Bavarian State Government

BAVARIAN BIOECONOMY STRATEGY

FUTURE. BIOECONOMY. BAVARIA.

SUSTAINABLE AND INNOVATIVE TRANSFORMATION

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IN ALL REGIONS AND ACROSS MANY INDUSTRIES, **SUSTAINABLE INNOVATIONS** ALIGNED WITH THE **BIOECONOMY STRATEGY** ARE PAVING THE WAY FOR THE TRANSFORMATION OF THE BAVARIAN ECONOMIC SYSTEM AND SOCIETY TOWARDS **MORE CLIMATE NEUTRALITY**.

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Future.Bioeconomy.Bavaria

The future

We are currently confronted by many different challenges! Although essential topics of future such as climate change have been temporarily side-lined due to the corona pandemic, these issues remain highly relevant. The pandemic will further accelerate already initiated structural changes in certain sectors such as in the automotive industry. In the global environment, insecurities have increased. Especially during this time, it makes sense to find our bearings and build on our strengths. The state of Bavaria is rich in resources. These resources include renewable resources as well as highly trained professionals, an excellent research landscape and innovative commercial enterprises. Therefore, there is no better time than now to advance the transformation towards a viable social and economic system.

Bioeconomy

The bioeconomy envisages a fundamental structural change: An economy based on fossil resources is to be continuously transformed into a viable, sustainable and bio-based economic system that takes the potential and limitations of natural resources into account. On the one hand, the bioeconomy is to contribute to environmental, resource and climate protection and, on the other, provide added value for locally sourced raw materials, create new workplaces, strengthen international competitiveness and develop new markets.

Bavaria

The Bavarian Bioeconomy Strategy Future.Bioeconomy.Bavaria addresses all relevant players: society, administration and politics, agriculture and forestry, industry and science. We want to actively develop the transformation with the implementation of fifty measures. The success of the bioeconomy critically depends on society's acceptance of these measures. For this reason, we must integrate all citizens and provide education about the benefits of the bioeconomy, e.g. by establishing targeted educational offers and fostering an intensive public discourse. At the same time, policy-makers and administration are to initiate necessary changes for the amendment of laws and ordinances and take on a role model function with respect to usage and consideration for climate and environmentally friendly products. Agriculture and forestry as producers of renewable resources are thereby strengthened offering business and industry an opportunity to become a driver of innovation within the bioeconomy. Science and research form the basis for new insights and for a science-based bioeconomy. Interdisciplinary cooperation and improved communication promote the transfer of new insights for practical application.

Consequently, the strategy was developed as an open and constructive process with the integration of all relevant players. We want to express our heartfelt gratitude to all workshop participants, all surveyed experts, the involved ministries and the clusters and especially the Bioeconomy Council Bavaria with its outstanding level of expertise.

Future.Bioeconomy.Bavaria is the guiding principle for the actions we will take in the future.

Preface by the Bioeconomy Council Bavaria

Global challenges such as man-made climate change and the loss of biodiversity have made it all the more clear that changing our way of life and economic system has become inevitable. The bioeconomy as a topic of the future focuses on reconciling economic, ecological and social aspects as it offers far greater opportunities than merely replacing fossil with renewable resources: The bioeconomy-oriented transformation by means of innovation, cooperation and participation also allows for and promotes structurally new production and consumption methods. The task of policy-makers is to initiate and introduce these measures by establishing ethically responsible framework conditions.

This strategy creates impulses for new ideas and actions and highlights political course adjustments for the bio-based future of Bavaria. The Bavarian State Government is hereby clearly positioning itself and advocating for a viable economic system and way of life. The implementation of this strategy and a knowledge-based bioeconomy can only be successful if many different players participate in the process. In this respect, Bavaria can provide a role model function for Germany and also create an impact at the European and international level.

We are grateful to all experts who contributed to the development of this strategy and committed themselves to the implementation of a viable and future-proof bioeconomy. The present task at hand is to build on this foundation and jointly advance the bioeconomy in Bavaria. We remain committed to this task in the future.

Sachverständigenrat
Bioökonomie Bayern

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Bioeconomy: The path towards a sustainable way of life and economic system

The 21st century is characterised by critical global challenges such as climate change and increasing environmental pollution. At the same time biodiversity is to be maintained, soils are to be protected and the world population is to be supplied with clean water and clean air. Securing the world's food supply as well as responsibly dealing with the increasing scarcity of our finite resources are enormous tasks, which are also addressed in the European Union's Green Deal.

Committed to sustainability, Bavaria is taking the next step with respect to the present strategy as it provides products, processes and services for all commercial sectors by producing and using biogenic resources and biological expertise within the framework of a viable way of life and economic system while concurrently also protecting the climate as best as possible.[1]

The bioeconomy envisages a fundamental structural change: An economy based on fossil resources is to be continuously transformed into a viable, sustainable and bio-based economic system that takes the potential and limitations of natural resources into account. Securing the food supply is of utmost importance. Furthermore, it is also about linking economic development with ecological compatibility by ensuring that technological and economic innovations promote a responsible, conserving and economical usage of natural resources.

The bioeconomy is guided by natural material cycles and utilises waste and refuse materials according to the cascade and by-product principle. Consideration for the goals of the circular economy is an absolutely essential precondition for achieving optimally resource-efficient and sustainable utilisation as well as ensuring the multi-use capacity of renewable resources and material flows. A sustainable and circular bioeconomy is an important element of transforming our way of life and economic system towards a post-fossil economy that takes responsibility for climate and environmental protection while protecting and conserving our ecosystems. This calls for a change of consumption patterns and a shift towards more sufficiency.

A sustainable bioeconomy encompasses all industrial and commercial sectors that produce, process and use biogenic resources and impacts the majority of application sectors that benefit from innovative developments, resource and energy-efficient procedures, products and services.

1 Modified according to: Bioeconomy Council – independent advisory body for the Federal Government of Germany (2020): What is the bioeconomy? https://biooekonomierat.de/biooekonomie/index.html (status: 23/08/2020).

In Bavaria, the bioeconomy is to become a guiding theme for the development and implementation of a more sustainable way of life and economic system. This transformation offers tremendous opportunities for the environment, society and the Bavarian economy. Scientific and technological innovations can significantly contribute to the creation of new workplaces and Bavarian prosperity as well as to increasing independence from fossil resources while ensuring greater supply security. New developments allow Bavarian enterprises to become technological leaders and global drivers of innovation in various sectors. This applies to a multitude of Bavarian core sectors due to the pronounced cross-sectoral character of the bioeconomy: from agriculture and forestry to the food, timber, paper, leather, textile and chemical industry as well as to certain areas of the energy and waste management sector. The overarching technological field of industrial biotechnology and its related disciplines provide an essential pillar as these areas further advance the biological transformation of production processes.

An open approach to technology within the bioeconomy affords the opportunity to develop innovation-driven, bio-based approaches to solutions for current and prospective challenges. Promoting innovation through research and development, technology and knowledge transfer, application-oriented strategies as well as practical implementation projects provides opportunities to strengthen our domestic economy and society. Bavaria can thereby become a model region for a sustainable bioeconomy in Germany and Europe as well.

Innovations within the bioeconomy are founded on science and research conducted in Bavaria. Viable solutions are created through interdisciplinary approaches and the merging of various research fields and technological areas beyond the limitations of specific industries and disciplines. Systemically linked knowledge about (bio)technological and ecological processes combined with economic and social-scientific competence constitute the precondition for sustainable innovations. Strengthening the exchange between life sciences and converging technological areas is especially important within this context.

An intensive, moderated dialogue among all relevant players in the Bavarian economy, science, civil society and politics is the basis for the advancement of society as a whole towards a sustainable bioeconomy and the successful transformation of our economic system. Our joint goal is to achieve a sustainable and ecologically responsible as well as socially just and thereby viable economy and way of life for Bavaria.

Goals of the Bavarian Bioeconomy Strategy

The Bavarian Bioeconomy Strategy pursues the following goals:

- Reducing the consumption of fossil resources by implementing a sustainable and viable economic system and developing sustainable, bio-based technologies, processes and products
- Contributing to the protection of the environment, resources and biodiversity
- Contributing to the implementation of the goals set by the Bavarian Climate Protection Programme 2050 and Bavarian climate initiative, specifically the legally binding goals of the Bavarian Climate Change Act
- Promoting an open dialogue and enabling social participation in order to foster acceptance and understanding for the bioeconomy within society
- Contributing to the Bavarian principle of "protection and use" of renewable domestic resources. The bioeconomy materializes the value of these resources while creating and securing new income perspectives and workplaces in rural and urban areas.
- Ensuring international competitiveness and the development of new markets by means of pioneering usage of renewable resources as well as waste and refuse materials, preferably in accordance with the principle of cascade and by-product usage. The development of new technologies and materials as well as necessary procedures for innovative products are thereby initiated, and new workplaces are created within the context of a viable economic system.
- Striving to become the leading location for sustainable products and methods of production thereby taking on a role model function for other regions
- Strengthening science for the further expansion of biological knowledge as well as for the targeted transfer of knowledge to industry

Procedure for the participatory process

The Bavarian State Government has developed the following Bioeconomy Strategy under the auspices of the Bavarian Ministry of Economic Affairs, Regional Development and Energy. Based on regional location factors, the strategy describes the path of the Bavarian bioeconomy and identifies respective measures. Some measures are already being implemented presently. Any already determined measures are implemented in accordance with available agencies and funds. Further measures are subject to prospective budget negotiations.

The strategy was drafted as a participatory process in order to give all relevant players the opportunity to be heard and to actively shape the development of the strategy. The Bioeconomy Strategy was developed in close coordination with the Bioeconomy Council Bavaria, the Inter-Ministerial Working Group on Renewable Resources and the Bioeconomy, the clusters as well as with representatives from agriculture and forestry, industry, science and society. Organisation and content-related support were provided by Bayern Innovativ.

Thematic workshops in the participatory process

- Resource supplies
- Resource usage
- Industrial processes
- Product development
- Recycling
- Collection
- Circular economy
- Research
- Innovation
- Training
- Society
- Consumption
- Communication

Embedding the Bavarian Bioeconomy Strategy within other strategies and initiatives

Awareness for the necessity of effective climate protection measures, the conservation of our basis of existence and the development of an adapted, alternative economic system is growing worldwide. The corona crisis is creating considerable additional problems for the political system, industry and society. However, the caesura caused by the crisis can also be perceived and utilised as an opportunity to implement solution-oriented changes. The Bioeconomy Council Bavaria encourages everyone "to take advantage of the potential afforded by the corona crisis" in order to accelerate and proactively support transformative processes that would have been necessary anyway. Transformation towards the bioeconomy can sustainably stabilise and further advance the Bavarian economic system once the crisis has passed."[1]

Bavaria is already currently orientating its sustainability strategy according to the sustainability goals of the United Nations (Sustainable Development Goals 2030, SDG). These measures should also effectively contribute to the implementation of environmental and climate protection measures of the Federal Government of Germany and the European Union.

Bioeconomic measures can help in the fight against climate change and achieve related climate-policy goals enshrined in law, which specifically includes attaining climate neutrality by 2050 at the latest. The implementation of the preventive three-pillar strategy of "reduction, adaptation and research" has been integrated in the Bavarian Climate Protection Programme 2050 in the form of specific climate protection goals. Thus, the currently presented Bioeconomy Strategy is also part of the climate initiative of the Bavarian State Government.

Moreover, at the state level, the Bavarian Bioeconomy Strategy also contributes to attaining the goals that Germany has set out for itself within the National Bioeconomy Strategy and the EU within its Bioeconomy Strategy and Green Deal: to develop a viable, sustainable, climate-neutral and recycling-oriented economic system.

The Bavarian State Government is aware of the importance of biodiversity with respect to the preservation of our natural basis of existence and utilises all available instruments at its disposal in order to maintain and further strengthen this basis. This occurs within the context of the Bavarian Biodiversity Strategy for the conservation of species diversity and the preservation of habitats. The Bavarian Bioeconomy Strategy is committed to these goals and takes the resulting limitations for the usage of renewable resources into account.

1 Bavarian Bioeconomy Council (12 May 2020): Long-Term Thinking and Acting in Crisis – Strengthening the Transformation Towards a Sustainable Bioeconomy Now http://www.biooekonomierat-bayern.de/dateien/SVB_Stellungnahme_Jetzt_langfristig_denken_und_handeln.pdf (status: 23/08/2020).

Modern technologies of the future within the area of industrial biotechnology are especially important for a sustainable, recycling-oriented bioeconomy in order to develop and efficiently use renewable resources for material usage. Thus, the Innovation Strategy of the Free State is closely interwoven with the Bioeconomy Strategy. Bavaria is promoting research and innovation within the state by means of the "High-Tech Agenda" and thereby securing the international competitiveness of the location with competences in promising technologies. Innovative technologies and CO_2-free green hydrogen also play an important role within this context – especially in the area of energy and mobility. The Bavarian State Government has set ambitious goals and strives for a consistent energy and mobility transformation. The Free State aims to quickly implement these measures by means of the Bavarian Hydrogen Strategy.

The "Bavarian Energy Programme" is the basis for the energy-political agenda over the next years. Pioneering goals have been established for Bavaria, and requirements have been implemented at the federal level. The "Bavarian Energy Programme" builds on and consistently continues the Bavarian Energy Programme from 2015 and the Bavarian Energy Concept from 2011. Accordingly, specific measures are currently being executed for the bioenergy area within the context of the "Bavarian Energy Programme".

Construction constitutes an essential material use, especially for timber. In a joint initiative in 2020 under the auspices of the Bavarian Ministry of Food, Agriculture and Forestry with the Ministry of Housing, Building and Transport and the Ministry of Economic Affairs, Regional Development and Energy, the Round Table "Climate Protection by Building With Wood" developed numerous measures for the areas of forestry and development, communication and public relations as well as incentives for climate-friendly building and the role model function of public works with expert contributions from industry, science and other organisations.

The Bavarian Bioeconomy Strategy includes the production of resources based on biomass from the area of agriculture and forestry, nutrition as well as material and energetic use of renewable resources. The focus is on the biological transformation of the economy. The goal of the strategy Future.Bioeconomy.Bavaria is to sustainably and innovatively shape this transformation. Environmentally compatible cultivation practices and usage recommendations are to be taken into account. Thus, the strategy is embedded within the context of the abovementioned strategies.


3

Strengthening the circular and sustainable bioeconomy

The goal of the bioeconomy is to realise a sustainable way of life and economic system based on biogenic resources. The limited availability of renewable resources due to land utilisation as well as increasing demand from various usage areas for biomass require efficient and sustainable usage. Therefore, the implementation of natural, closed-loop material cycles and an increase in resource efficiency are basic pillars of climate and environmental protection. The bioeconomy must consistently align itself with the principles of a circular economy.

Presently, approaches such as Cradle to Cradle[1] are already demonstrating how resources and materials can be used in technological and biological cycles in order to minimise negative impacts on the environment. Cascade usage, recycling as well as reusing waste and refuse materials are central aspects for a sustainable, circular bioeconomy in order to utilise products for as long as possible in a technological and ecological cycle based on biogenic resources. The goal is to decouple economic growth from resource consumption.

Bio-based circular processes, products and services can thereby contribute to the conservation of soil, water, air and biodiversity resources. This contribution afforded by a sustainable bioeconomy to combating climate change, protecting biodiversity and implementing sustainability goals has been described in greater detail in chapter 2.

In Bavaria, there are various initiatives and joint research projects focussed on an economical and circular use of valuable resources. Joint projects by industry and the state visualise the opportunities of ecological economic activity within the context of the Bavarian Environmental and Climate Pact. Moreover, numerous innovative companies and research institutes have already developed procedures, technologies and products in this field and brought these to market. Various application sectors perceive growing potential in the circular usage of biogenic resources and the concomitant initiation of regional value cycles. Political and legal framework conditions must be prospectively adapted in favour of a circular bioeconomy in order to utilise this potential and strengthen the protection of resources and ecosystems.

1 Cradle to Cradle is a design principle that potentially envisages an infinite circulation of materials and nutrients in biological and technical cycles. The principle was developed by Braungart and McDonough. Cf. http://www.braungart.com/ (status: 17/09/2020).

1 Measure

▶ **Review during the amendment of laws**

A solution must be found to examine the amendment of laws and ordinances with respect to their influence on the development of the bioeconomy and initiate necessary changes that support the conversion process towards a sustainable, circular bioeconomy.

Innovative application forms based on regional subsidiary and waste flows from agriculture and forestry, the food and fodder industry as well as other industrial processes offer great potential for achieving closed-loop cycles. Value chains and cycles must be redeveloped and restructured while also taking the aspects of climate protection into account. The primary sector that creates and provides renewable resources is regarded as an especially important player. All participants benefit from the bioeconomic added value when agriculture and forestry are actively integrated as equal partners. At the same time the logistics of renewable resources must be taken into account for the establishment of new value cycles. Forestry and agricultural resources are mainly harnessed in a decentralised manner while logistics solutions for low-carbon transport are required for further processing. New logistics chains must be established for thus far underused or unused resources as e.g. from food production or organic waste products. Establishing and transforming these capabilities towards new value cycles constitute core aspects of the bioeconomy. Implementation occurs by making adjustments along the entire value chain. Thus, numerous measures within this strategy significantly contribute to the implementation and pursuit of the goal of establishing sustainable and innovative value cycles.

2 Measure

▶ **Establishment of sustainable value cycles and conversion of existing value chains**

The Bavarian State Government supports the establishment and structuring of new sustainable value chains and cycles. On the one hand, optimised, individually existing value chains can reduce resource consumption and increase cascade and by-product usage and, on the other hand, convert production to renewable resources. The associated harnessing of new added value potential is to be developed.

Measure 3

▶ **Logistics of biogenic resources**

The Bavarian State Government supports projects that optimise logistics processes of regionally produced biogenic resources such as renewable resources, biological waste, food industry remnants and previously unused subsidiary material flows with the use of digital methods.

For closing material cycles, biowaste collection, usage and logistics are also important aspects of a circular bioeconomy. Compost from communal biowaste constitutes a valuable and increasingly important fertiliser for the agriculture. For years, communal biowaste collection has also been facing growing challenges due to stagnating collection amounts and increasing plastics contamination of biowaste. Current studies have ranked compost as the second-biggest polluter with respect to the introduction of microplastics into the environment.

Measure 4

▶ **Practical test for the usage of bio-based carrier bags (T-shirt bags) in order to reduce the intrusion of microplastics into the environment and promote organic recycling**

The Bavarian State Government is promoting a model project under the leadership of C.A.R.M.E.N. e. V. in cooperation with commerce and waste management in which the increase of properly collected amounts is tested by means of innovative, bio-based products in order to improve and secure the circular economy for the long-term using communal biowaste.

In addition to the conversion of existing and establishment of new value cycles, bio-based products and their product characteristics represent an essential factor for a circular bioeconomy. It must be the goal to develop recyclable products that, in addition to their resource base and recyclability, are also durable and repairable. Bio-based products can thereby not only be maintained within a closed-loop cycle but also contribute to sufficiency.

A gauging device is needed for evaluating the ecological footprint of products, processes or services in order to foster understanding and raise awareness for the bioeconomy within society and industry. Lifecycle analyses or ecobalances provide the basis for this. Thereby the environmental impacts of a product can be systematically examined throughout the entire product lifecycle and environmental impacts that occur due to the harnessing of resources, production, transport, usage and disposal as well as released emissions can be analysed.

Prospectively, the creation of lifecycle analyses will become even more complex and extensive. Besides the factors that are being examined presently – such as resource and land consumption or CO_2 emissions – further criteria such as origins or raw material sources, cultivation practices, secondary raw material usage or recyclability must also be included in the future. Today's available and established models do not yet sufficiently depict the circular bioeconomy.[2]

5 Measure

▶ Life-cycle analysis and requirements for recyclable products

The Bavarian State Government is committed to a sustainable product policy at the federal and EU level. The goal is to design products with a long service life and a high content of recycled starting materials as well as products that are easily repairable and can be recycled to a high degree. A quick implementation of the action plan for the circular economy is expressly promoted.

The Bavarian State Government is also committed to the development of new lifecycle analysis models for the bioeconomy that provide uniform and comprehensive assessments and create framework conditions for the application of respective tools. Methods for the determination of external environmental costs such as for energy, water, resource and land consumption as well as CO_2 emissions will be prospectively taken into account and implemented to a greater degree. Existing methods or technologies or methods and technologies that are currently in the developmental phase such as AI, big data and machine learning are utilised in order to analyse the production path and lifecycle of a product as well as prospective material flows and recovery paths.

The bioeconomy in Bavaria is to significantly contribute to the protection of the ecosystem and climate. According to this premise, a sustainable, bio-based economy contributes to the implementation of the goals enshrined in the Bavarian Climate Change Act, which specifically includes food security, ensuring the diversity of crops as well as the protection and conservation of the ecosystem, biodiversity, soils as well as ground and surface water. At the same time, the bioeconomy is to contribute to the recognition of services that benefit the ecosystem. The ecological services provided by agriculture and forestry must continue to be promoted and land consumption must be restricted in order to reach these goals. Within this context, regional, decentralised added value not only offers potential for rural areas but also resource protection. Sustainable and diversified biomass cultivation is just as critically important as the abovementioned aspects of resource efficiency and the circular economy.

2 For example, the Fraunhofer IWKS is researching viable material flows and material cycles. See https://www.iwks.fraunhofer.de (status: 23/08/2020).

Optimising CO_2 capture in agriculture and forestry as well as in the material usage of biogenic resources are important factors for a viable economy. In addition to agriculture and forestry, bio-based products, processes and services also act as carbon reservoirs that are superior to fossil alternatives in terms of longevity and recyclability. Product prices reflect production processes that are harmful to the climate and the environment due to internalised external costs incurred during the production, usage and recovery of products. However, limits are imposed where cost increases are no longer socially compatible. Producers and manufacturers are thereby held accountable, which has a steering effect on the process of transformation. Based on renewable resources, the integration of these costs can provide a cost advantage for products whereby bio-based products become competitive and more attractive for consumers.

Measure 6

▶ **International CO_2 pricing**

At the federal and EU level, the Bavarian State Government advocates for international CO_2 pricing. It must also be taken into account that biogenic carbon has a different intrinsic value than fossil carbon. Maintaining international competitiveness of European producers as well as fair pricing for external environmental costs must be taken into account.


4

Strengthening the willingness of society for transformation

A sustainable bioeconomy in Bavaria is based on a holistic and comprehensive sustainability concept. This value concept for the bioeconomy must be acknowledged and adapted by society in order to foster acceptance for the necessary consumption and behavioural patterns in favour of bio-based products and processes. The goal is to increase the visibility of the bioeconomy, establish an intensified dialogue within society and convey a holistic understanding of the bioeconomy. Consumers can also be actively integrated in the further development of the bioeconomy.

The shaping of public opinion with respect to topics of the bioeconomy or the bioeconomy as a viable economic system is still only at a very early stage. Social groups such as environmental protection organisations emphasise the risks and challenges of commercial activities based on biogenic resources. A majority (57 percent) of the German public endorses the goal of the bioeconomy to replace fossil with renewable resources.[1] Technological innovations make bioeconomic processes possible. These innovations are not always uncontroversial or immediately accepted by society. A majority of the public (70 percent) wishes to be included in the decision-making process on contentious issues.[2]

The Bavarian State Government is committed to a sustainable bioeconomy in accordance with ecological and environmental protection principles (see chapter 3) and perceives the strengthening of society within the transformation process as a central aspect. The strategy was initially developed in a participatory procedure and continues to focus on social participation. These measures inform and empower citizens and ensure a successful discourse, which also includes anchoring the topics of the bioeconomy within the Bavarian educational system and making it possible for all players to properly deal with concomitant changes and opportunities. The willingness of society for participation is reflected in individual measures and also discussed in chapter 10 as part of the further development of the strategy.

1 acatech and Körber Foundation (ed.) (2020): TechnikRadar 2020. What Germans Think About Technology. Focal Point Bioeconomy, https://www.acatech.de/wp-content/uploads/2020/05/Broschuere_Technikradar_Langfassung_Einzelseiten_final.pdf (status:26/08/2020)

2 acatech and Körber Foundation (ed.) (2020): TechnikRadar 2020. What Germans Think About Technology. Focal Point Bioeconomy, https://www.acatech.de/wp-content/uploads/2020/05/Broschuere_Technikradar_Langfassung_Einzelseiten_final.pdf. (status: 26/08/2020)

Informing and empowering citizens and consumers

Awareness for sustainability and climate change has increased among consumers[3] and companies. It would make sense to establish uniform and reliable standards for bio-based products and their production in order to support these developments. Seals and certifications can, e.g., visualise the share of renewable or secondary resources, resource-conserving raw material usage, the CO_2 footprint, ecological impacts, biodegradability, recyclability, energy consumption during production, resource consumption (fossil or regenerative), etc.

7 Measure

▶ **Implementation of uniform standards**

The Bavarian State Government is committed to instituting uniform national and EU-wide standards for bio-based products and product labelling.

Target group-appropriate and transparent communication allows for critical discussions, creates knowledge and raises awareness and places the bioeconomy within the context of the topics of climate change, sustainability, the circular economy and food production. Effective climate and environmental protection challenges society as a whole and demands active participation from everyone. It is important to sensitise citizens for resource-conserving and viable (consumption) behaviour and personal responsibility. The goal is to highlight the complex correlations with respect to the consumption of food, bio-based products and the resulting impacts on climate and the environment by means of communication and education. Traditional and modern communication channels and media are used in order to reach mainstream society and stakeholders. Besides consumers, this specifically also includes addressing resource producers, manufacturers, processors and disposers as well as the commercial sector and legislators.

3 German Environmental Agency (2019): Environmental Awareness and Environmental Behaviour. https://www.umweltbundesamt.de/daten/private-haushalte-konsum/umweltbewusstsein-umweltverhalten#das-umweltbewusstsein-in-deutschland (status: 27/08/2020).

Measure 8

▶ **Educational work on bio-based products**

The Bavarian State Government is initiating the development of an information campaign on bio-based products that also discusses their impacts on sustainability. The goal of this campaign is to raise awareness for the bioeconomy and for climate protection while concurrently increasing the practical knowledge of consumers.

The food sector is centrally important with respect to food production and consumption patterns. All target groups are to be held to account in equal measure: on the one hand, for daily individual consumption behaviour, on the other, as willing cooperative citizens for the new alignment of nutritional habits. Raising awareness for the complex correlations between an 'ecologically stable', i.e. a 'healthy environment' and a 'healthy lifestyle' for all people based on 'commitment to the Bavarian bioeconomy' should be an important goal of the state-promoted transfer of knowledge.

Measure 9

▶ **Educational work on sustainable food supply**

The Bavarian State Government will intensify its public relations efforts on sustainable food supply in order to also address the topics of lifecycle assessments of food, reduction of food waste, cultivation practices and consumption habits.

Social dialogue on the transformation process

For a successful bioeconomy it is important to comprehensively inform society and take citizens along on the path of transformation.

Critical voices must be heard and integrated in the discourse. This is all the more important since the term bioeconomy can be ambiguous and may require interpretation while also implying value judgements. Moreover, the public is also not yet sufficiently aware of this term and its connotations.

The goal of fostering a dialogue is to establish a basis and generate knowledge about the social advantages of the bioeconomy, global correlations and the necessity for a more sustainable, viable economic system and sustainable consumption. Ethical topics can also be addressed, and an objective discussion can be held based on facts.

10 Measure

Platforms for the civil dialogue

Dialogue platforms are created in order to allow for an open discourse with the public and discuss questions related to the bioeconomy, its advantages, framework conditions and economic perspectives. Current environmental changes, economic stipulations, planetary limits, biodiversity and ecosystem services as well as man's reliance on nature are especially taken into account.

Bioeconomic model regions ideally integrate all stakeholders within an industry, a region, a value cycle and society. Bavaria is already well-positioned in terms of outstanding expertise in regions like Straubing.

11 Measure

Support of bioeconomic model regions

The promotion of Bavarian bioeconomic model regions is pursued within the context of the promotional programme of the Federal Ministry of Economics. The Bavarian State Government supports bioeconomic model regions with their applications.

Bioeconomic content and competences within the education system

The key to a successful bioeconomy is to establish a broad knowledge base in order to raise awareness for the bioeconomy and promote innovation, which is, among other things, also made possible by anchoring basic concepts and topics within the education system.

Associated topics in the developing LehrplanPLUS curriculum are to be embedded across school types, academic years and disciplines in order to establish a knowledge base for the bioeconomy and its far-reaching correlations at an early age. Educational materials taught in school not only contribute to basic bioeconomic knowledge but also provide a basis for training prospective specialists.

Thus, education on the bioeconomy can already begin in elementary school by examining products made from renewable resources. Secondary schools can convey processes, economic observations and scientific background knowledge. The topic is perceived in an interdisciplinary manner in order to elucidate complex correlations.

Measure 12

▶ **Anchoring the topics of the bioeconomy in the curricula of all school types**

The implementation of the developing LehrplanPLUS curriculum makes it possible for the Bavarian Ministry of Education and Cultural Affairs to develop comprehensive competences with respect to the topics of the bioeconomy.

Bioeconomic knowledge should not merely be taught in science and engineering degree programmes so that bioeconomic concepts can impact the thinking and behaviour of everyone. Conveying the basics of the bioeconomy in other degrees programmes such as in economics, mathematics, law and administration highlights bioeconomic correlations with individual disciplines, trains interdisciplinary thinking and interlinks all training areas on the topic of the bioeconomy amongst each other. Especially apprentices and students are to learn about the professional perspectives of a sustainable bioeconomy in order to prepare them for the prospective professional world. The TUM Campus Straubing for Biotechnology and Sustainability in Bavaria, which has been institutionalised by a separate law, precisely implements the interdisciplinary approach for research and teaching in the bioeconomy.

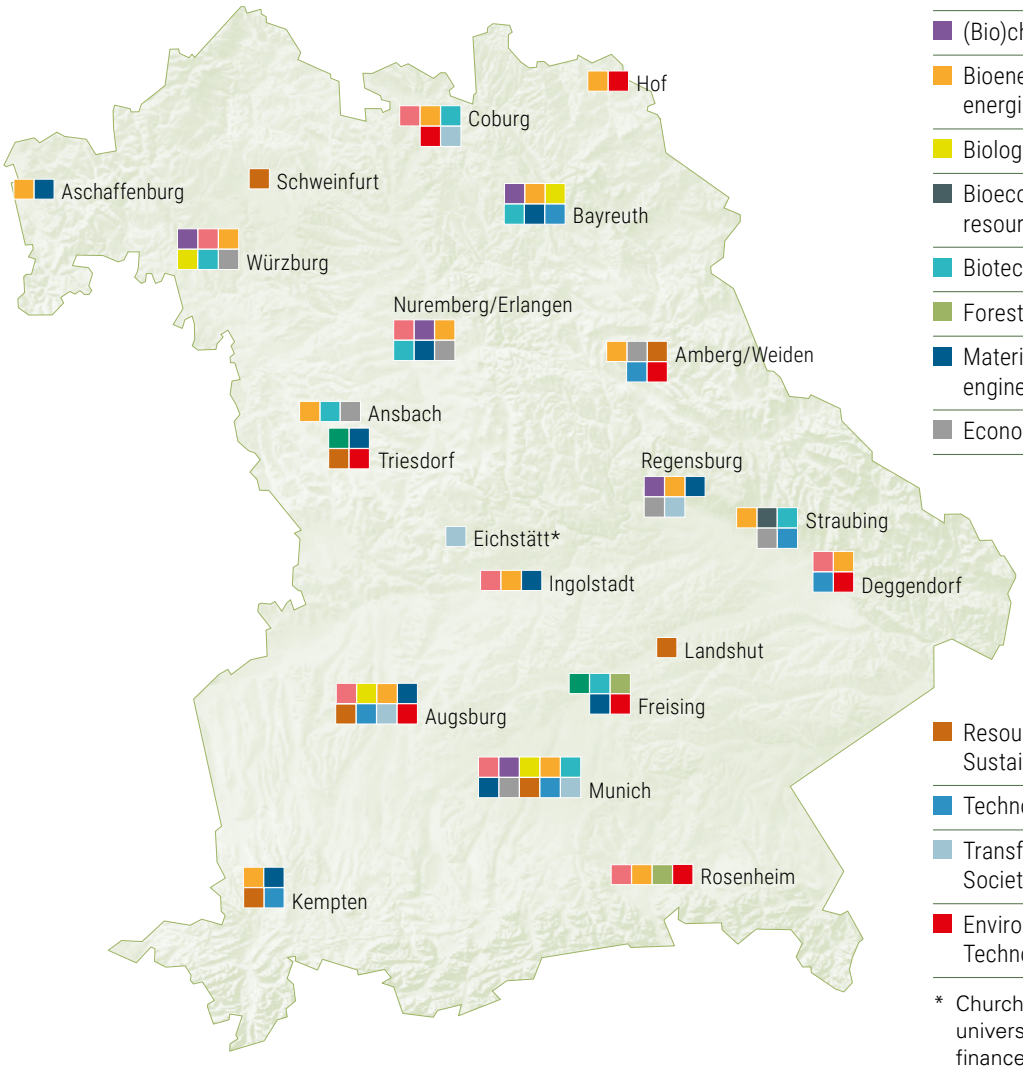
13 Measure

▶ Expansion of teaching in the bioeconomy

The Bavarian State Government aims to integrate bioeconomic topics in university degree programmes while taking the academic autonomy of educational institutions into account. The goal is to embed the teaching of fundamentals and correlations of the bioeconomy at a commercial, political and ecological level in all natural science and economics programmes. Bioeconomics students are to learn commercial, political-science and financial knowledge.
The expansion of bioeconomic teaching and research at the dedicated bioeconomy location Campus Straubing is being implemented as planned.

Degree programmes relevant for the bioeconomy

All state universities of applied sciences/polytechnic universities and universities are taken into account.



- Agricultural sciences/ management
- Building/Design
- (Bio)chemistry
- Bioenergy/Renewable energies
- Biology/Ecology
- Bioeconomy/Renewable resources
- Biotechnology
- Forestry/Wood science
- Materials sciences/ engineering/packaging
- Economy/Management
- Resource management/ Sustainability
- Technologies/Procedures
- Transformation/Ethics/ Society
- Environmental sciences/ Technology

* Church-sponsored university, predominantly financed by the state

Teachers must be given the opportunity to build up and expand well-founded scientific knowledge about the bioeconomy and sustainability.

Measure 14

Continuing education for teachers

Existing continuing education offers for teachers are being further expanded by integrating the topics of environmental education and climate protection (including bioeconomic topics) in the priority programme that is binding for all levels of state-required continuing education for teachers.

For many today, lifelong learning is a matter of course. However, this learning often takes places outside of formal educational institutions. Museums, adult education centres, clubs and youth organisations as well as Chambers of Commerce and Industry (CCIs) can take on the role of comprehensively informing and further training various social groups including senior citizens, volunteers but also executives of medium-sized/family-owned businesses through interactive offers and seminars.

Measure 15

Integration of non-scholastic institutions for the conveyance of bioeconomic topics

The Bavarian State Government is in favour of institutions such as museums (specifically Deutsches Museum and BIOTOPIA) providing background knowledge on the sustainable bioeconomy to adult education centres, CICs, social groups and interested citizens of any age and thereby raising awareness for this topic. The new permanent exhibition at Deutsches Museum on the topic of agriculture and food supply can provide a role model function as planning for the integration of bioeconomic aspects has already been concluded.

Measure 16

Establishment of an information, learning and consultation centre

The Bavarian State Government is establishing "NAWAREUM", a modern information, learning and consultation centre at the Technology and Support Centre in Straubing at which visitors can prospectively receive comprehensive and illustrative information about the central topics of the bioeconomy.


5

Administration and politics on the path of transformation

Politics and public administration possess a role model function and are to be pioneers with respect to the usage and consideration of climate and environmentally friendly products. The role model function of the public sector was therefore explicitly taken into account during the drafting of the Bavarian Climate Change Act. The Bavarian Waste Management Act[1] is referenced in the Environmental Guidelines on Public Procurement (öAUmwR). The law regulates how the goals of the circular economy are to be implemented. Accordingly, the Free State, municipalities, counties, districts and other legal entities of the public sector possess a role model function and are to contribute to waste avoidance including the reduction of food waste and pollutants in waste as well as to the material recovery of unavoidable waste. In addition to the principles of efficiency and parsimony, these basic concepts and the aspects of energy efficiency are also important for awarding public contracts.

The Bavarian Environment Agency has addressed a sustainable public procurement with the newly developed guideline "Environment and Climate Protection in Government Agencies". This guideline is part of the package of measures for the Bavarian climate initiative with which the State Government is actively taking on climate change as the task of the century as it strives to achieve climate neutrality for the public administration of Bavaria by 2030 at the latest. The guideline constitutes an important tool for achieving a quick, effective and cost-efficient implementation. It is to contribute to the per capita reduction of CO_2 emissions and support responsible agencies with the optimisation of their administrative activities. Government agencies and institutions of the Free State of Bavaria possess a role model function with respect to climate protection.

Measure 17

▶ **Sustainable public procurement**

Bavarian ministries are orientating their procurements according to increase the usage of bio-based and recyclable products and sustainable services.

1 Cf. Section 2 (1) of the Bavarian Waste Management Act – BayAbfG (1996).

The use of bio-based materials can also contribute to the area of construction within the context of further sustainability criteria.

18 Measure

▶ Sustainable construction

The use of sustainable building methods for public construction projects fulfils a role model function.

The public sector, state institutions such as communes, agencies and administrative offices take on a special role with respect to the establishment of the bioeconomy. They provide a role model function for other areas of society based on their purchasing policies related to bio-based , sustainable products and the conservation of resources (e.g. food waste) and also contribute to the shaping of legal framework conditions. Employees at these institutions must be informed about all current developments of the bioeconomy in order to utilise the full potential of a sustainable bioeconomy.

19 Measure

▶ Information on the bioeconomy for municipalities and counties

The Bavarian State Government is initiating an information campaign on the transfer of knowledge in order to inform municipalities about the bioeconomy concept and its advantages and correlations as well as about related technologies, products and services. Successful examples from the bioeconomy are used.

20 Measure

▶ Further training in public administrations and state agencies

The Bavarian State Government will offer employees at state institutions, public administrations and state agencies regular and wherever possible continuing interdepartmental further training measures on the sustainable bioeconomy. This makes it possible to convey basic knowledge and information about the advantages and correlations of the bioeconomy as a sustainable and viable economic system as well as information about new procedures, norms or standards and legal framework conditions. These measures empower employees to base their decisions on the principles of the bioeconomy.


6

Strengthening agriculture and forestry on the path of transformation

Many biogenic resources are suitable for energetic and material usage. Sugar, starch, plant oils, lipids and lignocellulose are already being harnessed as industrial crops today. In Bavaria as well as in Germany as a whole, the quantitatively greatest share of renewable resources is currently being utilised as energy crops, which is most often accompanied by low added value for the resource. The specific valuation is often higher for material use than for energetic use. Furthermore, material usage also offers the following advantages: Carbon is captured long-term in products; valuable plant-based contents are used in numerous industries; bio-based products can be used multiple times by means of cascade usage and ultimately also for energy generation at the end of the lifecycle.

Not only new renewable resources but also alternative uses of existing resources (grain, sugar, starch) are to be developed, and intelligent methods for the concurrent production of food and industrial resources are to be developed in order to alleviate usage competition between food production and industrial starting materials. Generating new sources of income for farmers and forest owners is crucial. For example, some of the straw that is not needed for preserving soil fertility or animal husbandry can be used as a biogenic resource for non-food usage.

According to the Agency for Renewable Resources (FNR), "the main challenge consists in perspectively further developing production, processing and marketing structures along the entire value chain so that a balance between profitability and supply security is ensured subject to the preference for food supply and consideration for sustainability aspects."[1]

1 Thielen, Michael (2020): Bioplastics. 7th revised edition, Fachagentur für Nachwachsende Rohstoffe e.V. (FNR), p. 11, https://mediathek.fnr.de/biokunststoffe.html (status: 16/09/2020).

Sustainable agriculture and forestry

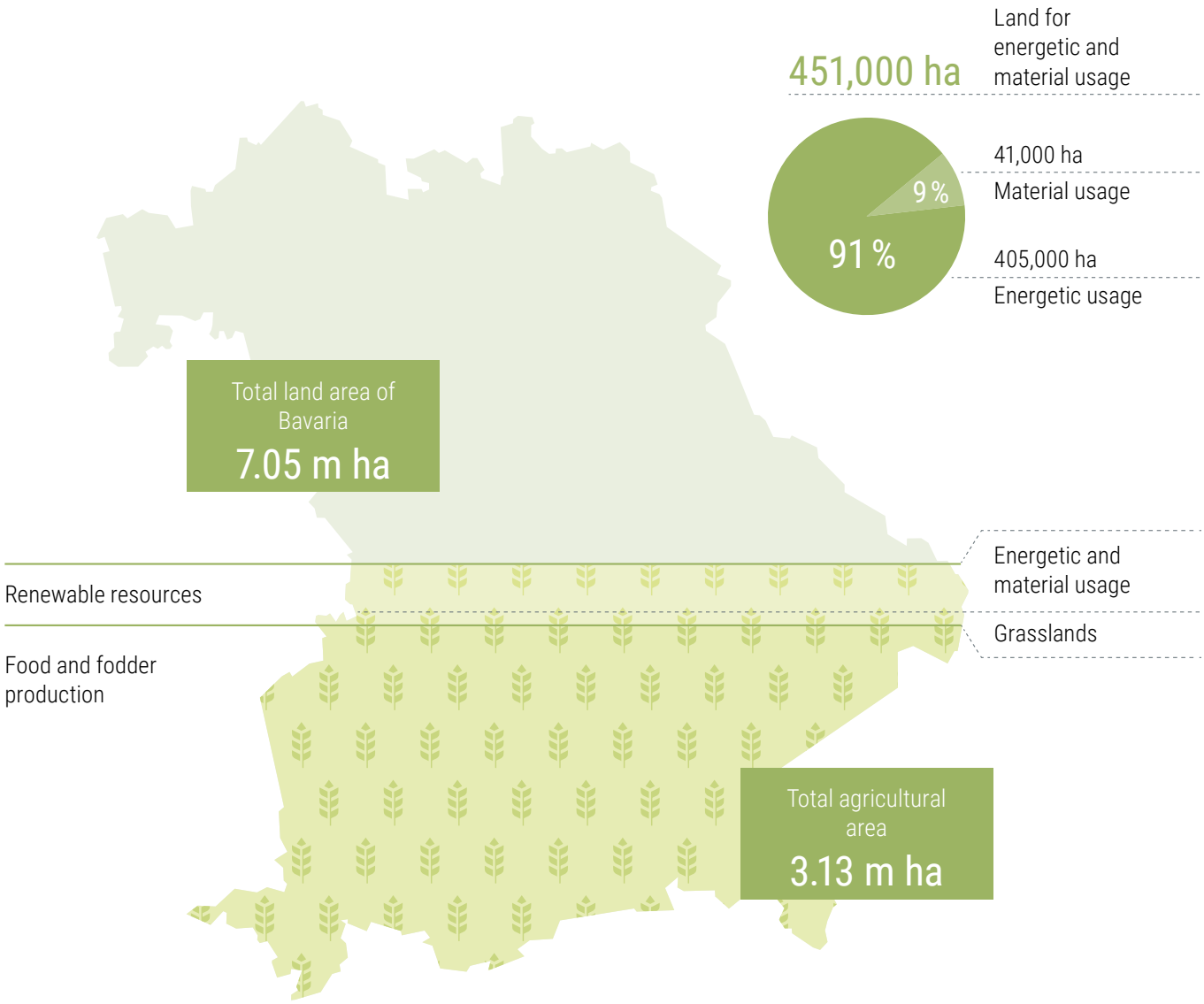
Ecological aspects such as protection and conservation of biodiversity, soils, water and air are especially important for the cultivation of biogenic resources.

Within the context of climate change it is becoming increasingly important to create adapted forests, which can be achieved with the conversion and prospective preference for deciduous over coniferous trees. Forests that are used as resources are cultivated in a sustainable manner. Accordingly, sustainably cultivated resource areas are additionally created or expanded and maintained.

Many cultivated and industrial crops may be of interest for usage in the Bavarian bioeconomy. The bioeconomic potential of resources can be better utilised by maintaining an overview and through diversity expertise. For the farmer, cultivating alternative bioeconomically interesting crops must be attractive as this concurrently contributes to sustainable agriculture and food supply.

Provision of biogenic resources

The agricultural area in Bavaria amounts to 3.13 m ha. Approx. 2.7 m ha of this total area are used for food and fodder production. In 2018, the land used for the production of renewable resources (non-food usage) amounted to 451.000 ha, which is about 14 percent of the agriculturally used area of Bavaria. In 2018, approx. 356,000 ha of arable land (approx. 17 percent of total arable land) was used for the cultivation of renewable resources for energetic and material usage, and about 95,000 ha was used as grassland. About 91 percent of the land used for renewable resources is designated for energy purposes, 9 percent for material usage.[2]



2 Bavarian Ministry of Food, Agriculture and Forestry (2020): Bavarian Agricultural Report 2020, https://www.agrarbericht-2020.bayern.de/politik-strategien/index.html (status 24/08/2020).

Agriculture and forestry are an important economic factor in Bavaria. As raw material suppliers these industries constitute the basis for a sustainable economy based on renewable resources.

Forests cover 2.6 m ha or about 35 percent of the total area of Bavaria. The Free State of Bavaria has a timber stock supply of about 1 billion cubic metres, which amounts to about 400 cubic metres per hectare of forest area. Thus, Bavaria has the most resource-rich forests in all of Europe.

In light of limited resources, highly efficient and holistic usage of renewable resources is indispensable. Biorefineries constitute an essential component and an interface between agriculture and forestry on the one hand and the chemical industry on the other.

In the agricultural industry, sustainable agrarian resources for production of highly valuable foods can be generated for a sustainable and healthy food supply and also for the non-food area. In forestry, timber from Bavaria is not only used in the wood-processing industry but increasingly also as a resource for the chemical industry. Timber is used as a building material for furniture and as a resource for the paper industry. Solid wood construction can capture CO_2 long-term. New procedures can harness bio-based basic chemicals for various applications from the wood components cellulose, hemicellulose and lignin.

Also in light of the existing forest ownership structure – forest owners and foresters must be actively integrated in the bioeconomy in order to ensure the supply of timber as a renewable resource. The potential for material and energetic usage of the resource timber as well as the opportunities afforded by such usage as part of a sustainable value chain must be highlighted in order to integrate farmers and foresters and elucidate the advantages available to resource suppliers.

21 Measure

Information for the food, agriculture and forestry sectors on the opportunities of the bioeconomy

The Bavarian State Government will develop an initiative in order to better educate farmers and foresters as well as professionals in the food craft trade and industry about the potential of the bioeconomy and bring them on board.

A comprehensive database for the availability of renewable resources in Bavaria is a central element on the path towards a sustainable bioeconomy. Information about quantities and time-resolved material flows from primary and secondary production are important planning and decision-making bases for processing enterprises and industries. Material flow models can be established based on the analysis of biomass availabilities and respective material flows. Resource potential as well as more valuable material flows can thereby be identified and quantified. According to this data basis, resource availabilities and resource potential can be estimated for planned facilities and projects in Bavaria.

Measure 22

Study on the availability of renewable resources in Bavaria

A study has been commissioned for the assessment of available renewable resources in Bavaria while taking existing surveys (e.g. National Forest Inventory, local surveys) into account. In addition to the analysis of regional biomass from agriculture and forestry, the study also integrates biogenic waste and residual materials. The potential for product development is evaluated ecologically and economically based on material flow analyses as well as dynamic modelling of material flow scenarios of existing and possible usage paths. For the identified biomass needs and the respective bioeconomic development paths, ex-ante studies for the assessment of technological consequences are conducted perspectively, and criteria are derived for recommendations as to how renewable resources can be used within the sense of a sustainable bioeconomy without entering into competition with the food and fodder-producing industries.

The usage of renewable resources that are produced by the local food and agricultural industry and also processed in Bavaria build up interconnected value chains and create new knowledge. Cooperation between farmers and foresters, processors and the agricultural machinery industry make innovations possible and in further consequence create new workplaces while ensuring added value and new perspectives for the rural region. New potential opens up for resource producers as integral players within the bioeconomy. The support of farmers and foresters for the development of innovative cooperation and the build-up of sustainable value chains has thus far already provided an essential basis for the further development of the bioeconomy. Economic perspectives for resource producers are linked to sustainable and viable cultivation.

Measure 23

Development of a biomass resource strategy

The Bavarian State Government will develop a Bavarian biomass resource strategy based on analyses of biomass availabilities and material flows. With respect to optimal organisation of biomass supply chains, information will be provided to farmers and foresters regarding the availability of alternative distribution channels for residual materials (e.g. biorefineries).

Measure 24

Support for resource producers

The Bavarian State Government has always supported resource producers at the beginning of the value chain and along the entire resource logistics chain including with respect to the cultivation, harvesting, transport and storage infrastructure.

Usage of biogenic resources

Biogenic resources can be used for the production of premium food and fodder. Securing the food supply and ensuring the safety of food and fodder products are prioritised.

If possible, resources that are not used for food purposes (non-food area) are to be initially recovered for material and then for energetic use according to the cascade principle. However, the importance of energetic usage must also be recognised. Biomass consists of stored up solar energy and, according to today's state of the art, provides the only form of renewable energy that can be stored on an appreciable scale. Thus, especially compared to photovoltaics and wind energy, biomass provides a flexible renewable energy source. Material usage of renewable resources mainly refers to the usage of starch, sugar, biogenic oils and fats, fibres, lignocellulose or timber and proteins. In Bavaria, resources cultivated for industrial purposes on an area of approx. 41.000 hectare of agricultural land are mostly used for the production of technical oils from rape, sunflower and linseed, which constitutes a further significant share of the starch production with emphasis on potato cultivation. In the chemical industry, about 13 percent of processed raw materials are harnessed from renewable sources.

As depicted in the "Bavarian Energy Programme", especially timber is used for heat generation, and agricultural resources are used for biogas and biofuels for the energetic recovery of renewable resources.

25 Measure

▶ **Investment funding programmes for the material usage of biogenic resources**

The Bavarian State Government is examining whether a funding programme for the material usage of biomass is to be initiated. The focus is on projects that process and utilise regionally produced resources.

26 Measure

▶ **Climate protection based on wood construction**

The rate of wood construction in Bavaria is already above average compared to the rest of Germany. A new section for wood construction has been added to the 10-point Bavarian climate initiative in order to capture as much carbon as possible long-term within wood products with the goal of further promoting wood construction. Besides the material usage of biomass, the usage of wood as one of many sustainable construction materials actively contributes to climate protection.

Technological innovations can afford new opportunities in order to meet the consistent demand for food with limited available resources. Therefore, the focus is on new foodstuffs and food ingredients.

Measure 27

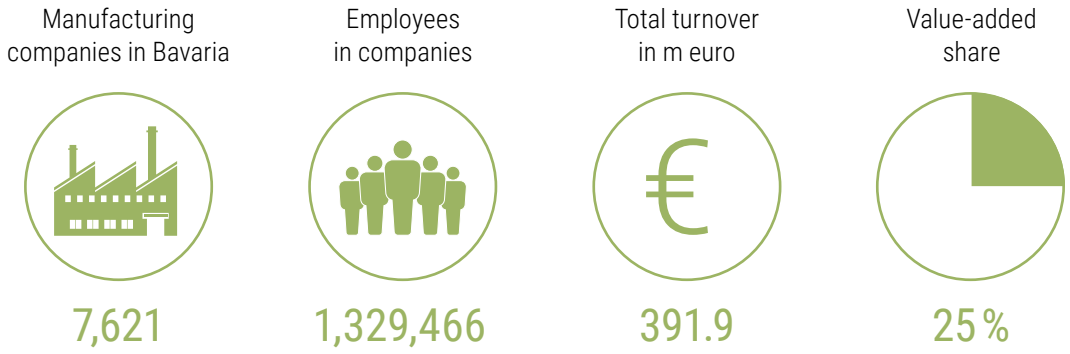
Developing new sources for food production and alternative production procedures

The Bavarian State Government is commissioning research initiatives for food produced with alternative production procedures. These include the recovery of subsidiary streams or residual materials, usage of algae, insects and fungal cultures as well as the development of modern procedures for cellular agriculture and vertical farming.


7

Strengthening companies on the path of transformation

As one of the most attractive business locations in the world, Bavaria has already demonstrated that it is capable of successfully implementing structural change. Today, the Free State is characterised by innovative, technology-oriented and research-focussed companies, efficient, industrial value chains, intensive networking among industry and science as well as highly trained specialists. With 7,621 small, medium-sized and large-scale enterprises, 1,329,466 employees and a total turnover of EUR 381.9 billion in 2019, especially the manufacturing sector of the Free State fulfils a central economic role as 25 percent of the total added value is created in this sector.[1]



The business location of Bavaria is home to important industry branches for the bioeconomy such as the food, chemical, plastics, paper, construction and textile industry as well as mechanical engineering, woodworking and the construction industry. The pronounced cross-sectoral character of the bioeconomy ensures that tremendous innovation potential exists for Bavarian companies due to new technological developments. This affords Bavaria the opportunity to become the technology leader and a global driver of innovation in various sectors. Industrial biotechnology and related interdisciplinary technologies are especially important for advancing the biological transformation of production and industrial processes.

Sustainable, efficient and new technologies, production processes and products must be developed as a substitute for conventional fossil-based procedures. The Free State will support and advise Bavarian companies on this path of transformation. A market environment that is favourable to the sustainable recycling-oriented bioeconomy is being created, which will allow companies to develop and create new business models and products.

1 Bavarian Ministry of Economic Affairs, Regional Development and Energy (2020): Industry Report Bavaria 2020, https://bayern.de/industriebericht-bayern-2020/ (status: 16/09/2020).

Bio-based basic chemicals can be harnessed from cellulose and phenolic base materials from lignin for the production of, among other things, bio-based resins, adhesives, foams, etc. Bio-based polymers can replace petrochemical polymers as drop-in solutions. Great potential especially exists with respect to the new properties of biopolymers, which cannot be realised with conventional polymers.

Natural fibres such as hemp or flax, regenerated fibres such as viscose and synthetic bio-based textile fibres significantly contribute to the bioeconomy. Lignin-based carbon fibres, fibres from spider silk protein or from polyethylene furanoate (PEF) are promising developments. Possible products include biocomposites, hygiene products and technical textiles.

Renewable resources can also be used for the production of insulating materials. The recovery of fungal mycelia offers wholly new approaches. Some companies have started to develop sustainable construction and insulating materials. Concrete additives from biogenic raw materials or bio-based asphalt are also being tested.

Establishing an attractive environment for investors for the provision of private capital

The development of new technologies, products and services is cost-intensive and requires large-scale investments from companies. These companies need investment security, reliable framework conditions and access to capital that is available long-term for bioeconomic ventures in order to win over as many economic players as possible who support a sustainable bioeconomy and develop their own products.

For years, the Bavarian State Government has been committed to the improvement of framework conditions for investors in the legal and fiscal area as well.

The Bavarian-based institution BayStartUp is one of the largest investor networks in Germany with over 300 private and 100 institutional investors.

Measure 28

▶ **Winning over investors for the bioeconomy**

As an important topic of the future, investor networks are to be sensitised for the bioeconomy. Activities for the transfer of knowledge are initiated so that investors and fund managers can receive current information about the potential of the bioeconomy. Cooperation is ongoing with other institutes such as the Bavarian clusters, LfA Förderbank Bayern, Bayern Kapital, the European Circular Bioeconomy Fund (ECBF) or the High-Tech Gründerfonds (HTGF).
Foreign investors are also to be connected with Bavarian companies in a targeted manner.

The Bavarian Transformation Fund has been established in a joint initiative of the Bavarian State Government and LfA Förderbank Bayern. The purpose of the fund is to support medium-sized companies in Bavaria who are in a transformational phase against the background of digitisation and climate and mobility changes. The fund can also contribute to other investment funds that invest in medium-sized enterprises in the transformation phase and/or support the transformation of the Bavarian economy.

Measure 29

▶ **Usage of the Bavarian Transformation Fund for investments in the bioeconomy**

Companies and investment funds can also use the Bavarian Transformation Fund for investments in the bioeconomy. The fund contributes to the strengthening of the equity base of these companies and thereby acts as an investor.

Support for company start-ups and innovation management

Besides innovation in established companies, especially innovative and sustainable company formations are exceedingly important for the viability of the business location of Bavaria and the transformation towards a sustainable, bio-based economy. Innovation is at the heart of growth, employment and prosperity. Risks and challenges can concurrently also create opportunities and possibilities.

The two-year idea and start-up contest "PlanB – Bio-based .Business.Bavaria" has been held in Straubing since 2014/2015 with the goal of promoting innovative, bio-based business ideas and company formations. The contest is organised by BioCampus Straubing GmbH and supported by the Bavarian Ministry of Economic Affairs, Regional Development and Energy. Participants receive expert feedback and coaching, establish contacts with venture capital and are given the opportunity to network with others. Prize money is awarded for the best ideas, and the winners also receive one rent-free year at the "BioCubator" Technology and Founder Centre at Hafen Straubing-Sand.

30 Measure

Expansion of the "BioCubator" Technology and Founder Centre

The "BioCubator" Technology and Founder Centre was inaugurated in 2010 in Straubing as the central infrastructure for company start-ups. Funded by the Bavarian State Government, a second building section is being added to the highly utilised start-up centre in order to account for the growth of the location and the increasing demand of founders for bio-based business models in Bavaria.

Innovation management refers to the systematic planning and guidance of innovative activities within a company with the goal of transforming ideas into economically successful products. While large-scale companies operate dedicated departments for innovation management, small and medium-sized enterprises often do not have the budget for this. Targeted support within the innovation process allows SMEs to develop ideas for bio-based innovations more quickly, identify proper cooperation and business partners and bring products and services to market. This can, e.g., occur by means of trend and technology radars, market and potential analyses for the comprehensive assessment of technical innovations, innovation workshops for companies and technology roadmaps. Innovation/idea workshops convey the necessary tools for innovation management. Participatory formats allow for the sharing of knowledge about technology potential and market barriers from which Bavarian players in the bioeconomy can benefit. The offer comprises the systematic analysis of innovation management and possible recommendations for actions for companies.

Measure 31

Support for innovation management

The Bavarian State Government continues to support small and medium-sized enterprises as well as enterprises in agriculture and forestry with their innovation activities by providing access to innovation workshops and coaching for innovation management methods. This assistance comprises offers for trend and technology scouting, market and potential analyses, technology roadmaps and research compasses.

Targeted use of the public support instruments and funding programmes

The Bavarian Research and Innovation Agency (BayFIA), initiated by the Bavarian State Government supports Bavarian companies and research institutes with innovative project endeavours. Many partners provide comprehensive service and consultation offers for the promotion of innovations – from the concept stage to the finished product and marketing:

Bayerische Forschungsallianz

Bayerische Forschungsallianz GmbH (BayFOR)
EU funding centre, Bavarian research associations, international cooperation

Bayerische Forschungsstiftung

Bavarian Research Foundation
Promotion of scientific-technological research projects in cooperation with science and industry

BayPAT

Bayerische Patentallianz GmbH (BayPAT)
Central patent and marketing agency for Bavarian universities,
SMEs as well as independent inventors

bayern innovativ

Bayern Projekt GmbH
Innovation and knowledge transfer, initiation and support of cooperation via networks and clusters, subsidy consultancy and project sponsorship

Bayern Innovativ and BayFOR are partners in the Enterprise Europe Network (EEN). The Enterprise Europe Network supports SMEs with respect to EU funding, international partnerships, EU certification or innovation assessments for innovation management.

Various programmes for the promotion of research and development projects exist in Bavaria.

Technology funding programmes in Bavaria

- Bavarian joint research programme "Materials"
- Bavarian joint research programme "Life Science, Focal Point Bio & Genetic Engineering"
- Bavarian promotional programme "Technology-Oriented Start-ups" (BayTOU): The goal of the promotion is to stimulate company start-ups in promising technology areas.
- Bavarian promotional technology programme (BayTP+): The promotional efforts are to make it possible for companies to develop new technological products and procedures and alleviate the application of modern technologies in products and production.
- Promotional programme "Innovation Voucher Bavaria": Supporting cooperation among small enterprises and handicraft enterprises with external research and development institutions by awarding innovation vouchers.

Moreover, promotional opportunities also exist at the federal and EU level as e.g. funding provided by the Agency for Renewable Resources (FNR), KMU-Innovativ: Bioeconomy, material research, resource efficiency (German Federal Ministry of Education and Research, BMBF), Idea Contest Biologisation of Technology (German Federal Ministry of Education and Research, BMBF), Central Innovation Programme for SMEs (ZIM) or EU funding for bio-based projects in the Horizon 2020 programme of Bio-based Industries Joint Undertaking. The European Innovation Partnership for Agricultural Productivity and Sustainability (EIP-Agri) is a further promotional tool that pursues the goal of strengthening innovation within the agrarian sector.

32 Measure

▶ **Usage of existing public support instruments and funding programmes**

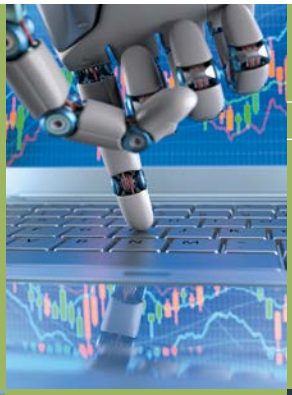
Existing Bavarian funding programmes provide numerous opportunities for new technology and product developments. Founders, companies and research institutions can take advantage of these tools for bioeconomy projects. Explicit funding calls are possibly initiated. Thus, industry-led R&D endeavours in the field of modern biotechnology with high innovative content in the industrial (white) biotechnology, circular economy and bioeconomy are promoted within the context of the Bavarian joint research programme "Life Science, Focal Point Bio & Genetic Engineering" with a funding call Bioeconomy 2020.

Research institutes as well as cluster structures play an important role for new cross-industry cooperation and technology transfer. The Cluster Initiative Bavaria provides both sector-specific and cross-sectoral networking opportunities for economic players and represents an important success factor of the Bavarian innovation landscape. Besides further regional clusters, sector-specific networks also offer a platform for transferring knowledge and practices to industrial application.

The clusters of the Free State of Bavaria are positioned at the interface of science, industry and politics. The clusters are aware of the demand and specific challenges of their partners from industry and science and advance the networking of players within the respective sector or the respective field of technology.

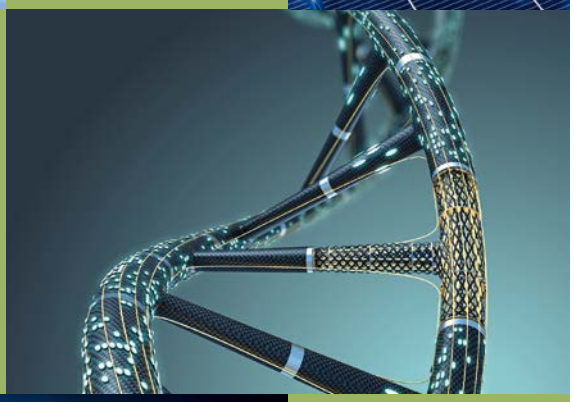
The Bavarian Cluster Initiative comprises 17 clusters.

Digitisation
- ZD.B
- Power electronics
- Sensor technology
- Mechatronics & automation



Energy
- Energy engineering
- Environmental technology

Life Science Health
- Biotechnology
- Medical engineering
- Nutrition



Materials
- Chemical industry
- Forestry and timber
- Industrial biotechnology
- Nanotechnology
- New materials
- MAI Carbon

Mobility
- Aerospace
- Automotive
- Railway technology

Measure 33

▶ **Networking through Bavarian cluster and cross-cluster activities**

The Bavarian State Government utilises cluster structures in order to initiate projects in the bioeconomy in a targeted manner and provide networking for players across industries and sectors. For example, cross-cluster projects promote the development and establishment of bio-based value chains, the support and networking of Bavarian start-ups in the topical field of the bioeconomy and support for the transfer of scientific findings.

Cooperation between players across industries and between users and science is an important criterion for the development of new production processes. The development of robust and flexible manufacturing processes in order to efficiently process material flows from various sources and of various qualities is especially important for the bioeconomy.

The transfer from the laboratory to the production scale within large-scale facilities often represents a daunting hurdle for companies. Support for building up infrastructure for process optimisation, upscaling, production and downstream processing is just as important as reliable framework conditions for companies within the bioeconomy.

An important component for the establishment of necessary infrastructure in Bavaria is the planned multi-purpose demonstration facility at Hafen Straubing where companies are supported in their efforts to scale up their developed processes.

34 Measure

▶ **Promotion of pilot/demonstration and first-of-its-kind plants**

The Bavarian State Government provides funding for the financing of pilot, demonstration and first-of-its-kind plants in order to support companies with the development of necessary infrastructures for the (further) development of innovative, sustainable/biotechnological procedures. Moreover, laboratory to production-relevant scaling and the production of large-scale test amounts are made possible. The goal is to establish biorefineries or bioproduct plants in Bavaria.

35 Measure

▶ **Support for the establishment of international companies**

Invest in Bavaria the Business Promotion Agency of the State of Bavaria has also emphasised the cross-industry topic of "Sustainability". Under this umbrella term, international bioeconomic companies who are interested in starting business in Bavaria are advised and supported. Moreover, international investors are made aware of specific institutions, initiatives, clusters and promotional programmes of the bioeconomy within the context of location marketing.

Measure 36

Creating investment incentives

Investment incentives must be provided for building up capacities for the production of sustainable bio-based productions. The Bavarian State Government will develop initiatives in order to modify EU stipulations on assistance for the promotion of investments, economic growth and employment. The goal is to not predominantly use available state funding in the energy sector within the context of public environmental protection assistance but also consider it for material usage.

Strengthening science and research in support of the transformation

Science and research form the basis for new insights and for a science-based bioeconomy. which harnesses this new knowledge about microorganisms, ecosystems, new cultivation methods and new materials, resource-conserving procedures and new processing methods. Moreover, knowledge about social-ecological issues such as consumer behaviour, global development and ethics are important for a sustainable transformation. The bioeconomy relies on systemically networked thinking so that research can increasingly be aligned according to an interdisciplinary approach.

For the successful development of the bioeconomy, it is essentially important that insights from biology and biotechnology including gained insights from climate research are merged with converging engineering and natural sciences as well as with social sciences, humanities and economics. This can occur by means of joint research at the intersections of various disciplines (see page 48). Cross-sectoral cooperation and a continuous transfer of knowledge from scientific research to industry is required in order to generate economic applications from gained insights. Ultimately, bioeconomic processes, products and services that have thus far hardly relied on renewable resources and industrial biotechnology can establish themselves within industries.

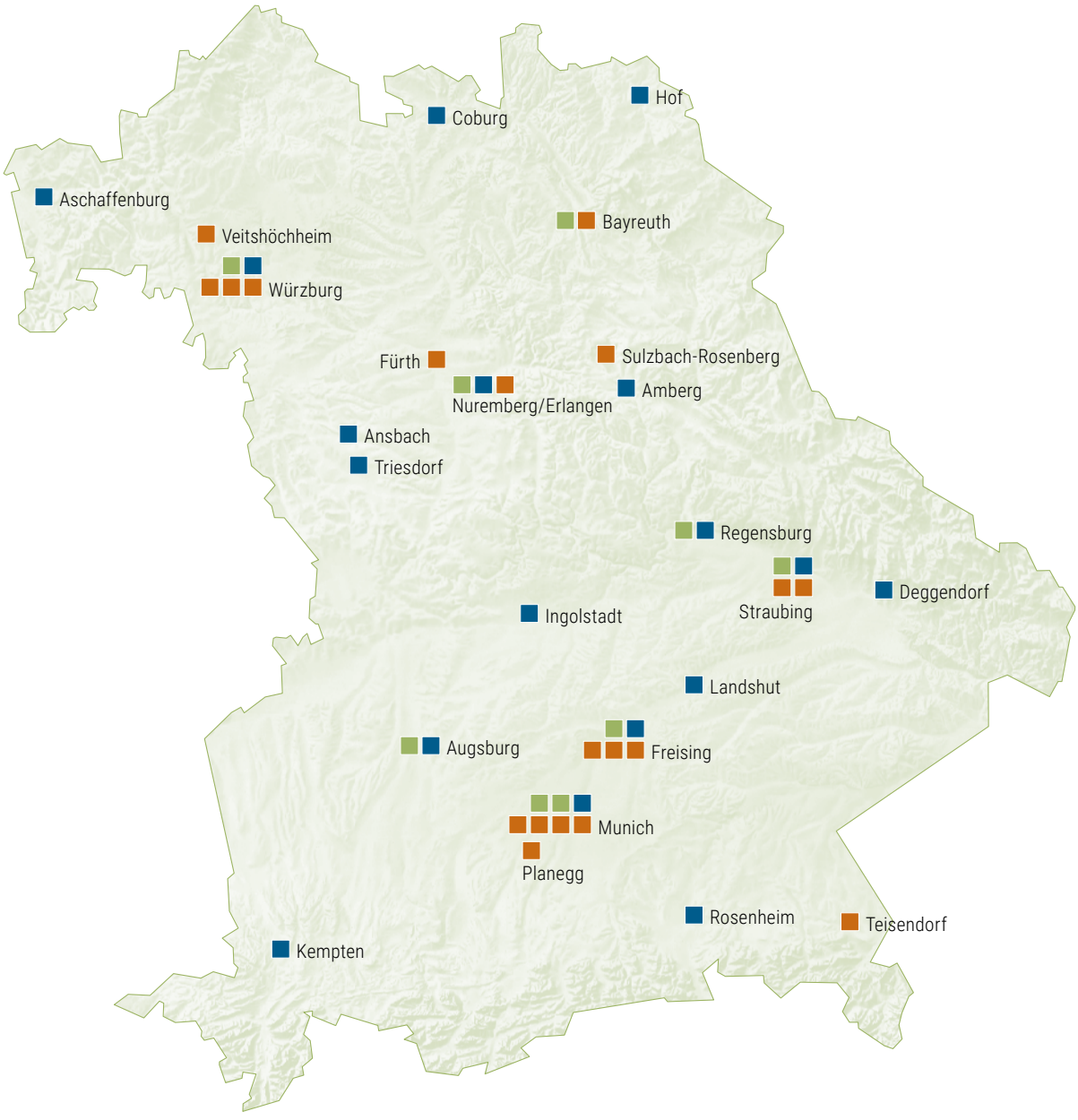
The goal is to generate and develop required (bio)technological, ecological, economic and social-scientific knowledge for the bioeconomy by means of scientific research. As a partner of commercial enterprises, there are numerous basic research institutes in Bavaria that are actively contributing to the development of innovative technologies and procedures by means of applied research.

Today, Bavarian universities and universities of applied sciences/polytechnic universities are already working on various aspects of the bioeconomy.

Research institutes related to the bioeconomy

Takes institutions that are relevant for the bioeconomy into account:

- Non-university research institutes and state institutions that receive at least 50 % of basic funding from the Free State of Bavaria
- Universities and state universities of applied sciences/polytechnic universities



An essential component of the bioeconomy is the sustainable supply of resources through primary agriculture and forestry production for whose further development applied research is indispensable.

Research for a knowledge-based bioeconomy in Bavaria is diverse and open to various technologies. Besides the interdisciplinary exchange within science and society, the generation of knowledge through natural sciences represents a central component for the further development of the bioeconomy. Innovations that are based on understanding biological systems can contribute to a sustainable economy and society by means of life and technical sciences. The current research landscape elucidates the many innovative procedures, processes and products that have already been successfully researched with promising results.

Thus, bacteria, fungi and microalgae can be used in order to recover various biogenic resources and residual materials by means of biotechnological procedures. The development of process technology for the further processing of biogenic resources and their (chemical) finishing allows for the production of bio-based chemicals and materials with innovative properties such as inducible degradation. This encompasses production processes as well as the development of new materials for bioreactors and bioprocess technology, separation processes, carrier structures for biocatalysts and functional surfaces for reactor components.

Subsidiary flows from agriculture and forestry as well as food production – such as residuals from viticulture and hops farming, spent grains and grass clippings – are significant regional resources that can be used as cascade and by-products. Previously used agricultural residual and waste materials such as liquid manure, animal and fat waste can also be utilised. New procedures prospectively allow for recovering valuable materials such as phosphate from wastewater and sewage sludge.

Subsidiary flows from other industry branches (e.g. lignin, biogenic CO_2, vinasse) can be recovered as cascade and by-products. Examples include the Power-to-X procedure for the generation of platform chemicals and basic chemicals from CO_2 as well as processes for the usage of lignin for bio-based materials.

The linking of synthetic biology for bioengineering in so-called biofoundries also aims to create next-generation processes for the bioeconomy. The development of biofoundries in Anglo-American countries, which is still in a very early stage, are being observed as discussions are ongoing whether such facilities should be expanded in Bavaria. Enzymes can be industrially harnessed and new biocatalytic procedures and chemical catalysts can be developed for more sustainable production processes by means of new molecular and microbiological methods as well as synthetic biology and enzyme engineering.

Only the linking of insights and procedures from industrial and chemical biotechnology, bioprocess engineering and related disciplines with materials sciences, process engineering or microelectronics will result in wholly new technological approaches for the usage of renewable resources as well as for sustainable technologies and processes.

The science of bionics encompasses learning from nature and transferring these insights to innovative technological developments. Also referred to as biomimetics, the goal of this discipline is to copy naturally occurring templates and convert these to technical applications. Additive production procedures can then imitate natural structures with bio-based materials.

The natural carbon cycle captures CO_2 by means of photosynthesis and creates new biomass. Today, CO_2 can be captured by means of Direct Air Capture and Carbon Capture and Utilisation processes. The greenhouse gas CO_2 can thereby be used as a starting material for the production of basic chemicals, polymers, materials and fuels and thus prospectively contribute to greenhouse gas reduction and independence from reliance on fossil resources. Future technologies such as artificial/technical photosynthesis, bionic leaves and artificial trees are currently in the basic research stage.

Digitisation is regarded as a converging technological area for the bioeconomy. The deployment of artificial intelligence and machine learning, big data analytics or blockchain technology also offer tremendous potential. These technologies can be used for digital land management, precision farming and more sustainable cultivation methods due to the conservation of fertilisers, optimised logistics and resource management. They are used for analysing material flows, for the establishment of material databases, material simulations and process control.

The Bavarian State Government diligently supports universities and non-university research institutes with respect to the exploration and development of these new and pioneering technologies and approaches.

37 Measure

▶ **High-tech professorships for the bioeconomy**

The Bavarian State Government has placed a strong emphasis on the high-tech agenda, which also promotes research and development of new technologies for innovative climate protection. Thus, artificial intelligence is to be interlinked and advanced by means of bioeconomic research. While respecting the university's academic autonomy, the State Government aims to also use professorships financed through the high-tech agenda for interdisciplinary research within the meaning of the bioeconomy.

38 Measure

▶ **Establishment of the research centre "Synthetic Fuels"**

The Bavarian State Government plans the establishment and expansion of a research centre for the usage of biogenic resources and of CO_2 in combination with regenerative energy for the production of synthetic fuels and energy sources.

Universities and non-university institutions are of central importance due to their research and training function and the services they provide for the further development of the bioeconomy. As a central driver of innovations, these institutions provide scientific, economic and social services. The complex problem areas and system correlations of the bioeconomy require key technological research. Interdisciplinary networking among disciplines for a critically-reflective bioeconomy is an important factor.

At the same time, the exchange of knowledge and technologies between science and industry is of great significance. The transfer of technology is crucially important in this area due to the pronounced interdisciplinary and cross-sectoral character of the bioeconomy.

Measure 39

▶ **Promotion of the transfer from Bavarian universities and research institutes in the area of the bioeconomy**

The State Government strives for an increased knowledge and technology transfer by universities and research institutes in the area of the bioeconomy while respecting the academic autonomy of the university in order to promote the conveyance of insights from all disciplines from universities and research institutes for practical application as well as for cooperation with companies. Ideally, the goal is to raise the practical application potential of the knowledge generated at universities and research institutes.

Timber as a valuable commodity and material is also of special importance since it contains a multitude of organic compounds with bioeconomic benefits. It is about expanding the potential with further research areas by means of national and international cooperation.

Especially the interface with materials research is promising for bioeconomic applications since the usage of renewable resources as educts may result in new functionalities and improved material properties.

40 Measure

▶ **Establishing a Centre for Bio-based Materials (ZBM)**

The Bavarian State Government is building up a Centre for Bio-based Materials (ZBM) at the Rosenheim Technical University of Applied Sciences at the location Waldkraiburg. The ZBM will develop premium products with new functionalities by means of the intelligent usage of natural material properties of wood within the meaning of a circular bioeconomy. The technical focus lies on wood pulping, fibre modification, lignin application and product recycling according to sustainable and cascade wood usage that also incorporates the food industry and agriculture as a secondary focus. The ZBM is regarded as a mediator of innovation between science and industry.

41 Measure

▶ **Build-up of new networks of the bioeconomy**

Networking between various subject areas of the bioeconomy is reinforced. The goal is to achieve a nationwide and international exchange with scientists as well as networking with players from various subject areas of the bioeconomy. The build-up of this comprehensive network represents the basis for an effective and efficient innovation development.

In application-oriented projects, the project network "BayBiotech" has advanced the conservation of resources by means of bio-based processes and biotechnological production of biologically degradable bioplastics, which significantly contributes to the Bavarian Sustainability and Bavarian Bioeconomy Strategy and creates ecological added value.

In multiple projects, the project network "BayBionik" uses samples from nature in order to sustainably and responsibly design prospective developments in research and industry. Biological processes, structures and materials provide a template for technological innovation. The Bionicum in Nuremberg supports this project network by means of an educational project in order to also reinforce this knowledge in society as well. The Bionicum directly presents sustainability and bioeconomy approaches to the general public based on research examples.

Within the context of the successful project network series ForCYCLE, the Bavarian State Government finances innovative technologies and procedures for efficient resource usage and for recycling. In the first funding period ForCYCLE I (2016 to 2019), technologies for biogenic polymers and valuable materials were developed in a partial area. In the second funding period ForCYCLE II, innovative technologies for the efficient usage of resources and for recycling are developed in a practical and application-oriented manner in a total of 10 individual projects of Bavarian universities, universities

of applied sciences and non-university research institutes together with over 50 Bavarian companies in the three research focal points of digitisation, integrated product policy and substitution of materials.

Measure 42

Supporting existing research networks

The Bavarian State Government supports interdisciplinary research in the area of the bioeconomy through project networks and multi-year network-oriented research projects. Successful approaches will be continued.


9

Strengthening cooperation

Both regionally as well as globally, the bioeconomy relies on systemically networked thinking and reinforced interdisciplinary cooperation along supply chains. The interdisciplinary usage of all competences constitutes the basis for the successful transformation towards the bioeconomy by means of knowledge and technology transfer. Closer networking and an interdisciplinary exchange between players from politics, society, science and industry are essential success factors for the development of the bioeconomy.

The bioeconomy addresses numerous industries and sectors. For transferring new insights into practical applications, it is necessary to promote a comprehensive and cross-sectoral exchange of information and knowledge between all players, specifically between research and industry as well as among individual industry branches.

Especially networking at a national and European level is a decisive factor for the further development of the bioeconomy.

Networking and cooperation of relevant players and networks from various disciplines and sectors creates important synergies for advancing the bioeconomy. Networking and the search for cooperation partners is increasingly performed via virtual platforms. Besides press releases and event notices, new scientific research findings are also often presented. Specific platforms with virtual formats for exchanging information and B2B partnering provide the opportunity to strengthen networking across industries between technology providers and producers.

Measure 43

▶ **Build-up of a digital portal for the bioeconomy**

The Bavarian State Government is establishing a digital portal for stakeholders and players within the bioeconomy. The platform conveys knowledge about specific applications of the bioeconomy for various industry branches, provides information about current trends and technologies and offers companies the opportunity to network with partners from industry and the commercial sector via the platform. Platform users can thereby build up cooperation and acquire business partners for the establishment of bioeconomic value cycles.

A successful transformation towards the bioeconomy requires cooperation across regions and states since regional concepts and value cycles can thereby be established that are linked to existing infrastructure, available resources and expertise for companies on site. For Bavaria, strategic cooperation with neighbouring states is also a possibility in order to create synergies with local players of the bioeconomy. Furthermore, building

on regional promotional programmes in the Alpine area such as Interreg Alpine Space seems to make sense. This is demonstrated by examples such as AlpLinkBioEco[1] or ARDIA-Net[2].

44 Measure

▶ **Supporting (trans)regional networks**

The Bavarian State Government supports the formation of (trans)regional networks with companies and research institutes in order to strengthen interregional cooperation and thereby utilise (trans)regional market, research and innovation potential. Clusters are to be integrated.

As a consequence of federalism within Germany, various initiatives and regional emphases have developed for the bioeconomy. This undoubtedly provides advantages as it allows for specialisation that can act as a driver for the bioeconomy. An exchange between states is nonetheless important in order to utilise synergies.

45 Measure

▶ **Federal states convention on bioeconomy**

The Bavarian State Government is committed to the realisation of a national bioeconomy event in which the states exchange experiences and information about region-specific projects, implementation opportunities and best practices (e.g. regional resource bases, soil protection, industries as on-site partners, relocation and investment incentives, etc.).

Moreover, international and development-policy cooperation is to be strengthened while learning from others and establishing an independent development potential for Bavaria. It is important to be open to global partnerships and cooperation for the development of resource bases, technological developments and exports. Regions such as Africa or Latin America play an important role for the promotion of foreign trade with respect to the topic of the bioeconomy. Within Europe, partnerships as e.g. with countries from the Danube region, the Alpine region and Scandinavia offer cooperation possibilities that are advantageous for both sides in order to jointly develop and strengthen biogenic usage paths and strengthen technological developments.

1 See https://www.alpine-space.eu/projects/alplinkbioeco/en/home (status: 16/09/2020)
2 https://www.bayfor.org/de/projekte/aktuelle-projekte-mit-thematischem-filter/ardia-net.html (status: 16/09/2020).

Measure 46

Expansion of international cooperation

The Bavarian State Government is expanding political cooperation with strategically important neighbouring European countries, international partners and regions and thereby strengthening international cooperation in the bioeconomy. Moreover, foreign representation of the Free State of Bavaria can provide a point of contact for establishing contact and networking in the target countries and possibly also market sounding for Bavarian bioeconomy players.

Measure 47

International stakeholder conference

The Bavarian State Government is establishing a regular, internationally aligned stakeholder conference on the bioeconomy. This conference is supported by the Bioeconomy Council Bavaria as it provides networking for Bavarian and international players and information about the current aspects of the bioeconomy in industry, research and politics.


10

Further development of the strategy

The transformation towards a bio-based way of life and economic system requires political decision-making. Accordingly, the Bavarian State Government already took up the issue in 2015. The initiative "Bioeconomy for Bavaria!" began that year, and the Bioeconomy Council Bavaria was convened. Within the context of two office terms, the council of experts developed impulses and recommendations for action for the implementation and further development of the bioeconomy. Additionally, the existing Inter-Ministerial Working Group on Renewable Resources was expanded with the topic of the bioeconomy. This working group is a comprehensive platform facilitating an exchange and cooperation among all Bavarian ministries that are involved with the development of the bioeconomy. By means of these three initiatives, the Bavarian State Government has clearly positioned itself and laid down important cornerstones at an early stage for the present Bavarian Bioeconomy Strategy.

The measures within the strategy set the course for the Bavarian bioeconomy of the future. This transformation cannot be sponsored alone by politics, science or industry. Cooperation and active participation of all players including civil society is the key to attaining a sustainable bioeconomy. The goals of the strategy also elucidate that a viable bioeconomy must reconcile ecological and economical aspects. The implementation of measures is to be evaluated and checked for possible undesirable developments in order to take these requirements into account. At the same time, the participatory process for the strategy development is to be continued, and framework conditions for a continuous further development of the bioeconomy and strategy are to be created.

Measure 48

▶ **Continuing inter-ministerial cooperation on renewable resources and the bioeconomy**

Cooperation is continued.

Measure 49

▶ **Continuation of the Bioeconomy Council**

The Bioeconomy Council Bavaria is continued as a committee for supporting the process of the bioeconomy in Bavaria. The council assesses the implementation of the Bioeconomy Strategy, accompanies its further development and works closely with the Inter-Ministerial Working Group on the Bioeconomy.

50 Measure

Participatory formats on the further development of the bioeconomy in Bavaria

An ongoing debate on the further development of the bioeconomy in Bavaria is implemented with the integration of representatives from science, industry and civil society. A framework is created by means of the development and regular execution of various participation models in order to realise a practical bioeconomical design.

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Note

This brochure addresses people of all genders as equals. We have omitted a consistently gender-neutral writing style due to legibility reasons.

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The content of the Bavarian Bioeconomy Strategy does not necessarily reflect the opinions of the stated persons.

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www.biooekonomie.bayern