The German Bioeconomy Council

About the German Bioeconomy Council

The Federal Ministry of Education and Research (BMBF) and the Federal Ministry of Food and Agriculture (BMEL) and four other Ministries established the Bioeconomy Council as an independent advisory committee to the German Federal Government in 2009. The council is headed by Prof. Christine Lang and Prof. Joachim von Braun as co-chairs. The 17 members represent industry, society and science, and their expertise covers the full spectrum of the bioeconomy value chain. The council is mainly tasked with providing advice on how to foster the development of a sustainable bioeconomy in Germany and in a global context. For this purpose, it engages in political and scientific dialogue, publishes position statements and promotes the future vision of the bioeconomy to broader society. The activities of the council are oriented towards long-term objectives and day-to-day policy requirements.

Appointment and Working Structure of the German Bioeconomy Council

Federal Ministry of Education and Research

Federal Ministry of Food and Agriculture

Federal Ministry for Economic Cooperation and Development

Federal Ministry for Economic Affairs and Energy

Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety

Federal Foreign Office

commissions

BIOCOM AG

Office (4 FTEs)

appoints

Bioökonomierat

17 Council members (4 meetings/year)

2 Chairpersons
2 Deputies

Members of the Bioeconomy Council

Prof. Dr. Georg Backhaus
Julius Kühn-Institut, Quedlinburg

Agriculture and Horticulture

Prof. Dr. Ulrich Hamm
University of Kassel

Market- and Consumer Research

Prof. Dr. Manfred Schwerin
Leibniz-Institute for Farm Animal Biology, Rostock

Livestock Farming, Ressource Efficiency

Prof. Dr. Daniel Barben
Alpen-Adria University, Klagenfurt

Sociology, Political Sciences

Prof. Dr. Dr. Reinhard Hüttl
National Academy of Science and Engineering, Berlin

Geographical Ecology, Soil Research

Prof. Dr. Daniela Thrän
Helmholtz Centre for Environmental Research, Leipzig

Potential- and Market Analysis

Prof. Dr. Regina Birner
University of Hohenheim

Social Change, Agricultural Development

Prof. Dr. Folkhard Isermeyer
Thünen-Institut, Braunschweig

Agricultural Economy and Research

Prof. Dr. Wiltrud Treffenfeldt
Dow Europe GmbH, Zürich

Industrial Biotechnology

Prof. Dr. Joachim von Braun (Chair)
Center for Development Research, Bonn

Agriculture, Food Security, Nutrition

Prof. Dr. Ingrid Kögel-Knabner
Technical University Munich

Land Use Change, Soil Research

Prof. Dr. Johannes Vogel
Museum of Natural History, Berlin

Biodiversity, Societal Dialogue

Dr. Léon Broers
CSO KWS Saat AG, Einbeck

Research, Plant Breeding

Prof. Dr. Christine Lang
CEO Organobalance GmbH, Berlin

Biotechnology, Molecular Biology

Dr. Holger Zinke
CEO BRAIN AG, Zwingenberg

Biotechnology, Industrial Change

Prof. Dr. Hannelore Daniel
Technical University Munich

Food and Nutrition Research, Physiology

Prof. Dr. Lucia Reisch
Professor Copenhagen Business School

Consumer and Nutrition Policy

- Ethics, Consumer, Sociology
- Chemistry, Biology, Ecology
- Agriculture, Forestry, Soil

Contact: Office of the German Bioeconomy Council, c/o BIOCOM AG, Dr. Patrick Dieckhoff, info@biooekonomierat.de, +49-30-46776743

Bioökonomierat

BÖRMEMO 01 | 13.1.2015

Agriculture in Germany – its Role for Competitiveness of the Bioeconomy

Preliminary Remarks

Agriculture is of great importance to the bioeconomy, not least as an important producer of raw materials for the food industry and for the recovery of energy and recycling of materials. In this memo, the Bioeconomy Council outlines its assessment of the future prospects for German agriculture and recommends political strategies for creating a more competitive bioeconomy in Germany. Focusing on competition necessarily includes considering environmental, social and animal welfare objectives. With these recommendations, the Bioeconomy Council is aiming to create a more favourable framework for the bioeconomy, in order to generate productive, sustainable jobs in Germany in this important future-oriented sector. In another paper, the Bioeconomy Council also looks at the international consequences of national agricultural and bioeconomic policy in terms of sustainable resource utilization, bioenergy and ensuring adequate food supplies.

Policy Recommendations

Since, as we have shown, German agricultural policy cannot be based on general recommendations, it will need to be continually readjusted to strike a balance between the German agricultural sector (a) contributing towards meeting the ever-increasing demand for food and biobased industrial raw materials and (b) at the same time meeting the specific requirements of the German population in terms of production methods, environmental protection and animal welfare. Three general recommendations can be derived for how to achieve this balance:

1) Concepts for enhancing the competitiveness of the German agricultural sector should be designed in such a way as to minimize any negative impact upon socially valuable protected resources (land, biodiversity etc.).

2) Concepts for improving environmental protection and animal welfare should be designed in such a way as to minimize any negative impact upon the production potential and competitiveness of the agricultural sector.

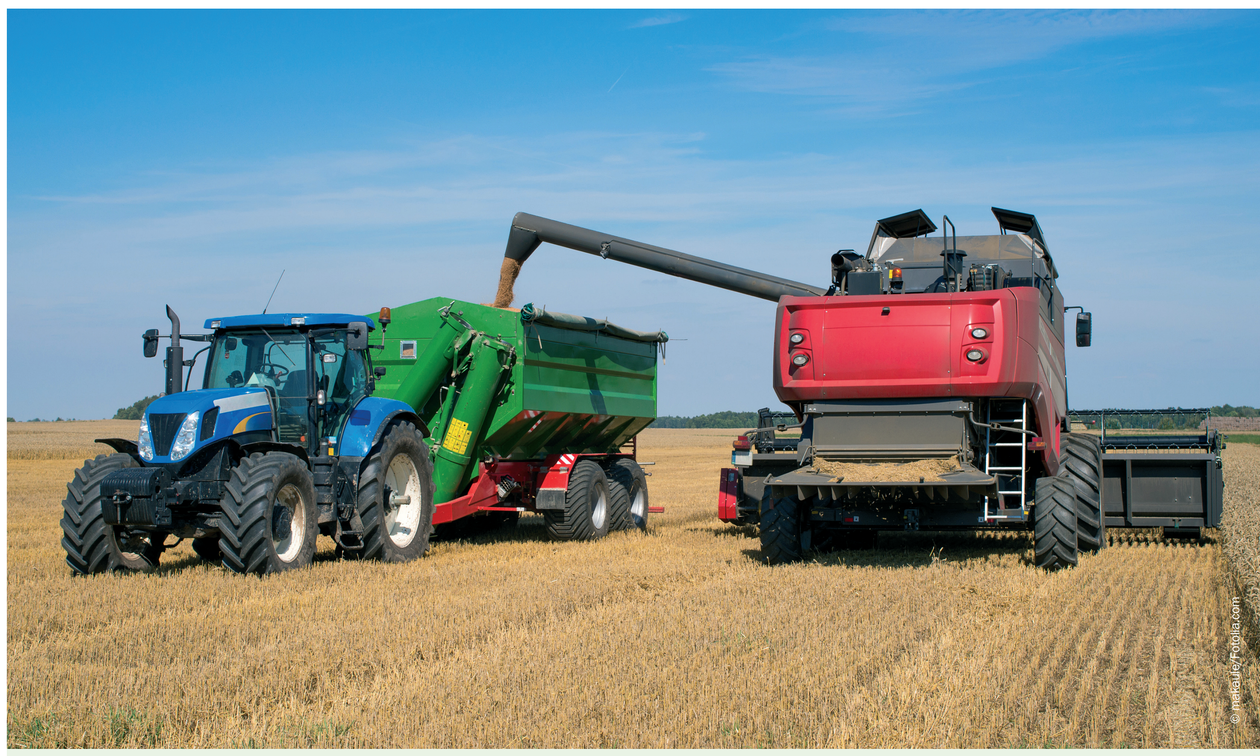
3) Research should be conducted to ensure that agricultural production processes conserve resources as much as possible and increase the competitiveness of the German bioeconomy.

Below these general recommendations are translated into specific policy recommendations:

EU agricultural policy: Instead of the renewed system of direct payments, which are now being “greened”, EU agricultural policy should establish instruments to achieve social objectives.
Reasons: The current, area-based subsidy system is not necessary for ensuring the competitiveness of arable farming. The greened direct payments are hardly effective as an environmental policy instrument. With targeted use of these funds, it would be possible to make a greater contribution towards competitiveness, while, at the same time, better fulfilling social expectations regarding animal welfare, environmental protection etc..

Animal farming: The federal and regional governments should initiate a joint national process to reach consensus on the future of animal farming, that is both non-partisan and long-term.
Reasons: Social acceptance is very important to the competitiveness of animal farming in the future. Although recent critical debates have given rise to many different political and economic activities, these are uncoordinated and probably inadequate in scale. What is required is a long-term strategy that is not only based on technical innovations but also addresses social expectations.

Bioenergy: The EU and the Federal Government need to fundamentally review public funding of bioenergy lines that are in competition with food production.
Reasons: The funding of bioenergy adversely affects the competitiveness of foodstuffs or biogenic industrial raw materials. If it is not used properly, bioenergy funding can generate risks to the environment, climate protection and world food supplies. In the long term, other renewable energies (wind power, solar power) offer greater potential and fewer risks. Bioenergy should therefore only be funded in exceptional circumstances (e.g. belts of woodland in biotope networks).



As a producer of renewable raw materials, the agricultural sector is of strategic importance to the bioeconomy.

Agrobiodiversity: The Federal Government should revise its so-called “Protein Strategy” and instead develop an internationally oriented strategy on agrobiodiversity.
Reasons: Because of international competition in plant breeding, the gap between the yields of globally dominant crops and other crops is widening. This encourages narrow crop rotation and leads to increased financial risks. This problem could be effectively resolved by means of internationally agreed strategies. The Federal Government’s “Protein Strategy”, which funds, inter alia, the cultivation of the globally dominant crop soybeans, is not sufficiently focused in this regard.

Water usage: The federal and regional governments need to develop a water usage strategy, aimed at boosting the productivity of agriculture, forestry and fisheries, while at the same time maintaining an overall positive ecological balance.
Reasons: Germany allows a large proportion of its rainwater to flow off into the sea unused. More careful management of this resource could help to increase crop yields in dry years and in dry regions. Synergistic benefits could be achieved by integrating aquacultures into agricultural production systems. There are few political strategies on this, partly due to the lack of coordination between the federal and regional authorities.

Agricultural research: Both the federal and regional governments should give more priority to agricultural research and establish mechanisms to make it more efficient and more effective.
Reasons: Agricultural research can make a huge contribution towards making the agricultural sector, as part of the bioeconomy, as competitive as possible. This requires (a) adequate financing, (b) good cross-departmental collaboration in the funding of research, (c) incentive and reward systems that do not disadvantage interdisciplinary or application-oriented research.

About BÖRMEMOS

BÖRMEMOS summarize the Council’s appraisal of key aspects of the bioeconomy in a condensed form. They do not claim to provide a comprehensive study of these facts. Rather, they present a focused and generally comprehensible view of each area and its relationship to the bioeconomy. BÖRMEMOS are designed as an incisive contribution to public debate. They are part of a series of analyses to be published by the Bioeconomy Council. They have their theoretical basis in extensive background papers that are also published on the Council’s home page. BÖRMEMOS are assessed together with BÖR background papers (peer review). While this process is taking place, they are identified as preliminary and the authors are named. This memo on agriculture was provisionally published on 4th June 2014 and finally approved by the Council at the 10th meeting on 14th November 2014, after going through the process outlined above.

Bioökonomierat

BÖRMEMO 05 | 1.11.2015

Bioenergy policy in Germany and social challenges

Preliminary Remarks

Effective climate protection as part of a transformation to a sustainable economy can only be achieved permanently if it is possible to switch the global economy from a fossil-based to a renewable energy supply. With its pioneering energy transition project, Germany is a key player enjoying global acclaim. In theory at least, there is no shortage of energy in the world thanks to ample sunlight. There are also numerous ways to save energy. In addition to solar and wind power, it is also important to define the role of bioenergy carefully. Back in 2012, the Bioeconomy Council made recommendations for the “Sustainable use of bioenergy”. Under the changed framework conditions – energy transition, amendment of the Renewable Energy Sources Act (EEG), a currently low oil price and increasing observation of competitive relationships regarding food security – the Council is taking up the topic of bioenergy once more. As part of the energy transition, it is necessary to ensure that the renewable energy supply is sustainable for its part and that the benefits of biotechnology, wind and solar energy are used in the system in the best way possible. Bioenergy should be consistently geared to areas of use in which it can demonstrate its advantages. They are constant availability, storage capacity and the ability to partially compensate for the high volatility of wind and solar power in the generation of electricity and heat.

Three goals of sustainable bioenergy policy: Climate and nature conservation, resolution of conflicting aims, unique technological features.

Further development of the bioenergy policy

From an ecological perspective, what matters is preserving the limited resources of soil and water as well as nutrients and the diversity of plants, animals and microorganisms. As a result of further developing certificates and standards, consideration should also be given to social criteria along the process chain. Further development of the bioenergy market should be based on long-term goals and should aim for a fair distribution of the added value. The previous promotion of bioenergy achieved unique technological features that are linked to market opportunities. It is important to protect them and to expand them in terms of added value potential. From these it is possible to derive the following approaches for developing national and global policy:

› **Primacy of sustainability:** For the production, provision and processing of biomass, the three dimensions of the sustainability concept must be considered on an equal footing. The primary use of biomass should always be a combination of material and energy-related use and should take into account systemic embedding in cascade utilization. The direct energy-related use of biomass can only be justified in developed countries in exceptional cases – for example, in areas where solar energy does not presently represent an alternative (shipping and aviation) or where byproducts arise that can be used in other industries (e.g. glycerol).

› **System Stability:** Concepts for power generation promoted so far, which go beyond the direct combustion of biomass (biomass gasification), should be given a clear perspective. From an environmental policy point of view, the Council welcomes the introduction of GHG-based crediting of biofuels and the priority use of waste and residual materials. However, this represents only one component of a comprehensive biofuels strategy which needs to be developed. Likewise, the position on research into new types of fuel in Germany should be stepped up in view of the overarching objectives of sustainably transforming economic systems, while respecting global interdependencies.

› **External Effects:** The Council generally recommends measuring completely the external effects of using biomass and in this way obtaining comprehensive footprint records. This includes the entire process chain in addition to different forms of use (food, material, energy). The possibility of introducing certificates must be checked out. Specifications in procurement and voluntary obligations could help here. Only in this way it is possible to evaluate biobased products and processes and to illustrate their advantages compared with other forms. These principles should be used in further work to develop an economically optimized development path for renewable energies. It is necessary from the outset to give significant consideration to the question of how best to divide the work up globally in this energy economy of the future.

› **Bioenergy innovations in developing countries:** The energy-related use of biomass (combustion) is very important particularly in developing and emerging countries. However, the traditional use of wood and charcoal is often inefficient here and leads to health problems due to open hearths in dwellings. Full access to energy is a global development goal. In developing countries that produce a large proportion of their primary energy by burning biomass, a different energy transition should be implemented which Germany should participate in to a greater extent with research and technology partnerships. One example of this is more efficient household stoves. Local power grids which are partly based on biomass waste can also be used as further steps towards an improved energy supply. Sustainable biomass cultivation and production methods should also be mentioned here. Training and transferring the technology of sustainable methods to the real lives of (small) farmers will play an important role in quickly preventing the adverse impacts of traditional bioenergy use and its harmful health effects.

› **System Stability:** In the future electricity market supplied to a greater extent by renewables, the production of electricity from biomass should be examined mainly to see whether it can provide system-stabilizing contributions in an economically efficient way. The Council referred to this in its report on bioenergy in 2012 and welcomes the initiatives for increasingly flexible provision of electricity from biomass. Here it is important to examine how best to achieve and implement the provision of electricity in line with demand for balancing energy and residual load with increasingly competitive incentive systems.

› **Timber Industry:** In the timber industry, checks must be made to ascertain the impacts of switching bioenergy promotion in the electricity and fuel sectors. There is a need for further development of new cascaded used between material and energy use.

› **Conflicting aims:** Measures to promote bioenergy should be designed on principle so that they do not compromise global and local food security. Under this premise, the measures should be designed so that the objectives (e.g. climate protection) pursued by promoting bioenergy are achieved as efficiently as possible. The specific implementation of these two guidelines would probably lead to a market-oriented pricing system for biofuels which does not require rigid quotas for individual bioenergy sources. Current subsidies often lead to local producers being unilaterally favored. This happens to the detriment of poor countries and the international division of labor, and in this respect would need critical reconsideration. In terms of food security, it would also be necessary to consider designing the bioenergy policy countercyclically, by suspending subsidies and quotas for example, when there are particular shortages on the food markets.

› **Dealing with losses:** To improve food security, losses would have to be reduced with the help of innovative and integrated production systems along the added value chain: This applies to both the production side – high pre- and post-harvest losses exist in developing countries – and also to the huge waste of food in industrialized countries. Innovative integrated production systems must facilitate efficient food production. The dual and cascaded use of residues arising should be designed so that it comprehensively promotes both the reduction of losses and also the establishment of integrated production systems. Optimal approaches and possible incentives for reducing losses and wastage should be explored more extensively, both with regard to food production and with regard to recovering material and energy.

› **Certificates:** The certification of bioenergy is already at an advanced stage. Globally coordinated biomass certification should take into account social standards and ecological footprints, water consumption and sustainability in the handling of soils which are fundamental to long-term food security. The transferability of existing standards and certification schemes for biofuels to other energy-related and material uses of biomass should be checked out. It should be determined to what extent environmental sustainability standards can be linked to tools that are aimed at social sustainability.

Bioökonomierat

BÖRMEMO 02 | 15.1.2015

The German Chemical Industry – Competitiveness and Bioeconomy

Preliminary Remarks

The chemical industry is traditionally a key part of the German economy. The sector is characterized by a highly concentrated structure. The chemical industry's main customers include the automotive industry and the machine-building sector, which in themselves are central to the German economy. The chemical corporations active in Germany, as well as a number of highly specialized medium-sized companies, compete globally. German chemical companies generate nearly 60% of their revenue abroad. Together with the USA, Japan and China, Germany is one of the largest players in the global market. Although many raw materials and preliminary products are imported, Germany has been a net exporter for many years. The reason for its success is its efficient and almost optimally configured composite structure at its base in Germany. The key raw materials for the chemical industry are petroleum products (naphtha) and natural gas. Nowadays, renewable raw materials such as fats, starches, cellulose and sugar are already being successfully used in biobased and thermochemical processes, if they offer competitive advantages in terms of sustainability, profitability or technology.

Challenges for the Bioeconomy

- **Establishing new processes:** Under the existing market and framework conditions, established fossil-based production usually offers cost advantages and better margins compared to new, still to be established, biobased production. There is therefore no financial incentive to invest in the development of more environmentally friendly, biobased products and processes.

- **Converting the existing infrastructure:** Germany boasts a mature and beneficial infrastructure for the petroleum-based chemical sector, manifesting itself in the form of crackers, pipelines and integrated and specialized production facilities. These facilities and the exploitation of material flows have been optimized over the course of decades. In most cases the infrastructure was written off several years ago and is therefore highly profitable; the process chains are well established. A transition to biobased production would involve considerable investment in new infrastructure and production facilities. Such investment,however, would not increase profits in the short term and is therefore not popular with the financial market.

- **Economies of scale:** In the basic chemicals sector, profit is primarily determined by economies of scale. For many chemicals there is only one "world scale" production plant. To bring corresponding biotech processes to such scales of production would require special knowhow, which is currently in limited supply.

- **Biotechnical challenges:** Special knowledge in the optimization of production organisms, fermentation and regeneration processes, as well as applications engineering, is required to develop biotech processes. Development times are usually long and the associated costs and expenditure high.

- **Lack of supply chains:** So far, farmers and agricultural businesses do not see themselves as feedstock or upstream suppliers for the chemical industry. There are no starting points for building up value chains and alliances that also include small and medium-sized companies. In particular, there are problems due to the heterogeneity of biomass, which is produced locally, mainly by small agricultural units and ideally consists of agricultural residues (cascaded use). Some of the coordination aspects relating to supply chain links and the suitable processing of this biomass for the chemical industry are still not resolved.

- **Lack of financing options:** The lack of available venture capital, which is in part due to the lack of depreciation allowances for R&D investment in Germany, has had a negative impact on the innovative strength of German SMEs. Because of their limited capital assets, they are particularly dependent upon investors. In contrast to the pharmaceutical sector, the market for acquisitions of small and medium-sized businesses is underdeveloped in the chemical sector. However, the possibility of making high profits from selling off companies is a key incentive for venture capitalists.

- **Prices and demand:** Driven by sustainability considerations, an increasing segment of consumers is interested in biobased and biotechnologically produced products. However, the willingness to pay premium prices for biobased chemical products is limited. Besides, the biobased content or production process is difficult to communicate to the consumer. In this respect, the first consumer goods companies have launched marketing activities in the bioeconomy with the aim of differentiating and better communicating the benefits of biobased products..

The chemical industry is a central innovator. However Bioeconomy is not perceived as a key area.

Conclusion

The chemical sector is dominated by a few large companies. These companies do not yet perceive the bioeconomy as a key area for innovation and growth. However, certain elements of the sustainability debate can be considered as part of a bioeconomy strategy. The size of the companies, healthy demand, almost ideal process conditions and vertical integration rather encourage incremental improvements in existing products and processes based on fossil resources. At the present time, however, it is difficult to imagine the chemical industry comprehensively transforming into a „biobased economy" in the sense of it turning away from petrochemicals. Due to the favourable trend in natural gas (and in future also crude oil), a renaissance in the use of fossil feedstock seems more likely in the midterm than a comprehensive transition to renewable raw materials. The systematic transition to a biobased economy is more difficult than generally assumed, precisely because of the economic strengths and excellent structure of the German chemical sector. It is therefore expected that biological processes will only be used by large companies where biobased products are more economical to produce, if they have no chemical equivalents or if they are clearly distinguished by improved properties in the marketplace. This applies to both fermented complex molecules such as amino acids and vitamins, and to the supplementation of individual synthesis steps by biocatalysis, where, for instance, special selectivities are required. Particularly the many small and medium-sized chemical companies in Germany that develop and manufacture user or consumer-oriented products are already making increasing use of biobased processes. Intensification is clearly discernible in this sector.

Observations regarding German Policy

The question is: how can the German chemical industry make greater use of the bioeconomy to remain competitive in the future and to produce more sustainably? The potential of the bioeconomy lies not merely in the substitution of raw materials but rather in the development and marketing of new biobased and bioinspired products with enhanced properties. The industry's future competitiveness crucially depends upon exploiting this innovative potential. The traditional instruments of public R&D funding as a basis for these innovations must be further developed or supplemented. The structure of funding programs should increasingly be aimed at involving medium-sized companies and investors. In many cases such measures go beyond the remit of individual ministries. We therefore need to look more closely at how to incentivize bold and unconventional business decisions and to encourage the mobilization of investment capital. It is important to involve society in the debate about the future viability of the country and its economic basis at an early stage. This also requires more widespread information and publicity about the social benefits of biobased products and methods and "nudging" incentives for consumers. In order to promote a "market pull" effect, consumers should be enabled to assess the benefits of biobased products, e.g., based on understandable information and verified sustainability measures.

About BÖRMEMOS

BÖRMEMOS summarize the Council's appraisal of key aspects of the bioeconomy in a condensed form. They do not claim to provide a comprehensive study of these facts. Rather, they present a focused and generally comprehensible view of each area and its relationship to the bioeconomy. They have their theoretical basis in extensive background papers that are also published on the Council's home page. BÖRMEMOS are assessed together with BÖR background papers (peer review). While this process is taking place, they are identified as preliminary and the authors are named. This memo on the chemical industry was provisionally published on 4th June 2014 and finally approved by the Council at the 10th meeting on 14th November 2014,

Bioökonomierat

BÖRMEMO 03 | 13.1.2015

Contribution of Crop Research to Covering the Bioeconomy's Demand for Raw Materials

Preliminary Remarks

Biobased raw materials are the most important foundation of the bioeconomy. As the bioeconomy increases in significance, the various ways of utilizing the biomass (food, feed, fiber, fuel, flowers, fun) may result in even greater competition for its generation and use. A raw materials strategy should have "food first" as its priority. It must also guarantee the sustainable use of basic resources (soil, water, nutrients, biodiversity) and should additionally be in harmony with societal perceptions of demand. To achieve these aims, it is necessary to organize the utilization of biobased raw materials more efficiently and more in line with demand. The most important aim, however, is to boost the sustainable production of biobased raw materials. This is where crop research assumes a special role.

Recommendations

The essence of the bioeconomy is a circular economy based on renewable raw materials that can essentially manage with solar energy as an external contribution. Sustainability is achieved in that this system supports itself without the addition of non-renewable materials or the expansion of production factors such as additional acreages. New technologies – not least in agriculture – are necessary if we are to gradually approach this ideal state. In the Bioeconomy Council's opinion, the following political fields of action exist and they can be used to strengthen crop research in Germany so that it can make a valuable contribution to the development of a bioeconomy:

Crop research can make an important contribution to covering the growing demand for biobased raw materials.

- **Increase production:** The aim of increasing sustainable production is to enhance the agricultural yield and therefore the output. At the same time it is necessary to counteract adverse environmental impacts, hence the need to reduce our resource footprint. In this case, it is absolutely essential to manage resources that have limited availability, such as soil, water, nutrients and energy, both carefully and efficiently. The funding policy must be adapted to these changing conditions, not least for the purposes of improving the coordination of funding instruments and objectives. It is therefore advisable to commit more heavily to research and development aimed at sustainably increasing the production of biobased raw materials and at achieving greater protection against losses of product quality and yields. In crop research, genomic and phenotypic selection should be combined and should support innovative sustainable systems of phytomedicine.

- **Utilization and maintenance of biodiversity:** Genetic diversity is the raw material for breeding plant varieties that are more productive and better able to adapt. In this connection, genome research and phenotyping should be encouraged under controlled conditions so as to evaluate the genetic diversity that is present in relevant databases. Genetic data should be made available to the public and breeders. This also includes a practical interpretation of the Convention on Biological Diversity (CBD) and the associated Nagoya Protocol. There should also be funding for new biostatistical methods for pre-breeding. Funding is particularly important for previously neglected agricultural crops which can contribute both to the diversity of the supply of raw materials and also to the resilience of the systems. Genetic diversity of, for example, antagonistic or symbiotic micro- and macro-organisms is also hugely important for the evaluation, investigation and utilization of biological defense systems (antagonists and micro-organisms) against biotic or abiotic stress components.

- **Understanding the plant system:** It may be possible with the help of predictive breeding to bring together the knowledge gained from genome research, phenotyping, integrative bioinformatics and breeding informatics with reference to specific biological questions. This is the basis for better understanding the biological plant system and being better able to predict breeding success. New physical and molecular biology processes for phenotyping, the development of user-friendly bioinformatics programs and databases plus the development of biostatistical methods should therefore be supported. To do this, there should be better financial provision for existing experimental stations and a long-term, broad-based field trials network. In addition to the plant system per se, consideration should also be given to further investigating the trophic systems of organisms in real cropping systems in order to improve the resource efficiency of the crop by specifically and sustainably influencing agro-economic systems. The knowledge gained in this way must also be incorporated in the formulation of breeding aims.

- **Collaboration between business and science:** Research in bioeconomy will pay off if the technologies and innovations developed during research become popular as products or processes in the market or form the basis for products that enjoy economic success. Basic research in Germany is positioned to be internationally competitive. By comparison, there is inadequate provision for transferring new knowledge from basic research to business and for developing the steps between research and utilization that are absolutely essential. Successful networks have been established in the crop breeding sector and also in phytomedicine. This public-private partnership concept should be strengthened from basic research through to applied research. Financial and legal frameworks must be reliably designed to meet these needs. Subsidy programs should be agreed between the various areas of responsibility.

Conclusion

Given the expectation of a rising demand for biobased raw materials, not only crop research but also agriculture in general are facing new challenges. Yield increases and loss minimization are necessary requirements for the success of a bioeconomy. With the measures described above, Germany can contribute to covering the worldwide demand for biomass in both quantity and quality. This strategy, however, must be aimed in all its components at overall sustainability and should therefore take ecological, economic, technological and social concerns into account. From an ecological perspective, what matters is maintaining the important but limited georesources of soil, water, nutrients and the diversity of plants, animals and microorganisms for coming generations by using them in a sustainable manner

About BÖRMEMOS

BÖRMEMOS summarize the Council's appraisal of key aspects of the bioeconomy in a condensed form. They do not claim to provide a comprehensive study of these facts. Rather, they present a focused and generally comprehensible view of each area and its relationship to the bioeconomy. BÖRMEMOS are designed as an incisive contribution to public debate. They are part of a series of analyses to be published by the Bioeconomy Council. They have their theoretical basis in extensive background papers that are also published on the Council's home page. BÖRMEMOS are assessed together with BÖR background papers (peer review). While this process is taking place, they are identified as preliminary and the authors are named. This memo on crop research was provisionally published on 4th June 2014 and finally approved by the Council at the 10th meeting on 14th November 2014, after going through the process outlined above.