

## Bioeconomy: a new model for industry and the economy

**On the one hand, a bioeconomy relies on renewable resources to meet society's need for food, energy and industrial products. On the other, it emphasises the role of biogenic material flows. The bioeconomy model is expected to reduce our dependency on fossil fuels in the long term. In order to implement the shift from a fossil-based economy to a biobased economy on the regional level, the Baden-Württemberg government launched the Bioeconomy Research Strategy in summer 2013.**

It is a very large wheel that natural scientists, engineers, economists, ethicists, politicians and others are starting to turn. A wheel that, understandably, is only slowly gaining momentum. After all, it is a question of creating a whole new raw material basis for industry and the economy. It is about developing a new system in which science, industry and value creation interact in different ways than they did before. In the transition from a fossil-based to a biobased economy, oil, natural gas and coal will gradually become less important. These fossil fuels will be replaced by plants, plant residues, biowaste and other biobased materials. More than ever before industry and science will have to act as a system, and previously non-existent connections will be established between different value creation chains.

### Important economic factor: hydrocarbons

The industrialisation of the past 250 years is based on good ideas, drive and fossil fuels. Therefore, all industrialised economies are built on oil, gas and coal. Oil plays a particularly important role as it is used to produce organic chemicals, i.e. hydrocarbons. These are the basis for energy carriers such as petrol, diesel fuel and kerosene. Hydrocarbons form the economic basis of the chemical industry.

Solvents, paints, plastics, basic and fine chemicals, additives and many other products are produced from oil using complex, but well structured and established industrial processes. Moreover, our mobility, communication, nutrition, agriculture as well as the energy sector and others are directly dependent on fossil hydrocarbons. Our everyday life is unthinkable without fossil fuels - coal, oil and gas. Hydrocarbons are an important element of the economies of industrial countries where value is created by the efficacy with which hydrocarbons are converted into marketable products; they also make a decisive contribution to shaping the global economic system.

### Four challenges

If the vision of a bioeconomy is to become reality, it must not be based on replacing existing infrastructures. Instead a bioeconomy must be built on existing industrial processes. This means that it should initially offer drop-in solutions in order to gain a foothold in industry. At the same time, new processes, products and value creation chains need to be established. Four challenges need to be solved.

First: The bioeconomy must ensure a solid and reliable raw material base through agricultural and forestry production. These raw materials must be distributed in a way that assures human nutrition as well as taking into account all the economic sectors that use these raw materials.

Waste management is an important source of raw materials in a biobased economy. It can provide large quantities of biogenic waste – plant residues, fermentation residues, organic waste and material from landscape management. These materials can primarily be used for the production of energy, chemicals and materials. However, it will be necessary to adapt waste management material flows to the new value creation chains of the bioeconomy.

The second challenge relates to the conversion of biobased materials into hydrocarbons using so-called conversion processes. Conversion processes can be seen as the bridge between petrochemistry and the new green

The bioliq® pilot plant in Karlsruhe is a conversion plant.

chemistry. The production of hydrocarbons directly from biomass is already possible, however, the methods need to be further developed on a large industrial scale.

Conversion is only one field where a bioeconomy offers sales opportunities. Further potential lies in new materials. The fine-tuned process control of chemical, thermal and biotechnological process steps has the potential to release and use these potentials. One example is the biobased polyamide-5,10 developed by the Biopolymers/Biomaterials cluster.

The third challenge is sustainability. Sustainability is inseparable from bioeconomy. No sustainability, no bioeconomy. This statement underlies further fundamental requirements. Although some have been discussed and dealt with over the past years and decades, they need to occupy a more prominent place in discussions relating to the economy and industry of the future, and include such issues as the effective protection of the climate, water, soil as well as biodiversity. The objective of using raw materials from fields, forests and meadows for industrial production is more than ever associated with the need to manage and maintain the respective ecosystems. This includes rigorous protection of the climate, water, soil and biodiversity. This is where biodiversity research comes into play, which essentially means that the bioeconomy needs to promote a wide range of species, i.e. a biodiversity. It would be contradictory and dangerous for biodiversity if land-use methods that were focussed simply on mass production were to be applied.

A bioeconomy also touches on ethical and social issues. Agricultural land is limited. We need to decide how much land is to be set aside for the production of food and feed, fuels and biobased materials. Against a background of hunger, species extinction, environmental and climate protection, the competition between food and fuel calls for a fundamental assessment of the respective fields of action in ethical terms. The Baden-Württemberg Bioeconomy Strategy Circle emphasises that the transition to a biobased economy also needs to take social interests into account.

The fourth challenge is to convert technological solutions that are established in the different sectors of the bioeconomy into jobs, production plants, services and goods for export.

A bioeconomy seeks ways to enable ecosystems to be recognised as capable of creating added value.

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This fulfils the economic and commercial aspects of a bioeconomy. In addition, criteria that enable the economic assessment of environmental and climate protection as well as biodiversity need to be developed. A bioeconomy also requires us to change our mindset. On the one hand, questions relating to immaterial values must be asked and answered and on the other hand, soft factors such as biodiversity need to be recognised as being able to create added value.

## Bioeconomy research in Baden-Württemberg

These challenges result in a considerable need for research. Scientists in Baden-Württemberg are investigating some of the topics that are of key importance in the transition from a fossil-based to a biobased economy.

The University of Hohenheim carries out research into biomass production, biomass potentials, land use, land-use changes and many other aspects associated with biobased raw materials. The Institute of Farm Management led by Prof. Dr. Enno Bahrs at the University of Hohenheim is mainly focussed on efficiency. How can land be used efficiently? Which plants are best for which purpose? How must material flows and production systems be designed and implemented in order to achieve ideal efficiency?

Prof. Gero Becker from the Institute of Forest Utilisation and Work Science at the University of Freiburg is focussed on research to improve the industrial utilisation of forest wood products. His research takes into account biomass quantities and resources as well as biomass quality in terms of conversion.

Professor Henning Bockhorn at the Karlsruhe Institute of Technology (KIT) has developed a method known as "biomass steam processing" that enables the production of biochar from residual biomass.

## Knowledge as a basis

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The transition to a biobased economy cannot be achieved without science and research, i.e. an increase in knowledge. This is why the term "knowledge-based bioeconomy" (KBBE) is often used. The Baden-Württemberg government launched the Baden-Württemberg Bioeconomy Research Programme in summer 2013, for which the Baden-Württemberg Ministry of Science, Research and the Arts will provide around 12 million euros between 2014 and 2019. Funding will be provided to research that is specifically focussed on biogas, the use of lignocellulose and the use of microalgae.

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## Dossier

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