Biomass – towards sustainable use of finite resources

Biomass is all around us. In daily life, we encounter renewable resources everywhere in many diverse forms. Biomass is used to produce food, paper goods, bioplastics and textiles and is also the main feedstock in the production of biofuels, which now account for 80% of the world's total supply of renewable energies.

There is a reason for the frequent utilisation of biomass: it has a very wide range of applications and is seemingly infinitely available since it can be regrown. Nevertheless, a degree of caution is required when considering the various advantages of these versatile raw materials. Cultivating energy crops for conversion into biogas or biofuels, for example, appears to offer the prospect of a reduction in carbon emissions from the heat and transport sectors. However, this directly competes with food production – in Germany and worldwide.

Arable land in limited supply worldwide

There is a substantial and growing demand for biomass in its many forms. Yet there is a limiting factor: only a finite amount of arable land is available worldwide. So it is important to look at how and where the biomass was grown, when it is genuinely climate- and environmentally friendly and how much potential it has in terms of sustainability. There is still untapped potential in biogenic wastes and residues, whose use offers environmental benefits.

This field of tension between high demand, limited land for cultivation, food security, land-use rights, climate change mitigation, preservation of biodiversity and the conservation of soil and water is highly complex, so it is essential to develop sustainable and appropriate solutions for the efficient and climate-friendly production and use of biomass.

The intensification of land use and particularly land-use change have adverse effects on biodiversity and greenhouse gas emissions. For example, if forests are cleared to make way for arable or grazing land, this substantially reduces biodiversity. Forests also capture large amounts of carbon. Whether biomass use has an adverse impact on the climate will therefore strongly depend on its overall carbon footprint. In order to assess this, it is important to consider all the steps in the value chain.

The goal: Greater efficiency in biomass use

A significant increase in efficiency is an important step towards sustainable biomass use. In food production, for example, there is scope to utilise additional harvesting potential and increase yields with better crop rotation and improved land management. However, efficiency should not be considered solely in terms of yields. Joined-up thinking about production and the associated impacts on environmental assets (e.g. yields vs. nitrogen surplus) is therefore important.

An integrated approach that simultaneously considers food production and bioenergy cultivation is essential in order to avoid land-use competition. Appropriate policy strategies are required here. It is also sensible to couple the different uses of biomass, based on the cascade principle in which material use of biomass comes before energy, so timber, for example, is used first for building or furniture production and last of all for bioenergy production.

Project: SYMOBIO – Systemic Monitoring and Modelling of the Bioeconomy

In the SYMOBIO project, funded by the German Federal Ministry of Education and Research (BMBF), Oeko-Institut researchers are working with other institutes to develop the scientific base for systemic monitoring and modelling of the bioeconomy. The project aims to produce a system for the analysis of agricultural production in Germany that integrates comprehensive sustainability aspects. Keywords are land footprint, agricultural modelling, land-use competition, biomass potential, and comparison of production systems.

The bioeconomy is seen as an opportunity to end the era of fossil resources and technologies, to promote health and nutrition for a growing world population, and to safeguard a sustainable supply of energy, water and raw materials while protecting soil, the climate and the environment.

This transformation creates economic, environmental and social challenges and opportunities. SYMOBIO aims to develop a system for smart monitoring of the bioeconomy, with a focus on learning. To that end, the researchers are defining analytical and assessment criteria and indicators, developing integrated modelling for footprint analysis, and investigating ways to improve environmental auditing and unlock certification potential.

Link to project website: Symobio – Systemic Monitoring and Modelling of the Bioeconomy

Study: Nexus Resource Efficiency and Land Use

Nexus Resource Efficiency and Land Use – A Multidimensional Approach for Biomass Production , a project commissioned by the German Federal Environment Agency (UBA), aimed to develop a multidimensional assessment method to evaluate resource efficiency and effectiveness of biomass production and land use and tested the prototype on selected agricultural and forestry production systems.

The multidimensional analysis looked at four environmental resources: air, water, soil and biodiversity. Various indicators were combined to assess the human use-benefit relationship and to compare scenarios in selected agricultural and forestry production systems.

A multidimensional indicator for sustainable resource efficiency

The project began by examining existing methods for assessing efficiency in relation to land use. Here, the aim was to determine how resource efficiency and land use are evaluated multidimensionally in accordance with environmental criteria.

Based on the findings, the researchers then developed a combined indicator for sustainable resource efficiency and discussed it at a workshop with expert practitioners. The indicator allows biomass use to be evaluated in relation to the utilisation of various environmental resources and takes into account threshold and limit values, e.g. for assessing nitrogen surpluses from fertilisers.

One of the aims of the German Resource Efficiency Programme is to increase sustainable biomass use. Informative indicators such as sustainable resource efficiency are important for the implementation of the strategy and impact monitoring.

Further information

Kurzstudie zur Prüfung der derzeitigen Anreizstruktur beim Einsatz von Holz zur energetischen Verwendung auf die Wirksamkeit hinsichtlich der Klima- und Nachhaltigkeitsziele (Short study: Assessment of the current structure to incentivise the use of wood for energy and its effectiveness in relation to climate and sustainability targets), by the Oeko-Institut

BfN project: *Naturschutz und fortschrittliche Biokraftstoffe* (Nature conservation and advanced biofuels)

Study: *BMUB Meilensteine - Elemente und Meilensteine für die Entwicklung einer tragfähigen nachhaltigen Bioenergiestrategie (Meilensteine 2030)*/BMUB Milestones – Elements and milestones of the development of a sound and sustainable bioenergy strategy, by the Oeko-Institut on behalf of the German Biomass Research Centre (DBFZ)

Study: ReceBio – Study on impacts on resource efficiency of future EU demand for bioenergy, by the Oeko-Institut on behalf of the European Commission

Study “Technical Assistance in Realisation of the 2016 Report on Renewable Energy, in preparation of the Renewable Energy Package for the Period 2020 -2030 in the European Union”, by the Oeko-Institut on behalf of the European Commission

Contact

Dr. Hannes Böttcher
Senior Researcher
Energy & Climate

Oeko-Institut e.V., Office Berlin
Phone: +49 30 405085-389
Mail: h.boettcher@oeko.de

Kirsten Wiegmann
Senior Researcher
Energy & Climate

Oeko-Institut e.V., Office Darmstadt
Phone: +49 6151 8191-137
Mail: k.wiegmann@oeko.de

Dr. Klaus Hennenberg
Senior Researcher
Energy & Climate

Oeko-Institut e.V., Office Darmstadt
Phone: +49 6151 8191-177
Mail: k.hennenberg@oeko.de

Margarethe Scheffler
Senior Researcher
Energy & Climate

Oeko-Institut e.V., Office Berlin
Phone: +49 30 405085-339
Mail: m.scheffler@oeko.de

Oeko-Institut is a leading independent European research and consultancy institute working for a sustainable future. Founded in 1977, the institute develops principles and strategies for realising the vision of sustainable development globally, nationally and locally. Oeko-Institut is represented at three locations in Germany – Freiburg, Darmstadt and Berlin.