How the Bioeconomy contributes to the European Green Deal

European Bioeconomy Alliance

Delivering on the European Green Deal's objectives and ensuring food security requires a strong bioeconomy

Fit for the world in 2023 and beyond

The Covid-19 pandemic shook global supply chains as never before, stressing how interconnected the world really is. Russia's invasion of Ukraine has further destabilised and reorganised global supply chains and markets. Energy and fertiliser prices are hitting new records, food prices are going through the roof, and food insecurity contributes to hunger and instability in already vulnerable regions worldwide.

About us

The European Bioeconomy Alliance (EUBA) is a unique cross-sector alliance dedicated to mainstreaming the bioeconomy and achieving its full potential in Europe.

EUBA is committed to helping lead the transition away from a fossil-based society by raising awareness among EU, national and regional leaders and stakeholders of the benefits of the bioeconomy.

The transition to a more sustainable, resilient, and competitive economy that places nature and people at its core requires actions across many sectors. The bioeconomy has the potential to contribute to the European Green Deal transition as it encompasses all sectors involving the use of renewable resources from agriculture, forests, and seas, including residues and waste, to produce food, feed, materials and energy, without compromising biodiversity goals**. It is by making this shift to bio-based products and processes that Europe will strengthen its resilience and reduce its dependency on fossil and non-renewable resources.**

As a catalyst for systemic change, the bioeconomy helps achieve the economic, social, and environmental objectives of the European Green Deal. By seeking new ways of producing and using resources responsibly, it contributes to working within planetary boundaries and takes the EU closer to a circular economy that respects nature. Through a systemic approach to the sustainable use of biological resources, the circular bioeconomy is contributing to the achievement of the UN Sustainable Development Goals (SDGs).

One of the tools to finance this change is the Bio-based Industries Joint Undertaking (BBI JU), launched in 2014 to stimulate innovation and investments. The BBI JU private-public partnership had received a total of €2.6 billion of private investments by the end of 2021, leveraging €822 million in support from the EU. Since 2021, innovative bio-based projects continue to be supported by the successor of the BBI JU: the Circular Bio-based Europe JU (CBE JU), with **a strong focus on the EU's environmental goals and support to local economies**.

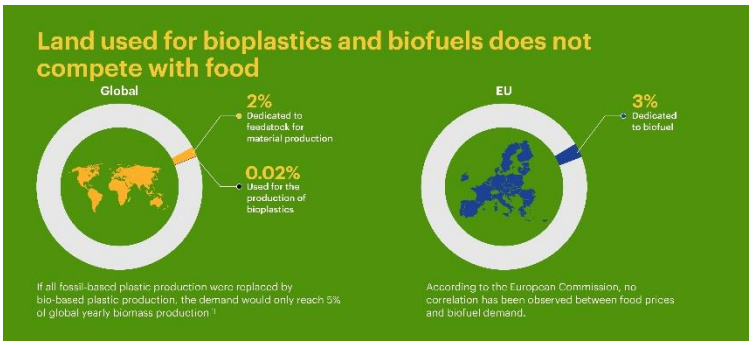
Food security & food sustainability: two sides of the same coin

Climate change is one of the critical drivers of food insecurity. Threats to food security from droughts, floods, and heatwaves as well as rising sea levels are already manifest and are set to grow with global warming, penalising mostly the least resilient regions. The war in Ukraine has brought food security back to the top of the political agenda and there is a growing consensus that the looming humanitarian crisis requires a strong, coordinated response from the international community.

Delivering on the green transition today is essential to ensure food security tomorrow.

The updated EU Bioeconomy Strategy reaffirmed food and nutrition security as one of its strategic objectives. The current challenges around food security should increase the efforts towards a stronger bioeconomy, which has a clear role to play in achieving food, feed, materials and energy security as well as the EU's climate ambitions. Investments in a strong bioeconomy therefore offer high-quality, sustainably produced and sufficient quantities of food.

Graph 1



Furthermore, in the bioeconomy, land use and security of supply are optimised through a resource-efficient utilisation of Europe's renewable raw materials. The various uses of crops grown in the EU[1] allow processing activities into many by-products and energy. Multi – and complementary streams are the essence of bioeconomy. Crops currently grown in the EU are used for making energy, non-food by-products as well as several food and feed ingredients. In 2021, producers of renewable ethanol produced more animal feed co-products than renewable ethanol – producing more food than fuel.

[1] Around 83% of crops grown in the EU is used domestically in food, animal feed, beverages, and non-fuel industrial uses. Nearly 11% is exported, and around 6% is used in fuel.

Recent data also shows that land used for growing feedstocks for the production of bioplastics is marginal: **only 0.02% of global agricultural area**.[2] *See graph 1 for more information on land used for material production and biofuels*.

Fostering a circular economy…

The bioeconomy is a model of production and consumption that is circular by nature. It involves practices such as growing, reusing and recycling biological resources and biomaterials, for as long as possible. The inherent circularity of the bioeconomy also contributes to achieving the goal of zero pollution: maximising the use of side and residual streams from agriculture, food processing, forest management and forest-based industries reduces waste.

… which is resource efficient…

In the bioeconomy, renewable biological resources are converted into food, feed, bio-based products, and bioenergy via innovative, efficient technologies. For example,

- The enzymes produced through industrial biotechnology transform such resources into everyday products, providing an alternative to the use of finite fossil resources. Enzymes are renewable and biodegradable, and they help to reduce energy and water consumption.
- Oleochemicals, replacing petrochemicals, provide fossil-free, renewable, functional solutions in coatings and plastics for the construction sector, the automotive industry, and furniture production.
- Vegetable oils are feedstock for the fully bio-based composites used, among others, in windmill blades and bridges.
- Wood and by-products of wood processing are often reintegrated in other products and are used in many other sectors, e.g., in the production of chemicals, cosmetics, construction, transportation fuels, pharmaceuticals, smart packaging, coatings, adhesives, plastics, composites, and as fabric fibres.
- Starches are a source for use in pharmaceuticals and make a variety of contributions to products as disparate as toothpaste, tablets, emulsions, lotions, liquid medicines, and creams. Human well-being and survival are also dependent on the role starch plays in the production of antibiotics, vitamins, penicillin, dialysis solutions, enteral nutrition, drip-feed systems, and even blood plasma substitutes. Starch is also used quite extensively in cosmetic products, paper and cardboard, paints and insulation, as well as bioplastics.
- In the bioplastics industry, new innovative processes are currently being developed using both first- and second-generation feedstock, i.e., from side-streams of the agri-industry, offering the potential for bioplastics[3] to provide the agri-industry **with a high value outlet for part of their side-streams, transforming waste into a valuable resource.**[4]

Biotechnology solutions to support the Green Deal objectives: the case of innovative feed solutions

Innovative feed solutions provide a useful example of how the bioeconomy can tackle several, current environmental and societal challenges:

- Feed additives enable livestock to retain more nutrients and nitrogen from less high-protein animal feed. **This helps to increase the efficiency by which animals convert feed into protein**.
- European production of amino acids, derived from European carbohydrates (beet sugar, cereals), **contributes to reducing the EU's dependency on imports of high protein feedstocks**.
- Using amino acids and enzymes in livestock production can also reduce the nitrogen and phosphorous burden of agriculture and water consumption in animal farming and **can contribute to reducing CO_2 emissions**.
- Innovations in industrial biotechnology are now moving beyond simple purification of water to **explore new ways to re-use the captured phosphorous as fertiliser**.

By way of example, biorefineries efficiently turn renewable raw materials, including agriculture and forestry residues, into non-fossil-based everyday products. Animal feed, for instance, is an important output from agricultural crops used for bioethanol and biodiesel production. In 2021, EU biodiesel production was 12.8 million tonnes and generated 14.3 million tonnes of protein-rich animal feed – in other words, more food than fuel; while EU ethanol production was 4 million tonnes, generating an equivalent amount of high-protein animal feed. **Biofuel production therefore offsets fossil-fuel use and also contributes to food security – without having to choose between one or the other.**

… contributes to waste reduction…

The many end-of-life options of, for example, bioplastics broaden possibilities in waste management and contribute to creating circular production systems. *See graph 2 for an illustration of the range of end-of-life options of bioplastics.*

The current capture of food waste is **just 16% of its theoretical potential:** too much waste is being landfilled. **Innovation will support tackling the issue of food waste, by valorising biowaste in the manufacture of high value products.**[5] Compostable bioplastics are a solution to increase the quantity and quality of organic waste collected, allowing its diversion from landfill, and the production of high-quality compost, to be used as soil amendment and as a carbon sink. The soil is a key non-renewable resource that plays a central role in our lives providing food and materials. The application of soil organic matter as compost is very important to sequester organic carbon, but also to keep the soil healthy.

[2] J. Lovett, F. de Bie, D. Visser, *Sustainable sourcing of feedstocks for bioplastics, clarifying sustainability aspects around feedstock use for the production of bioplastics*, 2017 (see here).
[3] Bioplastics refers to plastics that are bio-based, biodegradable, or both.
[4] M. van den Oever, K. Molenveld, M. van der Zee, H. Bos, *Bio-based and biodegradable plastics - facts and figures - focus on food packaging in the Netherlands,* 2017 (see here).
[5] Zero Waste Europe, *Bio-waste generation in the EU: current capture levels and future potential*, 2020 (see *here*).

In Europe, currently, 48 million tonnes of biowaste are collected; 12 million tonnes of compost are applied on land, leading to the carbon sequestration of 1.3 million tonnes of CO_2.

When it comes to mechanical paper recycling, paper fibres can be recycled many times when they remain within the paper loop, and not necessarily for the same application. The European paper industry is building on decades of work to make its industrial model circular; it is an example of a successful and well-established market for secondary raw materials. In 2020, it achieved the highest recycling rate worldwide: 73.9% compared to the global average of 56.8%. **Paper-based packaging is 82% recycled.** Wood-based paper in Europe achieves on average 3.8 cycles.[6]

In 2019, **one out of two beverage cartons placed on the market was recycled and transformed into a wide range of new products.** When ambitious national collection targets are implemented, collection rates reach up to 70%, as is the case in Germany and Belgium.[7]

The bioeconomy can also help reduce waste from changes in dietary trends and maximise resource use for food, feed, industrial and energy applications. There is a discrepancy in the EU between the increasing demand for plant-based proteins and fibres, and the decreasing demand for carbohydrates.[8] To produce more of one, you also need to produce more of the other, as biorefineries extract and separate all of these ingredients in the same production process. While the additional proteins and fibres can be sold to EU food customers, the carbohydrates will need additional markets. **The bioeconomy, and specifically the recycled paper, cardboard and bioplastics sectors, creates the necessary outlets for the agri-food system to adapt to the increasing demand for plant proteins**. By covering all outlets, the bioeconomy can adapt to the new increasing demand for plant-based and fermented proteins while using the remaining components of agricultural raw materials to reduce dependence on fossil fuels in non-food products and avoid waste.

A bioeconomy to enhance sustainable land and biological resource management, within ecological boundaries

Mitigating climate change

The call from the IPCC's latest report is clear: there is a rapidly closing window of opportunity to secure a liveable and sustainable future for all.[9] We must de-fossilise the economy. Using renewable materials is advantageous for several reasons: they have a low carbon footprint; they are regenerative by nature; they capture and sequester CO_2.[10]

The bioeconomy, by producing fossil-free renewable materials and fuels, can help reduce greenhouse gas emissions (GHG) and remove CO_2 from the atmosphere. Switching to using biological resources and processing methods in a sustainable way **could save up to 2.5 billion tonnes of CO_2-equivalent per year in the EU by 2030.[11]**

Between 1990 and 2020, the area of forest in the EU increased by around 14.4 million hectares and covers around 40% of its territory. Over the same period, wood stock in forest increased by around 8.2 billion m^3.[12] Sustainably managed forests in the EU – 60% of which are privately owned – play a key role in achieving the EU climate neutrality target by acting as carbon sinks while preventing fossil emissions through the substitution effect, which is achieved by reducing the demand for products and energy that are based on fossil fuels. The overall positive climate effect of the forests and wood-based sector is estimated at -806 million tonnes of CO_2 equivalent annually. **This corresponds to savings amounting to approximately 20% of all fossil-fuel emissions in the European Union.[13]**

[6] Report of the Finnish Environment Institute, *Fossil carbon emission substitution and carbon storage effects of wood-based products*, 2022 (see here).
[7] Roland Berger, *Impact assessment study of an EU-wide collection target for beverage cartons*, 2022 (see here).
[8] Wheat, maize, potatoes, sugar beets and vegetable oils, for instance, contain both.
[9] Working Group II contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (see here).
[10] European forests have the capacity to absorb the equivalent of nearly 10% of all European GHG emissions each year. European Commission, *Climate neutral food and wood: Showcasing best climate practice in agriculture, forestry, food systems and the bioeconomy*, 2020 (see here).
[11] European Commission website, *Bioeconomy, Bio-based products and processes* (see here).
[12] In M. Köhl, S. Linser, *Part I, Status and trends in European forests characterized by the Updated pan-European indicators for sustainable forest management*. In *FOREST EUROPE, 2020: State of Europe's Forests 2020* (see here).
[13] P. Holmgren, *Climate effects of the forest-based sector in the European Union*, 2020 (see here).

A number of BBI JU-funded projects contribute to climate change mitigation.[14] Considering only the BBI JU Flagships, **the total CO_2 savings are expected to surpass 800 kt CO_2 per year**.[15]

Significant emission reductions can also be found in other sectors

Agri-food	Construction	Bio-based coating materials	Transport
Cover crops can contribute in addition to biomass production, to mitigate climate change by absorbing carbon dioxide through photosynthesis and storing \ carbon in the soil. Sequestering atmospheric carbon (CO_2) in the soil helps to offset greenhouse gas emissions.[16] Biogas production from animal manure is an important energy source that helps in climate change mitigation. Up to 240% GHG savings compared to fossil fuels are reached when biogas is produced from animal slurry, the biogas plant has closed digestate storage and the energy (power + heat) needed to operate the biogas plant originates from its own combined heat and power unit. [17]	If 80% of new residential buildings in Europe used certified wood in the structures, cladding, surfaces and furnishings, the houses would store 55 million tonnes of CO_2 a year, **equivalent to 47% annual emissions of Europe's cement industry.**[18]	Life-cycle analyses show that, compared to conventional plastics, bio-based plastics generate significant CO_2 savings – up to carbon neutrality – depending on the feedstock, the product, and the application. **Substituting the annual European demand for fossil-based polyethylene (PE) with bio-based PE would save around 73 million tonnes of CO_2.**[19]	In 2021, **renewable ethanol reduced GHG emissions by 77% compared to fossil fuels.**[20] Biodiesel can achieve significant reductions in the range of **50% to 90% compared to conventional diesel.** The significant GHG-saving performance of ethanol is also accompanied by **significant capture of CO_2 (1.05 million tonnes).**

An economy that supports nature

Biodiversity conservation and climate conditions are fundamentally intertwined. Addressing the challenge for biodiversity conservation and climate change mitigation implies synergies and trade-offs. A strong bioeconomy is vital to address these planetary crises.

Forests are home to much of the continent's biodiversity.[21] When sustainably managed,[22] forests maintain their ecological functions, including biodiversity preservation. Despite ongoing climate change, the index for common forest birds has been stable over the last 30 years and 50% of forest habitats listed in Annex 1 of the EU Habitats Directive are in good condition.[23]

Developing bio-economies can contribute to the enhancement of biodiversity while improving the provision of other ecosystem services.[24] **In the EU, biomass is produced according to standards that are among the highest in the world in terms of quality and sustainability, which farmers, forest**

Sustainable crop cultivation

Industrial biotechnology provides innovative solutions for sustainable agriculture, for instance through the use of biostimulants and biocontrol, thus contributing to the objectives of the Farm-to-Fork and Biodiversity strategies.

A number of CBE JU-funded projects like PHERA, B-FERST and BIOVEXO are contributing to the EU's biodiversity goals by providing innovative bio-based alternatives to more traditional pesticides and fertilisers.

[14] BIC, *Towards a climate-neutral Europe by 2050, the contribution of the bio-based industries*, 2021 (see here).
[15] CBE-JU, *Strategic Research and innovation* Agenda, 2022 (see here).
[16] European Commission, Joint Research Centre, *Adoption of cover crops for climate change mitigation in the EU, 2019* (see here)
[17] European Commission, Joint Research Centre, *Solid and gaseous bioenergy pathways: input values and GHG emissions,* 2017 (see here)
[18] Aalto University, *Building European cities with wood would sequester half of cement industry's current carbon emissions*, 2020 (see here).
[19] Based on the European demand for conventional polyethylene in 2020 (Plastics Europe) as well as on -3.09 CO2-eq/kg bio-based PE (Braskem, I'm GreenTM) (European Bioplastics, *Environmental benefits of bioplastics,* see here).
[20] This marks the tenth consecutive year in which EU renewable ethanol increased its GHG-reduction score. The 2021 findings were compiled from ePURE members and certified by auditing firm Copartner (E-Pure, press release, see here).
[21] European Commission website, Forest, Forest Ecosystem Services and Biodiversity (see here).
[22] Second Ministerial Conference on the Protection of Forests in Europe, Helsinki Resolution - General Guidelines for the Sustainable Management of Forests in Europe, 1993 (see here)
[23] European Environment Agency, *State of Nature in the EU, result from reporting under directives 2013-2018*, 2020 (see here).
[24] European Commission, Directorate-General for Research and Innovation, *How the bioeconomy contributes to the European Green Deal*, 2020 (see here).

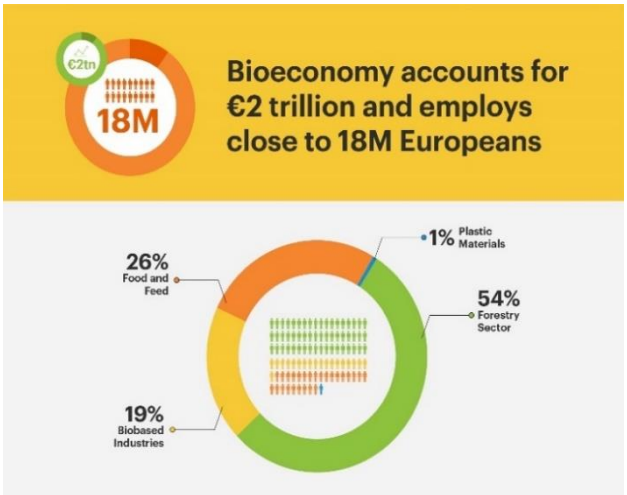
owners and their cooperatives are legally bound to respect.

A bioeconomy that drives social fairness

Creating green jobs and adding value locally

The bioeconomy provides numerous and skilled jobs, thereby safeguarding social fairness in the transition towards a resilient economy including in rural areas.

This is in line with the European Commission's latest EU Bioeconomy progress report, which found that *"there is a need to transform and re-skill the workforce in all parts of Europe for a just transition".*[25]



In the EU, more than 17 million jobs are linked to the bioeconomy, generating a global turnover exceeding 2.4 trillion euros.[26] These values represent 4.7% of the EU's gross domestic product and 8.3% of its labour force.[27]

The EU biotechnology industry generates over 900,000 jobs – 223,000 directly, 710,500 indirectly. This includes numerous positive spill-over effects in terms of employment throughout the whole value chain. **For every direct job in the biotechnology industry, there are more than three created within the overall economy**.[28] The 2.6% annual growth rate in employment achieved by the biotechnology industry is far above overall rate of 0.2% and demonstrates the role this sector plays in stimulating the EU labour market.[29]

The primary food processing industry uses around 220 million tonnes of agricultural raw commodities (e.g. cereals, sugar beet, rapeseeds, soybeans, sunflower seeds, crude vegetable oil, starch potatoes, cocoa beans) a year, employing directly over 120,000 people in Europe, and, indirectly, an additional one million people. **In 2018, 401,000 enterprises were active in wood-based industries across the EU** – 20% of all manufacturing enterprises.[30] Forestry contributes directly to Europe's rural economies. The EU wood-based sector represents 3.5 million jobs, while the value-chain structure offers the possibility of a broader distribution of income and jobs across the territory – critical for the inclusive growth sought by the Green Deal.[31]

These jobs benefit urban areas, but particularly favour rural development.[32] For instance, cooperatives in agriculture and forestry sector are becoming a driving force in deploying the bioeconomy, effectively integrating primary producers and revitalising rural areas. In 2018, the primary biomass production sectors in the EU with over 10 million jobs provided 54% of the total employment in the Bioeconomy, mainly in the agricultural sector which alone accounts for 50%.[33] 83% of BBI JU-funded projects resulted in the creation of skilled jobs, of which 53% are created in rural regions (forestry and agricultural) and 15% in coastal areas.

The bioeconomy is the production, use, conservation, and regeneration of biological resources to provide durable solutions within and across all economic sectors and enable a transformation to a sustainable economy.

It holds the potential to provide innovative solutions to ensure the sustainability and competitiveness of the EU. By securing food, feed, materials and energy supplies while ensuring the transition to a fossil-free system decoupled from environmental destruction and resource overuse, the bioeconomy contributes to achieving the objectives of the European Green Deal.

[25] European Commission, 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*, 2022 (see here).
[26] This represents a 25% increase since 2008. EU Bioeconomy in figures 2008-2018 (see here).
[27] European Commission website, Knowledge Center for Bioeconomy (see here).
[28] Each biotechnology sector – healthcare, industrial, and agriculture – has different employment spill-over multipliers – respectively 3, 4.2, and 0.6. WifOR Institute, *Measuring the economic footprint of biotechnology in Europe, Research Report*, 2020 (see here).
[29] WifOR Institute, *Measuring the economic footprint of biotechnology in Europe, Research Report*, 2020 (see here).
[30] EFI, *How does forest management and the use of wood contribute to economic prosperity and employment?* (see here).
[31] EU forest-based industries generate a production value of €460 billion and provide nearly 3.5. million jobs (European Commission website, Forest-based industries, see here).
[32] Based on the latest data collected from the BBI JU Flagship Projects in October 2021, flagship biorefineries producing materials and ingredients from locally sourced biomass plan to create about 20,000 direct and indirect jobs in rural and coastal areas (CBE-JU, *Strategic Research and innovation* Agenda, 2022 - see here).
[33] EU Bioeconomy in figures 2008-2018 (see here).