BioÖkonomieRat

Implementing a bioeconomy sustainably

Initial recommendations for action by the Bioeconomy Council with the aim of implementing the National Bioeconomy Strategy

- Condensed Version -

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1. Introduction

In view of climate change, the loss of biodiversity and the urgently required reduction in the use of fossil resources, it is necessary to transition the resource base of our society and economy as fully and as quickly as possible. Now, more than ever, policymakers are being called upon to develop effective strategies to drive towards sustainable development. If our future is to be shaped in a climate-friendly, environmentally, socially and economically sustainable manner, we need to be successful in shaping the energy, mobility, agricultural and resource transformation, creating incentives for new lifestyles and gaining approval from the broader public. Tasks – such as energy production and supply based on renewable resources, sustainable production of healthy food, the preservation of biodiversity, social justice and a competitive and climate-neutral industrial sector – must be addressed decisively. Only in this way can we achieve resource-efficient prosperity as well as a high quality of life on a global scale. The course we set in the coming decade will, in particular, determine whether ecosystem tipping points are exceeded or whether the long-term viability of our civilisation can be secured.

A bioeconomy, i.e. sustainable living and economic activity in line with ecosystems and their regulatory functions, as well as systemic knowledge of biological and ecological interrelationships, provides an approach to successfully mastering these future tasks within planetary boundaries.[1] Its implementation requires close coordination of regulatory and process policies, land and land-use strategies, nature conservation, and closed-loop processes and added value networks, taking the concerns of society into account.

2. From NBÖS to an implementation plan

With the National Bioeconomy Strategy (NBÖS), the German government is aiming to expand this ground-breaking method of using resources economically. In 2023, it has set itself the goal of submitting concrete measures for doing so in an 'implementation plan'. The Bioeconomy Council has been commissioned to submit proposals and recommendations for this plan. The statutory targets in the areas of environmental protection, biodiversity, sustainability and the circular economy, as well as the multilateral agreements to which Germany is a signatory, serve as points of reference for the Council's work. A detailed description of this can be found in the first working paper.[2] Significant points on how these guidelines can be implemented are in the following fields of action, including:

[1] As defined by the German government, it encompasses the production, development and use of biological resources, processes and systems to provide products, processes and services in all economic sectors as part of a sustainable economic system. (Bundesregierung (2020): Nationale Bioökonomiestrategie (Nationale Bioökonomiestrategie, bundesregierung.de)

[2] Bioökonomierat (2022): Bioökonomie: Gemeinsam eine nachhaltige Zukunft gestalten 1. Arbeitspapier des III. Bioökonomierats (https://www.biooekonomierat.de/publikationen/positionen/2022/arbeitspapier.php)

a) Sustainable land and land use: The plethora of demands on land and open spaces, e.g. for food security, for biodiversity and climate protection, for the construction of settlement and transport infrastructure, as well as for energy supply, often compete with each other. Besides the rapid reduction of impervious surfaces, the shift in eating habits (e.g. reduction in the consumption of animal products) and the prevention of land degradation, diversifying land use can help to achieve multiple goals – where possible – on one and the same area.

b) Measures and innovations for reducing greenhouse gas (GHG) emissions: In addition to technological innovations, which play a significant role in reducing GHG emissions and contributing to the establishment of low-emission products[3], incentives for changing consumption patterns should be provided. This applies, in particular, to the reduction in the consumption of animal products, more social innovations (e.g. sharing economy, urban gardening) and political steering elements such as quota systems or CO_2 pricing.

c) Resource shift: A bioeconomy can play a limited but essential role in the 'resource shift', whereby some of the raw fossil materials used up to now are replaced by biogenic materials. This contribution will become significant if we succeed in simultaneously implementing comprehensive resource conservation, especially by recycling all kinds of materials and through synthesis-oriented biogenic CO_2 use.[4]

d) Reliable framework conditions for sustainable innovations in the bioeconomy: Advocates can only successfully invest, produce, provide services or create jobs under reliable framework conditions, which do not only include taxation issues and clear criteria for support, rather they must also create sufficient scope for re-investment and risk assessment of entrepreneurial innovations, as well as for fair market access.[5] Small and medium-sized enterprises have a central function in anchoring innovations in the wider national economy.

Derived from these fields of action, the first concrete topics (cf. Fig. 1) were identified that are considered to be of high importance due to their significance and leverage effect for the implementation of the bioeconomy strategy. Specific challenges posed by the following topics were discussed in 'project-oriented work units' by more than

[3] Europäische Umweltagentur (2016): Umwelttechnologien (Umwelttechnologien — Europäische Umweltagentur (europa.eu))

[4] Examples of this include CO_2 use and recycling via biotechnological processes and procedures (see https://biooekonomie.de/themen/dossiers/biotechnologisches-co2-recycling) and bio-based carbon fibres (see Arnold U., Brück T., de Palmenaer A., Kuse K. "Carbon Capture and Sustainable Utilization by Algal Polyacrylonitrile Fiber Production: Process Design, Techno-economic Analysis, and Climate Related Aspects"; Ind. Eng. Chem. Res. 2018, 57, 7922−7933; Arnold U., de Palmenaer A., Brück T., Kuse K. "Energy-Efficient Carbon Fiber Production with Concentrated Solar Power: Process Design and Techno-economic Analysis"; Ind. Eng. Chem. Res. 2018, 57, 7934−7945).

[5] Entrepreneurs For Future (2021): Die Wirtschaft braucht stabile Rahmenbedingungen – auch beim Klima (Zukunftswirtschaft_Forderungen_BTWahl.pdf (entrepreneurs4future.de))

by the following topics were discussed in 'project-oriented work units' by more than 150 bioeconomy experts during workshops and dialogues, and proposals for possible solutions were formulated:

- Dialogue and participation
- Approaches for greater policy coherence and policy integration
- Promoting innovation
- Carbon accounting
- Land management diversification
- Alternative protein sources
- Valorisation of material flows in biorefineries[6] and biogas plants[7]
- Wood/lignocellulose

[6] Biorefineries are understood to be an overall integrative concept for the processing or use of biological resources and biotechnological processes for the production of e.g. food, chemicals, materials, fuels and other material products, making the fullest possible use of the raw material source. It works in a similar way to that of an oil refinery, which manufactures a variety of different substances from crude oil. The raw material sources of biorefineries are, for example, primary biomass, wastewater, waste and exhaust air. The biorefinery process chain essentially consists of raw material pretreatment and processing, and the separation of biomass components (primary refining) and conversion and refining steps (secondary refining).

[7] A biogas plant is a structural unit for the production of biogas from the materials supplied, comprising at least one or more fermenters and the necessary piping and wiring. As a rule, a biogas plant also includes storage and feeding facilities for the fermentation substrates, gas purification and utilisation systems (e.g. combined heat and power plants), as well as storage and sometimes also processing facilities for the fermentation residue.

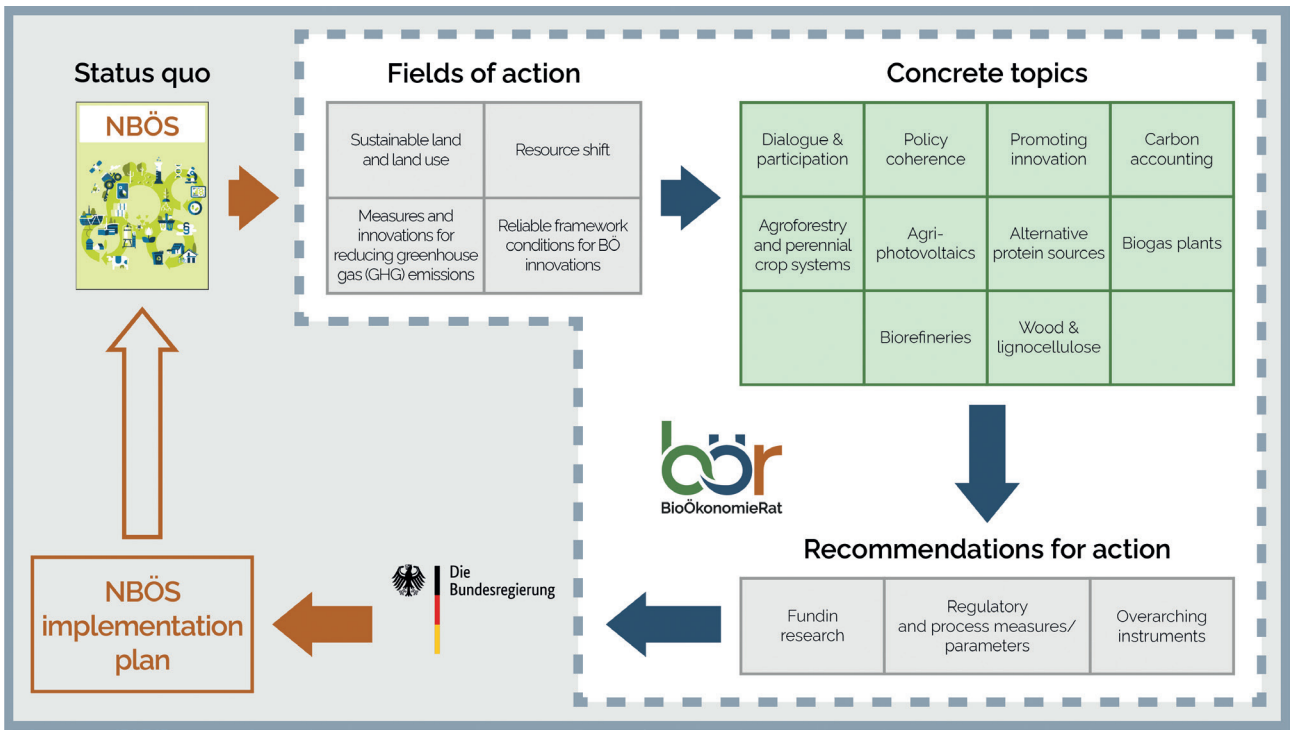

Figure 1: From the National Bioeconomy Strategy to an implementation plan

The first results of these discussions, which took place between March and September 2022, were presented to a wide audience at the Bioeconomy Forum on 21 and 22 September 2022. From the insights gained from these discussions and the suggestions received by the Council during the 2022 Bioeconomy Forum, an initial set of 57 concrete recommendations was derived on how to implement the NBÖS. This is described in detail in the position paper entitled 'Implementing a bioeconomy sustainably'. The proposed regulatory and funding policy, as well as any overarching measures, are directed exclusively at the German government. However, the implementation of such measures requires the support and participation of science, industry and society as a whole. We recommend that the government actively involves these stakeholder groups in implementing these recommendations for action.

3. Recommendations for action

In this condensed version, the Bioeconomy Council presents its initial recommendations for action, which are characterised by a high degree of leverage in the fields of action and should therefore be addressed by the German government as a matter of priority. Detailed explanations of each individual recommendation for action can be found in the full version of this report, which is available on request from the Bioeconomy Council's office. We would like to stress that these recommendations were requested by the interministerial working group responsible for the bioeconomy strategy implementation process, which began in parallel to the Council's work. These initial recommendations for action only reflect the state of work up to March 2023.

3.1 Dialogue/participation

Dialogue and participation play a major part in the economic and social transformation towards a sustainable bioeconomy. The NBÖS (p. 53) describes 'communication and dialogue' as an 'overarching tool' within the bioeconomy strategy, and states that 'the German government uses a variety of platforms to involve groups within the realm of civil society through transparent dialogue and participation processes. It is important to interact with all interested social groups – both with the frontrunners and advocates of the bioeconomy and with those who are critical of various aspects of it.' In the Bioeconomy Council's view, participation should also be considered explicitly alongside communication and dialogue, even if the terms are often not clearly distinguished in the public discussion. The NBÖS aims to initiate deliberate transformations in society. In a democracy, transformation processes within society require political and social legitimacy, as they usually generate winner and loser positions to a considerable extent. This makes securing legitimacy for the desired social transformation towards a bioeconomy a democratic political task that is not confined to obtaining support for individual projects, technologies or political programmes designed to promote the bioeconomy. Participation processes that are open in terms of people, topics and positions play an important role in legitimising transformations. Ideally, these can support or even initiate transformative implementation processes based on a broader social foundation.

Recommendations for action:

1. Promote documentation, evaluation and synthesis of experiences with dialogue and participation in the bioeconomy and comparable projects.

2. Institutionalise exchange of views and cooperation among regional initiatives.

3. Provide resources for including both organisations within civil society and other participants with a limited amount of their own resources in dialogue and participation processes.

3.2 Approaches for greater policy coherence and policy integration – results from exchanges with country advisory councils, cluster initiatives and regional networks from different German states

The topic of bioeconomy concerns the departmental responsibilities of several German ministries. However, there is still no overarching coherent bioeconomy policy at national level. As implementation in many policy areas of the bioeconomy is down to state policy (e.g. forestry and agriculture), there are also major vertical coordination tasks within the multi-level political system. To improve the dovetailing and networking of state-specific activities, the Bioeconomy Council established a new dialogue format between December 2021 and February 2022, in which it regularly exchanges information on current bioeconomy topics with organisations and institutions from outside the ministries. With the support of the corresponding state ministries, it was possible to pinpoint one initiative representative per state who is involved in shaping the bioeconomy there and/or who plays an active role in implementing it, e.g. through network-building. In collaboration with these people, the following recommendations were developed.[8] They aim, in particular, to strengthen the involvement of those with practical experience and who are active in state advisory councils, cluster initiatives and regional networks, to name but a few.

Recommendations for action:

4. The Bioeconomy Council recommends that the German government, with the cooperation of the states, press ahead with the creation of a database in which the existing technical infrastructure of universities and non-university research institutions within Germany is recorded and updated regularly. Furthermore, measures to identify the existing industrial infrastructure and practical projects should be initiated, e.g. by docking such a query in the context of research and development (R&D) and implementation projects that are either awaiting approval or that are already underway and being funded or co-financed by the German government or the states.

[8] An initial product of this cooperation is a background paper that was published in September 2022. (Bioökonomierat (2022): „Daten, Fakten, Zuständigkeiten: Wo steht die Bioökonomie in den Ländern“ (Daten, Fakten, Zuständigkeiten: Wo steht die Bioökonomie in den Ländern? (biooekonomierat.de))

5. In addition to the above-mentioned recommendation for action, measures are recommended to promote greater cooperation between non-university research institutions, universities and industry, making joint use of the existing infrastructure. Framework conditions should also be created to enable the use of large-scale equipment and existing infrastructure funded by the German Research Foundation (DFG), such as at institutions belonging to the Helmholtz Association, by industrial companies, research institutions and, if necessary, by other interest groups.

6. In conjunction with the goal of determining the practical suitability of bioeconomy-related laws and regulations, taking into account practical experience from industry and civil society, the Bioeconomy Council recommends that the German government establishes a participation platform. The knowledge and experience gained from this could serve as a blueprint for other topics of similar high complexity.

7. The Council recommends that the German government creates structures for networking rural, municipal and regional bioeconomy initiatives and ensure that they are given greater consideration in national-state structures and funding policy.

8. It is recommended that the progress of the 'implementation plan' be acknowledged and discussed with the state advisory councils, cluster initiatives and regional networks from different states every two years.

9. The Council recommends the German government advocate classic professions requiring an apprenticeship be adapted to the bioeconomy.

10. It is recommended that the bioeconomy be positioned under the 'climate and resource protection, energy and environment' lead market. This also requires a strengthening of the infrastructure for bio-based/biotechnological processes.

11. The Bioeconomy Council proposes integrating the bioeconomy into the Kreditanstalt für Wiederaufbau (KfW) growth fund with an independent funding programme and anchoring it within the DeepTech & Climate Fund (DTCF) so as to close the existing gap and support companies, even without their own capital. Furthermore, it is recommended that public sector instruments (e.g. sustainable procurement) be used as significant financial leverage.

3.3 Promoting innovation

Research and innovation are not only the engine that drives progress,[9] they are also factors that determine success, especially for countries poor in raw materials such as Germany, in order to hold their own in international competition, open up future markets and secure jobs, making them indispensable for the overall social prosperity of our country. A sustainable bioeconomy as an economic and social system that is generation-friendly and geared towards the United Nations Sustainable Development Goals (SDG) requires innovation at all levels. In order for results from science, non-university research institutions or industry to find their way into resource-efficient manufacturing processes and marketable products in a targeted manner, it is not just inventiveness and entrepreneurial action that are required, rather also an innovation policy that understands that it serves as a link between R&D and an industrial policy, one that provides maximum support to innovation system actors in the transition to a 'green' Kondratieff cycle.[10] To achieve the bioeconomy's overarching objectives – e.g. more sustainability and competitiveness decoupled from resource and energy consumption, in addition to investments in research and innovation by the state in particular – it is necessary to reduce the barriers and obstacles to innovation (cf. EFI, 2020) that small and medium-sized enterprises (SMEs) encounter in financing, legal regulations, skilled workers and management of innovation processes.[11]

Recommendations for action:

12. Establish influential science-to-business platforms or centres as the nucleus of innovation regions or areas.

13. The Bioeconomy Council recommends professionalising university start-up activities and corresponding participation models. To this end, new participation models should be set up as part of experimental clauses that go beyond the virtual participation model (see Darmstadt model), thereby enabling the direct involvement of private investors.

14. It is important to promote technology-driven, social and institutional innovations comprehensively and equally. In the technology sector, particular attention

[9] Bundesregierung (2023): Fortschritt durch Forschung (Forschung: Schlüssel zu Fortschritt und Wohlstand | Bundesregierung)
[10] Bundeszentrale für politische Bildung (2016): Kondratieff-Zyklen (Kondratieff-Zyklen | bpb.de)
[11] ZEW (Leibniz-Zentrum für Europäische Wirtschaftsforschung) und Prognos AG (2013): Untersuchung von Innovationshemmnissen in Unternehmen – insbesondere KMU – bei der Umsetzung von Forschungs- und Entwicklungsergebnissen in vermarktungsfähige Produkte und mögliche Ansatzpunkte zu deren Überwindung (https://ftp.zew.de/pub/zew-docs/gutachten/Abschlussbericht_InnovationKMU2013.pdf)

should be paid to disruptive innovations with a high impact on sustainable transformation (prioritisation).

15. Create knowledge-based assessment systems and establish comparable accounting frameworks.

16. Establish new instruments for assessing ESG (environmental, social, governance) criteria to support entities and/or individuals investing capital, create framework conditions and introduce measures to support necessary equity financing.

17. The Bioeconomy Council recommends that the German government introduce a simplified system of tax benefits for SMEs that use 'bio-based clean technologies' (modelled on successful implementations in the Basque Country and based on Dutch and British programmes).

18. In addition to a stringent transposition of EU directives into national law, the Council recommends using the scope available in the procedure, for instance in the dynamisation of standards, to provide maximum support for the sustainable development of the bioeconomy. The German government should advocate at European level for the consistent implementation of corresponding EU requirements within Member States with a view to harmonising minimum requirements and quality standards for biobased solutions at EU level.

3.4 Carbon accounting

The success of the bioeconomic transformation is not only dependent on how efficiently technical developments create products from bio-based raw or residual materials and with biological processes. Even if substances are increasingly used in cascades and material cycles are to be closed, the raw material base from production and extraction is needed primarily in agriculture and forestry as well as in waters and aquacultures. However, this base is limited and marked by manifold competing uses. Just as the existing primary energy consumption based on renewable energies cannot simply be allowed to continue indefinitely, the bioeconomy resource cannot continue or even expand the consumption and use of finite resources with an equally large consumption of renewable resources. Instead, the bioeconomic transformation must go hand in hand with a significant reduction in absolute consumption, the protection of the ecosystems and the services they provide. Carbon – one of the main components of biomass and the basis of many important everyday and special products – is strategically significant for our national economy and of central importance here. This is why we welcome the German government's announcement that it will develop a national carbon management strategy (CMS) and publish it in 2023. Similar to the 'National Hydrogen Strategy', this can create an overarching umbrella which, in the Bioeconomy Council's view, is crucial for doing justice to carbon in terms of climate, energy, industry and innovation policy. To get such a strategy off the ground, the Council considers it necessary to implement preparatory measures.

Recommendations for action:

19. To prioritise the use of renewable raw materials beyond ensuring food security, as envisaged by the biomass strategy, among other things, a comprehensive assessment of their main component, carbon, is required. The Bioeconomy Council therefore recommends that the German government commissions a study in which the national and international data situation of previous observations and detailed studies can be systematically recorded, the resulting key figures brought up to date and standardised using suitably derived data structures.

20. We recommend that the current focus (storage and material use of CO_2) by the CMS be significantly expanded to include other carbon sources (including biomass, waste and residual flows). In the interest of policy coherence, the CMS should take the NBÖS 'implementation plan' into account, in particular, in formulating the biomass strategy.

3.5 Land management diversification – agroforestry and perennial crop systems

The aim of agroforestry and perennial crop systems is the productive integration of perennial crops' ecological functions into agricultural systems. These functions include humus build-up and carbon storage in soils, erosion control, water retention in landscapes, mitigation of climate-changing emissions, reduction of pollutant input (e.g. nitrate, pesticides) to surface waters and groundwater, habitat function and other ecosystem services.[12] One challenge of perennial crop systems is long-term planning – the capital and land commitment reduces farmers' flexibility in managing crop rotations, which often need to be adapted to short-term market conditions. Another challenge is successfully managing agroforestry systems to maximise the potential of the various environmental benefits – this requires an understanding of the system and good adaptation to the local environment.

Recommendations for action:

21. Grant farmers freedom and flexibility through regulatory adjustments, such as in the Direct Payment Regulation or in the European Agricultural Fund for Rural Development (EAFRD), and through fundamental, structural administrative adjustments based on this, e.g. in licensing law.

22. Establish both regional lighthouse and model projects, as well as demonstration projects, as protected innovation zones for faster practical implementation of agroforestry and perennial crop systems.

23. To better put research results into practice, it is necessary to realign research policy for agroforestry and perennial crop systems in that it must be geared towards a systemic, transdisciplinary research approach and significantly longer project durations.

24. The complexity of agroforestry and perennial crop systems requires that objectives be prioritised and management be streamlined. There is a need for research in the integrative development of decision-making tools for the purpose of optimising systems, in the further development of mechanisation technologies and in the accompanying ecological research.

[12] von Cossel, M., Winkler, B., Mangold, A., Lask, J., Wagner, M., Lewandowski, I., et al. (2020). Bridging the gap between biofuels and biodiversity through monetizing environmental services of Miscanthus cultivation. Earth's Future, 8, e2020EF001478. 10.1029/2020EF001478 (Bridging the Gap Between Biofuels and Biodiversity Through Monetizing Environmental Services of Miscanthus Cultivation - von Cossel - 2020 - Earth's Future - Wiley Online Library)

25. The quantification and financial reward of ecosystem services have long been at the centre of global discussions. There is a considerable need for transdisciplinary research in the development of a measurement and assessment system for ecosystem services and their financial reward.

26. A realignment of agricultural and forestry education is essential for sustainable land management. Optimal establishment and management of agroforestry and perennial crop systems require experience and knowledge anchoring in both education and training and in teaching.

3.6 Land management diversification – agri-photovoltaics

Agri-photovoltaics (agri-PV) describes specially developed photovoltaic systems that are installed on agricultural land and, through specific technical modifications, enable agricultural or arable production to continue under or in conjunction with the system. By combining the production of agricultural products and energy on the same land, agri-PV can typically increase the land efficiency ratio (LER) in Central Europe from 1 for pure agricultural use to 1.2 to 1.4 for ground-mounted and 1.6 to 1.8 for elevated racking systems. In Germany, elevated racking systems (> 2.10 metres clearance) are more expensive than ground-mounted systems, mainly because the substructure costs more. Besides lower electricity generation costs, ground-mounted systems offer potential wind protection for crops and tend to have less impact on the landscape and rainfall distribution. Elevated racking systems, on the other hand, use land area more efficiently, allow more light for photosynthesis due to more scattered shading, and can offer agricultural crops better protection from negative impacts from the environment, such as heavy rain, hail and frost damage, or drought damage associated with high soil temperatures, evaporation rates and soil drying during hot weather periods caused by shading.[13] One challenge to implementing agri-PV can arise from the fact that there may be a reduction in the amount of usable agricultural land. The more synergies between agri-PV and agricultural production are used, the less the agricultural area and productivity will be reduced. These can, like shading by agri-PV in hot and dry regions, even lead to an increase in agricultural productivity. However, given the climatic conditions and forms of cultivation currently prevalent in Germany, we can only assume that the use of conventional agricultural machinery will result in land losses because the areas underneath the modules cannot be cultivated using large-scale equipment.[14] Depending

[13] Fraunhofer-Institut für Solare Energiesysteme (ISE) (2022): Agri-Photovoltaik: Chance für Landwirtschaft und Energiewende – Ein Leitfaden für Deutschland. (https://www.ise.fraunhofer.de/de/veroeffentlichungen/studien/agri-photovoltaik-chance-fuer-landwirtschaft-und-energiewende.html)
[14] Weselek (2022) The impact of agrivoltaics on crop production. Dissertationsschrift, Universität Hohenheim (Dissertation_Axel_Weselek.pdf (uni-hohenheim.de))

on the system design and type of cultivation, these vary and can amount to 10 to 15% according to DIN SPEC 91434:2021-05.

Recommendations for action:

27. The expansion of PV systems outside the agricultural sector (i.e. on roofs, in car parks, etc.) should be prioritised in line with the legal requirements of neighbouring countries.

28. Regulatory (e.g. the German Renewable Energy Sources Act, construction laws) and administrative structural adjustments are needed if agri-PV is to be established as a fundamental component of the energy transition without significantly reducing the amount of agricultural land available for food production. When using agri-PV, therefore, land-efficient solutions are to be given binding preference. The loss of yield should be minimised by choosing suitable locations and crops. Agri-PV systems should be built primarily on marginal land and designed to protect biodiversity.

29. Standardisation should be developed and adapted as both a market strategy tool and to accelerate market development in the context of the energy transition.

30. Rapid and optimised implementation of agri-PV requires – concurrently with the installation of facilities – research funding for sustainable implementation, especially regarding technological and agronomic issues.

31. Increase the acceptance of agri-PV through dialogue and communication in society.

3.7 Alternative protein sources

Climate change will reduce the use of agricultural land available in the future. At the same time, the demand for land is increasing sharply due to non-agricultural use in Germany and further population growth worldwide. Currently, food-related greenhouse gas emissions (including transportation) account for about a quarter of total emissions in Germany. In 2021, around 36 million tonnes of CO_2-equivalent GHG emissions were attributable to direct livestock farming alone. This equates to 66% of all agricultural emissions.[15] The change in dietary habits in developing and emerging countries towards a Western-oriented diet has resulted in a sharp rise in demand for animal-based foods (the Food and Agriculture Organization [FAO] of the United Nations forecasts a demand of 160% of current production). This inevitably leads to a significant increase in GHG emissions. To counteract this global trend, the goal should be to reduce meat consumption by at least 75%.[16] The consumption of animal products can be significantly reduced through a plant-based diet or opting for alternative protein sources. The latter sources include technologically modified vegetable proteins, such as extruded pea proteins in meat substitutes, and biotechnologically produced proteins. Biotechnological processes mainly include the in vitro cultivation of animal cells (cultured meat) or products of precision fermentation. Alternative protein sources make an important contribution, as they enable consumers to transform their diet[17] without having to give up their usual eating habits – such products can take a consumer's individual preferences into account in the most ideal manner possible. Furthermore, fermentative processes offer great potential for significantly reducing the amount of land needed for food production.[18]

Recommendations for action:

32. Establish standardised evaluation parameters and procedures for the sustainability of food products and production processes, taking sustainability criteria such as GHG emissions, water consumption, land use and biodiversity into account both along supply chains, i.e. at product level, and throughout the entire life cycle. Where new production processes are concerned, the potential for translating this into industry using standardised procedures is to be assessed

[15] Umweltbundesamt (2022): Beitrag der Landwirtschaft zu den Treibhausgas-Emissionen (Beitrag der Landwirtschaft zu den Treibhausgas-Emissionen | Umweltbundesamt)
[16] Willett et al. (2019): Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems. The Lancet Commissions, 393(10170), p 447-492 (Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems - The Lancet)
[17] Banks et al. (2022): Industrial production of microbial protein products. (Industrial production of microbial protein products - ScienceDirect) Current Opinion in Biotechnology
[18] Lindner, T. (2019): Microbial alternatives to conventional sources of food and feed. Frontiers in Sustainable Food Systems. Volume 3, Article 32.

too. The results of these assessments provide the basis for government incentives and development support for products and processes, as well as for consumer information.

33. Promote the consumption of sustainable plant proteins and alternative protein sources through process policy instruments such as adjusting the rate of applicable value-added tax (VAT) or including them in the emissions trading system. Any measures that lead to an increase in the price of less sustainable foods must be accompanied by appropriate social policy provisions. (The recommendation for action related to alternative protein sources is supported by: Michael Böcher, Viola Bronsema, Thomas Brück, Jürgen Eck, Stefanie Heiden, Ralf Kindervater, Iris Lewandowski, Monika Pischetsrieder, Klaus Richter, Daniela Thrän, Markus Wolperdinger).

34. The German government should advocate within the EU for the redesign of approval procedures for novel foods (e.g. alternative proteins) with the following objectives: (1) defined requirements for applicants, (2) transparent and uniform evaluation guidelines, (3) acceleration of the approval procedure while maintaining quality and safety criteria.

35. Mission-oriented R&D funding, as envisaged by the German government's 'Strategy for the Future', requires a collaborative network that brings together stakeholders, organisations, users and other relevant groups of people in new agile and participatory formats. Besides technical innovations, social and institutional innovations should also be promoted. The Bioeconomy Council recommends that the German government actively support the establishment of such innovation systems by setting up hubs.

36. Create funding policy framework conditions at national level for the development and large-scale establishment of various open-technology production platforms with a focus on plant, microbial and cell-free systems.

37. Knowledge-based information for consumers on the sustainability of food and production processes to enable them to make informed consumption decisions.

3.8 Valorisation of material flows in biorefineries and biogas plants

3.8.1 Biogas plants

To achieve the goal of establishing a sustainable circular economy, the vast infrastructure of biogas plants in Germany must be developed further to make it fit for the future. This involves a more sustainable supply of raw materials and technical solutions for providing renewable energy that contribute both to the reduction of greenhouse gases and to the self-sufficiency of farms by supplying them with energy and fertilisers. One way to achieve this can be the expansion and integration of biogas plants into modular biorefineries or the conversion of biogas plants into biorefineries on or near farms. This is demonstrated, for example, in a BMBF-funded project in which the integration of a production process for fatty acids into end products in existing biogas plants enables combined material-energetic biomass use.[19] Biorefineries that produce fertiliser and vegetable charcoal[20] or fibres for the packaging industry are particularly suitable for agricultural operations. If biorefineries are installed on farms in the future, or as close to them as possible, the raw materials, most of which are liquid and contain water, can be processed directly on site, so that costly transportation can be avoided. However, more research is still needed in this area. Such an expansion of biorefineries or the further development of biogas plants offers farmers the greatest opportunity possible to participate in creating added value as well as providing additional sources of income in rural areas.

Recommendations for action:

38. It is necessary to sustainably change the raw material base of biogas plants and make them less dependent on annual energy crops grown in monoculture, such as maize for energy use.

39. The added value of biogas plants should be optimised in line with the bioeconomy. Biogas plants should be expanded into modular biorefineries for the extraction of raw materials (by-products and new products) where it makes sense to do so. Existing biogas and biofuel plants must be developed into production systems with high value-added potential in climate-neutral supply systems.

[19] Braune und Sträuber (2017): Bio-basierte Capron- und Caprylsäure: Herstellung, Aufreinigung, Vermarktungsstrategie (CapAcidy). (Bio-basierte Capron- und Caprylsäure (openagrar.de))
[20] The European Biochar Industry Consortium (EBI) (2020): EBI-Whitepaper – Mit Pflanzenkohle basierten Kohlenstoffsenken dem Klimawandel entgegenwirken. (Bio-basierte Capron- und Caprylsäure (openagrar.de)

40. More facilities for recovering nutrients and producing mineral fertilisers, for example struvite (phosphorus fertiliser) or ammonium sulphate (nitrogen fertiliser), from organic residues from livestock and biogas production and, above all, from liquid manure and biogas fermentation residues should be built.

3.8.2 Biorefineries

Biorefineries open up the possibility of extracting many different valuable substances such as chemicals, biomaterials, fuels and other material products from biomass, gaseous substances such as biomethane or CO_2, and organic residues and waste materials, using the raw material source as fully as possible, and making them available for further processing. The aim is to promote the transition to renewable resources, resource conservation and the circular economy,[21] climate protection and innovation. The supply of biorefineries with sustainably procured raw materials plays a key role in this. Such biorefinery technologies are currently only partially used. In the future, biorefineries can become an important module within the chemical sector and contribute to shifting the manufacture of products, which today are mostly produced with fossil raw materials, to a sustainable raw material basis. Besides the use of biogenic raw materials, CO_2 can be used as a raw material or secondary raw materials from residues and, in general, substances can be recycled very efficiently. This makes an important contribution to achieving the goal of a greenhouse gas-neutral chemical industry by 2050. Expanding the application of established biorefinery technologies can also lead to effective climate protection and contribute to sustainable recycling and the defossilisation of industry.[22]

Recommendations for action:

41. Promoting research to expand the raw material base for use in regional and municipal biorefineries. Municipal waste, wastewater and carbon dioxide are important raw materials, as are biogenic raw materials. Furthermore, cultivated biomass that is not competing for land with food production and that can, therefore, support nature conservation and environmental protection should also be considered.

[21] UBA (2017): Biomassekaskaden – Mehr Ressourceneffizienz durch Kaskadennutzung von Biomasse – von der Theorie zur Praxis, UBA-Texte 53/2017 (BIOMASSEKASKADEN - Mehr Ressourceneffizienz durch stoffliche Kaskadennutzung von Biomasse – von der Theorie zur Praxis | Umweltbundesamt)
[22] Verein Deutscher Ingenieure (VDI) (2016): Klassifikation und Gütekriterien von Bioraffinerien, Beuth-Verlag Berlin VDI 6310 Blatt 1 (2016-01) (VDI 6310 Blatt 1 - Klassifikation und Gütekriterien von Bioraffinerien | VDI)

42. Research and development on conversion processes must be promoted more to enable the extraction of high-quality value-added substances from the complex mixtures in biorefineries. The intensity of research within companies and research institutions must be expanded as a matter of urgency.

43. Biorefinery pilot and demonstration plants should be promoted in the context of protected spaces. Technological developments must focus on preparing new processes and plant types for the market quickly and effortlessly.

44. The German government should examine legal framework conditions in order to begin construction of new biorefineries without delay – in a concerted effort, the expansion of biorefinery technologies can be launched quickly in order to promote the broad spectrum of biorefinery concepts across Germany's states.

45. Favourable biorefinery locations must be provided – biorefineries need the correct infrastructures to pave the way for a sustainable circular economy.

46. The CO_2 price for introducing bio-based products to the market must be made effective.

47. There must be clear life cycle assessment rules to demonstrate the sustainability of biorefineries and biogas plants. Furthermore, standards for compiling product information are needed.

48. For the implementation of biorefineries to succeed, lead markets must be created and sustainable marketing must be made possible.

49. The implementation of biorefineries and the expansion of biogas plants must be supported by standards and legislation. This requires adjustments to the Waste Ordinance and the Renewable Energy Sources Act and an intelligent orientation of the biomass strategy.

3.9 Wood/lignocellulose

The demand for biological resources in various applications is increasing steadily. This also applies to the renewable raw material wood. The composite material lignocellulose is already used in a variety of material applications, including as a material for construction and furniture and as a fibre base material for pulp, paper and cardboard manufacture, as well as in providing energy for private, commercial and industrial heat supplies. Native renewable lignocellulose will, in particular, be a key raw material for the bioeconomic transformation. To expand the established uses of wood and to add new product lines, especially in biotechnology and biorefinery processes, the availability of raw materials under future constraints (climate change, forest conversion, soil ecology, carbon sinks, biodiversity protection, circular economy) needs to be mapped as central issues, and guidelines for prioritising use (priority of material over energy use) must be discussed. The foreseeable intensification of use will lead to further pressure on wood-producing forest ecosystems, the stability and productivity of which are already considerably limited due to climate change and its consequences. This means that the wood-based bioeconomy is faced with the task of making the greatest possible contribution to the bioeconomic transformation from a regionally available and renewable, but nevertheless limited, supply of biomass. Besides prioritising use preference, technology that optimises materials and their application must be developed and incentives for long-term material flow management must be established. These should also increasingly involve consumers, as the positive aspects of regional economic activity can be communicated well using wood as an example, as can a discussion of values on the conscious restriction of consumption behaviour (keyword: sufficiency).

Recommendations for action:

50. Long-term and ongoing monitoring of forest ecosystem services and biodiversity (including soil biodiversity), the sustainably available quantities of wood and their use must be expanded and further developed nationally with the introduction of uniform assessment parameters.

51. Targeted promotion of wood use in long-term usable and climate-efficient constructions.

52. State regulations for a sustainable circular economy, especially regarding waste and waste wood, must be renewed.

53. The use of wood should be prioritised based on the principle of material before energy.

54. The environmental consequences of wood consumption must be investigated and assessed, and the results should be made accessible in a central location.

55. Incentive structures and funding instruments must be adapted to promote durable products, reuse and cascade utilisation.

56. Guideline values must be set for sustainable wood consumption from forests that take planetary boundaries into account.

57. All those involved must be encouraged to share knowledge. Research and training must be strengthened by providing a comprehensive curriculum.

Legal Notice

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