.32	0.59	-0.11
12.5%	Low	-0.16	26.1	0.51	1.70	-0.21
	High	-0.11	24.3	0.50	1.30	-0.19
15%	Low	-0.23	38.8	0.69	2.79	-0.26
	High	-0.17	36.1	0.67	2.23	-0.18

Source: MAGNET simulations

The land footprint of total chemicals production increases with the ambition of the target, from around 13% at the 10% target to over 36-38% at the 15% target. These increases represent an increase in land use for chemical feedstocks from 50,000 km² in the baseline to up to 69,000 km² in the 15% target scenarios. At the level of the total economy, the land footprint remains comparatively small with an increase of 0.3-0.7%. Overall, the increases in the land footprint are smaller under high-tech pathways than under low-tech ones within each target.

As for emissions footprint, marginal increases are exhibited across all scenarios, although the rate of increase is lessened in the high-tech scenario variants. For the whole EU27 economy, the emissions footprint is below the baseline across most scenarios, suggesting that reductions in emissions in other sectors broadly offset the additional footprint generated by the upscaling of bio-based chemicals production.

As a measure of the decoupling of economic activity from emissions, Table 4 shows the quotient between tonnes of CO₂-equivalent emissions generated in the EU per million Euro of GDP. All scenarios show a marginal improvement relative to the baseline, as economic activity declines less than that of emissions, indicating a decoupling of growth from emissions. Changes of small magnitude are expected, since only the chemicals sector is shocked in these scenarios, but it accounts for less than 1% of EU GDP. However, the results may suggest that upscaling bio-based chemicals in the EU is a potential tool to move the EU (bio)economy towards cleaner production pathways, although trade-offs need to be carefully considered and addressed by policies.

Table 4. Tonnes of CO₂-equivalent emissions per million Euro of GDP

Scenario	Baseline	10% target		12.5% target		15% target	
Technological improvement	n.a	Low tech	High tech	Low tech	High tech	Low tech	High tech
Tonnes of CO ₂ -equivalent	173.27	173.13	173.15	173.13	173.09	173.16	173.15

Source: Computed from MAGNET simulations.

Conclusions

The scenario analysis presented in this brief illustrates the potential socioeconomic and environmental implications of upscaling bio-based chemicals and plastics in the EU by 2040. Assuming a high rate of return on investment and a 30% share of non-food biomass use, the results indicate that such policy-driven expansion involves environmental and macroeconomic trade-offs.

In this scenario, the bio-based industry would generate a turnover of EUR 2.84 trillion in 2040 (vs. EUR 2.74 trillion in the baseline), EUR 650 billion in value added (vs. EUR 640 billion) and 7.8 million jobs (vs. 7.5 million). Bio-based chemicals and plastics would reach EUR 148 billion in turnover and EUR 18.2 billion in value added, compared to EUR 68 billion and EUR 9.2 billion in the baseline.

From an environmental perspective, upscaling bio-based alternatives reduces direct GHG emissions from the chemicals and plastics industries in the EU in 2040, but not demand-driven footprints, which measures non-tradable resources (i.e., land, emissions) embedded within domestic and foreign inputs used in all stages of production to bring a product to market. The land footprint of chemical products demand would rise above the baseline due to a greater reliance on bio-based feedstocks, while equivalent emission footprints remain similar. These effects are limited in scale and offset by emission and land-use reductions in other bio-based and non-bio-based industries. On the macroeconomic side, economic activity under this scenario is slightly below the baseline in 2040, given the higher fiscal costs of upscaling of bio-based chemical industry alternatives in lieu of fossil equivalents.

Overall, if the assumed technological and investment conditions materialise, upscaling bio-based chemicals and plastics could contribute to a more sustainable growth path for the EU's bioeconomy. However, socioeconomic and environmental trade-offs must be evaluated, especially under less

ambitious assumptions on investment-driven productivity gains and non-food biomass use.

Policy coherence and multi-instrument bioeconomy interventions will be needed to boost sustainability and competitiveness in the EU

References

- [1] Philippidis, G., van Leeuwen, M., Bartelings, H., Smeets Kristkova, Z., Laquai, V. et al., The EU bioeconomy towards 2040 - an exploratory baseline with a whole-economy, an agricultural and a bio-based industry model, Publications Office of the European Union, Luxembourg, 2025, <https://data.europa.eu/doi/10.2760/4403180>, JRC143688.
- [2] European Commission (2025). Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. A strategic framework for a competitive and sustainable EU bioeconomy (COM(2025) 960 final). Official Journal of the European Union.
- [3] Woltjer, G.B., Kuiper, M.H., 2014. The MAGNET Model: Module Description. LEI Wageningen UR (University & Research centre), LEI Report 14-057, Wageningen. <https://edepot.wur.nl/310764>.
- [4] European Commission, Directorate-General for Agriculture and Rural Development. (2024). EU agricultural outlook, 2023–2034. Publications Office of the European Union.
- [5] Lasarte-López, J., González-Hermoso, H., Tamosiunas, S., Porc, O., Poranki, N., & M'barek, R. (2025). Jobs and wealth in the EU bioeconomy [Dataset]. European Commission, Joint Research Centre (JRC). <http://data.europa.eu/89h/7d7d5481-2d02-4b36-8e79-697b04fa4278>

Disclaimer

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Acknowledgements

This brief is part of the Knowledge Centre for Bioeconomy (KCB) activities, partially funded under the Horizon Europe Programme. More info at [Bioeconomy | Knowledge for policy](#).

Suggested citation

Philippidis, G., Bartelings, H., Gatto, A., Lasarte-López, J., van Leeuwen, M. et al. *Upscaling bio-based chemicals and plastics in the EU: Exploratory economic modelling for bio-based pathways to 2040*. European Commission, Seville, 2026, <https://publications.jrc.ec.europa.eu/repository/handle/JRC144266> JRC144266.

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