BIOTECHNOLOGY - OPPORTUNITIES FOR CLIMATE AND NATURE?

IN BRIEF

- A sustainable bioeconomy within the planetary boundaries, i.e. earth's ecological carrying capacity, is an important building block on the way to a carbon-neutral, sustainable society.
- Great expectations: (Future) biotechnology is expected to contribute to climate and resource protection on a large scale by increasing circularity, improving the cascading use of renewable resources, or by directly contributing to the production of biomass, food, and energy.
- Challenge: Industrial biotechnology itself often requires large amounts of energy and resources such as water, whose sustainable provision must be ensured.

WHAT IS IT ABOUT?

It is necessary to phase out an economy that is primarily driven by fossil resources. A sustainable bioeconomy is expected to be a central building block for the sustainable transformation of our society.
However, biomass, especially sustainably produced biomass, is not infinitely available as a substitute for fossil resources, and cultivation areas are limited.
One such example is the production of basic chemicals from renewable raw materials (platform chemicals) required by industry. Although this replaces crude oil, it also exacerbates the food-feed-fuel problem, resulting in competition for land for the cultivation of food, animal feed, and biofuel. Against this backdrop, the requirements for a sustainable bioeconomy are high. A sustainable bioeconomy is expected to protect the climate and resources, contribute to biodiversity, and promote regionality, social participation, and responsible consumption. Production and supply chains are meant to be traceable, companies are to assume greater social and environmental responsibility whilst also being highly innovative. Biotechnology plays an important role here, for example in improving circularity or in efficiently using biomass in cascades for various products, such as in green chemistry, new materials, food production or recycling.

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Platform chemicals and food from fermenters as a central component of a sustainable bioeconomy?

Another expectation is that biotechnology will contribute to solving current sustainability problems. Examples of this would be the large-scale degradation and recycling of plastic waste with the help of microorganisms, and the replacement of conventional types of plastic with biodegradable variants made from renewable raw materials. However, such hope-driven discourse also quickly distracts from more fundamental problems such as the global overproduction of plastic, thereby obfuscating the urgent need for political action. In the project, experts and stakeholders developed options on the future of biotechnology in a sustainable bioeconomy. The use of genetically modified organisms was mainly discussed for closed systems, not the open field. The results describe viable paths for social change, but also highlight conflicting goals and trade-offs. However, the combined expertise also shows a tendency towards techno-solutionism, i.e. the conviction that complex problems such as resource scarcity can be solved relatively easily using technology.

BASIC DATA

Project title:	Pioneers for a sustainable bioeconomy
Project team:	Gudowsky-Blatakes, N.; Bechtold, U. (in an international consortium)
Duration:	11/2021 – 12/2023
Funded by:	Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (GER)

KEY RESULTS

Chemicals and materials: According to the experts surveyed, Europe is expected to become a leader in the development and production of many (fine) chemicals from renewable carbon sources, with reduced energy consumption and less toxic waste. The use of fossil raw materials is to be reduced as much as possible, and greenhouse gas emissions are to be recycled. Strengthening regional value chains makes sense and also supports small and medium-sized enterprises and innovative, sustainability-oriented start-ups.

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Municipal wastewater as a resource: microalgae and cyanobacteria could contribute significantly to biomass production.

Food production: Novel foods produced by microorganisms in the bioreactor, such as mushroom mycelia, cheese, or oils from the bioreactor, can, in theory, help reduce the amount of land and fertiliser required, and thus contribute to the extensification of agriculture and farming. However, fermentation capacities and substrates, energy and water requirements have a limiting effect here. There are also legal hurdles, e.g. the waste management plans of many EU countries prevent further processing of organic waste. Nevertheless, proteins and oils could also be produced using plants. A sustainable restructuring of the food system seems realistic, especially through reducing both the industrial mass production of livestock and meat consumption.
Cycles, cascades, and recycling: The goal is to create a value chain of the industrial bioeconomy that is organised in cascades and cycles. Residual and waste materials are fully utilised, with material recycling being preferable to energy recovery. Unavoidable losses and process energy are covered by carbon from renewable sources. Emissions are captured through carbon capture and utilisation (CCU). The focus is on the most efficient use of sustainably produced natural materials, such as wood and fiber plants, and the manufacture of products with long life cycles in accordance with ecodesign guidelines.

WHAT TO DO?

A sustainable bioeconomy must take into account the limits of ecological sustainability. In view of the threefold climate, resource, and biodiversity crisis, a rapid change of course is required.

- *Transfer infrastructure* must be created and operated long term to establish innovative production processes: (Demo) fermentation plants / biorefineries, but also knowledge and skilled workers; public investment through tools such as IPCEI (Important Project of Common European Interest) for the construction and operation; avoidance of a reduction to a few production paths.
- *Existing and future regulation* is to be revised to ensure compatibility with a sustainable, circular bioeconomy: Special focus on the complex interaction of waste management and product recycling as well as circular economy acts, genetic engineering laws (regulation and patenting), the supply chain act, and import and domestic market regulation so that sustainable production and the closing of material cycles become possible and realistic.
- *Taxing fossil production as highly as possible* will create incentives to keep carbon in the cycle for as long as possible, thus making products from renewable resources cheaper in comparison.
- *Sufficiency* as a solution must be given greater prominence in public (political) discourse, i.e. addressing the question of what level of limited resource consumption and overall consumption is sufficient for a ”good life”.

FURTHER READING

Gudowsky-Blatakes, N.; Zauner, A. (2024). Biotechnologie in einer zukunftsfähigen Bioökonomie – Dokumentation Expert:innen und Stakeholderworkshop (Berlin, 24.10.2023) und Nachbefragung (p.22). Wien. doi:/10.1553/ITA-2024-03
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