



NATUR FUTUR

BIOÖKONOMIE ERLEBEN

- english version -

A cooperation of:

BIOÖKONOMIE  DE



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Foreword

The term bioeconomy has received considerable attention in politics, business and the sciences in recent years. Although, or precisely because, the term is very present, it also leaves much room for interpretation. Moreover, corresponding surveys show that debates associated with it have only reached the population to a limited extent. Both observations are the starting point and motivation for this cooperative project, in which the relationship between nature, society and their futures are traced.

For the NaturFutur project, the term bioeconomy forms an umbrella under which various aspects are gathered. These include questions of everyday consumption as well as questions of sustainable production with the help of new technologies. NaturFutur aims to demonstrate their interrela-

tionships by building practical bridges and thus offering points of contact for diverse target groups. The exhibition also aims to show in concrete terms which research projects the German Federal Ministry of Education and Research (BMBF) is funding in the field of the bioeconomy and to present their contents, together with different ideas of the bioeconomy, openly for discussion. NaturFutur invites you on an exploratory journey that should reveal new insights for participants and researchers alike. This journey could not take a more suitable starting point than the experimental setting of the Museum of Natural History. Here we find not only a place that authentically stands for the negotiation of the relationship between nature and society, but also a testing space for various participatory procedures.

For five weeks, a collection of exhibits will be on display here, bringing new bioeconomic developments in research, society and industry to life. The exhibition is divided into four areas with different thematic focuses: Soil|Growth|Food, Material|Fashion|Consumption, Production|Change|Circularity and City|Country|Diversity. The fifth week is dedicated to the overarching theme of Society|Research|Dialogue.

An augmented reality exhibit, in which a self-guided virtual bioeconomy world can be explored, opens up further access to all five thematic areas. An art installation that changes weekly encourages interaction in a completely different way. These different exhibits are in dialogue with each other and thus allow for individual engagement with different aspects of the bioeconomy theme.

Each of the five weeks focuses on one of the thematic fields. This is reflected not only in the exhibition, but also in an accompanying program: various event formats address different target groups and invite interaction. In workshops, textiles can be dyed with algae or the variety of fermenting can be learned. In this way, visitors come into direct contact with possible applications. Discussion rounds open up new insights, and a guided tour of Berlin focuses on the sustainability of cities. However, a central concern of NaturFutur is also to describe as precisely as possible the conflicting goals and challenges of this bioeconomy picture that is emerging here. This is the basis for conducting debates in a sustainable manner, which continue to arise in connection with the bioeconomy: competing uses for land and biomass, the food of the future, the connection between consumption and production,

biotechnology and nature conservation. In this sense, NaturFutur sees itself as an open invitation to participants to express their opinions, stances, convictions. The practice in which this takes place is characterized by a lively culture of debate, in which the common good becomes recognizable in a continuous process of consideration.

The project thus brings together science and society in a forum that aims to enrich the public sphere. It uses unconventional methods, for example by combining the latest multimedia approaches with artistic interventions, each of which creates a different sensory approach. NaturFutur is not a communicative one-way street: The impressions, opinions and stances of visitors and participants will be collected and presented as the results of an evaluation process after the exhibition.

We look forward to your visit!

Julia Diekämper

Museum of Natural History Berlin

Kristin Kambach and Martin Reich

bioökonomie.de

Overview

Soil
Growth
Food



Material
Fashion
Consumption



Interventions

**Production
Change
Circularity**



**City
Country
Diversity**



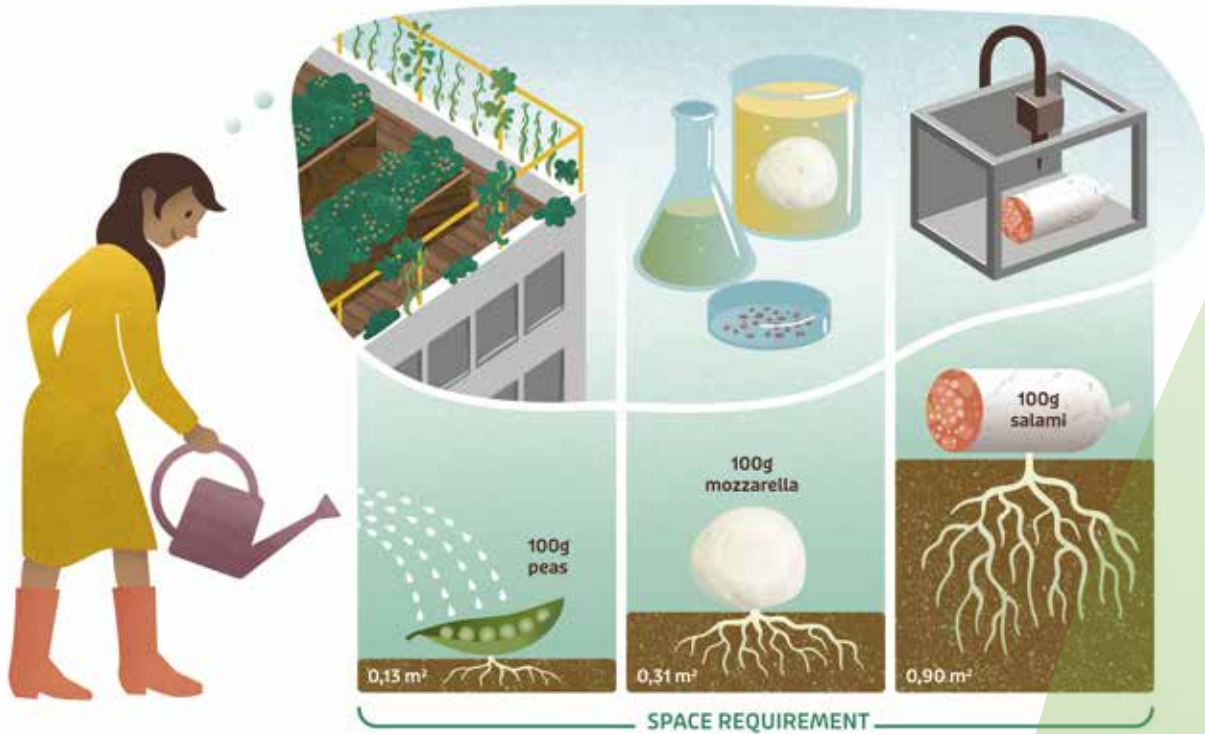
**Info &
Reading
Corner**



Augmented Reality Exhibit



Soil • Growth • Food



It is predicted that there will be up to ten billion people on earth by 2050. Even today, with just under eight billion, it is not possible to supply all of them with fresh, nutrient-rich food in sufficient quantities. This is due to a complex mix of economic and political issues, but also to a large extent to questions of social justice. Additional controversy is caused by increasing soil scarcity and the consequences of climate change. Soil can only produce high yields if it is wet and supplied with nutrients. Increasing periods of heat and drought, as well as intensive forms of land use, are increasingly standing in the way of this. The individual has little direct influence on this. However, our nutritional behaviour can influence how much fertile soil is consumed. For example, raising a pig whose meat is later used to make salami requires about nine times as much soil as growing pea pods.





Speaking of proteins, most people around the world meet their protein needs through animal-based foods. Plant-based alternatives with a smaller resource footprint, such as lentils and edamame in addition to peas, are steadily gaining in popularity. In the form of spaghetti, the edamame as well as many other foods can be discovered on our dining table of specialties. The diverse potential of mushrooms is also alluded to here: Kombucha and so-called vital mushrooms are used for stimulating teas and coffee alternatives, and the high protein content of other species is used to produce nutritious meat alternatives.

Those who still like animal products can reach for a range of insects. Mealworms, crickets and grasshoppers are already permitted in the EU as food alternatives. Their low-CO₂ cultivation is also possible regionally and in the smallest of spaces. They convert their feed more efficiently than other animals and they are rich in proteins with a high-quality amino acid profile. They share all these characteristics with Roman snails. Eaten pure, with butter or as caviar, they are still an exotic exception in Germany.

Jellyfish and Salicornia - also two exotics on German plates. While the latter thrive despite the high salt content on sandy soils by the sea, jellyfish are considered survival artists in the middle of the sea. They, too, are rich in nutrients and thrive in a way that conserves resources.





What and how we eat could change dramatically in the future. The do-it-yourself trend has also returned to kitchens. Quite traditionally, we use fermentation at our dining table to prepare vegan yogurt. We grow mushrooms on coffee grounds and use a modern app to ensure the best possible supply of light and nutrients for lettuce in a mini garden.

Modern technology is also at work in 3D printing. Will it be used in the future as a small kitchen device to make fake rabbit out of mixed mealworms or to make sea pasta out of algae filament? What some might consider more of a gimmick has quite serious potential applications. In the future, 3D printing could be used to create appetizing, easily chewable meals in the healthcare sector, such as an artificial chicken thigh made from real chicken.



Material • Fashion • **Consumption**



The transformation of the economy to a bioeconomy has already found its way into many sectors. The fashion sector is a good, multi-faceted example of this. In fact, the industry like no other uses a wide range of bio-based alternatives and innovations.

This range takes us into laboratories where high-tech materials are grown in petri dishes, microalgae are cultivated, and clothing is treated with enzymes to prevent linting and faded colours. It allows us to peek into the compost, where potential candidates for making vegan leather and odour-reducing fibres are lying around. And on a walk in the woods, we walk on nature's gifts, which creative fashion designers use to dye and tan different materials.

There exists a fast-growing, young fashion community that is boldly experimenting with novel natural materials and alternative manufacturing processes. Some of them are already emerging as small businesses, while others are for the time being putting their skills to use as part of their studies.





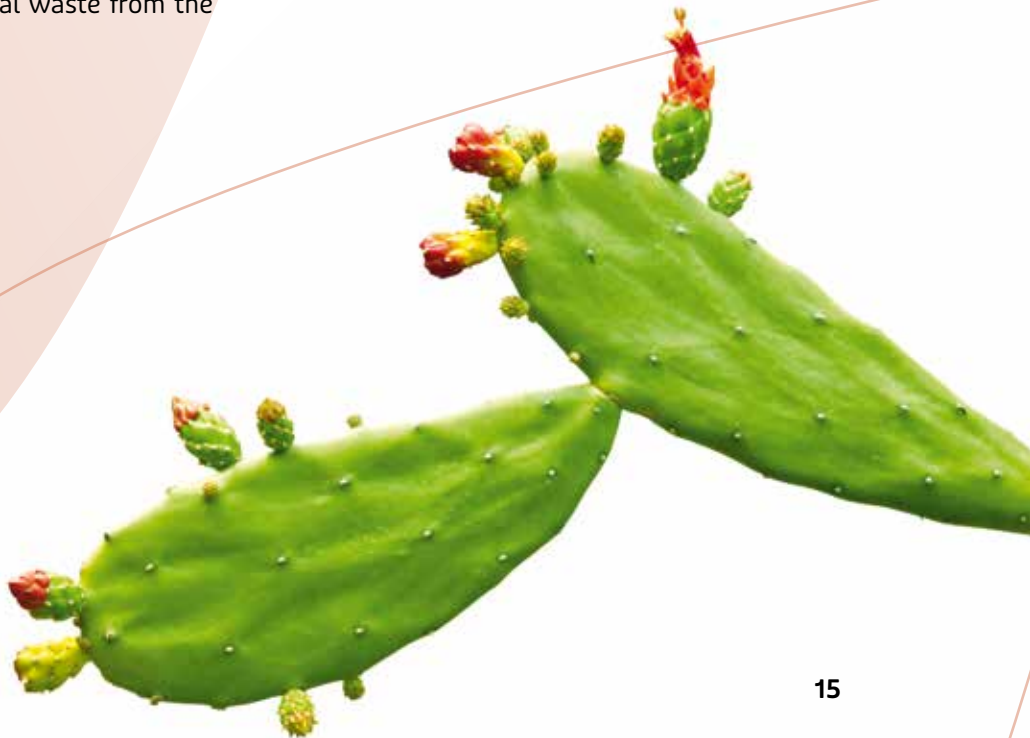
Some of these creative minds are represented in our exhibition with special individual pieces. Charlett Wenig and Johanna Hehemeyer-Cürten use the bark of different trees for their creations. In the case of the pumps, the heel is made of robust Robinia bark; the duo used flexibilized bark from pine trees for their prototypical poncho. Another prototype is right next to it. Young Berlin designers Marie Klages, Maria-Helena Loheide, Nobahar Majidi and Zoe Zobel made the brown and black coloured top largely from asparagus scraps, and the sleeves are made from a sustainable wood fibre called Tencel. The neighbouring garment's plaid pattern is not based on a chemically produced dye. Instead, Essi Johanna Glomb and Rasa Weber use pigments from microalgae for this purpose. The batik shirt in a strong purple also owes its colour to a pollutant-free natural material: blue wood. It was cre-



ated at a DIY workshop as part of the BMBF's Year of Science Bioeconomy. The delicate dress with its perforated pattern was made by designer Freya Probst. She lets her creations grow from roots in close cooperation with nature.

The new, bio-based process and material world is also increasingly showing up in the collections of well-known fashion brands with medium to high production volumes. This segment is represented by the exhibits in the second frame. The outfit in cream combines several bioeconomy aspects at once. The top is made of algae fibres and covered with a protective film of peppermint oil. The highlight of the shorts is their print. The colour is based on dirt particles extracted from the air. The bag and necklace in green are made of the innovative material malai - a composite obtained from bacterial cellulose growing on agricultural waste from the

coconut industry. Red handbag and green sneakers are united by the fact that they are both made of a vegetable leather alternative. In the case of the shoes, cacti have been used for the starting raw material, while the bag uses residual materials from apple juice production. The roller skates are made of animal leather. Their bioeconomy trick: they were not treated with chemical substances, but with vegetable tanning agents.





Production • Change • **Circularity**





The basic goals and visions of a sustainable bioeconomy are relatively clear: with the help of biological knowledge and resources, an economy based on circularity is to be created. However, how the economic transformation takes place depends largely on local conditions. Since these vary greatly from region to region and around the world, there is no one-size-fits-all approach. Instead, the strengths of regions must be worked out in order to identify and exploit potentials for bioeconomic value creation.

These potentials can lie dormant, for example, in the form of locally available biological raw materials in fields and meadows. Forests, oceans or moors can be used sustainably - but also overexploited. At the same time, in our current form of production, much is lost, wasted and ends up as waste. That is why efforts are being made to harness the potential of residual materials through bioeconomic innovation. The aim is to close cycles and reduce waste and exhaust gases. But how exactly can this be achieved? New types of factories play an important role here: so-called biorefineries.



Basically, these plants are used to break down biological raw materials into their chemical components, which can then serve as the basis for a wide variety of products (e.g. animal feed, composite materials, fuel). The RWTH Aachen model illustrates the entire process using the example of a biorefinery that can process wood residues into valuable products to replace petroleum-based ones.

In simplified terms, this proceeds as follows: Wood residues, for example from a sawmill, are transported to the biorefinery. The wood is shredded, treated with heat and pressure, and chemical compounds are separated. This is followed by separation into different components. Some of these are then already suitable for processing into a product, while others remain in the biorefinery for further conversion steps. The components are thoroughly cleaned and enter the heart of the plant, the fermenter. Here, specialized microorganisms convert the former wood pieces into biobased chemicals. Finally, these are purified via evaporation or distillation, and a building block for a bio-based fuel or other petroleum-free chemical is ready.






Germany will completely phase out coal by 2038 at the latest. Coalfields such as the one in North Rhine-Westphalia are facing particularly major changes that primarily affect the lives of local residents. The model region BioeconomyREVIER Rhineland is an example of how not only the transformation of a single raw material, but that of an entire region can succeed according to bioeconomy principles. As in the case of biorefineries, the basis here is also the intertwining of technical and biological knowledge. However, the objectives of the project, which is funded by the German Federal Ministry of Education and Research (BMBF), are broader and include not only economic and eco-

logical aspects but also many social aspects. The aim is to adapt a region to the climatic, economic and social conditions of the future. But how do you design such an extensive change in concrete terms that provides people a perspective and allocates existing space sustainably and equitably for new applications? Housing, transport, industry, research laboratories, business incubators, biorefineries, nature reserves, forestry and arable land - all this and more should be part of it.




City • Country • **Diversity**





Urbanization is increasing worldwide, including in this country. Almost a third of the German population already lives in a major city with more than 100,000 inhabitants. This agglomeration not only brings with it competition for living space, but also confronts us with the fundamental challenge of bringing together the multi-layered needs of people and nature in a limited area. Creating living space for people is one thing. But what about animals and plants? Are their needs sufficiently taken

into account? And what measures need to be taken for climate adaptation and food security? Increasingly, questions like these are being answered with the „green city of the future.“ In many places, this is still in the planning stage; in some regions, it is already being realized. The ideas about how to get there are not congruent, but the core content almost is. Essentially, it is about developing a diverse, green infrastructure from whose ecosystem services people and nature can benefit.



Profiting in the financial sense is not the main focus. Rather, the aim is to enhance the urban quality of life with social and ecological elements. Parks and meadows with bodies of water are an important part of this. These places bring people together for conversation, outdoor play and sports activities; they enable social and cultural participation. They are also a haven for biodiversity, which has been in sharp decline for decades in both urban and rural areas.

At the same time, bodies of water and plants cool, humidify and purify the air - important for the health of all living things. Alongside trees, moss masters these tasks particularly effectively. In a vertical, space-saving orientation, the curly green-

ery can therefore be found in more and more urban centres. Often with sophisticated technology behind it: Fans are installed behind the dense layer of moss. These suck in the warm, polluted air, it flows through the moss layer and emerges cleaned and cooled at the back. In addition, sensors control the moss supply and provide environmental data in real time.



Another element of the green city of the future is sustainable, multi-use architecture. Houses can accommodate several generations, provide space for childcare and home offices, and at the same time be a place where food is produced. Herbs in nutrient solution under LED light, tomatoes in raised beds, and microalgae in a small bioreactor on the roof - the list of new, bio-based possibilities is long.

In addition, the bioeconomy can make an important contribution in terms of sustainable, innovative building materials. Two of these are on display at the exhibition. The futuristic pavilion, which was developed in a joint project between the universities of Stuttgart and Freiburg, consists largely of flax fibers. Their strength is about one-third that of carbon fibers. In terms of shape and structure, the researchers were inspired by cacti. The original model of the MY-CO-X science and art collective led by microbiologist Vera Meyer consists of a plywood construction that connects 300 honeycomb-shaped fungal mycelium elements. These are mushroom-straw composites that are completely biodegradable. The wall sections were filled with tinder sponge, also a fungus.



Experience Bioeconomy - The Augmented Reality Exhibit

The main topics of this exhibition can additionally be experienced in a very special way: virtually. „Augmented reality“ roughly means „extended reality“ in German. What is meant is that virtual objects appear in the real world. In the case of our augmented reality exhibit, these are exciting bioeconomy worlds that appear and can be discovered via a tablet.

With the help of this technology, we can gain insights into a possible near future. Should it look like this or perhaps completely different? What role could the bioeconomy play in this? And what is the relationship between humans and nature?

At one of five entry points, you can explore a city with bio-based innovations, a research institute for soil and plant research, a bioeconomy shopping centre, a biorefinery and an information centre. They are all peppered with information on interesting research projects in the form of texts and videos as well as small animations.

In cooperation with Dr. Zoltan Ferenczi, xrperiences programming and 3D design) and contura Modellbau (construction of the physical model).



Artistic Intervention

Exhibit series

„What does this have to do with me?“

Art creates scope for interpretation and thereby enlivens social discussions - including those about the bioeconomy. It can reveal areas of tension and contradictions, help to formulate thoughts and feelings, but also connect supposedly contradictory things.

The exhibits from the series „What does this have to do with me?“ exemplarily convey the supposed ambiguity and contradictoriness of different (technical) innovations that also play a role in the bioeconomy. The focus is on novel products and processes that demonstrate opportunities for progress, but at the same time call into question the concept of nature and individual action. Raspberry flavour that comes from the bioreactor and can conserve resources and the environment. Or bumblebees, which pollinate plants in the greenhouse as farm animals in winter but are not allowed to be released into the wild once their work is done. Such examples create situations in which social

and personal concepts such as naturalness and sustainability must be questioned and sometimes weighed against each other.

The installations are intended to stimulate reflection on personal desires and expectations in dealing with nature. From this, a positioning towards bioeconomic issues could develop - an important building block to be able to participate in social discourses on the bioeconomy.

The installations presented here change together with the weekly thematic focuses of the exhibition. They also form the starting point for the workshop series „To Nature,“ which takes a closer look at the changing concept of nature.

In cooperation with **Stefan Schwabe and Jannis Hülsen.**



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