Deutsches Biomasseforschungszentrum
gemeinnützige GmbH

DBFZ


# Annual Report 2024

## Directions

**By train:** to Leipzig main station. Take tram line 3/3 E (towards Taucha/Sommerfeld) as far as the Bautzner Strasse stop. Cross the street, leave the car park on the right and use the main entrance of the DBFZ (House 1, Torgauer Str. 116). Please check in at the front office.

**By car:** on the A 14 motorway. Exit at Leipzig Nord-Ost; follow signs for Taucha; then follow signs for Leipzig; then follow signs for Zentrum, Innenstadt. Turn off left after the “bft” filling station (see “By train” for further directions).

**By tram:** line 3/3 E towards Taucha/Sommerfeld; Bautzner Strasse stop (see “By train” for further directions).


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# Annual Report 2024



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# 1

# Editorial



## Dear Readers,

**Fig. 1:** The General Management of the DBFZ

2024 was an exciting year in which we were particularly concerned with the cuts in national research funding. Against this background, it is encouraging to note that we were able to increase third-party funding revenues again in 2024 by around 1.5 million euros to almost 18 million euros. Well over 100 research projects were successfully completed in 2024, around 25 % of them in cooperation with industries. This also marks the successful start of the implementation of the DBFZ Roadmap, Part II, for the years 2024–2026, as decided by the Supervisory Board.

We are particularly pleased to be able to present two projects in this year's annual report that are among the DBFZ's major lighthouse projects: "ETH-Soil" and "Pilot-SBG", which are two of the research focus areas "SmartBiomassHeat" and "Biobased Products and Fuels". We were able to make significant progress in both projects in 2024.

Our international activities in Africa were successfully pursued not only in Ethiopia but also in Togo. In the "LabTogo" project coordinated by the DBFZ, targeted knowledge and technology transfer on the bioenergetic use of organic residues has been taking place since 2019. The aim is to contribute to the fight against climate change and to significantly reduce deforestation in the target region. In May 2024, we handed over a complete biomass laboratory to the local scientists as part of the project. You can find a comprehensive multimedia report on this research highlight at **www.dbfz.de/en/togo-story**.

We would like to express our special thanks once again to all our partners (Supervisory Board, Research Advisory Council, project management organisation and project partners) for their very extensive scientific input, numerous constructive suggestions and the overall very constructive cooperation!

This 2024 Annual Report contains a wealth of information about the work of the research focus areas, as well as the promotion of young scientists, science communication, policy advice, involvement in expert committees, finances and much more. On behalf of the entire DBFZ team, we hope you enjoy reading the annual report and gain new insights.

**Prof. Dr. Michael Nelles**
Scientific Managing Director

**Dr. Christoph Krukenkamp**
Administrative Managing Director

# 2

# Key figures 2024

## Our Mission

The DBFZ develops practical solutions along the biomass value chains and cycles based on the “Smart Bioenergy Approach”[1] developed by the DBFZ. Through applied research and development (R&D) of technologies for the energy-related and integrated material use of biomass, the DBFZ is strongly contributing to realise the climate neutral society, which is to be achieved by 2050 at the latest.

Due to its close network of partners from science, industry and society, the DBFZ plays a special role in the development of rural areas as well as in the regions affected by the coal phase-out and other structural changes in Germany. Through international cooperations, DBFZ promotes transfer of knowledge and technologies worldwide.

→ **Further information:**
www.dbfz.de/en/the-dbfz/mission-statement
www.dbfz.de/en/the-dbfz/scientific-assignment

[1] www.smart-bioenergy.com



**30**
**Newly launched projects**
Market and third-party funded projects

**40**
**Completed projects**

**107**
**Processed projects**

**280,230.–**
**Average project volume**
of the projects launched in 2024

**271**
**Employees**
as of 31/12/2024

**47**
**Peer reviewed publications**
(including 41 open access articles)

**73**
**Events**
(internal/external)

# 3

# Scientific highlights and awards




**Fig. 2:** The KIDA conference took place for the first time at the DBFZ in Leipzig in 2024

On 2–3 December 2024, KIDA-KON 2024 brought together a total of 125 AI experts, data scientists and specialists from science and industry at the DBFZ in Leipzig. The highlights included topics such as AI-based innovations in agriculture, AI research for agricultural, nutritional and environmental sciences, visual farming and computer vision. In a total of seven sessions with 21 lectures, two keynotes and 25 posters, participants were given exciting insights into the work of various institutes. Prof. Dr. Engel Arkenau, head of subdivision and Digitalisation Officer at the Federal Ministry of Food and Agriculture, highlighted the role of KIDA – AI in Food and Agriculture as a beacon project in her speech. In his video message, Federal Minister Cem Özdemir also emphasised the need to accelerate artificial intelligence in departmental research. KIDA-KON 2025 will take place from 17–18 September 2025 at the Thünen Institute in Braunschweig.

→ **Further information:**
**www.kida-bmel.de/en/**

## E-Boot II – Development of a boat for the environmentally friendly harvesting of aquatic plants

The aim of the “E-Boot II” project (FKZ: 031B1095), funded by the German Federal Ministry of Education and Research (BMBF), was to develop a particularly

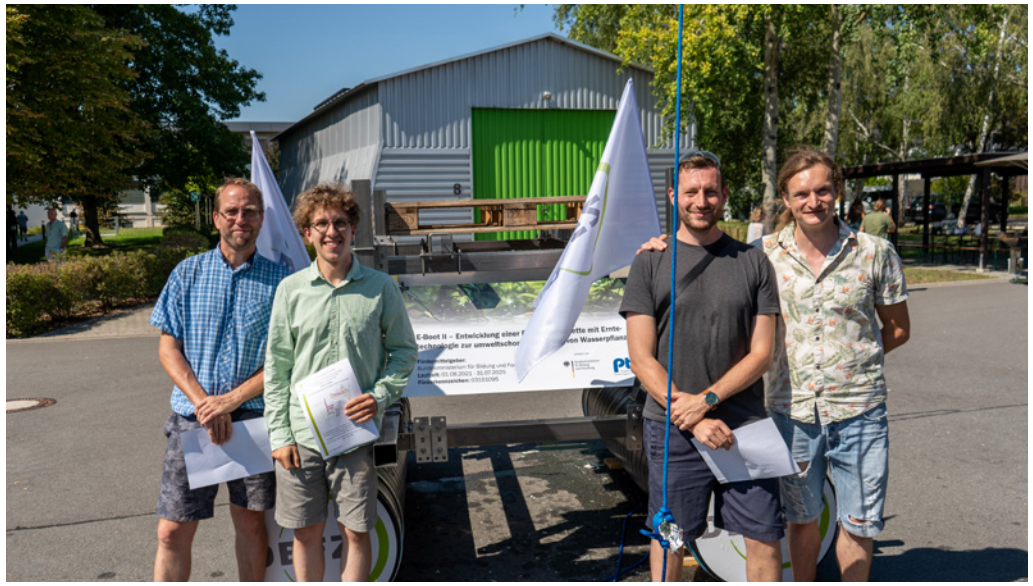

**Fig. 3:** Project manager of the “E-Boot II” project

nature-friendly and marketable harvesting process for aquatic plants that would reduce the costs of weeding/harvesting aquatic plants from larger bodies of water by at least a factor of 3–4 (estimate) compared to current methods. In particular, the water hyacinth, due to its mass growth and spread, poses a problem in almost all tropical and warm subtropical areas. At the same time, it can provide a significant, rapidly renewable raw material potential for the bioeconomy. Invasive aquatic plants, such as the Canadian waterweed, are native representatives of invasive aquatic plants, with a previously untapped biomass potential. Here, too, the cost reduction of harvesting can bring about a paradigm shift and turn a waste material flow into a resource. The planned process chain using a modular harvesting boat was developed, implemented and patented at the DBFZ. The targeted cost savings should make it possible for the value of the least valuable product from this biomass, namely biogas, to cover the costs of the harvest. The prototype of the harvesting boat developed at the DBFZ was christened on 13 August 2024.

## Innovation: DBFZ presents new “Apeli” cooker to BMBF

Deforestation in African regions and many other parts of the world is increasing rapidly. Reasons for this are growing population figures and the increased use of wood/charcoal as a cooking fuel. In the context of the “LabTogo” project funded by the Federal Ministry of Education and Research (BMBF), an “Apeli” cooker was developed for the special requirements in Togo. The new development is based on a multi-stage combustion process that makes it possible to fully utilise the fuel (wood pellets and local residues such as bamboo or palm kernel shells) thermally. The Apeli not only requires significantly less fuel than traditional stoves, but also produces fewer emissions during operation. On



**Fig. 4:** Dr. Dennis Krüger (left) presented the Apeli cooker at the Federal Ministry of Education and Research

16 October 2024, DBFZ scientist Dr. Dennis Krüger (working group “Biogenic Char Applications”) presented the novel cooker to the hydrogen representative of the federal government, Mr. Till Mansmann, at the Federal Ministry of Education and Research.

→ **Further information:**
**www.dbfz.de/en/labtogo**
**https://youtu.be/IDKCSm6jU8M**

## Project brings chemical production for biogas plants to pilot scale

The “CapUp” project (FKZ: 13BDA30012), which was successfully completed in 2024, aimed to further develop and scale up a biorefinery process that produces chemicals, biogas and fertiliser from biogenic raw materials. Locally available biomass such as corn silage or waste products such as apple pomace were fermented to caproic and caprylic acid, which serve as basic chemicals for biological speciality chemicals such as lubricants and cleaning agents or bioplastics. In the project, the DBFZ scaled up a purification cascade to separate the carboxylic acids from the fermentation broth on an industrially relevant and pilot scale. Any side streams that arise are further processed into biogas and fertiliser to make the best possible use of resources. As part of the scaling of the CapUp processes, the project partner GNS – Gesellschaft für Nachhaltige Stoffnutzung mbH has carried out an economic and ecological evaluation for a production plant with a capacity of 1000 t/a carboxylic acids. With this process, GHG emissions can be reduced by up to 75 % compared to the use of palm oil. The production costs of around € 3,000/t of product are competitive and could be further improved in the future to enable them to compete with established chemicals. Thanks to the results achieved, the project has made

**Fig. 5:** Project team “CapUp”

a significant contribution to transferring the process into industrial practice.

## UBA study published: Evaluation of the 1st BImSchV of 2010

In the research project carried out by the DBFZ, the 1st BImSchV (Ordinance for the Implementation of the Federal Immission Control Act) was evaluated with regard to the measures for reducing air pollution from solid fuel firing systems, in particular single-room firing furnaces. Both the type testing and the quality assurance of systems and fuels – during the manufacturing process and in long-term operation – were examined with regard to their potential for improvement. The authors, Prof. Dr. Ingo Hartmann, Prof. Dr. Volker Lenz, Christian Thiel and Tobias Ulbricht, considered the influence of the system operator on the emission behaviour in real everyday operation and demonstrated and evaluated possibilities for reducing real-life emissions. In addition, the extent to which operating measurements, as prescribed for central heating boilers, are suitable for EFA was investigated. As part of the project, extensive emission measurements were also carried out and evaluated on five wood-burning stoves using three different test cycles.

→ **Free Download:**
**www.umweltbundesamt.de/publikationen/evaluierung-der-1-bimschv-von-2010**


**Fig. 6:** Published UBA study

## Awards/Honours

### DBFZ scientist Ronja Wollnik successful at FVEE and EUBCE

DBFZ scientist Ronja Wollnik (DBFZ research department “Bioenergy Systems”) presented the keynote address at the opening session of the European Biomass Conference and Exhibition 2024 (EUBCE) on 24 June 2024. Her lecture was entitled “The role of renewable carbon in a circular economy – spotlight on carbon removals” and was extremely well received by the participants of the international conference. In addition, Ronja Wollnik won the pitch for the best poster at the annual conference of the Renewable Energy Research Association (FVEE) in Berlin on the topic “The future of bio-based $CO_2$ removal from the atmosphere – scenarios for the use of negative emissions technologies in Germany up to 2045”. The DBFZ was represented by a total of four colleagues at the pitch.


© EUBCE

**Fig. 7:** DBFZ scientist Ronja Wollnik gave the keynote address at EUBCE 2024

### DBFZ doctoral students win 1st prize at Leipzig Founders’ Night with spin-off

DBFZ doctoral students and research associates Alberto Meola and Simon Hellmann won first prize for the best start-up idea at the Leipzig Founders’ Night on 19 November 2024. Their start-up, “clever bioTechnologies”, develops models for the automation of biogas plants and prevailed over almost fifty exciting ideas at the event. The prize, awarded by a jury from the city of Leipzig, recognises the public added value that the start-up aims to create for the city and its surroundings – now and in the future. Another prize was awarded by the competitors, who chose clever bioTechnologies, among others, as the start-up that has contributed most to creating a strong sense of community among the participants. SpinLab – The


**Fig. 8:** Award winner and founder Alberto Meola (left) and Simon Hellmann

HHL Accelerator provided the mentorship for the preparation, the event was organised by SMILE – the start-up initiative of the University of Leipzig.

**→ Further information:**
**www.cleverbiotech.de**

## DBFZ scientist Dr. Bettina Stolze receives bronze science award

The bronze science award, endowed with 1,000 euros, went to DBFZ scientist Dr. Bettina Stolze (“Thermo-chemical Conversion” Department) at the Biogas Innovation Congress 2024. Her topic was entitled “From waste material to catalyst to methane oxidation” and deals with oxidation catalysts for the reduction of methane in the exhaust gas of biogas CHP units. The basis or technical requirements for retrofitting an active oxidation catalyst that is also able to oxidise methane are already present at many CHP units. However, there is currently no catalyst available on the market that can reliably oxidise methane under these conditions. In the research project presented here (FKZ-Nr. 03EI5456), a catalyst based on biogenic silica is being developed that reduces the methane slip in the exhaust gas of biogas CHP plants to a minimum. This should ensure compliance with existing and future limit values for methane emissions and reduce overall methane emissions despite the expansion of renewable energies.


**Fig. 9:** Award winner Dr. Bettina Stolze




© Cosun Beet Company

**Fig. 10:** One of the three winning teams: “CAPitalize Leaves”

## DBFZ and UFZ scientists win innovation competition (Hackathon)

Which innovative ideas and methods can be used to turn the residues from sugar beet processing into starting materials for a wide range of new applications? An innovation competition (HACKATHON) organised by the Cosun Beet Company and WITENO GmbH under the title “Transforming Sugar Beet Residues from Waste to Value” aimed to find answers to this question. On 16–17 April 2024, a total of ten research teams competed against each other in Anklam. The task: to find innovative solutions for better utilisation of the by-products of sugar beet processing. The “CAPitalize Leaves” team, consisting of colleagues from the DBFZ and UFZ, was one of three winning teams of the HACKATHON with its presented Capraferm® process. The DBFZ team “Leaves-4Chem” was also among the selected ideas. The team’s idea focuses on the use of sugar beet leaves, which remain in the fields in large quantities during the harvest season, but which can be highly attractive for hydrothermal chemical production.

## DBFZ receives the “Young Entrepreneurs in Science Campus” certificate

In 2024, the DBFZ successfully acquired the “Young Entrepreneurs in Science Campus” certificate. It honours institutions that promote more entrepreneurial spirit in science and research. The basis for the award is the fulfilment of quality standards in the application and implementation of awareness-raising measures in cooperation with Young Entrepreneurs in Science. The certificate is valid for one year from the date of acquisi-

tion and can be extended by re-examining the commitment to start-up sensitisation by Young Entrepreneurs in Science. In addition, DBFZ colleagues Karen Deprie and Dr. Elena H. Angelova have successfully certified themselves as YES trainers and organised the YES workshop “The impact of your research” at the DBFZ as part of the Doctoral Colloquium BIOENERGY AND BIOBASED PRODUCTS.

## DBFZ is once again certified for work and family

On 18 June 2024, the DBFZ was once again awarded the “berufundfamilie” certificate for 2023 at a ceremony in Berlin. Anne Sehl, representing the DBFZ Quality Management, accepted the official certificate for the organisation. The award of the certificate attests that the DBFZ, as an employer, has successfully undergone the auditing process and developed company-specific goals and measures for designing and further developing a human resources policy that is aware of family and life phases. With the renewed certification, the DBFZ has reached the final stage of the audit (dialogue process).

→ **Further information:**
www.berufundfamilie.de/english-info


**Fig. 11:** The DBFZ has been awarded the “Young Entrepreneurs in Science Campus” certificate


© Jens Schicke/berufundfamilie Service GmbH

**Fig. 12:** DBFZ employee Anne Sehl (Quality Management) received the “beruf und familie” certificate in Berlin

## DBFZ spin-off “enaDyne” wins the 2024 Saxon Start-Up Award

Behind the young Leipzig-based start-up enaDyne GmbH is a team that includes four former DBFZ employees. The company has developed a process that uses wind or solar power to convert $CO_2$ and a hydrogen source in a special plasma reactor in a single step into fuel or platform chemicals. To scale up its activities, enaDyne GmbH has already secured a large grant from the Federal Agency for Disruptive Innovations (SPRIN-D). In addition, the team received the 2024 Saxon Founder’s Award on 19 June 2024. enaDyne GmbH used a DBFZ patent by licence in the pre-incorporation phase to further develop its technology and attract investors.

→ **Further information:**
www.enadyne.de/en/

**Fig. 13:** Successful Startup: enaDyne GmbH

# 4

# From research to practice: knowledge and technology transfer



**Ms Deprie, how would you define your role as transfer coordinator at the DBFZ?**

**KAREN DEPRIE:** Essentially, I support our scientists in ensuring that their findings and developments are received in society and especially in industry. In addition to the scientific fields, I work closely with the scientific management here, as it also involves cross-departmental and strategic issues. In addition, my work overlaps with many other areas, such as policy advice, science communication and research data management. My goal is quite simply formulated: research can only have an impact if the results are actually used!

**Before joining the DBFZ, you worked for the FNR project management agency, the Helmholtz Centre for Environmental Research in Leipzig and the Saxon State Ministry for Science and the Arts, among others. What have you been able to take from your previous positions for your current role?**

**KAREN DEPRIE:** At the FNR, I was responsible for participation in networks in the European research area. I applied for and managed one of these networks with 18 partners from 15 EU and associated countries as a coordinator. I benefit greatly from this time in terms of project initiation and coordination processes, both across the DBFZ and with external partners. At SMWK, too, my focus was on European cooperation, here, of course, from a Saxon perspective. Particularly in transfer projects, short distances between partners are a great advantage. Technical possibilities or not: personal dialogue is irreplaceable for trusting cooperation! From my work at UFZ, I have taken with me a great deal of knowledge about knowledge transfer and the administration of intellectual property rights, which I try to implement in a modified form at our comparatively small research institution.

**PROFILE**

**Karen Deprie** (born 1982) is a transfer coordinator at the DBFZ. After many years of working for the Agency for Renewable Resources – FNR (as an EU & International Officer), she worked at the Saxon State Ministry for Science and the Arts (SMWK) and most recently at the Leipzig Helmholtz Centre for Environmental Research – UFZ in the Knowledge and Technology Transfer Department (WTT). Karen Deprie has been working at the DBFZ as a knowledge and technology transfer coordinator in the Executive Support Team since March 2020. Her work focuses on the strategic and practical support of the transfer of R&D results to society and industry, business cooperation, intellectual property management and start-up support.


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**Fig. 14:** Transfer in Focus: Workshop on behalf of the SMWA for projects in the EFRE-/JTF-F&E-project funding

**The ways of thinking and working in science and business are very different. How easy or difficult is it to bring these worlds together?**

**KAREN DEPRIE:** The difficulties that sometimes arise and complicate or prevent the start of a collaboration often lie in the way people communicate and approach projects. In science, you should be passionate about a topic and, of course, examine it very intensively. The focus is on gaining knowledge. By contrast, a company is not necessarily interested in all the details or many different options. Here it is more important to quickly filter: What will it cost me, and conversely, what will I get out of it, or what are the risks, what resources do I need to plan for – and when? If you don't speak the same language, frustration quickly arises. That's why I try to provide support in initial discussions or inquiries – especially to colleagues who have not yet worked with companies. The goal here is to find a common language.

"Research can only have an impact if the results are actually used!"

**How can scientists learn at an early stage to publicise their research results and put them into practical use?**

**KAREN DEPRIE:** It is indeed a challenge to get everyone in the organisation excited about the topic of transfer. However, precisely because the DBFZ mainly conducts applied research, a practical focus is very important. At the working level, it is important to look at the transfer potential together as early as the project planning stage, to establish contacts and to check whether the planned R&D work fits the innovation needs of the industry and what social impact can be achieved. At the strategic level, it is also important that the topic of transfer is consistently demanded and supported not only internally but also by the project sponsors. In addition, it is extremely helpful for research associates when good examples of successful transfer are actively communicated as such. This motivates those involved, but also other employees. This is also why I have supported the Saxon State Prize for Transfer for several years as a member of the jury: this attention to a transfer service provided is a great opportunity.

**From your perspective, what are the most important criteria for a successful transfer service?**

**KAREN DEPRIE:** A typical scientific answer would be: it depends! There are many different forms of knowledge and technology transfer; "success" can look very different. Basically, I have "successfully transferred" if I have achieved a positive effect at the "recipient". From a societal perspective, that would be a change, for example, more sustainable behaviour in a particular target group. In terms of technology, it can mean that a better, for example, more environmentally friendly product is qualitatively better or cheaper than the conventional variant, or that a new process enables farmers to sell a residual material as a raw material, i. e. of higher quality. From my personal point of view, we at the DBFZ have successfully achieved a transfer when the cooperation has benefited both sides – the company has been able to use scientific findings for its business activities and we have used the practical experience of our partner to improve the quality of our research performance.

**In your opinion, what external conditions would have to be improved to favour the market transfer of bioeconomic innovations?**

**KAREN DEPRIE:** The legal framework is the big issue. After all, we want to close material cycles, and that means putting more and more of our previous residual and waste materials to use. Unfortunately, waste legislation – keyword "waste end property" – but also, for example, the Fertiliser Ordinance or standards in the construction sector, still stand in the way of this today. An increasing number of politicians are aware that changes are needed here, but unfortunately the wheels of change turn slowly.

**What role does research funding play in market transfer?**

**KAREN DEPRIE:** Actually, it plays several roles! First of all, public funding enables us as a research institution to advance a topic independently of the interests of individual companies, a topic whose potential is not yet clearly tangible or that carries a high risk of failure. When it comes to funding collaborative projects, we are then closer to the market, with companies contributing their own resources and also committing their own personnel. Special transfer funding instruments, with which small and medium-sized companies are financially supported in acquiring technical knowledge, property rights or scientific advice from a research institution, can also be important for small companies. For the DBFZ, validation funding is also an exciting prospect when it comes to technical innovations. It closes a gap between a successful research project and commercialisation by enabling the testing of fields of application and markets, scalability or the construction of a demonstrator.

**Can you give us an example of a particularly innovative or exciting knowledge or technology transfer that you have been involved with?**

**KAREN DEPRIE:** Most projects are exciting when you start looking at the topic and background of the research work. With a view to the transfer idea, the series of events "Bioökonomiewerkstatt Sachsen" was very

“At the strategic level, it is important that the topic of transfer is not only consistently demanded and supported in-house, but also by the project sponsors.”

interesting. Here, in a total of six events, we were able to bring together people from science and industry in a relaxed atmosphere to exchange experiences across sectors on topics such as “digital models”, “circular economy and nutrient recycling” and “hemp fibres”. Another specific research and development project is the “HanfNRG” project, in which the energy utilisation options of residual materials from hemp processing are being investigated for exemplary integration into the energy concept of a hemp fibre factory. (More on this from page 103).

**What added value does the DBFZ offer for partners from industry?**

**KAREN DEPRIE:** The DBFZ conducts applied research and development for the integrated material and energy use of biomass, i. e. its integration into an overall system of renewable energies and as the basis of a bioeconomy. To this end, we operate a large number of technical facilities that can also be used in cooperation projects. In addition, we at the DBFZ not only have state-of-the-art technical equipment but also the corresponding expertise. This is very attractive for companies, as they do not have to set up the corresponding specialised infrastructure and personnel for research themselves. The concentration of various pilot plants and laboratories in the field of biomass, in particular pilot-scale plants, is certainly unique in Germany, if not in all of Europe.

**Can interested parties also access the DBFZ’s R&D networks as part of a project collaboration?**

**KAREN DEPRIE:** JYes, of course. For example, if companies want to use research to map a specific agricultural value chain and cultivation or harvesting experiments or plant breeding are an issue, we work together with other research institutions within the BMEL. We also have strong partners for other renewable energy sources or certain basic research.

**Another aspect of your work is start-up advice. How do you support scientists with possible start-up ideas?**

**KAREN DEPRIE:** We have many very talented employees with exciting research topics at the DBFZ. Some have the desire to further develop and put into practice the results of their long work themselves. However, some lack knowledge, networks and contacts in the business world. My aim in providing advice is to support and assist staff in planning the commercial exploitation of their research results at an early stage. This may mean that the DBFZ registers the relevant intellectual property rights, which can be licensed to a later start-up. However, the DBFZ is also a partner in the Falling Walls Foundation’s Young Entrepreneurs in Science (YES) network, through which we offer various training courses for those interested in setting up



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**Fig. 15:** Transfer workshop for the SMWA: participants work on their own project ideas

their own business. We run such workshops, e.g. on design thinking, pitch training or social entrepreneurship, ourselves or in cooperation with other YES partners. After a successful start-up, there is the possibility of renting laboratory and office space from us. And finally, through the network, I can provide further support to other institutions, e. g. the Saxon Start-up Network, SpinLab or FutureSAX.

**What was your personal highlight in 2024?**

**KAREN DEPRIE:** One disadvantage of transfer activities is that it is often difficult to measure success. So, of course, I am all the more pleased when the work bears visible fruit. Two current examples of such visible transfer successes are the spin-offs EnaDyne, which received the coveted Saxon State Prize for Founders in 2024, and our latest start-up project, “clever bioTechnologies”, an idea from two very committed colleagues of the biochemical conversion department, which won first place at the Leipzig Start-Up Night in 2024. This is, of course, fantastic, and I hope that both teams continue to be as successful.

**Thanks for the interview.**

→ **Further information:**
www.dbfz.de/en/services/research-with-companies
www.dbfz.de/en/research/research-infrastructure
www.dbfz.de/en/research/rd-networks

# 5

# Policy advice



Advising the German government on issues related to biomass utilisation is one of the DBFZ's core tasks. As a scientific institution, the DBFZ strives to make research results available to all interested political stakeholders. This effort was intensified in 2024 by expanding proactive consultations. In recent years, the DBFZ has further intensified its services for political decision-makers in ministries and parliaments, as well as for the professional public. These took the form of scientific statements, background or discussion papers, (short) studies on current political processes, as well as lectures and expert discussions.

## Key areas of policy advice in 2024

The advisory services provided during the development of the National Biomass Strategy (NABIS) in 2023 and at the beginning of 2024 led to increased attention being paid to the topic of wood energy. This complex of topics is not only the subject of heated debate in scientific circles, but is also having an impact in many areas of application. In addition to informing other stakeholders and communicating data, the focus here is on moderating different perspectives when considering sustainability. Since wood as a biomass binds carbon through natural processes and releases it again during decomposition or (energetic) use, the time horizon plays a crucial

**Fig. 16:** Hearing on the topic "Future prospects for bioenergy" with Dr. Peter Kornatz (left)

role in the considerations. Different positions and perspectives on this issue need to be condensed into common positions through argumentation.

At the online event “Sustainable Wood Energy” on 24 January 2024, the central contents of a current discussion paper by the DBFZ on this question were presented. Afterwards, other representatives from the scientific community had their say, highlighting selected aspects of the topic in 10-minute short contributions. The event was supplemented by the assessments of associations.

On 15 May 2024, Dr. Peter Kornatz (Head of the Biochemical Conversion Department) accepted an official invitation to speak to the German Bundestag’s Committee on Climate Protection and Energy on the topic of “Future prospects for bioenergy” as a biogas expert at the DBFZ. The basis for this was a motion by the CDU/CSU parliamentary group. In it, the members of parliament call on the federal government to give bioenergy a clear perspective for the future and to reduce barriers. In his statement, Dr. Peter Kornatz referred to the EU’s plans. As part of Repower EU, the EU wants to increase the production of biomethane to 35 billion cubic meters per year by 2030. While the expansion of biomethane plants is only progressing slowly in Germany, the expansion is being pursued more consistently in Denmark, France and the Scandinavian countries, for example, according to Kornatz.

The range of further advisory services highlights the diverse material and energetic utilisation options of biomass. The following are examples of some of the key messages in response to enquiries from political circles:

_ **Prioritisation of biomass in areas with difficult defossilisation opportunities:** The DBFZ recommends prioritising the use of biomass in the heating sector in areas with difficult defossilisation opportunities, such as industrial heating.

_ **Hybrid solutions in the building sector:** Biomass can continue to play a role in the building sector, especially in combination with other heating solutions such as heat pumps (so-called hybrid solutions).

_ **The importance of energy-related wood use:** The DBFZ considers a transformation towards a multifunctional role for wood-based energy sources to be necessary. Blanket financial subsidies for wood energy are contrary to sustainable use and do not adequately reflect the complex and highly context-dependent climate effects of energy-related wood use. The DBFZ therefore recommends an orientation of use according to the criterion of “qualified climate protection efficiency”, as well as a $CO_2$ price on biogenic wood emissions and a financial reward for carbon stores.

_ **Crediting green hydrogen in transport:** The DBFZ recommends crediting green hydrogen in transport to promote the use of this technology and thus contribute to the decarbonisation of the transport sector.

_ **Cost analyses for maximum bid values:** The DBFZ has conducted cost analyses as part of the debate on increasing remuneration (maximum bid values) and recommends incorporating them into political decision-making.

_ **Reduction of methane emissions from animal excrement:** The DBFZ recommends measures to reduce methane emissions from animal excrement in order to advance climate protection and at the same time improve the sustainability of animal husbandry.



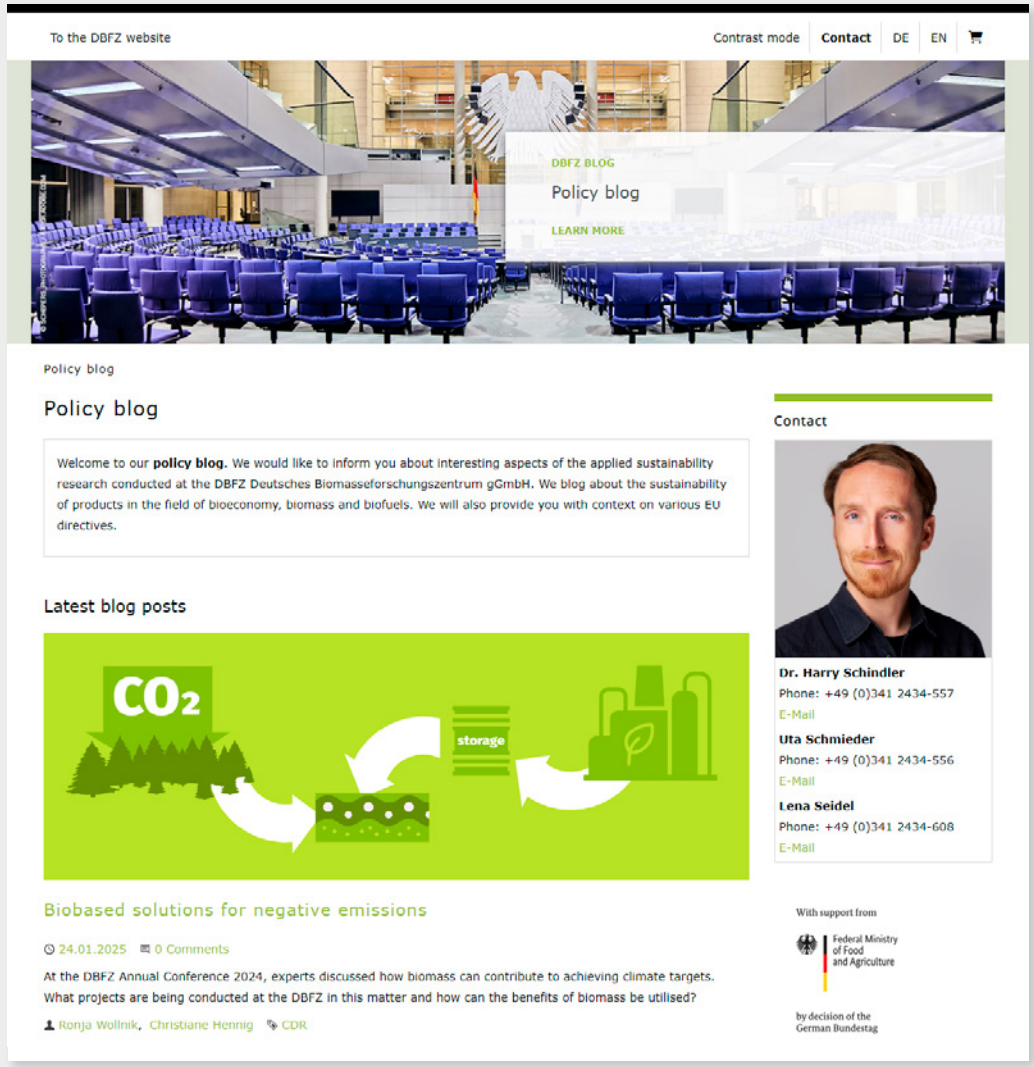


**Abb. 17:** New DBFZ policy blog

In order to make the policy-relevant research content accessible to a wider range of interested parties, in 2024, in addition to the advisory activities, work was carried out on the publication of a blog. Politically relevant results from DBFZ projects, as well as background information and statements, are prepared and categorised politically here. The blog complements the policy advice services with a modern and low-threshold information platform.

→ **www.dbfz.de/en/policy-blog**

_ **Electricity price brake:** The DBFZ recommends measures to reduce the burden on consumers caused by high electricity prices, without, however, unduly restricting the promotion of renewable energies.

_ **Biochar:** The DBFZ recommends measures to promote the use of biochar in agriculture to advance climate protection while improving soil quality.

These recommendations reflect the range of the DBFZ's consulting activities and underscore its commitment to a sustainable energy transition in Germany.

## Overview of services

_ Scientific support for legislative and administrative law-making procedures
_ Support for political strategy development in the field of bioenergy/biomass strategy
_ Monitoring and impact assessment
_ Analysis of the climate, energy, environmental and research policy
_ framework conditions of the bioeconomy

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www.dbfz.de/en/press-media-library/more-publishments/statements-studies

6

# Project co-operations (EU and national)

Through close research cooperation with numerous partners from science, industry and society, the DBFZ was able to further expand its position as a leading national research institution in the field of energy and integrated material use of biomass in the past year. In 2024, well over 100 research projects were conducted in collaboration with scientific institutions. The share of collaborations with partners from industry was around 25 per cent. This annual report provides an overview of all projects conducted in 2024, starting on page 138.

The DBFZ is actively involved in committee work and is expanding its scientific networks as part of 35 EU project collaborations (FP7/Horizon2020/HEU) with over 350 partners or as an active member and national team leader in leading international research networks, the IEA Energy Technology Collaboration Programme, the European Energy Research Alliance (EERA) and the European Technology and Innovation Platform Bioenergy (ETIP Bioenergy), the DBFZ is actively involved in committee work and continues to expand its scientific networks at national and international level. An overview of the extensive committee and network activities can be found in this annual report from page 116.

**Tab. 1:** Main partners of EU cooperation (number per country/region)

| Research partners at EU level | Share |
|---|---|
| Private-for-profit organisations (industry, SMEs) | 35 % |
| Research institutions | 21 % |
| Colleges and universities | 18 % |
| other (associations, agencies, networks) | 18 % |
| Public-sector organisations (public administration) | 8 % |
| **Funding for the DBFZ:** | **11.7 million EUR** |

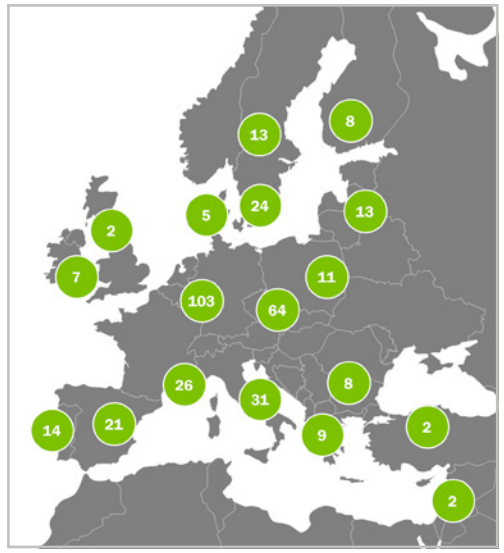


**Fig. 18:** International co-operation at EU level

→ **Interactive overview of EU projects managed by the DBFZ:**
https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/how-to-participate/org-details/998003222?isExactMatch=true&keywords=dbfz

# 7

# Selected references from the research focus areas



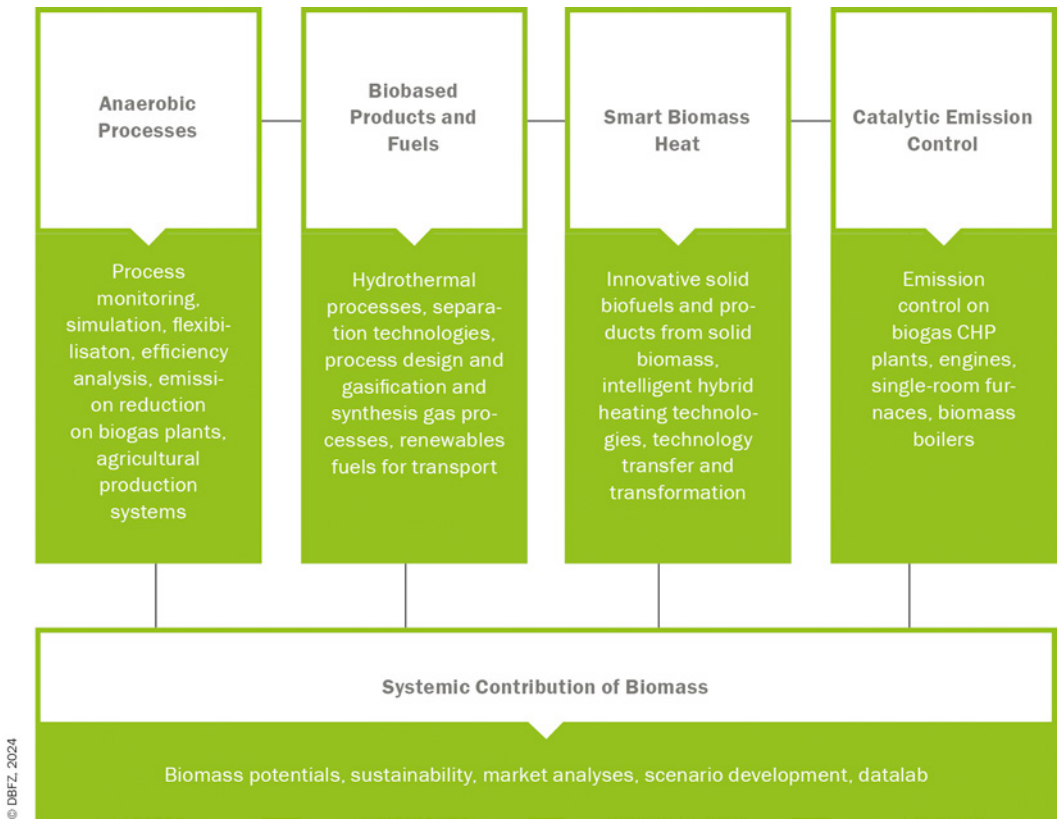


**Fig. 19:** The five research focus areas of the DBFZ

A large number of different research projects in the field of energy-related and integrated material use of biomass were successfully completed in 2024. Key research topics are being addressed at the DBFZ in five research focus areas. They ensure that important aspects of bioenergy and bioeconomics can be modelled in the depth necessary for excellent research. The DBFZ's research focus areas are aligned with current and future research policy challenges and frameworks (e. g. the National Bioeconomy Strategy, the Mobility and Fuels Strategy, the EU Green Deal and a future National Biomass Strategy). The funding policy framework, the unique selling points in the research landscape and the excellent research infrastructure of the DBFZ are also important cornerstones for the scientific orientation of the research focus areas.

→ **Further information:**
**www.dbfz.de/en/research/research-focus-areas**

# 7.1 Development of a systematic monitoring of the bioeconomy – Mobi II

"Bioeconomy becomes an even more sustainable 'circular bioeconomy' by utilising biogenic waste and residues to produce bio-based products and generate bioenergy. To do so, economic planning needs to know how much of the resource is available. The 'Biomassemonitor' developed in the 'Monitoring of the Bioeconomy II' project supports decision processes involving the national resource base of biogenic waste residues and by-products. The Biomass Monitor helps to develop ideas on how we can make even better use of our 'bio' waste for the benefit of us all."

**Dr. Burkhard Wilske**
Project manager

## MoBi II – Development of a systematic monitoring of the bioeconomy – consolidation phase; sub-project 2: update of residual material monitoring

The MoBi II project (FKZ: 2221NR062B) is a joint project with the three Thünen Institutes for International Forestry, Market Analysis and Sea Fisheries, which is funded by the Federal Ministry of Food and Agriculture. The aim is to further develop and supplement the concept for quantifying the biobased resource base developed during the first phase of the establishment of a systematic bioeconomy monitoring system. This includes linking waste, residues (e.g. municipal waste, sewage sludge, industrial residues from the food industry, biotechnology, biofuel production) and by-products more closely with the material flows of agriculture, forestry and fisheries in order to be able to make statements about the level of potential and existing uses. Likewise, the data structures of the 77 biomasses in the DBFZ resource database are being updated with time series from 2010 to 2020. The results are available as an **open source application** and are incorporated into the **bioeconomy monitoring**.

**KEYWORDS**

secondary biomass
biomass potential
DBFZ biomass monitor
time series analysis
bioeconomy



**Fig. 20:** Biogenic secondary resources from the municipal waste sector prior to material/energetic utilisation

The bioeconomy is considered a central field of the future and innovation that can reconcile ecological and economic developments. At the same time, the bioeconomy is associated with fundamental challenges, for example, how we regulate, use and extract resources, and how we use, trade, consume and recycle these resources in the economy. Since the beginning of the first pilot phase, political and social understanding of the bioeconomy has evolved. This is reflected, on the one hand, in updated political strategy papers at the German and EU level. On the other hand, it is also reflected in a growing number of new bio-based products and value chains. This development is becoming visible in, fo example, changing bio-based material flows. Accordingly, the continuous recording of biomass resources and the evaluation of their use in material production and energy generation is a key functional component to achieve a sustainable bioeconomy.

### Methods

In the predecessor project *AG BioRestMon* (FKZ: 22019215), the DBFZ developed and implemented a cross-sectoral monitoring system for biogenic residues, by-products and waste for the reference year 2015. The 77 biomasses included in the system represent the totality of biogenic waste, residues

and by-products in Germany. [2, 3] The origin of the residual biomass is distributed across five sectors: agricultural by-products, wood and forestry by-products, municipal waste and sewage sludge, industrial residues and residues from other areas. A total of ten potential levels are identified for the aggregated biomasses. The calculation of the potential of the individual secondary biomasses is based on the primary biomass, on the coupling of static residue factors and a dynamic dimension. The static calculation elements contain information on the proportions of the primary biomass that arise on average during harvesting, processing into a product or product consumption as biogenic waste, residue or by-product. The dynamic dimension indicates, in simplified terms, the factor to which the residue factor is to be applied, e.g. acreage, number of animals or even product or consumption quantity. This initially yields the theoretical potential (1). Combining the theoretical potential with the recovery rate, for example, yields both the *non-usable potential* (2) and the *usable technical potential* (3). The technical potential is in turn divided into the *used technical potential* (4) and the unused or *mobilisable potential* (5). In practice, a corrective potential for data situation unclear (6) may also occur. In the area of the utilised potential, a distinction is made between the potential for material use (7) and the potential for energy use (8). However, the data situation also requires the potential level for material or energy use (9), which describes, for example, combined use. On the utilisation side, there is also a need for the corrective potential of non-differentiating utilisation (10) if it is unclear which utilisation is involved. By calculating the upper and lower limits of the potential, or the minimum and maximum, ranges are indicated, although the comparison of different potentials is usually communicated in the form of mean values.

The update of the residual material monitoring that was based on this included, on the one hand, the recording and addition of biomass potential for the period from 2010 to 2020. On the other hand, a series of modifications were made within the calculations. For example, when calculating the biomass potential of “cattle slurry”, the form of husbandry, which was previously only taken into account in the technical potential, has now been integrated into the theoretical potential. Furthermore, the animal-specific calculation of the potentials for the manure factor, dry matter content, grazing time and form of husbandry was revised and updated. Further methodological adjustments were made for wood and forestry by-products, cereal straw and fish processing residues. These are presented in the final report of the DBFZ, which will be published shortly.

## Results

The theoretical biomass potential from biogenic waste, residual materials and by-products in 2020 is on average 208.7 million tonnes of dry matter (Mt DM), as shown in Figure 21, and has decreased by 4.3 Mt DM compared to the previous reference year 2015. This national potential of secondary biomass contrasts with the overall increase

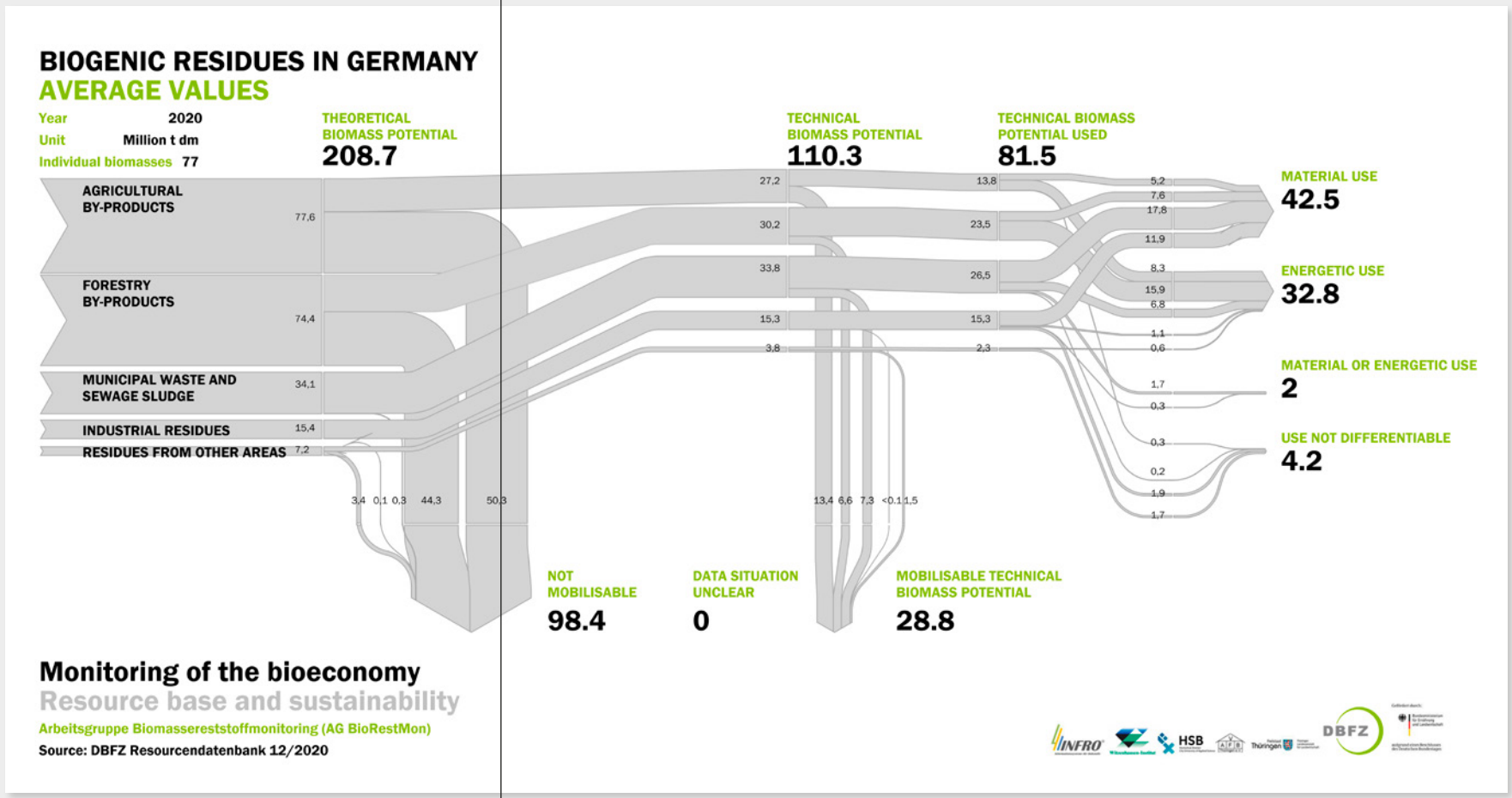


**Fig. 21:** Total material flow of the national potential of biogenic secondary resources in 2020. Imports are not included. Potentials are shown as mean values in million tonnes of dry matter [Mt DM].

in demand for biogenic carbon sources, including waste, residues and by-products.

However, a closer look reveals untapped potential that could be mobilised. For example, a little less than half (98.4 Mt TM or 47 %) of the theoretical potential is shown as non-mobilisable potential for 2020 due to technical and/or ecological assumptions (including recovery rates and humus balance assumptions). If the use of bioenergy carriers (e. g. anaerobic digestion) allows the recycling of digestate, much higher extraction rates of agricultural residues are possible [4, 5, 6].

In 2020, a biogenic secondary resource of 110.3 Mt DM on average is available to the bioeconomy as technical potential. This means that the technical potential has decreased by 2.4 Mt DM compared to 2015. However, the decrease is not uniform (Figure 22, black figures for technical biomass potential).

The ranking of sectoral contributions to the technical potential changed between 2015 and 2020: municipal waste and sewage sludge continued to make the largest contribution with 33.8 Mt DM in 2020 (Figure 22, white figures for the technical potential of the sectors). The area of wood and forestry by-products has moved up from third to second place with 30.2 Mt DM in 2020. By contrast, agricultural by-products have fallen back from second to third place with 27.2 Mt DM in 2020. Ranks four and five are still occupied by industrial residues and residues from other areas, respectively. The largest decreases were recorded in the agricultural by-products (–3.3 Mt DM) and industrial residues (–0.4 Mt DM) sectors. The technical potential of wood and forestry by-products is the only one to have increased, rising by 1.4 Mt DM compared to 2015 to 30.2 Mt DM.

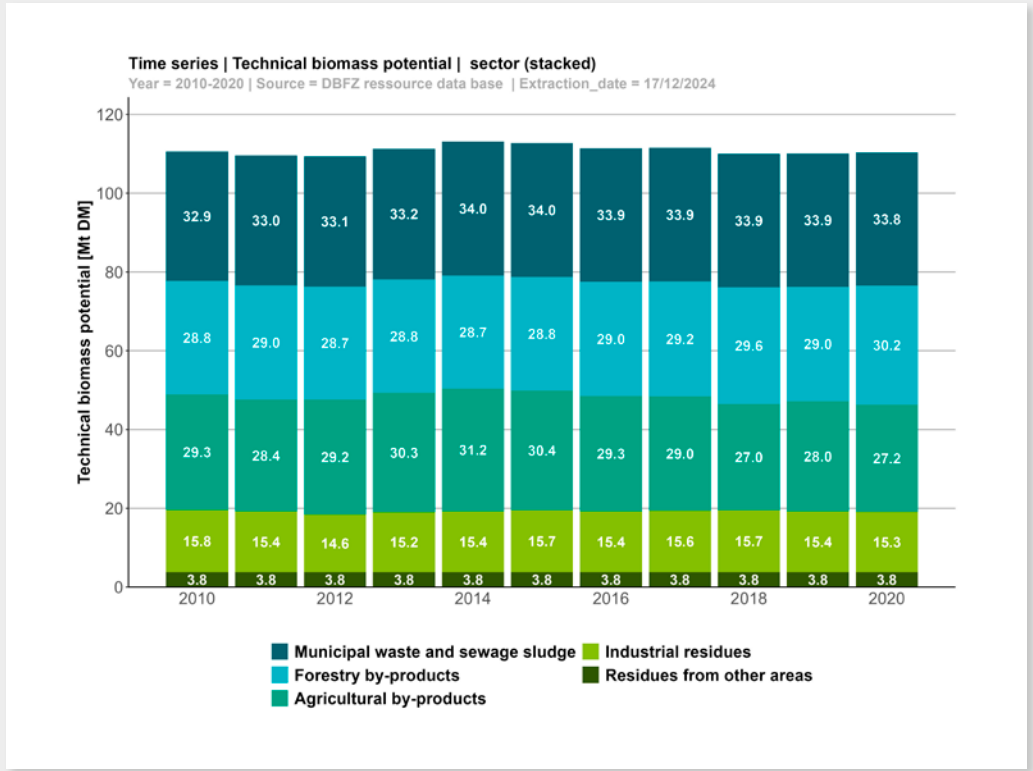




**Fig. 22:** Technical potential of biogenic waste, residues and by-products and its sectoral composition in the monitoring period 2010–2020 (technical biomass potential: black numbers on the columns, sectoral potential: white numbers in the column compartments)



In both 2015 and 2020, six biomasses contribute more than 80 per cent to the average mobilisable technical potential. These biomasses and their average contributions (2020 vs. 2015) are green waste (20 vs. 15 %), cereal straw (16 vs. 20 %), forest residues from coniferous forests (16 vs. 12 %), cattle dung (14 vs. 18 %), cattle slurry (13 vs. 17 %), and forest residues from deciduous forests (7 vs. 5 %).

Of the technical potential, 74 % was used in 2020, leaving 26 % or 28.8 Mt TM of mobilisable potential untapped. On the utilisation side, the technical potential is essentially divided between material and energy use. Material use in 2020 is 42.5 Mt DM, which is 2.0 Mt DM less than in 2015. In contrast, energy use is 32.8 Mt DM, which is a slight increase of 0.4 Mt DM compared to 2015.

## Perspectives

On the basis of the significantly expanded biomass potential data in the resource database, it seems unlikely that the growing bioeconomy will be able to rely on a massively increasing technical potential of biogenic secondary resources. However, regulatory requirements for existing and future sustainability criteria can significantly influence the usability of biomass potentials. Three options are recommended to meet the growing demand for resources:

1. Policy should create a technical and, above all, regulatory framework that makes it possible to leverage a larger share of the potential that can be mobilised.

2. Improving the regulatory framework to further promote the development of higher-value uses and cascading use.

3. A permanent monitoring system with transparent data structures is needed to ensure the long-term data quality and informative value of biomass potential and its use.

In an increasingly circular bioeconomy, there will be greater fluctuations, depending on the type of use, particularly with regard to technical potential. Estimates of potential must therefore be made less linearly and more in terms of scenarios (development of use). This enables more precise monitoring that better supports the importance of the bioeconomy for overall economic development and political decisions in the field of the bioeconomy.

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**PROJECT PROFILE**

**Duration:**
01/11/2021–31/01/2025

**Scientific contact:**
Dr. Burkhard Wilske,
Karl-Friedrich Cyffka

**Project number:**
2221NR062B

**Project partner:**
Thünen Institute of
International Forestry;
Thünen Institute of Market Analysis;
Thünen Institute of Sea Fisheries

**Funding body:**
Federal Ministry of
Food and Agriculture

With support from

Federal Ministry of Food and Agriculture

by decision of the German Bundestag



EINBLICK

## Resource database

The DBFZ resource database is presented in the video. DBFZ scientist Dr. Friederike Naegeli de Torres explains how the database works and what problem it can solve.

→ **Further information:**
**https://youtu.be/6s1Ca5I-1w8?feature=shared**
**https://datalab.dbfz.de/resdb/potentials?lang=en**
**www.dbfz.de/en/resource-database**


## Research focus area “Systemic Contribution of Biomass”

The research focus area “Systemic Contribution of Biomass” is intended to contribute to the development of sustainable bioenergy strategies at national and international level. To this end, regionally and globally available biomass potentials are determined and the diverse options of different biomass utilisation concepts are considered and evaluated. The overarching goal of this research focus is to answer methodological and system-related questions regarding the efficiency and sustainability of biomass use from an economic, ecological and technical point of view, taking into account both the land resources used and the energy source-specific processing and conversion technologies. The combination of these topics provides the basis for deriving strategies and recommendations for decision-makers in politics and business.



## Important reference projects and publications

**Project:** Bio2x – Metaanalyse zu nachhaltigen Biomassepotenzialen für die Mineralölwirtschaft, Market project, 01.06.2023–31.12.2023

**Project:** BioNET – Biomassebasierte Negativ-Emissions-Technologien, Federal Ministry of Education and Research, 01.01.2022–31.12.2024 (FKZ: 01LS2107B)

**Project:** HURRICAN – Sector-coupling hub for circular use of thermal and industrial waste, European Commission, 01.01.2024–31.12.2028 (GA: 101138494)

**Project:** ScrAIbe – Unterprojekt Umsetzung der Maßnahme “KI- und Daten-Akzelerator”, Federal Ministry of Food and Agriculture, 01.03.2022–31.12.2025

**Project:** SUSTRACK – Supporting the identification of policy priorities and recommendations for designing a sustainable track towards circular bio-based systems, European Commission, 01.11.2022–31.10.2025 (GA: 101081823)

**Publication:** Brödner, R.; Fürst, K. (2024). “A case study of the regional bioeconomy in Central Germany: Construction with renewable resources”. *Discover Civil Engineering* (ISSN: 2948-1546), Nr. 1. DOI: 10.1007/s44290-024-00082-y.

**Publication:** Günther, S.; Karras, T.; Naegeli de Torres, F.; Semella, S.; Thrän, D. (2024). “Temporal and spatial mapping of theoretical biomass potential across the European Union”. *ESSD* (ISSN: 1866-3516), Vol. 16, Nr. 1. S. 59–74. DOI: 10.5194/essd-16-59-2024.

**Publication:** Meisel, K.; Jordan, M.; Dotzauer, M.; Schröder, J.; Lenz, V.; Naumann, K.; Cyffka, K.-F.; Dögnitz, N.; Schindler, H.; Daniel-Gromke, J.; Paiva, G. C. de; Schmid, C.; Szarka, N.; Majer, S.; Müller-Langer, F.; Thrän, D. (2024). “Quo Vadis, Biomass?: Long-Term Scenarios of an Optimal Energetic Use of Biomass for the German Energy Transition”. *International Journal of Energy Research* (ISSN: 0363-907X), Vol. 14, Nr. 1. DOI: 10.1155/2024/6687376.

**Publication:** Richter, S.; Szarka, N.; Bezama, A.; Thrän, D. (2025). “Enhancing the circular bioeconomy transition in Germany: A systematic scenario analysis”. *Sustainable Production and Consumption*, Vol. 53. S. 125–146. DOI: 10.1016/j.spc.2024.12.004.

**Publication:** Wollnik, R.; Borchers, M.; Seibert, R.; Abel, S.; Herrmann, P.; Elsasser, P.; Hildebrandt, J.; Meisel, K.; Hofmann, P.; Radtke, K. S.; Selig, M.; Kazmin, S.; Szarka, N.; Thrän, D. (2024). “Dynamics of bio-based carbon dioxide removal in Germany”. *Scientific reports* (ISSN: 2045-2322), Nr. 14. DOI: 10.1038/s41598-024-71017-x.

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# 7.2 Emission reduction in biogas processing, compression and injection – EmMinA

"Biogas is a key to sustainable energy supply – but methane leaks often go undetected. The EmMinA project is shedding light on the issue: using state-of-the-art measurement technology, 15 biogas processing plants across Germany were examined for methane emission sources using an optical gas imaging camera (qOGI camera). This technology not only enables the visualisation of methane leaks, but also their quantification – even in places that are difficult to access. The results could pave the way for making biogas even more climate-friendly."

**Lukas Knoll**
Project manager

## Emission reduction in biogas processing, compression and feed-in (EmMinA)

In biogas upgrading plants, raw biogas is processed by separating $CO_2$ and other unwanted components to obtain biomethane that can be fed into the natural gas grid. There are legal requirements stipulating that only a very small amount of methane may be present in the waste gas stream (the separated $CO_2$ stream) – a maximum of 0.2 %, according to the requirements of the Gas Network Access Ordinance (GasNZV) and the Technical Instructions on Air Quality Control (TA Luft). Therefore, some processing technologies such as pressure swing adsorption (PSA), pressurised water scrubbing (DWW) or membrane processes require additional post-treatment to achieve these values. Other processes, such as amine scrubbing, meet the limit values even without post-treatment.

**KEYWORDS**

Biogas
biogas treatment
methane emissions
regenerative thermal oxidation
qOGI gas camera

In recent years, methane losses have been reduced through improvements in the technologies. However, low methane concentrations in the exhaust gas and low volume flows place certain demands on post-treatment technology. To date, processing and injection have been little systematically investigated in terms of their emissions. The same applies to the efficiency of post-treatment technologies.

In the context of the further development of the biomethane sector, the objectives of the EmMinA joint project (FKZ: 2220NR151A/B) were to determine emissions from processing and post-treatment plants and to evaluate post-treatment technologies in terms of costs, energy efficiency, performance, emission reduction and operating experience. In addition, the methane oxidation filter (MOF) was evaluated as a technology for lean gas treatment that has been little used to date as an alternative to the previous methods for locations with lower volume flows. The task here was to assess the potential of the process for the range of applications and to evaluate it in terms of its suitability as a technical cleaning process with reliable degradation rates and a high level of operational safety.

The following questions were therefore considered with regard to the assessment of emissions:

_ Which technologies are available for after-treatment, what are their limitations and what costs are involved?
_ Can the limit values be met in practice with and without after-treatment?
_ How is the operation of the exhaust gas after-treatment integrated into the overall system and what is the energy requirement and, if applicable, the extraction of energy?
_ What other emissions, apart from methane slip, can occur as a result of the processing procedure during feed-in and processing?
_ What optimisation strategies are available and what measures can be taken to reduce emissions?
_ What options are available, particularly for small plants?
_ Does the methane oxidation filter represent an alternative for treating waste gases from small plants?

### Methods/measures

There are basically two methods for measuring methane emissions: the on-site method and the off-site method. The off-site method looks at the total emissions of a biogas plant. This involves measuring the methane concentrations in the surrounding area to calculate the emissions of the entire plant. Special methods such as the Inverse Dispersion Modelling Method (IDMM) and the Tracer Dispersion Method (TDM) are used for this. In contrast, the on-site method focuses on individual components of the plant to detect and measure emissions from those specific parts. The components examined include, among others, the biogas treatment plants (BGAA), open or non-gas-tight digestate storage facilities, leaks in gas lines, combined heat and power plants (CHP) or overpressure protection devices.

The on-site method was chosen for this project because it allows for a more precise recording of methane emissions from individual sources. In this method, all identifiable emission sources of the respective component of the biogas plant are individually analysed, quantified using special measurement methods and finally added up to an overall emission. Since only a limited section of each emission source can be displayed at a time, the consistency of the methane


**Fig. 23:** Detection and quantification of methane emissions using a q-OGI gas imaging camera at a pressure relief device

emissions is assumed. Depending on the type of source (point/area source, guided/diffuse, time- and/or operation-dependent), different individual methods must be used for quantification.

## Milestones/challenges

Quantifying emission sources has so far been extremely time-consuming, as each source had to be individually enclosed and quantified using adapted film tunnels. In this project, an optical gas imaging camera with quantification function (qOGI camera) was used for the first time to measure methane emission rates. This technology makes it possible to detect and quantify emission sources even in places that are difficult to access.

In order to verify the accuracy of the qOGI camera “Mileva 33” from SENSIA under real conditions, a method comparison was carried out. For this purpose, a methane source was examined at the A03 facility using both the qOGI camera and the dynamic chamber method . The leakage was not a leakage in the classical sense, but the ducted exhaust air from the gas analysis of the biogas processing container. The leakage was enclosed and ventilated with a constant air flow using a blower. The flow velocity of the air flow was measured with a vane anemometer (TESTO 416), while the methane concentration in the exhaust air was analysed. For this purpose, five gas samples were transferred into evacuated vials and analysed in the laboratory using a gas chromatograph (GC). The emission rates were determined at two different volume flows (45 and 90 $m^3/h$).

The dynamic chamber method yielded an average emission mass flow of 73.35 $gCH_4/h$. By comparison, the Mileva 33 yielded an average emission mass flow of 75.17 ± 33 $gCH_4/h$ (n = 8). The deviation between the two methods was only 2.5 %, which confirms the suitability of the qOGI camera for quantifying methane emissions under real-life conditions.

Of the 77 leaks detected, 46 were quantified using the qOGI gas camera. The average emission rate at the biogas plants was 354 g/h, and at the biogas treatment plants, it was about half that at 157 g/h. The highest emission rates measured at the biogas plants were found at a double-membrane seal of a foil roof with 2354 g/h. A pressure relief valve showed emission rates of 893 g/h, while a leaking pipe penetration had an emission



**Fig. 24:** Exhaust gas analyser

rate of 611 g/h. The lowest emission rate measured was 30 g/h for a substrate feed screw of a digester. In comparison, the emission rates of the quantified leaks at the BGAA were relatively low. The highest emission rate was measured at a compressor with 562 g/h, while the lowest was measured at a valve with 30 g/h.

The measurements show significant differences in the emission rates, which vary depending on the type of leakage. In Figure 25, eight leaks detected at different biogas plants are shown in order of their emission rate.

## Perspectives

The reduction of methane slip can be achieved by various approaches.

One particularly promising approach is $CO_2$ processing and recirculation of waste gases into the raw gas. This process forms a closed system and thus theoretically enables operation without emissions. However, both the technical effort and the energy consumption are considerable. The reduction of emissions is more of an additional effect here, since the main goal is the extraction of $CO_2$ as a product. If a market with attractive prices for renewable $CO_2$ is established in the future, this method could quickly become economically viable.

Another approach is the post-combustion of exhaust gases. The continuous development of processing technologies for ever lower slip has led to the fact that only regenerative thermal oxidation (RTO) is currently considered for the post-treatment of exhaust gases from biomethane processing. Most existing RTO systems do not yet have a heat extraction system, but this is possible in principle. In combination with membrane processes, the RTO can be optimised so that the heat generated in the oxidation process can be extracted and used to supply heat to the biogas plant.

Another approach, which according to the specialist literature and on the basis of extensive studies of a methane oxidation filter is demonstrably feasible, is the biological oxidation of lean gases. However, the current use of the process does not yet provide any reliable guarantees for clearly defined levels of degradation. There is therefore still a need for research into crucial process parameters

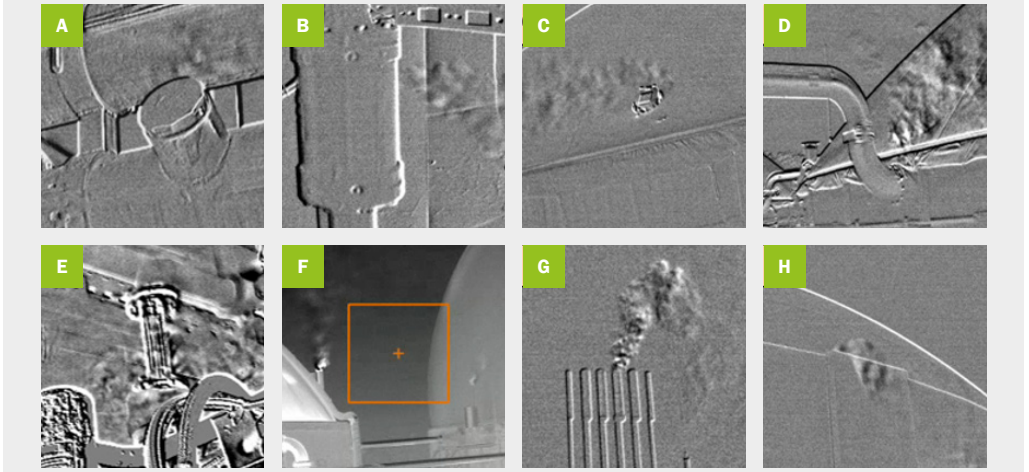


**Fig. 25:** Visualisation of various leaks using an OGI gas camera: A) screw connection; B) pneumatic slide valve; C) supporting air double membrane gas holder; D) pipe penetration; E) compressor; F) over- and under-pressure protection; G) blow-out and H) leak in the foil roof connection

and the development of an effective process control.

The project results clearly show the important role of exhaust gas treatment in significantly reducing greenhouse gas emissions during biogas processing. Furthermore, the results emphasise the necessity of regular leak detection and repair (LDAR) programmes that enable the identification and timely repair of leaks. These programmes not only increase the efficiency of biogas production processes, but also minimise environmental pollution by reducing unwanted emissions. The consistent implementation of such measures thus promotes more sustainable and environmentally friendly energy production.

**→ Further information:**

Final report EmMinA
**www.fnr.de/fileadmin/projektdatenbank/2220NR151B.pdf**

IEA brochure “Reduction of methane emissions from biogas systems and landfills”
**https://task37.ieabioenergy.com/technical-reports/reduction-of-methane-emissions-from-biogas/**



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**PROJECT PROFILE**

**Duration:**
01/09/2021–31/08/2024

**Status:**
completed,
utilisation of project results
2024/2025

**Project partner:**
Rytec GmbH

**Scientific contact:**
Lukas Knoll

**Project number:**
2220NR151A/B

**Funding body:**
Federal Ministry
of Food and Agriculture

With support from

Federal Ministry of Food and Agriculture

by decision of the German Bundestag

## Research focus area “Anaerobic Processes”

Microbial processes of biomass conversion under anaerobic conditions are the basis for a multitude of biotechnological processes for the provision of energy sources and materials used as raw materials. In the research area “Anaerobic Processes”, efficient and flexible processes for the production of biogas are developed with priority for the requirements of the future energy system.

A higher added value is achieved by coupling to processes for material utilisation. In the research focus, tools for process monitoring and control, concepts for flexible, low-emission plants and operating regimes, methods for evaluating and optimising efficiency, and processes for maximising material conversion, particularly for difficult substrates, are being developed.



## Important reference projects and publications:

**Project:** AGEEstat – Wissenschaftliche Analysen zu ausgewählten Aspekten der Statistik erneuerbarer Energien und zur Unterstützung der Arbeitsgruppe Erneuerbare Energien Statistik, Market project, 01.04.2019–15.10.2024

**Project:** AntbioHK – Auswirkungen des verstärkten Einsatzes von Geflügelexkrementen in BGA auf die Belastung der Gärreste mit Antibiotika, Federal Ministry of Food and Agriculture, 01.05.2022–30.11.2024 (FKZ: 2221WD002A)

**Project:** BioSim – Nachwuchsforschergruppe zur modellbasierten Zustandsüberwachung und Prozessführung an Biogasanlagen, Federal Ministry of Food and Agriculture, 01.11.2020–31.12.2025 (FKZ: 2219NR333)

**Project:** E-Boot II – Entwicklung einer Ernteprozesskette mit Erntetechnologie zur umweltschonenden Ernte von Wasserpflanzen, Federal Ministry of Education and Research, 01.08.2021–30.07.2024 (FKZ: 031B1095)

**Project:** Sargasso – Sargassum utilization and treatment in the Carribean, Market project, 22.05.2024–15.01.2025

**Publication:** Dzofou Ngoumelah, D.; Heggeset, T. M. B.; Haugen, T.; Sulheim, S.; Wentzel, A.; Harnisch, F.; Kretzschmar, J. (2024). “Effect of model methanogens on the electrochemical activity, stability, and microbial community structure of Geobacter spp. dominated biofilm anodes”. *NPJ biofilms and microbiomes* (ISSN: 2055-5008), Nr. 10. DOI: 10.1038/s41522-024-00490-z.

**Publication:** Engler, N.; van Looveren, L.; Zschätzsch, M.; Hayn, K.; Thurau, J. L.; Flechsig, A.; Werner, A. Forschungsprojekt BiberZym: typische Nahrung und Einblicke in das Verdauungssystem des Eurasischen Bibers. In: Contributions to hunting and game research. S. 271–283.

**Publication:** Hellmann, S.; Wilms, T.; Streif, S.; Weinrich, S. (2024). Comparison of Unscented Kalman Filter Design for Agricultural Anaerobic Digestion Model. In: 2024 European Control Conference (ECC). Piscataway, NJ (USA): IEEE. ISBN: 978-3-907144-10-7. S. 1729–1735. DOI: 10.23919/ECC64448.2024.10591126.

**Publication:** Knoll, L. (2024). Methane Emissions from Biogas Upgrading Plants. In: Boissonet, G.; Scarlat, N.; Grassi, A. (Hrsg.) Papers of the 32nd European Biomass Conference: Setting the course for a biobased economy. Extracted from the Proceedings of the International Conference held in Marseille, France, 24–27 June 2024. Florence (Italy): ETA-Florence Renewable Energies. ISBN: 978-88-89407-24-0. S. 528-530.

**Publication:** Pohl, M.; Stur, M.; Oehmichen, K.; Etzold, H. (2024). Anaerobe Fermentation: Bereitstellung von Biogas und Gärrest aus landwirtschaftlichen und kommunalen Reststoffen. Focus booklet in the Pilot-SBG project. Leipzig: DBFZ. 27 S. ISBN: 978-3-949807-09-1. DOI: 10.48480/b9vn-9686.

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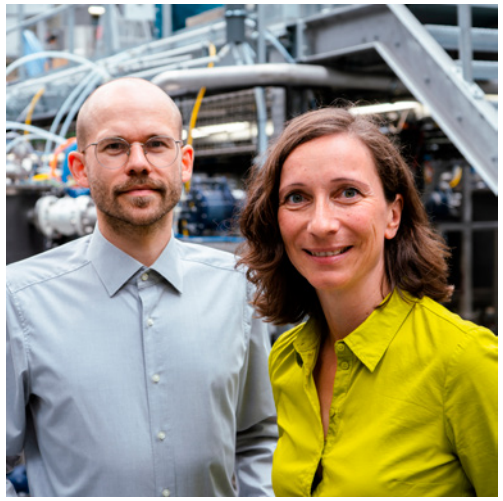
# 7.3 Renewable methane from residual and waste materials – Pilot SBG



“The Pilot-SBG project and the pilot plant that emerged from it are an important bridge between research and the industrial implementation of sustainable technologies as a building block of a holistic bioeconomy. Anaerobic fermentation as a core technology of biorefinery concepts is suitable for processing a large part of the potential of biogenic waste and residues. In this way, established cascades of use can be expanded through innovative upstream and downstream process steps, enabling efficient resource utilisation and a marketable range of products.”

**Karin Naumann/Philipp Knötig**
Project management

## Research and demonstration project Pilot-SBG: Bioresources and hydrogen to methane as fuel – Pilot-SBG

The Pilot-SBG project addresses the provision of renewable methane as an energy source for transport sectors that are difficult to electrify. The central component of the research and demonstration project is the planning, construction and successful trial operation of a pilot plant on a pilot scale. The concept combines both established and innovative technologies and processes biogenic residues, by-products and waste as well as green hydrogen to provide renewable methane as the main product and valuable by-products.

In the sense of an innovation-supporting service, extensive tests are carried out and process parameters are iteratively optimised. On the other hand, the data collected will be analysed and comprehensively evaluated in order to further develop the overall concept and support its scaling up to commercial scale. Central aspects of an accompanying feasibility analysis are, above all, resource distribution and availability, as well as other location, infrastructure and market issues.

**KEYWORDS**

Pilot plant
renewable methane
anaerobic digestion
methanisation
hydrothermal pre- and post-treatment
digestate treatment



**Fig. 26:** The pilot plant “Pilot-SBG” in April 2024

Once the pilot plant is up and running, the focus will be on stable operation. The main objectives within the four planned operating campaigns are to optimise the resource efficiency and the methane yield, and to expand the product portfolio. Several campaigns are planned by the end of 2026, using agricultural residues (straw and cattle slurry) and municipal biowaste (green and biowaste).

After the pilot SBG project, the pilot plant is to be used as a central component of an R&D technology platform for further research and development projects with partners from industry and science. The plant’s high flexibility is particularly advantageous in this respect, with regard to the addition of new, innovative modules and the possibility of detaching individual plant components from the process chain and operating them separately.

### Methods/measures

In 2024, a number of milestones were reached in the Pilot-SBG project. In addition to the progress made in the pilot plant, there were numerous scientific publications and presentations of interim results at specialist events.

The pilot plant with its modular design was put into operation step by step and its interaction along the entire process chain was

**Fig. 27:** Left: press screw separator for solid-liquid separation of digestate/Right: filling of the reactor with real substrate for hydrothermal treatment

successfully tested. Some highlights in the pilot plant were:

_ In the “Hydrothermal Processes” module, the reactor unit was successfully tested with real substrate after initial leaks. The first batch of hydrochar was produced. Routine use is planned from 2025.

_ Since 2024, the “Anaerobic Fermentation” module has been producing biogas with real substrate in a stable manner. Biogas of promising quality (ratio 55/45 – $CH_4/CO_2$) and quantity (80–120 L/H) was produced. Especially in the initial phase, it is not uncommon to be confronted with disruptions and false alarms. These typical teething problems affected the timetable and the research data, but were overcome as operating experience increased and adjustments were made to the system.

_ The multi-stage “digestate treatment” has also been successfully put into operation. Various preliminary tests have already been carried out on the various solid-liquid and liquid-liquid separation plants.

In addition to the central process chain, technical devices for plant safety and automation as well as for thermal post-combustion also play an important role. Furthermore, the plant is equipped with a high density of measurement technology. This is the basis for the plant’s self-sufficient operation and the efficient utilisation of the data in the context of the research objectives and holistic concept considerations. Based on the digital twin of the pilot plant, the basic concept for a possible commercial supply chain was simulated (50,000 t of liquid manure and 17,000 t of straw). It serves as a basis for the evaluation of individual optimisation approaches and optimised process chains. To support this evaluation, work is continuously being carried out on the selection of suitable KPIs (key performance indicators).

In addition to the technical and ecological evaluation, the economic evaluation of the cost-revenue structures plays a central role. Monitoring market developments and relevant legal and regulatory frameworks, particularly with regard to bio-LNG and LNG, is just as relevant as the development of infrastructure for this renewable fuel. In addition, continuous work has been carried out on database-supported data management and on the integration of interfaces between plant control and the automated storage of measurement data, particularly with regard to fermentation.



## Milestones/challenges

In 2024, four focus issues were published as part of the pilot SBG project, dealing with the individual technologies and the overall concept. Following the three focus issues on methanisation, market analysis and greenhouse gas quota, infrastructure for renewable methane in transport, published in 2023, these focus issues address the topics:

_ substrate preparation to optimise the degradation of fibre-rich biomasses,
_ methane liquefaction by comparing small-scale technologies,
_ anaerobic digestion for biogas production and digestate from residues, and
_ a first example concept for the production of renewable LNG and hydrogen from biogenic residues.

The focus issues are freely accessible on the project website and make a significant contribution to the dissemination of knowledge and the promotion of a sustainable bioeconomy.

In 2024, the “Pilot-SBG” project presented numerous results, interim results and innovative approaches at renowned conferences, trade fairs and specialist events. The focus was on renewable methane, biofuels and sustainable biorefinery concepts. Highlights included presentations at the 21st International Conference on Renewable Mobility (“Fuels of the Future”) in Berlin, ACHEMA in Frankfurt and the 32nd European Biomass Conference & Exhibition (EUBCE) in Marseille. Topics such as the monetisation of biomethane in the context of GHG quotas and the integration of hydrogen into bio-based value chains were presented to an international audience.


**Fig. 28:** Freely available focus issues as part of the “Pilot-SBG” project

The project also received attention in the press beyond the trade media. Articles in ADAC Motorwelt and the magazine Land und Forst made the project results accessible to a broad public. A FAQ section published on the project website offers an easy-to-understand introduction to topics such as renewable methane, biofuels and the further project content.

In December 2024, an internal follow-up workshop for the pilot plant discussed its future use and further development. After taking stock and hearing pitches of ideas from the participants, a creative process was used to develop promising approaches. The event generated innovative ideas for the long-term use of the plant and underlined the importance of interdisciplinary cooperation. The process will be intensified and fleshed out in the coming months and years.

## Perspectives

The focus of the research will continue to be on the agricultural residues straw and manure in 2025, and on municipal waste in 2026. In addition to the smooth routine operation and the automated and continuous

interaction of all modules, process-specific and conceptual research questions are also to be answered, including: How can the hydrothermal digestion of selected biogas substrates be assessed? What residence time achieves optimal results in the fermentation of agricultural input materials and which reactor type is better suited for this? Which catalysts and adsorbents are most promising for the methanisation of biogas? What influence does the recirculation of process water into the fermentation have to avoid additional waste streams? How are the cost and revenue structures and ecological indicators of optimised overall concepts? How can the market opportunities for renewable methane as a fuel be evaluated?

## Formal opening of the Pilot-SBG plant on 18 March 2025

After several years of planning and construction, the research facility was officially opened on 18 March 2025 in the presence of around 120 guests from research, politics and industry. In his speech, Hartmut Höppner, State Secretary at the Federal Ministry of Digital and Transport (BMDV), pointed out that the climate targets in the transport sector could hardly be achieved without renewable fuels: “We need innovative solutions like those being developed in the ‘Pilot SBG’ project in Leipzig. It is of great importance that projects like this one are implemented at the DBFZ, in order to create the conditions


**Fig. 29:** Official opening of the new research facility for renewable methane: Philipp Knötig, Karin Naumann (project management), Dr. Sven Halldorn (BMDV), Prof. Dr. Michael Nelles (Scientific Managing Director of the DBFZ), from left to right.



for climate-neutral mobility and logistics in the future.” In a welcoming address, the scientific managing director of the DBFZ, Prof. Dr. Michael Nelles, expressed his thanks for the research facility financed by the BMDV: “Our pilot plant for renewable methane is an excellent basis for targeted technology development and scaling on the road to climate neutrality, particularly in the transport sector. We would like to express our sincere thanks to the Federal Ministry for Digital and Transport for its funding,” said Nelles.

**PROJECT PROFILE**

**Duration (Phase 1b):**
01/01/2023–31/12/2026

**Scientific contact:**
Karin Naumann, Philipp Knötig

**Contracting authority:**
Federal Ministry for
Digital and Transport

On behalf of:
Federal Ministry for Digital and Transport
GESAMTKONZEPT ERNEUERBARE KRAFTSTOFFE

## Scientific paper (open access) on the Pilot-SBG project:

Etzold, H.; Nitzsche, R.; Oehmichen, K.; Schröder, J. (2024). *Methanverflüssigung: Technologievergleich im kleinskaligen Leistungsbereich. Focus booklet in the Pilot-SBG project*. Leipzig: DBFZ. 29 S. ISBN: 978-3-949807-11-4. DOI: 10.48480/bh9h-am62.

Pohl, M.; Stur, M.; Oehmichen, K.; Etzold, H. (2024). *Anaerobe Fermentation: Bereitstellung von Biogas und Gärrest aus landwirtschaftlichen und kommunalen Reststoffen. Focus booklet in the Pilot-SBG project*. Leipzig: DBFZ. 27 S. ISBN: 978-3-949807-09-1. DOI: 10.48480/b9vn-9686.

Röder, L. S.; Nitzsche, R.; Etzold, H.; Oehmichen, K. (2024). *Beispielkonzept zur Bereitstellung von erneuerbarem LNG aus biogenen Rest- und Abfallstoffen und erneuerbarem Wasserstoff im kommerziellen Maßstab: Focus booklet in the Pilot-SBG project*. Leipzig: DBFZ. 31 S. ISBN: 978-3-949807-06-0. DOI: 10.48480/jsct-z879.

Röder, L. S.; Etzold, H.; Gröngröft, A.; Grünewald, M.; Riese, J. (2024). “Decision support tool to determine the suitability of demand side management implementation in continuously operated processes: A biorefinery case study”. *Biofuels, Bioproducts and Biorefining* (ISSN: 1932-1031), Vol. 18, Nr. 1. S. 18–41. DOI: 10.1002/bbb.2558.

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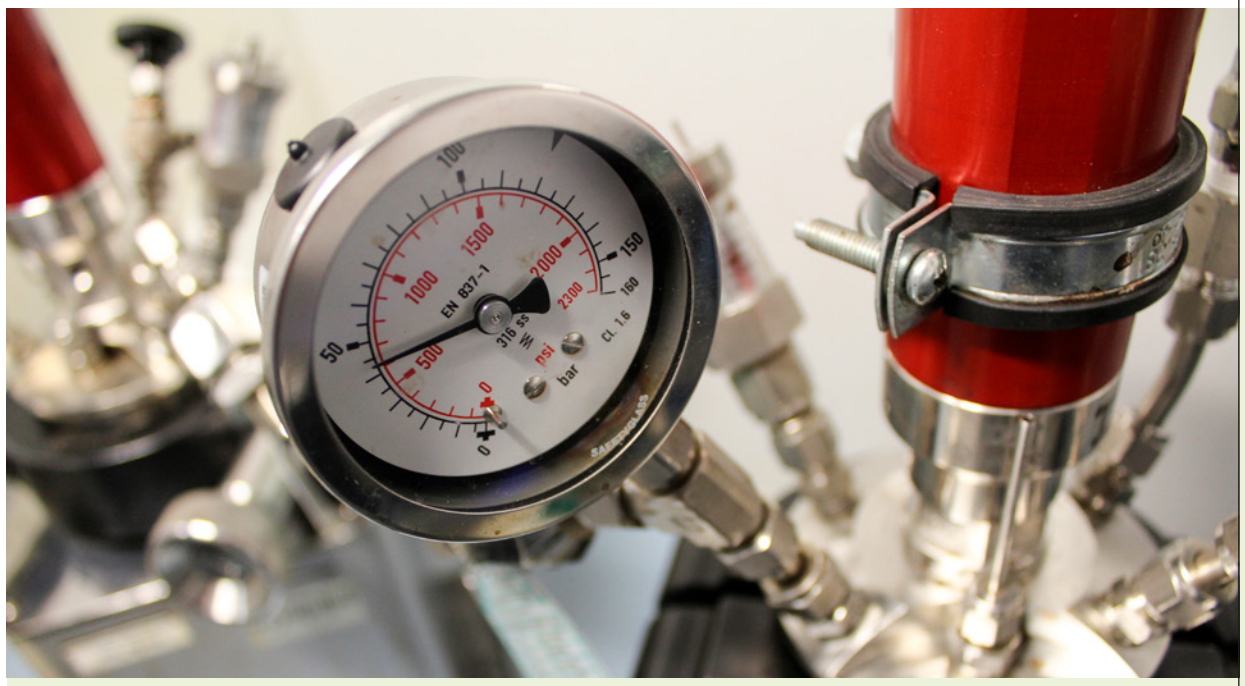
Klüpfel, C.; Yuan, B.; Biller, P.; Herklotz, B. (2025). “Hydrothermal liquefaction as a treatment technology for anaerobic digestate: A review”. *Renewable and Sustainable Energy Reviews*, Vol. 210. S. 115–156. DOI: 10.1016/j.rser.2024.115156

→ **Further information:**
**www.dbfz.de/en/projects/pilot-sbg**




## Research focus area “Biobased Products and Fuels”

The research focus area “Biobased Products and Fuels” investigates the entire process chains of biorefineries. In addition to developing processes and concepts for the bioeconomy, the work also includes implementation on a laboratory and pilot plant scale, as well as technology assessment. The overarching goal is to contribute to flexible, highly efficient and sustainable biorefinery concepts using innovative technological approaches. To this end, chemical refining processes are being researched with a focus on hydrothermal processes (HTP) and hydrotreatment. The development of fractionation processes for solid-liquid and liquid-liquid separation plays an important role as a link between the individual research topics (e. g. in connection with anaerobic processes and HTP intermediate products).

Another building block is the development of synthesis gas processes for the production of high-quality products, with biomethane being the main focus. Synergies between the topics are addressed in joint projects. To this end, the work in the research focus area concentrates on (i) the analysis of relevant individual processes and necessary system components, (ii) preliminary experiments for selected individual processes (e. g. HTP, gasification, methanation, separation technology) and (iii) the preparation of an accompanying technology assessment (focus: material and energy balancing, costs and economic efficiency, environmental effects).



## Important reference projects and publications

**Project:** AltCell – Alternative Cellulosequellen für künstliche Cellulosefasern, Federal Ministry of Education and Research, 01.08.2023–31.07.2025 (FKZ: 03WIR3806C)

**Project:** HemiCoat – Konversion von Hemicellulose zu Beschichtungen, Federal Ministry for Economic Affairs and Climate Action, 01.09.2024–31.08.2026 (FKZ: 01IF00399C)

**Project:** INNOFUELS – Vernetzung, Weiterentwicklung und Rahmenbedingungen zum Hochlauf strombasierter Kraftstoffe und fortschrittlicher Biokraftstoffe, Federal Ministry for Digital and Transport , 01.02.2023–31.08.2026 (FKZ: 16RK34002F)

**Project:** KonditorGas – Verbundvorhaben: Industrielle Prozesswärmeerzeugung durch katalytische Konditionierung von Synthesegasen; Teilvorhaben II: Katalytische Konditionierung von Synthesegasen aus der autothermen Vergasung, Federal Ministry for Economic Affairs and Climate Action, 01.09.2020–31.08.2024 (FKZ: 03EI5417B)

**Project:** NextStep – Next-gen of sustainable biobased chemical platforms, European Commission, 01.06.2024–31.05.2028 (GA: 101157081)

**Publication**: Etzold, H.; Dögnitz, N. (2024). New Value for Biofuels: Monetizing Low Emissions via GHG Quota in Germany Exemplified by Biomethane. In: Boissonet, G.; Scarlat, N.; Grassi, A. (Hrsg.) Papers of the 32nd European Biomass Conference: Setting the course for a biobased economy. Extracted from the Proceedings of the International Conference held in Marseille, France, 24–27 June 2024. Florenz (Italien): ETA-Florence Renewable Energies. ISBN: 978-88-89407-24-0. S. 403–405. DOI: 10.5071/32NDEUBCE2024-3CO.9.2.

**Publication**: Klüpfel, C.; Yuan, B.; Biller, P.; Herklotz, B. (2025). “Hydrothermal liquefaction as a treatment technology for anaerobic digestate: A review”. *Renewable and Sustainable Energy Reviews*, Vol. 210. S. 115156. DOI: 10.1016/j.rser.2024.115156.

**Publication**: Kurth, M.; Javed, M.; Schliermann, T.; Brösigke, G.; Kämnitz, S.; Bhatia, S. K.; Repke, J.-U. (2024). “Pure Hydrogen and Methane Permeation in Carbon-Based Nanoporous Membranes: Adsorption Isotherms and Permeation Experiments”. *Membranes* (ISSN: 2077-0375), Vol. 14, Nr. 6. DOI: 10.3390/membranes14060123.

**Publication**: Naumann, K.; Cyffka, K.-F.; Karras, T. (2024). Bio2x: Vergleichende Analyse zu nachhaltigen Biomasse- und Substitutionspotenzialen. Background paper. Leipzig: DBFZ. II, 3–37 S.

**Publication**: Röder, L. S.; Gröngröft, A.; Grünewald, M.; Riese, J. (2024). “Optimization of design and operation of a digestate treatment cascade for demand side management implementation”. *Computers & Chemical Engineering* (ISSN: 0098-1354), Nr. 191. DOI: 10.1016/j.compchemeng.2024.108838.

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# 7.4 Soil improvement for a world without hunger – ETH-Soil

"The ETH-Soil project simultaneously addresses capacity building in education and research, quality assurance, agricultural extension, as well as trade and agriculture in Ethiopia. Together with a wide range of stakeholders, the project is gradually changing the conditions under which smallholder and rural communities in Africa can improve soil and yields and use bioenergy."

**Kerstin Wilde**
Project manager

## Soil improvement in Ethiopia through the energetic and material use of agricultural residues

The decline in soil fertility has become a critical challenge for food security and economic growth in many African countries. This is due to a variety of factors:

1. increasing deforestation, not least due to the demand for firewood where electricity is expensive and only available in cities;
2. Regular heavy rainfall and droughts that wash nutrients out of the soil and damage important soil bacteria in the humus layer;
3. Insufficient fertilisation, irrigation and recycling of nutrients (compost) caused by widespread poverty;
4. Limited availability of means of production, modern technologies and knowledge.

**KEYWORDS**

Low-emission cooking
climate adaptation
soil improvement
Ethiopia
carbon storage



With rapidly growing populations and climate change, this problem is becoming more acute. Can the trend be reversed to improve the living conditions of smallholder farmers?

The DBFZ was commissioned by the German Federal Ministry for Economic Cooperation and Development (BMZ) in 2021 to demonstrate by 2026 how transformation can be initiated and technologically supported in pilot regions of Ethiopia. According to World Bank statistics (2024) [1], Ethiopia has achieved an annual per capita income of $ 1,020 and consequently ranks 176th out of 185 countries on the UNDP Human Development Index [2]. In the largest Ethiopian region, Oromia, 70 % of the 35 million inhabitants work in agriculture. Where the agricultural area per household rarely exceeds 1.5 ha, it is difficult to feed a family [3]. The Ethiopian Ministry of Agriculture's view of the problem was recently presented by the responsible state minister, Prof Eyasu Elias, at a project meeting as follows: It is of the utmost importance to establish food security in Ethiopia. To do this, agricultural yields would have to be tripled. This goal, in turn, cannot be achieved without massive soil improvement measures. Soil erosion, salinisation, soil acidity and the depletion of organic carbon in the soil (only 1.4 %) have reached alarming levels in Ethiopia.

_ The ETH-Soil project aims to address these issues by a) mobilising biogenic residues for the production of biochar-based fertilisers (BBF), b) adapting suitable technologies to the local conditions, residues and preferences and transferring them into broad application, and c) combining, if possible, low-emission energy use with the material use of residues. The domestic production of BBF can also help to reduce the import of mineral fertilisers. This saves foreign exchange and reduces the country's international dependencies. Overall, ETH-Soil contributes to the implementation of the 2030 Agenda (Sustainable Development Goals):Combating hunger through untapped agricultural and social potential (SDG 2 "No hunger", SDG 3 "Good health and well-being"),

_ Promotion of sustainable management of natural resources (SDG 7 "Affordable and clean energy", SDG 15 "Life on land"), and

_ Education and training for economic, social and technical progress (SDG 4 "Quality education")

### Methods/Measures

An increasing number of studies prove the agronomic potential of biofertilisers based on biochar [4][5]. Therefore, biochar is mixed with nutrient-rich materials such as compost, worm castings, digestates from biogas production or animal manure [6]. Biochar absorbs and retains nutrients even through periods of heavy rainfall, thus promoting their return to the nutrient cycle [7]. The introduction of biochar also improves the water retention capacity, microbial activity and humus formation in the soil. On acidic soils, a liming effect can be achieved [8], while saline soils also benefit significantly from BBF [9]. Finally, biochar is furthermore attracting increasing attention because with it, carbon can be stored in the ground for the long term. [10].

The implementation of ETH-Soil began with the politically coordinated selection of pilot districts in the Oromia and Sidama regions. These were selected on the basis of criteria of soil quality and food insecurity, and considering the activities of other donors (see Figure 30). Two consulting firms were commissioned to collect data on residues that can be used to produce BBF. Data on the quantities of waste materials that are not already used by the producers themselves or sold is now

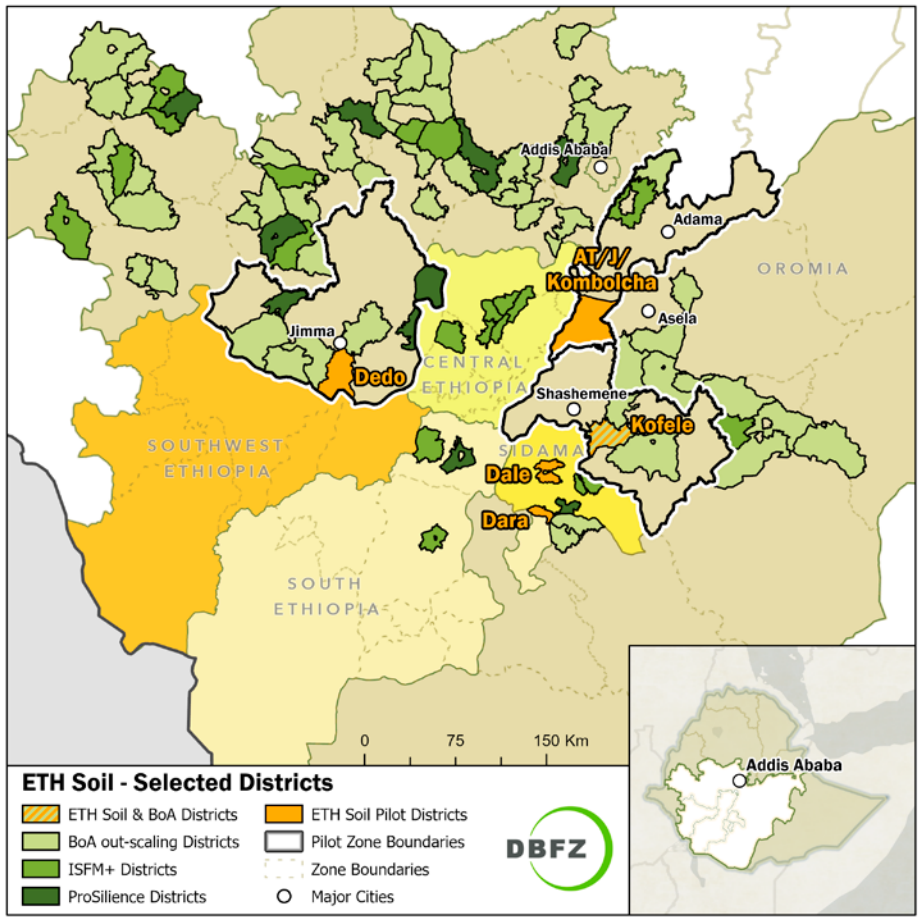


**Fig. 30:** Pilot regions of the ETH-Soil Project in the context of Ethiopian-German efforts towards integrated soil fertility management (ISFM) and the promotion of agro-ecological approaches for resilient agriculture and food systems (ProSilience)

available for 261 stakeholders. Significant quantities of pulp and coffee berry pulp, dried manure, khat plant cuttings and bones are available for new economic activities. Generic business models for the use of nine different waste materials will be developed in 2025.

Meanwhile, the necessary skills to produce high-quality biochars on a larger scale and to scientifically prove the effects of BBF in the soil have been developed at the Oromia Agricultural Research Institute (IQQO) and the Faculty of Agriculture at Jimma University (JUCAVM) through study trips, training, laboratory training and advisory services. Storage rooms were built, equipment and materials were procured locally, and the import of analytical instruments and vehicles were



**Fig. 31:** Biochar production from corn cobs using the Kon-Tiki technology (top left), biochar-based fertiliser (top centre), application of the fertiliser in furrows in the soil before sowing (top right), an Ethiopian farmer on his test field with different biofertiliser formulations, inspecting the expected harvest

coordinated. The regional state's agricultural extension service has received a DBFZ training manual for multipliers, translated it and adapted it for farmers.

By 2024, the Oromia extension service trained over 244 farmers and supplied them with test quantities of biochar and BBF. Mixed with the target groups' own compost or digestate, over 350 tonnes of BBF were applied to more than 16.6 ha of degraded land.

Research grants were offered to solidly test specific BBF formulations for the country's most important cereal varieties in 2023 and 2024, with a large number of research groups applying for them. The required submission of biochar samples had a resounding effect on nationwide awareness of toxic polycyclic aromatic hydrocarbons, which should not exceed a European threshold. The presentation of research results and international findings on BBF at annual Soil Symposia ensured an increasing synthesis of different levels of knowledge.

At the Jimma University Faculty of Engineering (JIT), ETH-Soil has designed a four-module specialisation in bioenergy for the MSc programme "Renewable Energies". Four teachers were trained in the operation of modern biogas plants during a study trip to Germany. The exchange of experiences with lecturers from four German universities on the structure of the planned modules also helped to promote the positive vote of the

senate. Now, 18 students are being trained as biogas specialists.

For the development and introduction of low-emission pyrolysis cookstoves, 282 households in the pilot districts were surveyed about their cooking and fuel habits. In addition, a fuel diary was kept by some households for 12 weeks. With this information, the DBFZ cookstove prototype could be adapted. It now consists of an outer clay shell and an inner metallic reactor made from a re-used can. The process works with natural draft, enables households to cook with biomass residues while producing biochar for co-composting. Production costs are low and all materials are locally available. The modular design responds to the need for women to be able to change the location of the cooker.

## Challenges and opportunities

Challenges for achieving the objectives of the ETH-Soil project can be found at various levels. The security situation in the country led to a travel ban in 2022 and has required intensive monitoring since 2023. The following factors are relevant for a sustainability transformation that strengthens the innovation system for organic fertilisers sustainably:

_ There is extensive knowledge in the academic field, but the reputation of the universities in the country is rather poor. The institutes for agricultural research, which are under the control of the regional governments, lack equipment and expertise. Special efforts are needed to promote cooperation between these unequal partners and with the public agricultural extension services;

_ The bioenergy strategy in the country is spread across two ministries;

_ In the private sector, there are no major fertiliser production companies with R&D expertise;

_ The official approval and licensing of pyrolysis stoves is difficult: there is no standard for this type of stove and emission measurement is only just being introduced;

_ State expertise in quality assurance for organic fertilisers is currently being developed/introduced;

_ $CO_2$ sequestration in the soil has not yet been institutionalised.

From a technical perspective, four factors stand out:

_ Coffee husks are a widely available waste material, but their use is difficult due to their structure, small particle size and chemical composition;

_ The prototype of the pyrolysis cooker was revised several times to meet local conditions and needs, optimise performance parameters and avoid stress cracks during operation. With strong differences in regionally available residues and cooking habits, the need for innovation continues;

_ Biochar production was started with the help of Kon-Tikis (conical metal kilns) and accompanying quality assurance. A large number of customised solutions are needed to enable simultaneous heat utilisation and biochar production;

_ The sustainable operation of a training biogas plant and a biogas laboratory on the premises of Jimma University also requires market success for short courses and contract analysis.


**Fig. 32:** ETH-Soil study trip and training in the operation of modern biogas plants

## Perspectives

The challenges are offset by multiple opportunities for substantial improvements in food security and quality of life (low-emission cooking) for the target groups. The enthusiasm of farmers when they see the difference in growth and yield with BBF is just as impressive as the joy of multipliers when they gain knowledge and skills. By the end of the project period, 1,000 tonnes of BBF on 50 hectares of degraded land should improve both crop yields and soil health for smallholder farmers. Sustainable dissemination of the concept can succeed if Artisan C-Sink certification improves the cost-benefit ratio for smallholder farmers, if quality assurance is successfully established and if capacities are built up to such an extent that the private sector can autonomously advance further developments in stoves and fertilisers.

With ETH-Soil, the DBFZ establishes itself as a partner for science-based transition funding with multi-stakeholder constellations, including in the Global South. Knowledge and know-how for the transition towards a bioeconomy come from the fields of thermo-chemical conversion, biochemical conversion and bioenergy systems at the DBFZ. These are combined in a new way in the ETH-Soil project. Creating impact in the pilot regions only indirectly via partners was and remains a new challenge for DBFZ. However, the Ethiopian partners are increasingly seeing the conditions for a successful rollout to other regions of the country. ETH-Soil can therefore be seen as a blueprint for a systemic impulse that works towards the goals of the 2030 Agenda.

→ **Further information:**
**www.eth-soil.com**

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**PROJECT PROFILE**

**Duration:**
01/07/2021–31/12/2026

**Status:**
In progess

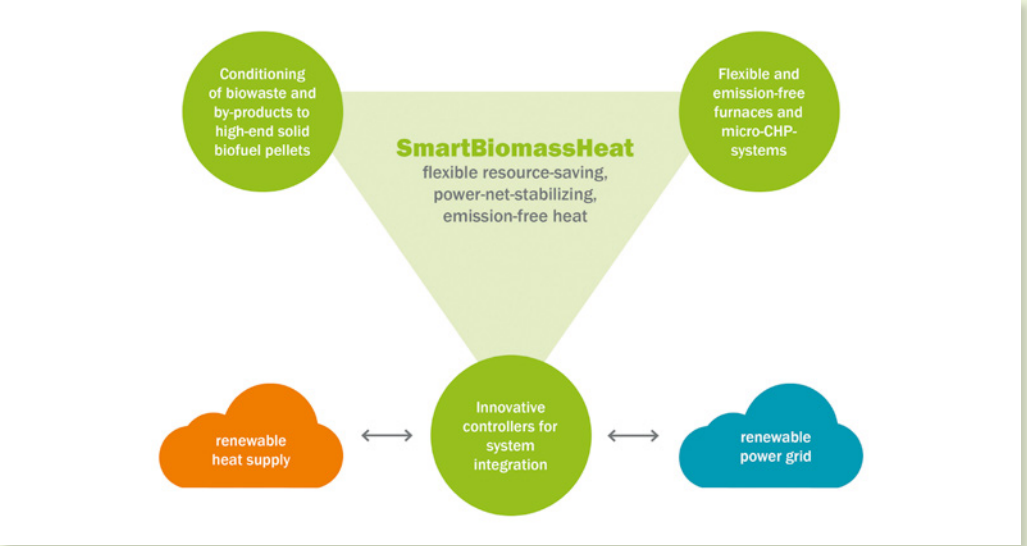
**Scientific contact:**
Kerstin Wilde,
Dr. Annett Pollex

**Project number:**
2021.0119.4

**Funding body:**
Federal Ministry
for Economic Cooperation
and Development

german cooperation
DEUTSCHE ZUSAMMENARBEIT

→ **Further information:**
**www.smartbiomassheat.com**




## Research focus area “SmartBiomassHeat”

The research focus is on the small-scale, renewable provision of heat in individual buildings and small groups of buildings, up to village communities or districts, using other renewable energy sources and networked, intelligent heating technologies based on biomass, which primarily comes from residual materials, by-products and waste. The aim is to optimise the use of all renewable heat sources, both technologically and economically, by using biomass-based heating technologies flexibly and in line with demand. To this end, the entire chain from the refinement of biomass fuels to new conversion plants and the integration of biomass heating systems, which in the future will also be designed as heating, power and cooling systems, into the heating and electricity grid is to be mapped, examined individually and in combination, simulated and optimised. By means of the necessary technical component development and the connecting control research and development, these are to be guided from flexible operation (including micro and small-scale CHP) to efficient, environmentally friendly, economical, safe, demand-adapted, flexible and sustainable (smart) operation.

With climate protection becoming an increasingly urgent issue, the research focus is also shifting more and more towards the short-term effects of the combustion of carbon-based fuels. Therefore, the levels of observation are increasingly being extended to include coupled material utilisation options for biomass before and after combustion. Extended material utilisation cascades, a more system-friendly integration of biomass combustion including high-temperature heat supply and the reuse of combustion residues such as ashes and coals are being specifically researched.



## Important reference projects and publications

**Project:** BioFe – Biomassenutzung in der Eisenerzeugung unter wirtschaftlichen und $CO_2$-mindernden Randbedingungen, Sächsische Aufbaubank, 16.05.2024–31.05.2027 (FKZ: 100704873)

**Project:** DeDiaPro – Verbundvorhaben Demonstration von Methoden zur Diagnose, prognose und Behebung von nicht-nominalen Betriebszuständen in biomassebasierten Versorgungssystemen; Teilvorhaben: Entwicklung von Methoden, Modellen und werkzeugen zur Fehlerdiagnose und -prognose mit Fokus auf brennstoffbezogene Fehler, Federal Ministry for Economic Affairs and Climate Action, 01.02.2024–31.07.2026 (FKZ: 03EI5471A)

**Project:** HeRoTogo – Entwicklung einer Roadmap für die nachhaltige Wärmeerzeugung mit Biomasse in Togo und Demonstration ausgewählter Technologien entlang des gesamten Nutzungspfades, Federal Ministry of Education and Research, 01.03.2024–28.02.2025 (FKZ: 03SF0749)

**Project:** WEPart – Untersuchung der Wirkung bestehender primärer und sekundärer Emissionsminderungstechniken an Feuerungsanlagen zur Partikelanzahlminderung abhängig von Brennstoff und Feuerungstechnik, Market project, 01.03.2022–31.07.2024

**Project:** ZirkulierBar – Interkommunale Akzeptanz für nachhaltige Wertschöpfung aus sanitären Nebenstoffströmen Nährstoffwende – von linearer Sanitärspülung zur zirkulären Nährstoffverwertung, Federal Ministry of Education and Research, 01.07.2021–30.06.2024 (FKZ: 033L242H)

**Publication:** Adam, R.; Yiyang, D.; Kruggel-Emden, H.; Zeng, T.; Lenz, V. (2024). “Influence of pressure and retention time on briquette volume and raw density during biomass densification with an industrial stamp briquetting machine”. *Renewable Energy* (ISSN: 0960-1481), Nr. 229. DOI: 10.1016/j.renene.2024.120773.

**Publication:** Adam, R.; Zeng, T.; Röver, L.; Schneider, P.; Werner, H.; Birnbaum, T.; Lenz, V. (2024). “Long-term emission demonstration using pretreated urban non-woody biomass residues as fuel for small scale boilers”. *Renewable Energy* (ISSN: 0960-1481), Nr. 237, Part C. DOI: 10.1016/j.renene.2024.121815.

**Publication:** Mengesha, T. T.; Ancha, V. R.; Sundar, L. S.; Pollex, A. (2024). “Review on the influence of pyrolysis process parameters for biochar production with minimized polycyclic aromatic hydrocarbon content”. *Journal of Analytical and Applied Pyrolysis* (ISSN: 0165-2370), Nr. 182. DOI: 10.1016/j.jaap.2024.106699.

**Publication:** Putra, R. D.; Dizaji, H. B.; Kulshresth, D.; Zeng, T.; Overmann, S.; Vollpracht, A. (2024). “Characterisation of Bottom Ashes from Non-Woody Biomass Combustion for Application as Sustainable Supplementary Cementitious Material”. *Energies* (ISSN: 1996-1073), Vol. 17, Nr. 2. DOI: 10.3390/en17020468.

**Publication:** Wilde, K.; Hermans, F. (2024). “Transition towards a bioeconomy: Comparison of conditions and institutional work in selected industries”. *Environmental Innovation and Societal Transitions* (ISSN: 2210-4224), Nr. 50. DOI: 10.1016/j.eist.2024.100814

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# 7.5 Primary and secondary techniques for controlling emissions from combustion plants – WePart

"The aim of the research project is to evaluate the effect of existing primary and secondary emission abatement techniques for particle number reduction depending on fuel and combustion technology. For this purpose, the particle number concentrations resulting from combustion of various fuels such as oil, natural gas, coal and wood are to be evaluated in the raw flue gas depending on the combustion technology. In addition, primary emission abatement techniques will be described and their effects on particle number reduction presented. In addition to primary emission abatement techniques, the effect of secondary measures on particle number concentration has to be evaluated. These include, in particular, catalysts, ceramic inserts, electrostatic precipitators and bag house filters. In order to close existing data gaps, particle number measurements have to be carried out on different combustion systems."

**René Bindig**
Project manager

## Investigation of the effect of existing primary and secondary emission abatement techniques at combustion units for particle number reduction depending on fuel and combustion technology

Small-scale furnaces are responsible for about 20 % of the total particulate emissions (PM2.5) in Germany. A large proportion of these emissions come from the 11.2 million single-room furnaces and the approximately one million solid fuel boilers. In addition, oil and gas-fired systems contribute to particulate pollution, albeit to a much lesser extent. These have negative effects on humans and the environment. In terms of their effect on health, ultrafine particles (UFP) with a diameter of less than 100 nm are particularly relevant; these can penetrate deeper into the lungs than larger particles and can have harmful effects on health. These UFPs are produced in all combustion processes, both primary, i. e. emitted directly, and secondary, i. e. from gaseous precursor substances in the atmosphere.

**KEYWORDS**

Ultrafine particles (UFP)
combustion units
particle number reduction
emission abatement techniques
electrostatic precipitators (ESP)

To date, the total particulate mass has been used to assess dust emissions from combustion units, although this only insufficiently records the human-toxicological significance of the UFPs. In contrast to particles larger than 100 nm, UFPs can be measured by counting the number of particles or the particle number distribution. However, there are only a few research results available to date for measuring the particle number or particle number distribution in the area of the combustion units that cannot be transferred to the totality of the combustion units, the associated flue gas cleaning techniques and fuels. In particular, the contribution of currently available primary and secondary emission measures to lower particle numbers and the particle concentrations as a function of fuel, plant technology and operation are not yet sufficiently known. Therefore, the effect of primary and secondary emission control techniques on particle number abatement should be evaluated as a function of fuel and combustion technology. Furthermore, particle number measurements had to be carried out on combustion units with a nominal thermal output of less than 100 kW that are not subject to licensing requirements.

### Methods/measures

Based on the objectives outlined above, the study is divided into the following work packages (WP):



- WP 1: Description of the particle number concentrations of different fuels depending on the combustion technology
- WP 2: Description of the effect of secondary emission reduction measures on the particle number
- WP 3: Particle number measurement

The contents associated with the individual work packages are explained below. The project consortium, consisting of the coordinator DBFZ and the partners DBI and TROPOS, has realised these tasks.

The aim of work package 1 was to evaluate the effect of existing primary emission abatement techniques for particle number reduction depending on fuel and combustion technology. To this end, an in-depth theoretical description of particle formation and particle agglomeration from biogenic and fossil-fired combustion units was first carried out. In addition, various literature sources were consulted to evaluate the particle number concentration and particle number distribution in the exhaust gas of commercially available combustion technologies over the past 20 years.

Based on a theoretical consideration of a possible influence of secondary emission control techniques on the particle number concentration and the particle number distribution in the exhaust gas, the values and information published in the literature were determined for different secondary emission control measures (in particular of catalytic converters, ceramic inserts, electrostatic dust collectors and fabric filters) in work package 2. The research was carried out in direct connection with the work package 1, with a separate evaluation and assessment of secondary emission abatement techniques with regard to the particle number concentration and the particle number distribution in the exhaust gas being carried out in this work package.

The metadata described in work package 1 were included in the research and the data quality was evaluated accordingly. With regard to the effect of the secondary emission control measures, the following points were particularly important:

_ Exhaust gas volume flow
_ Particle mass and particle number concentration or particle number distribution in the raw gas
_ Particle composition (e. g. carbon content and type of carbon compounds)
_ Design and efficiency of the emission control system

In particular, the study looked at combustion units within the scope of the 1st BImSchV with a heat output of less than 1,000 kW. The focus in this power range was on solid fuel combustion systems (coal, pellet, wood chip and log wood combustion systems) with electrostatic precipitators or catalytic converters, as well as on automatically or manually fed single-room combustion systems (fireplaces, pellet stoves and heat accumulation fireplaces) with electrostatic precipitators or catalytic converters. Furthermore, plants of the 44th BImSchV with a heat capacity range between 1 MW and 5 MW were considered.

In work package 3, particle number measurements were carried out on combustion units with a nominal heat output below 100 kW that do not require an extra permit from local authorities. This mainly concerns units for which the data based on the results of work packages 1 and 2 is not yet sufficient. In this context, the project consortium was able to draw on many years of experience in the field of particle number measurements and the testing of biomass, oil and gas combustion units. In addition to the measurement of the particle number distribution using SMPS and the particle number concentration derived from it, other exhaust gas parameters such as oxygen were measured continuously. A questionnaire for recording emission-relevant parameters was agreed in advance with the client during the interim discussion on WP3 at the beginning of the work package.

## Milestones/challenges

The measurements at the DBFZ were carried out on a wood chip boiler with a CE marking and a nominal heat output of 49 kW from the manufacturer A. P. Bioenergietechnik GmbH (type: Ökotherm, C0 UA-E AP 10) with an electrostatic precipitator also from A. P. Bioenergietechnik GmbH (type: field separator 1) (see Figure 33). The client, UBA, requested a parallel measurement before and after the precipitator, and this was implemented accordingly.

Wood chips were used for the investigations. Three measuring instruments were used to determine the particle number concentrations: an MPSS, an HC-NPET and an ELPI®+. Table 2 summarises the specifications of these instruments and the particle size ranges that can be determined.

For the investigations, the boiler output was not varied, but kept as constant as possible. The measurements showed that the number of particles was already reduced by the switched-off electrostatic precipitator. When the electrostatic precipitator was switched on, the separation effect of the electrostatic field was clearly visible. The mean values of the measured total concentrations of the particles and the reduction levels calculated from them at the two positions as a function of the operating state were summarised in Table 3. In addition, the gravimetric reduction level was listed.

Further measurements were carried out at the DBFZ on a CE-marked pellet boiler with



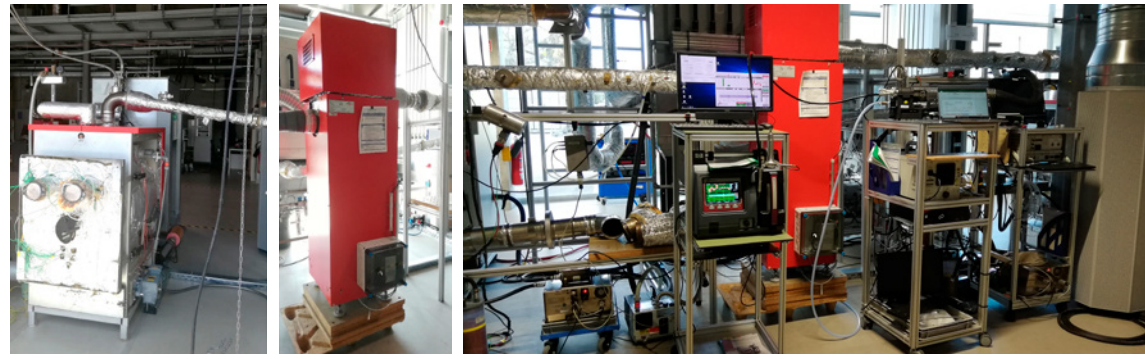

**Fig. 33:** Woodchip boiler (left), electrostatic precipitator (centre) and the measurement technology used (right) on the DBFZ test bed

**Tab. 2:** Measuring instruments used to determine the particle number size distributions

| Device name | Manufacturer | Structure/ measurement principle | Configurable particle size range |
|---|---|---|---|
| MPSS | TROPOS | DMA/CPC | 10 to 800 nm |
| HC-NPET | TSI | CPC | 23 to 1,000 nm |
| ELPI®+ | Dekati | Cascade impactor | 6 to 10,000 nm |

**Tab. 3:** List of the mean values of the measured total concentrations of particles and the calculated reduction rates for device E before and after the electrostatic precipitator, depending on the operating state.

| | Position/ Modus | Measuring device | | | |
|---|---|---|---|---|---|
| | | **HC-NPET** (Partikel/cm³) | **ELPI** (Partikel/cm³) | **MPSS** (Partikel/cm³) | **Gravimetry** (mg/m³) |
| **Mean values** | **Before** electrostatic precipitator | 4,7E+07 | 5,1E+07 | 4,1E+07 | 47 |
| | **After** electrostatic precipitator/ **switched off** | 2,1E+07 | 4,2E+07 | 2,1E+07 | 42 |
| | **After** electrostatic precipitator/ **switched on** | 0,7E+06 | 2,4E+06 | 1,8E+06 | 9 |
| **Degree of reduction via the separator** | **switched off** | 56 % | 18 % | 48 % | 10 % |
| | **switched off** | **98 %** | **95 %** | **96 %** | **63 %** |

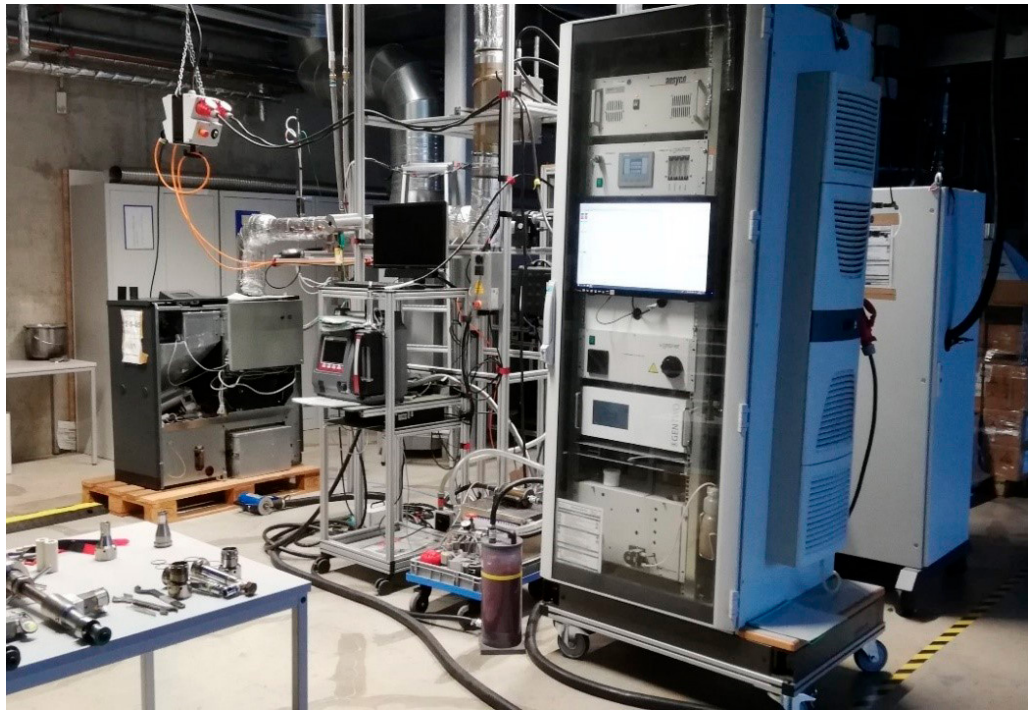

**Fig. 34:** Pellet boiler (left) and the measurement technology used on the DBFZ test bed

**Tab. 4:** List of the mean values of the measured total concentrations of the particles and the reduction levels calculated from them for device F before and after the electrostatic precipitator, depending on the operating state

| | Position/ Modus | Measuring device | | | |
|---|---|---|---|---|---|
| | | **HC-NPET** (Partikel/cm³) | **ELPI** (Partikel/cm³) | **MPSS** (Partikel/cm³) | **Gravimetry** (mg/m³) |
| **Mean values** | **Before** electrostatic precipitator | 5,2E+07 | 7,8E+07 | 6,3E+07 | 16 |
| | **After** electrostatic precipitator/ **switched off** | 2,1E+07 | 2,6E+07 | 2,4E+07 | 17 |
| | **After** electrostatic precipitator/ **switched on** | 1,3E+06 | 1,5E+06 | 2,9E+06 | 1 |
| **Degree of reduction via the separator** | **switched off** | 61% | 66% | 61% | 0% |
| | **switched off** | **98%** | **98%** | **95%** | **94%** |



a rated output of 15 kW from the manufacturer ETA Heiztechnik GmbH (type: PelletsUnit 7 to 15 kW) with an electrostatic precipitator from the company OekoSolve AG (type: OS-CTRL). The client UBA requested parallel measurements before and after the precipitator, which were carried out accordingly. An MPSS, an HC-NPET and an ELPI®+ were also used in these investigations to determine the number concentrations and distributions of the particle emissions (see Table 2). Wood pellets were used for the investigations. The boiler output was not varied for the investigations on the pellet boiler either, but kept as constant as possible.

The mean values of the measured total concentrations of the particles and the reduction levels calculated from them at the two positions, depending on the operating state, were summarised in Table 4. In addition, the gravimetric reduction level was also listed.

## Perspectives

In the further course of the project, DBFZ, TROPOS and DBI will complete the evaluation of the particle measurements and assess the results in the context of the literature results. The literature research has been finalised and the planned measurements at the furnaces have been carried out and finally calculated accordingly. The evaluation of the results and the final report will follow.

**PROJECT PROFILE**

**Duration:**
01/03/2022–31/03/2025

**Scientific contact:**
René Bindig

**Project number:**
3721533040

**Funding body:**
Umweltbundesamt

Umwelt Bundesamt

## The research focus area “Catalytic Emission Control”

The vision of a climate-neutral and sustainable bioeconomy and the associated premises place very high demands on the research area of “Catalytic Emission Control” in terms of pollutant-free bioenergy use. In particular, the increased use of biogenic residual and waste materials of varying quality presents a challenge for emission-free utilisation. The focus here is on reducing emissions from combustion processes for bioenergy sources by using and combining with solid catalysts. In particular, climate-relevant methane ($CH_4$), toxic volatile organic compounds (VOC), semi-volatile and non-volatile hydrocarbons such as polycyclic aromatic hydrocarbons (PAH) and polychlorinated dioxins and furans (PCDD/PCDF), soot particles (black carbon) and nitrogen oxides ($NO_x$) must be largely reduced. The overarching goal of the research focus is to investigate long-term and high-temperature stable, recyclable and cost-effective catalysts with no or significantly lower proportions of precious metals. In particular, the combination of catalysts with additional emission control methods is to be researched in detail.



## Important reference projects and publications

**Project:** BioFeuSe – Neue Sensorik für die Prozessoptimierung von SCR-Verfahren und Partikelabscheidung an Biomasseverbrennungsanlagen, Federal Ministry for Economic Affairs and Climate Action, 01.07.2021–30.06.2024 (FKZ: 03EI54346A)

**Project:** LangEFeld – Langzeitmonitoring und Funktionalität von Staubabscheidern für Einzelraumfeuerungen im Feld, Federal Ministry of Food and Agriculture, 01.01.2023–31.12.2025

**Project:** MeKat – Entwicklung eines Methanoxidationskatalysators auf Basis von biogenem Silika für die Entfernung von Methan im Abgas von Biogas-BHKW, Federal Ministry for Economic Affairs and Climate Action, 01.01.2023–31.12.2025 (FKZ: 03EI5456A)

**Project:** TWOx – Entwicklung eines preisgünstigen und ressourceneffizienten Systems zur Abgasnachbehandlung für Holzgas-BHKW; TV: Erweiterung einer mobilen Katalysatortestapparatur zur Katalysatorvermessung und Insitu-Alterung sowie Laborversuche zur Katalysatorcharakterisierung, Federal Ministry for Economic Affairs and Climate Action, 01.01.2024–31.12.2025 (FKZ: 03EI5470A)

**Project:** UFP-MESS – Messung ultrafeiner Partikel aus Kleinfeuerungsanlagen, Market project, 27.07.2022–30.11.2025 (FKZ: 3721522050)

**Publication:** Hartmann, I.; Formann, S.; König, M.; Bindig, R.; Stolze, B.; Sittaro, F.-C.; Schliermann, T. (2024). “Studie über die Gewinnung von biogenem Siliziumdioxid aus Reisspelzen im Mekong-Delta”. *Müll und Abfall* (ISSN: 0027-2957), Vol. 56, Nr. 2. S. 79–85.

**Publication:** Kurth, M.; Javed, M.; Schliermann, T.; Brösigke, G.; Kämnitz, S.; Bhatia, S. K.; Repke, J.-U. (2024). “Pure Hydrogen and Methane Permeation in Carbon-Based Nanoporous Membranes: Adsorption Isotherms and Permeation Experiments”. *Membranes* (ISSN: 2077-0375), Vol. 14, Nr. 6. DOI: 10.3390/membranes14060123.

**Publication:** Prempeh, C. O.; Formann, S.; Hartmann, I.; Nelles, M. (2024). “An improved method for the production of biogenic silica from cornhusk using sol–gel polymeric route”. *Biomass Conversion and Biorefinery* (ISSN: 2190-6815), Vol. 14, Nr. 22. S. 28701–28711. DOI: 10.1007/s13399-022-03615-6.

**Publication:** Schliermann, T.; Bindig, R.; Stolze, B.; Lange, L.; Öfner, F.; Ercolano, G. (2024). Entwicklung eines preisgünstigen und ressourcenefzienten Systems zur Abgasnachbehandlung für Holzgas-BHKW. In: Nelles, M. (Hrsg.) 18. Rostocker Biomasseforum: Tagungsband. am 20. und 21. Juni 2024. Rostock: Univ., Professur Abfall- und Stoffstromwirtschaft. (Schriftenreihe Umweltingenieurwesen, 124). ISBN: 978-3-86009-559-1. S. 253–258

**Publication:** Wink, K.; Hartmann, I. (2024). “Recent Progress in Turning Waste into Catalysts for Green Syntheses”. *Sustainable Chemistry* (ISSN: 2673-4079), Vol. 5, Nr. 1. S. 27–39. DOI: 10.3390/suschem5010003.

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# 8

# Promoting young talent: the DBFZ doctoral programme



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**Fig. 35:** Successful completion of a doctorate with distinction: DBFZ doctoral student Clement Owusu-Prempeh

With the DBFZ's doctoral programme, which has been in place since 2013, doctoral students at the DBFZ have a variety of opportunities to work on a topic in the field of bioenergy/bioeconomy and to implement the knowledge they have acquired in applied research. For the practical work on their research topics, they will find state-of-the-art equipment in the DBFZ's well-equipped laboratories, pilot plants and offices. Expert supervision by experienced scientists provides an additional guarantee of high-quality doctoral supervision and research. Through regular participation in high-level scientific events (e.g. Doctoral Colloquium BIOENERGY AND BIOBASED PRODUCTS and DBFZ Annual Conference), young scientists doing their doctorates are introduced to the scientific community at an early stage. In addition, they are given the opportunity to consolidate their experiences in the context of committee work.

**Tab. 5:** Overview of doctoral degrees

| | |
|---|---|
| **Number of doctoral projects in 2024** | **66** |
| of which are supervised at the DBFZ: | 31 |
| of which are supervised at the Universities of Leipzig and Rostock and UFZ: | 30 |
| of which were sucessfully completed in 2024: | 4 |
| Further co-operations with national and international universities and Universities of applied sciences in the context of supervising the above-mentioned doctoral projects. | 1 |

# 7th Doctoral Colloquium BIOENERGY AND BIOBASED PRODUCTS

The seventh edition of the Doctoral Colloquium BIOENERGY AND BIOBASED PRODUCTS took place on 24–25 September 2020 at the DBFZ and offered plenty of opportunities for new scientific insights and networking with a total of six sessions, an extensive poster session, two keynote speeches and a social programme. After a total of seven successful editions of the event series, the patronage of Prof. Dr. Daniela Thrän was handed over to the scientific managing director of the DBFZ, Prof. Dr. Michael Nelles. The conference reader, which is available free of charge, offers an extensive overview of the current state of the art in energy and integrated material use of biomass on over 300 pages.

→ **Further information:**
**www.doc-bioenergy.de**
**www.linkedin.com/showcase/doctoral-colloquium-bioenergy**

**SAVE THE DATE!**

The 8th edition of the event series will take place from 10–12 September 2025 at the University of Stuttgart.

**Fig. 36:** Impressions of the 7th Doctoral Colloquium BIOENERGY AND BIOBASED PRODUCTS (24–25 September 2024)



| 4th Doctoral Colloquium BIOENERGY | 5th Doctoral Colloquium BIOENERGY | 6th Doctoral Colloquium BIOENERGY | 7nd Doctoral Colloquium BIOENERGY |
|---|---|---|---|
| 2021 | 2022 | 2023 | 2024 |
| Host: KIT, Karlsruhe | Host: DBFZ, Leipzig | Host: HAWK, Goettingen | Host: DBFZ, Leipzig |
| 70 Participants | 75 Participants | 42 Participants | 85 Participants |
| Participants from Austria, Brazil, Canada, China, Germany, Ghana, Greece, Iran, Nigeria, Poland, Russia, Syria, Thailand and Zambia | Participants from Austria, Belgium, China, Columbia, Denmark, France, Germany, Ghana, Greece, India, Indonesia, Iran, Iraq, Italy, Norway, Pakistan, Phillipines, Republic of Cameroon, South Africa, Spain, Sweden and Switzerland | Participants from Austria, China, Columbia, Germany, Great Britain, India, Iran, Italy, Norway and Pakistan | Participants from Austria, China, Colombia, Denmark, Germany, Iran, Italy, Mali, Sweden and Switzerland |
| Scientific Advisory Board: 46 Members representing | Scientific Advisory Board: 46 Members representing | Scientific Advisory Board: 46 Members representing | Scientific Advisory Board: 46 Members representing |
| 37 Institutions | 37 Institutions | 37 Institutions | 37 Institutions |

**Fig. 37:** Key figures of the Doctoral Colloquium BIOENERGY AND BIOBASED PRODUCTS event series

# List of current promotions at the DBFZ

(As at: 31 January 2025)
* Successful completion in 2024

**Adam, Roman**
Investigating the compaction of biomass using DEM simulation
Technical University of Berlin

**Angbé, Kassé Jean Hugues**
Process development for the utilization of residues from cocoa cultivation using pyrogenic processes
University of Rostock

**Bindig, René**
Procedure for developing catalysts for reducing emissions from incinerators
Martin-Luther-University Halle-Wittenberg

**Delory, Felix**
Model-based monitoring of anaerobic digestion plants
Technical University of Berlin

**Dietrich, Sebastian**
Synthesis of Light Hydrocarbons from Biogas
Technical University of Berlin

**Dotzauer, Martin**
Business assessment of policy instruments to achieve the expansion targets of bioenergy plants in the electricity sector using object-oriented programming
University of Leipzig

**d'Espiney, Ana Careirra**
Bioenergy production optimization through complementary effluents management
University of Leipzig/University of Lisbon

**Gallegos*, Daniela**
Optimization of ensiling fermentation of Elodea genus for biogas production
University of Rostock

**Grimm, Daniel**
Oyster mushroom cultivation on straw: productivity, sustainability and adaptability to the case of Uganda
University of Kassel

**Hellmann, Simon**
Process Monitoring and advanced control of agricultural biogas plants
Technical University of Chemnitz

**Karras, Tom**
Biomass supply costs for biogenic waste
University of Leipzig

**Klüpfel, Christan Paul**
Hydrothermal liquefaction of biomass residues
Technical University of Berlin/ Aarhus University, Denmark

**Köchermann, Jakob**
Hydrothermal Conversion of Hemicellulose Sugars for the Production of Furfural
Technical University of Berlin

**König, Mario**
Investigations into the development and application of new SCR catalysts for the reduction of nitro-gen oxides in exhaust gases from the thermo-chemical conversion of biogenic solid fuels
Martin-Luther-University Halle-Wittenberg

**Kurth, Matthis**
Mass transfer descriptions of carbon membranes for water, hydrogen and methane
Technical University of Berlin

**Lenhart, Markus**
Determination of factors influencing climate-relevant emis-sions at biowaste treatment plants on the basis of various field measurement methods
Still open

**Manolikakes, Nikolaus**
Investigation of bonding mechanisms of organic binders in iron ore agglomeration
Still open

**Matlach, Julian**
Determination of factors influencing climate-relevant emissions at biowaste treatment plants on the basis of various field measurement methods
Magdeburg/Stendal University of Applied Sciences

**Meola, Alberto**
Artificial Intelligence for process simulation of anaerobic digestion plants
University of Leipzig

**Nieß, Selina**
Methanation catalysts for the direct biogas methanation of purified biogas
Technical University of Berlin

**Pouresmaeil, Shabnam**
Bioelectrochemical Power-to-Gas using bed electrodes based on biochar
University of Leipzig

**Prempeh*, Clement Owusu**
Generation of biogenic silica from biomass residues for sustainable industrial material applica-tions
University of Rostock/University of Stellenbosch, South Africa

**Putra, Rafiandy Dwi**
Exploring various ways of using biomass in the direct reduction process to decarbonise iron and steel production
Freiberg Mining University

**Richter, Lukas**
Optimised energy management in a power cell
Technical University of Dresden

**Richter, Sören**
Development of bioeconomy scenarios up to 2050
University of Leipzig

**Röder, Lilli Sophia**
Strategies for demand side management in biorefineries – Exploring new frontiers in enhancing load flexibility and optimization
Ruhr University Bochum

**Siol, Christoph**
Assessing new technologies for the circular bio-economy with combined environmental and eco-nomic LCSA
University of Leipzig

**Sumfleth, Beike**
Integrated Assessment Framework for Low-ILUC-Risk Certification of Sustainable Biofuels
University of Leipzig

**Verworner, Bengt**
Development of the potential of lignocellulosic biomasses using white rot fungi
Technical University of Dresden

**Weber, Svenja Nathalie**
Elimination and sorption behavior of veterinary antibiotics during digestion of dry chicken manure
University of Rostock

**Wedwitschka, Harald**
Development of methods for characterising the ingredients used in box fermentation processes
University of Rostock

**Wilde, Kerstin**
Transition towards a bioeconomy: discourses, vantage points, and actors' contextualized institu-tional work
Martin-Luther-University Halle-Wittenberg

**Wollnik, Ronja**
Decision support for regional integration of bio-based carbon dioxide removal in Germany
University of Leipzig

**Yuan, Bomin**
Investigation and modelling of the influence of the recirculation of partially treated digestate on methane yield and process efficiency
Technical University of Berlin

→ **Further information:**
**www.dbfz.de/en/career/phd-program**

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# List of current doctoral theses with the cooperation partner Helmholtz Centre for Environmental Research – UFZ

(As at: 31 January 2025)
* Successful completion in 2024

## Cooperation UFZ – BEN

**Chan, Katrina**
Modelling the energy use of biomass in sustainable agriculture and nutrition scenarios
University of Leipzig

**Cheng, Zhe**
Fate and effects of antibiotics in anaerobic digestion systems
Technical University of Berlin

**Guerra-Blackmer, Elliot**
Microbiological strategies to mitigate foaming events in biogas reactors
University of Leipzig

**Kähl, Daniel**
Reducing the inhibitory effects of propionic and butyric acid during methanation by promoting direct interspecies electron transfer
University of Leipzig

**Manske, David**
Monitoring Renewable Energy Landscapes in Germany: A spatial-systemic approach
University of Leipzig

**Musonda, Frazer**
Modelling of Bioenergy and bioeconomy futures: The optimal allocation of biomass to competing sectors
University of Leipzig

**Sadr, Mohammad**
Modeling bio-based NETs in Germany considering regional perspectives
University of Leipzig

**Schäfer, Christina**
Engineering microbial communities for the conversion of ligno-cellulose into medium-chain carboxylates
University of Leipzig

**Strobel, Piradee**
Sustainable bioethanol development for an approach to circular economy in Thailand – an evalua-tion by multi-criteria decision making
University of Leipzig

**Welker, Matthias**
Governance Monitor – Tracking and assessing governance narratives for sustainability transfor-mations
University of Leipzig

**Zeug*, Walter**
A holistic life cycle sustainability assessment for bioeconomy regions – linking regional assess-ments, stakeholders and global goals
University of Leipzig

## Cooperation UFZ – MicAs

**Guerra-Blackmer, Elliot**
Microbiological strategies to mitigate foaming events in biogas reactors
UFZ–Department Mikrobielle Biotechnologie (MIBITECH), University of Leipzig

**Kähl, Daniel**
Reducing the inhibitory effects of propionic and butyric acid during methanation by promoting direct interspecies electron transfer
UFZ–Department Mikrobielle Biotechnologie (MIBITECH), University of Leipzig

**Schäfer, Christina**
Engineering microbial communities for the conversion of lignocellulose into medium-chain carbox-ylates
UFZ–Department Mikrobielle Biotechnologie (MIBITECH), University of Leipzig



# List of current doctoral programmes with the University of Rostock

(As at: 31 January 2025)

**Afrakoma Armoo, Ekua**
Closing the loop in a circular economy – sustainable compost product from fermentation residues
University of Rostock

**Al Saadi, Abdullah**
Optimisation of Charcoal Application on Anaerobic Digestion Process
University of Rostock

**Al-Bewani, Rzgar**
Increasing the efficiency of mechanical-biological residual waste treatment through the fermentation of the liquids after pressing the organic fractions
University of Rostock

**Amin, Alfred**
The influence of material flows on the resilience of bioenergy plants
University of Rostock

**Bassey, Uduak Gabriel**
Thermochemical conversion of single-use and multilayered waste plastics
University of Rostock

**Beguedou, Essossinam**
Development of holistic research based implemen-table strategy for Togo to supplement the industrial energy requirements through alternative fuels
University of Rostock

**Chaher, Nour El Houda**
Towards a Circular Economy: Systematic FWWE Integration for Sustainable Development in Tunisia
University of Rostock

**Darmey, James**
Continuous process biogas production from municipal solid wastes from Ghana
University of Rostock

**Ender, Tommy**
A concept for the treatment and nutrient recovery from process water used in the hydrothermal carbonisation of waste
University of Rostock

**Gbiete, Djangbadjoa**
Biohydrogen Production from Food Waste through an Integrated Biochemical and Thermochemical System
University of Rostock

**Häner, Jurek**
Investigations on Biogas Plants in a Collective System
University of Rostock

**Lara, Cynthia**
Assessing the Carbon Footprint of Agricultural Products and Residues
University of Rostock

**Sambiani, Edward**
Supercritical water gasification technology as an alternative for MSW materials conversion into synthetic gas
University of Rostock

**Shettigondahalli Ekanthalu*, Vicky**
Hydrothermal carbonization of sewage sludge and the influence of pH on phosphorus transformation and hydrochar properties
University of Rostock

**Vincent, Lynn**
Extension of energy system modelling for Thuringia – survey of biomass potential, expansion of bioenergy pathways, life cycle assessment
University of Rostock

**Weppel, Johanna**
Options for mechanical-biological waste treatment plants (MBT) in the context of future technical, social and legal conditions
University of Rostock

**Zipporah, Asiedu**
Developing a sustainable model for management and sustainability of bioeconomy urban metabolism; Accra as a case study
University of Rostock

9

# Press, media and events: the DBFZ in the public

By 2024, scientists have successfully transferred the numerous research topics of the DBFZ to the scientific community and the interested public together with the press and public relations department. The freely available series of publications “DBFZ Report” and “Conference Reader”, specialist events, press and media work, social media, exciting multimedia reports and the production of science videos were the focus of the activities. In addition, selected events were covered by the media.

## Press & Media

Whether as guests in podcasts or as experts in print/online or TV contributions: DBFZ scientists were again in demand as interview partners in the media in 2024. Highlights in the press/media sector included TV interviews as part of the “zirkulierBAR” and “HanfNRG” research projects, as well as various expert interviews on topics such as biogas from cereal straw or innovations and challenges in the stove industry. The media presence was also expanded in an international context, for example for the “ETH-Soil” project, through the broadcasting of various reports in important Ethiopian media.

Do you want to stay up to date on bioenergy and be informed about current developments and research projects? Register for our press mailing.

→ **Further information: www.dbfz.de/en/press-media-library/press**

### DBFZ scientists in the media

**Fig. 38:** Dr. Claudia Kirsten as an expert in the tv freature “The treasure in the toilet” (ZDFtivi)


**Fig. 39:** DBFZ scientist Harald Wedwitschka in the programme “Klimazeit”


**Fig. 40:** Podcast “The joy of fire” with Prof. Dr. Ingo Hartmann

## Video production/ multimedia report

Since March 2024, the DBFZ has been producing a wide range of scientific video formats and multimedia reports on selected research projects and current energy topics. In total, five short videos on research projects, various conference documentaries and an “explanatory series” on the topic of bioenergy were created in 2024. In August 2024, for example, the “MycoForm” project was filmed as an example of scientific video communication: the project, which was carried out by the DBFZ, investigated the cascade use of organic residues for the production of completely biogenic materials such as insulation boards and moulded packaging parts, which are kept in shape by fungal mycelium. MycoForm investigated the possibility of making the best possible use of fungi in the context of bioeconomy.

→ **More project videos are available at:**
www.dbfz.de/pressemediathek/mediathek/videos
www.youtube.com/@dbfz_de

**Fig. 41:** Video on the “MyCoForm” project (german language)



**Fig. 42:** Comprehensive multimedia report on the biomass laboratory in Togo

## Multimedia report on the biomass laboratory in Togo

On 19 May 2024, a complete biomass laboratory was handed over to university scientists at the University of Lomé in Togo (further information on page 95). In a comprehensive multimedia report with five chapters, the biomass research in West Africa is presented using the laboratory, with its functionalities in images and sound, as well as a wide range of background information.

→ **Multimedia-Report:**
www.dbfz.de/en/togo-story



## Publication Series

The diversity of the scientific events is reflected in particular by the further expansion of the DBFZ publication series “Tagungsreader” (Conference Proceedings) in 2024. A total of six digital editions for the “Separator Expert Discussion & Dust Measurement Methods”, “DBFZ Annual Conference”, “Doctoral Colloquium BIOENERGY AND BIOBASED PRODUCTS” and “HTP Expert Forum” series of events were produced in 2024 and made available free of charge on the DBFZ website. The conference readers contain presentations and abstracts of all participating speakers and thus provide an excellent overview of the current state of research in the respective topics.

The DBFZ conference readers, annual reports, brochures and the scientific publication series “DBFZ Report” are available as free PDF downloads from the following addresses:

→ **Downloads:**
www.dbfz.de/en/reports
www.dbfz.de/en/conference-reader
www.dbfz.de/en/brochures
www.dbfz.de/en/annual-report

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**Fig. 43:** Freely available series of conference readers published in 2024

## Event and visit management

Numerous project meetings, workshops, in-house specialist events and event collaborations were on the agenda of the "Communications and Events Management" department in 2024. With a total of over 70 events, the DBFZ further expanded its visibility in the scientific community. In addition, the DBFZ welcomed almost 60 groups of guests totalling 660 people from various regions of the world in 2024. Highlights included a visit by the Indian ambassador, H.E. Harish Parvathaneni, a delegation from the National Renewable Energy Laboratories (NREL) in Denver, Colorado, and a visit by the Science and Technology Department of the French Embassy in Germany. In addition to various political representatives, we were able to welcome EU politician Anna Cavazzini (Alliance 90/The Greens) to the DBFZ on 18 June 2024.

**Fig. 44:** Visit of the Indian ambassador, H. E. Harish Parvathaneni (second from left)/EU politician Anna Cavazzini (Alliance 90/The Greens) visits the DBFZ's Biorefineries technical centre

### Highlights of the event year 2024

The annual industry get-together on the topics of "Particle separators in domestic furnaces" and "Dust measurement methods for small combustion plants" took place on 7/8 February 2024 in proven cooperation with the Technology and Funding Centre Straubing (TFZ) as a double event at the DBFZ in Leipzig. At the 15th edition of the event series, around 100 interested parties from science and industry discussed the state of the art, the challenges with regard to the assembly and use of dust separators, and this time also the measurement methods necessary for evaluation. The technical state of the art in the field of dust separators, including those for small combustion capacities, is high, according to the positive conclusion of the approximately 100 participants. In this context, the focus of the event was not so much on the status quo of development as on the intelligent combination of existing dust collectors with other pollutant reduction techniques and their integration into the combustion plant.



**Fig. 45:** DBFZ Annual Conference 2024: "Multitalented Biomass: Basic Raw Material, Carbon Carrier and Energy Option"

### DBFZ Annual Conference discusses the "Multitalented Biomass"

The 6th DBFZ Annual Conference on 11/12 September 2024 was held under the question of what requirements biomass can and must meet. Around 160 participants from the fields of science, business and politics discussed the topic "Multitalented Biomass: Basic Raw Material, Carbon Carrier and Energy Option". In his welcoming address, the former Saxon State Secretary for Energy, Climate Protection, Environment and Agriculture, Dr. Gerd Lippold, pointed out that knowledge about the finite nature of fossil resources is the central starting point for future strategies. He said that bioeconomy plays a crucial role as a solution for a more sustainable and future-oriented economy. In a total of three sessions, fourteen expert lectures on the topics "The future of biomethane – an expedition of possibilities", "Bio-based solutions for negative emissions" and "Biomass cycles", a poster session and accompanying workshops, not only the wide range of possible applications for biomass, but also its important contribution to climate protection were expressed over two days.

## The DBFZ at the International Biomass Conference in Marseille

The European Biomass Conference and Exhibition (EUBCE) is the leading conference for global biomass innovation and one of the most important conferences in the European-speaking world. The 2024 event took place in Marseille, France, from 24–29 June. A total of fourteen DBFZ scientists were represented at the conference with a trade fair stand, ten technical presentations, four poster presentations, the moderation of three sessions and in a panel discussion.

The extensive presence allowed the DBFZ to expand its knowledge, establish new partnerships and initiate innovative project collaborations. EUBCE 2025 will take place in Valencia, Spain, from 9–12 June.

→ **Further information:**
www.eubce.com/previous-events-2024


**Fig. 46:** DBFZ participants at the EUBCE 2024



# Event highlights 2025

**18 March 2025**
Formal opening of the Pilot-SBG Demonstration Plant & Workshop “Renewable LNG in transport”

**19 March 2025**
Leipzig biofuels expert talk:
”20 years to climate neutrality in Germany”

**23 May 2025**
4th Long Night of Education

**20 June 2025**
Long Night of the Sciences

**10–12 September 2025**
8th Doctoral Colloquium BIOENERGY AND BIOBASED PRODUCTS

**16 September 2025**
6th Biorefinery Day

**5 November 2025**
Leipzig biogas expert talk
“Substrate disintegration process – the latest research”

**20/21 November 2025**
Status Conference Bioenergy 2025

**Fig. 47:** The DBFZ event team

→ **You can find an overview of our events at:**
www.bioenergie-events.de

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# 10

# International Research



One of the DBFZ's key objectives is to carry out scientific project work in an international (non-European) context. The aim is to make the scientific expertise of the DBFZ available to foreign partners and to initiate research collaborations. In addition to the joint processing of research projects, the exchange of doctoral students and the implementation of mutual research stays are also planned. Another goal is to establish cooperation with international universities and non-university research institutes, as well as to consolidate and selectively expand non-European networks. In addition to the initiation and mediation of mutual visits, this also includes the organisation of workshops and conferences.

## DBFZ hands over biomass laboratory to Togolese scientists

As part of the research project "Development of research activities and demonstration of technologies for the use of biomass potential in Togo" (LabTogo), financed by the German Federal Ministry of Education and Research (BMBF), a fully equipped biomass laboratory was handed over to scientists from the Togolese University of Lomé on 19 May 2024. In the project coordinated by the DBFZ, targeted knowledge and technology transfer on the bioenergetic use of organic residues has been carried out since 2019. The aim is to contribute to the fight against climate change and to significantly reduce deforestation in the target region. The biomass laboratory is used to characterise substrates in terms of

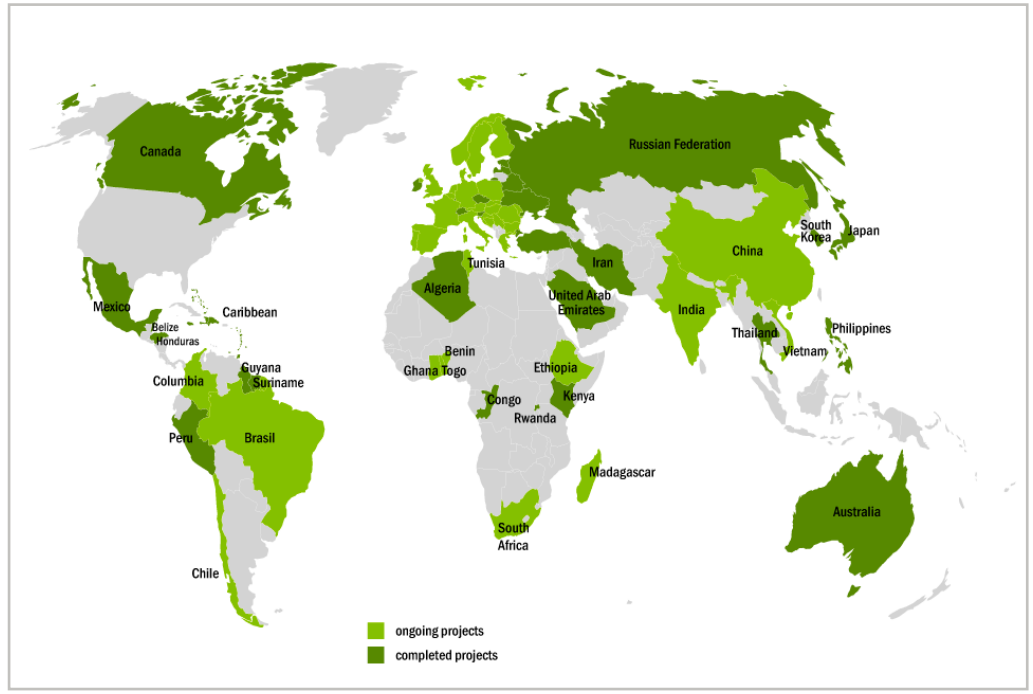


**Fig. 48:** International projects of the DBFZ

**Fig. 49:** Handover of a new biomass laboratory to Togolese scientists

their fermentability, to determine process parameters for fermentation and to evaluate process optimisations. Furthermore, the laboratory will be used to train personnel in the operation of biogas plants with regard to the fundamental parameters. The exchange of scientific experts serves as an introduction to the theoretical and practical knowledge required for operating and conducting research in the biogas laboratory, as well as the long-term development of corresponding knowledge and research activities in Togo.

## Macroalgae utilisation project in the Caribbean

Sargassum, a brown macroalgae, washes up annually on Caribbean coasts, causing significant problems for fishing and tourism and endangering the livelihoods of coastal communities. In response, Caribbean states are working with local academic institutions to develop solutions that will transform this challenge into an economic opportunity or manage it in an ecologically and economically sustainable way. On behalf of the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), the DBFZ is supporting scientific cooperation and exchange between European and Caribbean research institutions and universities on the topic of material and energy use of the Sargasso Sea.

An initial on-site mission revealed that various local actors, some with different international partners, are working on a wide range of recycling options. These range from composting, biochar, animal feed and alginate production to the manufacture of plastics. The unresolved question of biowaste recycling and the very high prices for energy, especially for electricity, suggest that biogas should be favoured as a recycling option. In order to develop local biogas expertise, the project is working with partner institutions to strengthen biomass and biogas research in Caribbean research institutes and universities. This includes procuring the necessary laboratory equipment and training staff. The aim of the project is to further consolidate cooperation and knowledge transfer for future joint project proposals and the joint development of laboratory equipment in the Caribbean.

From 9 to 13 September 2024, 15 people from the Caribbean took part in a week-long biomass and biogas training course at the DBFZ in Leipzig. The training programme included various activities designed to provide a comprehensive understanding of biomass utilisation: theoretical lectures, calculations, practical exercises, presentations of current and past biomass utilisation projects, excursions to pilot and industrial biogas plants and biowaste disposal facilities, and subsequent discussions on how biogas production would need to be adapted to Caribbean conditions. The series of lectures was continued online after the workshop until the beginning of February 2025. In 2025, another four-week DBFZ biogas laboratory training course will be held for a group of seven visitors from the Caribbean. The training course will focus on teaching practical laboratory skills for characterising biomass and conducting biogas potential analyses.

**Fig. 50:** Sargassum algae are causing problems on Caribbean beaches

**Fig. 51:** Biomass and Biogas Workshop in Leipzig (9–13 September 2024)

## The DBFZ is joining the German-African Business Association

With the aim of consolidating and further expanding the numerous activities in Africa in recent years, the DBFZ joined the German-African Business Association in September 2024. The aim of the association, which has existed for 90 years, is to promote exchange between German and African representatives from business and politics. The association has more than 450 members from all sectors of the economy – SMEs and large corporations, agricultural enterprises, energy and transport companies. With its membership, the DBFZ aims to increase its own visibility, as well as to come to concrete projects with companies.

Afrika-Verein der deutschen Wirtschaft

→ **Further information:**
www.afrikaverein.de/en

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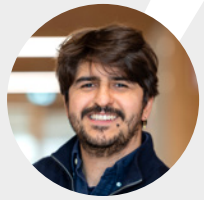
## International scientists at the DBFZ

### What are you working on?

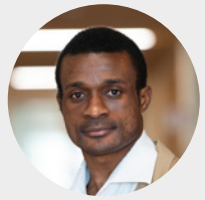
**Duaa Yousef Mohammed Al-Laseh**
**Thermo-chemical conversion**

“I am a research associate and contribute to the ETH SOIL project as a developer of master’s materials, while also monitoring the progress of the master’s programme. In addition, I am working on the development of hybrid heating systems, with a focus on the application of heat pumps and hydrogen to implement efficient and environmentally friendly heating solutions.”



**Dr. Andrés Camilo Acosta Peláez**
**Biorefineries**

“I have a PhD in bio- and chemical engineering from Aarhus University in Denmark and am currently working as a research associate (postdoc) in the field of biorefineries. My research work includes the catalytic hydrothermal synthesis (HTS) of platform chemicals (e. g. furfural and HMF).”

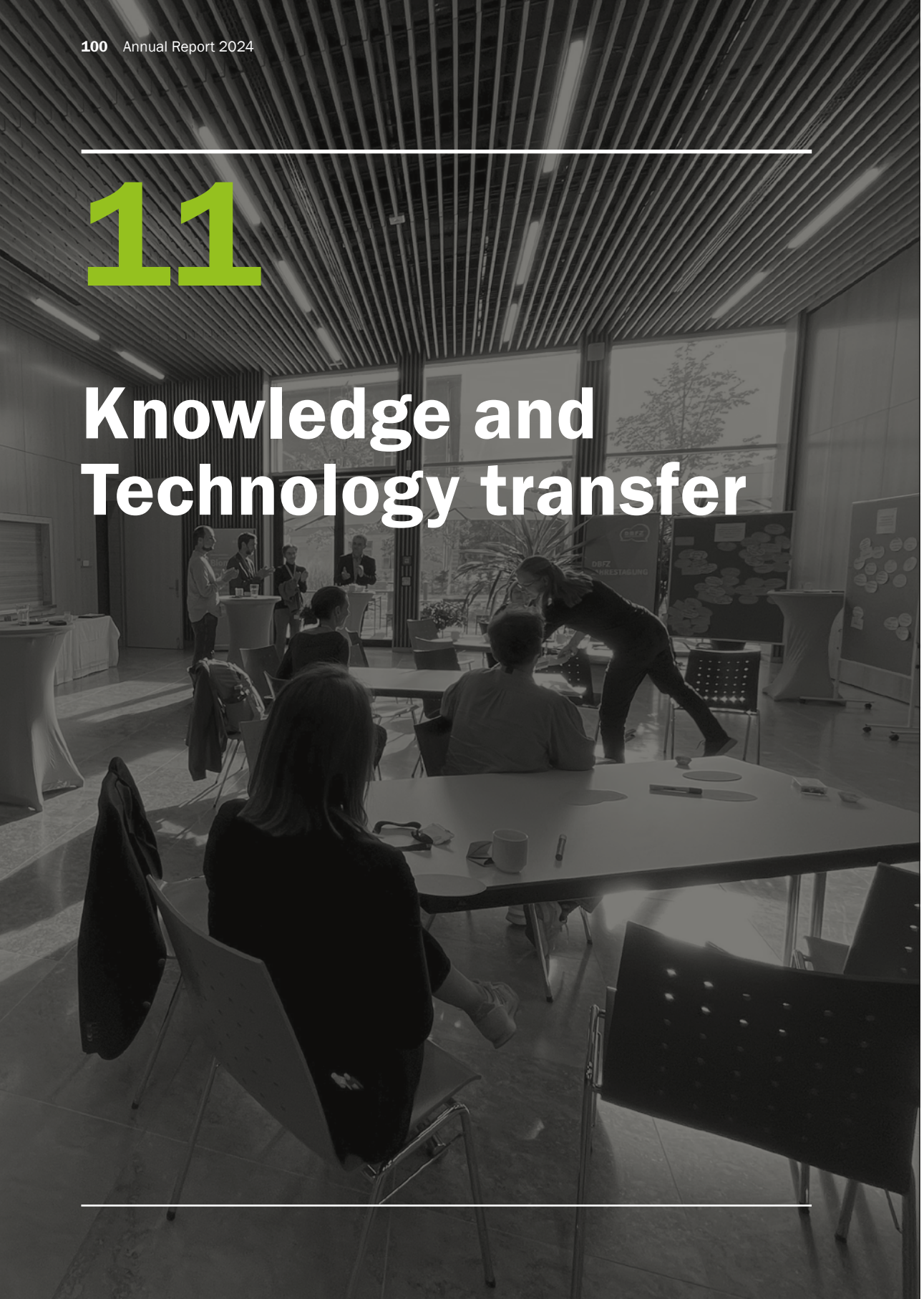


**Dr. Daniel Dzofou Ngoumelah**
**Biochemical conversion**

“I am currently leading the European project Biomethaverse at the DBFZ, in which we are optimising the biological in situ methanation process to reduce the $CO_2$ in the biogas and increase the biomethane content by over 30 %. I am also leading the CarboFerro project, in which we are developing biocarbon from carbon and iron supplements to remove $H_2S$ and increase the energy content of the biogas.”

**Isis Paola Núñez Franco**
**Bioenergy systems/datalab**

“I am the project manager of the AI & Data Accelerator (KIDA) project, an AI initiative of the BMEL that applies data-driven methods in the agrifood sector. My work includes time series and energy price forecasting, energy system analysis, machine learning and deep learning. I also implement solutions for natural language processing, large language models and retrieval-augmented generation.”



# 11

# Knowledge and Technology transfer



The DBFZ conducts applied research and development (R&D) in a variety of facilities, test centres and laboratories. The primary goal is to transfer scientific findings from research projects into practical application. Whether technological, in the form of an improved production process or a new product from biowaste, or knowledge-based, for example, providing information on available raw material potentials or comments on planned legislative changes: research achieves an impact when it reaches its respective target group.

## 11.1 Knowledge transfer

### zirkulierBAR: Recovery of nutrients from consumed food for a sustainable, regional circular economy

The interdisciplinary, BMBF-funded project “zirkulierBAR” (FKZ: 033L242H) researched the treatment of human excreta to produce fertiliser, and tested the application of this fertiliser in agriculture. The project also focussed on dialogue with politics and society, development of transformation paths in the field of sanitation, and networking of interested municipalities. As part of the project, an innovative and flexible recycling plant for the contents of dry toilets was built. The end products are recycled fertilisers for agriculture and horticulture: non-hazardous, nutrient-rich and low in pollutants. This provides municipalities with a water-saving and resource-conserving alternative to linear, water-dependent sewage systems.

In the project, the DBFZ, together with partners, was responsible for quality assurance, standardisation and identifying legal hurdles in the production of humus and recycled fertilisers from the contents of dry composting toilets.

#### Project completion and results

On 17 October 2024, the final event of the research project “zirkulierBAR – REGION. innovativ” took place in Berlin. More than 140 participants attended the event in the large cinema hall of the Hackesche Höfe Kino in Berlin Mitte. The project also included publication of the Handbook for the Sanitation and Nutrient Transition. This publication is a practical guide for municipal employees, planners, farmers, politicians and anyone


**Fig. 52:** Expert Dr. Claudia Kirsten (centre) at the final event of the zirkulierBAR project

interested in resource-efficient sanitation. In addition to many other publications in the project, three position papers which examine the current legal framework were produced under the leadership of the DBFZ. Furthermore, a comprehensive data publication was produced, which shows that the recycled fertilisers are safe in accordance with DIN SPEC 91421.

→ **Free Download:**
**www.naehrstoffwende.org/zirkulierbar-handbuch/**
**www.naehrstoffwende.org/rechtliche-einordnung/**
**https://data.mendeley.com/datasets/fjv2bf6mh2/2**

**Contact:**
**Dr. Claudia Kirsten**
E-mail: claudia.kirsten@dbfz.de



# 11.2 Technology transfer

## HanfNRG: Studies of the energy utilisation options for hemp fibre residues for exemplary integration into the energy concept of a processing site; sub-project: comparative study of the energy utilisation options for hemp fibre residues

In recent years, the hemp industry has grown rapidly due to changed political conditions and innovative product applications. As the use of renewable energy sources increases, other resources dwindle and the use of renewable raw materials for energy production is being discussed ever more critically, the development of biogenic residual and waste materials for the production of efficient, storable, flexible and decentralised bioenergy sources is becoming increasingly important.

The goal of the “HanfNRG” project (FKZ: 03EI5448) is to use residual materials from the hemp processing industry as cost-effective raw materials for bioenergy production and to identify economic and environmentally friendly process chains for subsequent transfer into practical application. In cooperation with the company Hanffaser Uckermark eG, a manufacturer of organic insulation materials, the project investigates various possibilities for energy recovery from the residuals. While the project partner works on optimising material separation, storage and pre-conditioning, the DBFZ investigates biogas potential, solid fuel properties and pyrolytic gasification.




**Fig. 53:** Pressing hemp briquettes using a thermal process

### Results so far

The pelletisation experiments carried out within the project have demonstrated how homogeneous and high-quality pellet fuels can be produced from hemp residues. Furthermore, the results of the chemical analyses of the hemp pellets prove that all properties except for the chlorine content already meet the requirements of fuel class 1 according to DIN 17225-6. To verify that pellet fuels from hemp residues can become an approved fuel, combustion tests were carried out in a small-scale biomass combustion plant. The emission values determined were compared with limit values according to the 1st BImSchV. The test results will now be incorporated into a final economic and environmental assessment and into the DBFZ resource database. On the basis of the project results, a well-founded selection of suitable residue treatment processes for the hemp processing industry will become possible, taking into account the respective local conditions.

→ **Further information:**
**www.dbfz.de/en/hanfnrg**

**Contact:**
**Harald Wedwitschka**
E-mail: harald.wedwitschka@dbfz.de




# 11.3 BMWK research programme “Biomass to Energy”

The “Energetic use of biogenic residuals and waste materials” research programme is part of the German Federal Government’s energy research programme and funded by the Federal Ministry for Economic Affairs and Climate Action (BMWK). The “Biomass to Energy” accompanying research has been awarded to the DBFZ several times in succession. The team of accompanying researchers is currently taking care of approximately 50 research projects that deal with the versatile energy potential of residual and waste materials. The accompanying research is also responsible for coordinating the Bioenergy Research Network, which is affiliated with the funding area. The aim is to create cross-project additional benefit and facilitate the transfer of valuable results to the energy market.

The specific tasks of the accompanying research include scientific monitoring, networking between stakeholders from research, industry and politics, and scientific communication. To promote fast and open transfer and discussions of results, the accompanying research team holds a monthly webinar, the Bioenergie Talk. Furthermore, the team organises workshops and conferences, publishes focus issues, presents individual projects in multimedia formats and initiates political statements. For the DBFZ’s 2024 annual conference, the accompanying research organised the workshop “Shaping Transfer: How bioenergy is finding its place in the economy faster”, which was followed by the publication of recommendations for accelerated transfer of bioenergy innovations to the energy market. In addition to the accompanying research, the DBFZ was represented in the funding area with 15 projects in 2024.

Biomass to energy

20.–21.11.2025
STATUSKONFERENZ
BIOENERGIE

**SAVE THE DATE:**

Status Conference Bioenergy
20/21 November 2025

→ **Further information:**
**www.energetische-biomassenutzung.de/de/node/554**

## Workshop “Shaping the transfer: how bioenergy can find its place in the economy faster”

In September, the two-day workshop “Shaping Transfer: How bioenergy can find its place in the economy faster” took place at the DBFZ as an accompanying event to the DBFZ’s annual conference. The aim was to share practical experiences with the market transfer of future-oriented bioenergy technologies with other innovation drivers. In the first part of the workshop, which took place online on 9 September 2024, best practice examples from the funding area “Energy use of biogenic residues and waste” were presented; in addition, participants were able to discuss with the speakers. At the get-together on 12 September 2024, the participants exchanged experiences and worked out measurements to accelerate the transfer of bioenergy innovations to the market. The resulting recommendations for action were published in an open access paper.


**Fig. 54:** Recommendations for action (german language)

→ **Download recommendations for action:**
www.energetische-biomassenutzung.de/de/node/553

→ **Further information:**
www.energetische-biomassenutzung.de/
www.forschungsnetzwerke-energie.de

### Contact

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**Fig. 55:** Workshop “Shaping Transfer” as part of the DBFZ Annual Conference 2024

# 12

# In focus: research data and fake science



Research data is any kind of information that has been generated, collected, observed or created during scientific work. However, a standardised definition of the term “research data” does not exist. The label “research data” results often from the project context and the hypotheses or research questions derived from it. Thus, even at DBFZ a variety of research data exists, amongst them measurement data, laboratory values, model simulations, surveys and questionnaires. Research data is provided in various formats, though a structured format and data storage support the enrichment with other data sources. Once the research data have been analysed and initially exploited, its primary use ends. Now at the end of its data life cycle these research data can be archived and made available for reuse by other scientists. FAIR (Findable, Accessible, Interoperable, Reusable) processed research data are one way of countering the increasing propagation of fake science publications (e. g. deliberately manipulated results or arbitrary analysis) and therewith improving reliability and the integrity of science itself.

**Fig. 56:** Data Steward Dr. Torsten Thalheim

**Dr. Thalheim, how much fake science exists and how does it affect the scientific community?**

**TORSTEN THALHEIM:** In 2022, 2 % of all published articles are confirmed fake science. This is a lower bound across all disciplines, because these number represent the validated issues only. Every single manipulated article is horrible for daily scientific work. Future research projects that derive their hypotheses from unrecognised manipulated results are doomed to fail before they start.

**How can scientists recognise and counter fake science?**

**TORSTEN THALHEIM:** It is important to make the scientific community aware that fake science articles can occur in any discipline. Taking this into account the results of other studies should not be adopted unscrutinized. Ideally, only content from original work that can be verified should be cited in own articles. If suspicious content appears, this can be reported on a platform such as PubPeer (**https://pubpeer.com**). The persons responsible for the content will be notified afterwards and given the opportunity to comment on this issues.

**What measures is the DBFZ taking to avoid fake science?**

**TORSTEN THALHEIM:** The quality management measures in place at the DBFZ, for instance regular audits, prevent the integration of fake science content. Adherence to “good scientific practice” is mandatory and a matter

of concern for every emploee at the DBFZ. To promote understanding of “good scientific practice”, we held an in-house training course for the first time last year and will continue this lecturesin future.

**To what extent does open data contribute to the success of fake science?**

**TORSTEN THALHEIM:** The question suggests that scientific integrity is undermined by open data. In fact, the opposite is true. The current success of fake science is mainly based on a strategy of presenting results highly unspecific and difficult to verify. Only the necessary information is published for each article, while raw or primary data is repressed. Unfortunately, this practice is still tolerated by various publishers. Of course, open data makes ghostwriters daily business easier. They offer the preparation of scientific articles as a service and relate this work to open data. However, a researcher who uses this service is committing scientific misconduct, since only a genuine contribution to a scientific paper qualifies a person to gain authorship. Finally, to get the point:Open data makes it more difficult to publish fake science, since manipulated results can easily be disproved by open data.

**Thank you for the interview.**

**PROFILE**

As Research Data Manager, **Dr. Torsten Thalheim** has been responsible for the cross-departmental, structured recording of all research data collected at the DBFZ since January 2023. The central goal is to promote the sustainable handling of research data in accordance with the FAIR principles and to support DBFZ scientists in preparing their data in accordance with the standards of good scientific practice and in transferring knowledge to the research community.


**Fig. 57:** FakeScience-Workshop with Dr. Torsten Thalheim

# 13

# Science-Based Services



As a research institute specialising primarily in applied research, the DBFZ works closely with project partners from industry, offering a wide range of contract research and a variety of science-based and technical services. These go beyond the five research priorities of the DBFZ and are aimed equally at politicians, business, associations, experts and committees. The content is handled in a cross-departmental and interdisciplinary manner so that the entire expertise of the DBFZ can be used comprehensively and efficiently for the following consulting and technical services.

## Science based services

_ Market analyses and data provision
_ Technical, economic and ecological evaluation
_ Concept and process development and optimisation
_ Scientific support of R&D projects
_ Scenario development
_ Knowledge transfer & OpenData

→ **Further information:**
**www.dbfz.de/en/services/science-based-services**

## Technical-scientific services

In addition to the above services, the DBFZ offers special R&D infrastructure in the three technical research areas of biochemical conversion, thermo-chemical conversion and biorefineries. The technical and scientific services are aimed at plant and mechanical engineering, process development companies, plant operators and other R&D-driven companies and institutions. In addition, there is the possibility of integrating the services of the analytical laboratory (chemical composition and fuel properties of solid biofuels, biogas substrates, liquid fuels, by-products from agriculture and forestry and other biogenic residues and waste materials, as well as their conversion products such as ash, filter dust, HTC coal and process water) in the context of research projects.

**Fig. 58:** Work in the DBFZ analytical lab

**Fig. 59:** DBFZ Combustion Technical Centre

## Biochemical Conversion Department:

_ Market analysis (based on the annual operator survey, among other things), forecasting and strategy consulting
_ Scientific support for the development of plant components
_ Balancing and evaluation of processes in terms of efficiency, technical feasibility and economics
_ Characterisation of substrates for biochemical conversion (digestibility, gas potential, etc.)
_ Biogas process analysis and characterisation of biochemical processes, mainly anaerobic processes
_ Experiment design (batch and continuous experiments, microbial electrochemical experiments)
_ Concept development for specific site conditions
_ Determination of energy quantities (electricity, heat) and identification of optimisation potential

## Thermo-chemical Conversion:

_ Development and characterisation of solid biogenic fuels and raw materials including pre-treatment, additives and compaction
_ Combustion experiments and comparative classification of the combustion properties of firing systems and fuels
_ Separator measurement with regard to dust emissions
_ Comparison measurements for dust measuring instruments (mass and number)
_ Characterisation and classification of pyrolysis coals in utilisation paths
_ Investigation of catalyst technology
_ Catalyst testing on the test bed and in practice with regard to efficiency and emissions
_ Catalyst screening in model and real gas

## Biorefineries Department:

Pilot plant tests on:

_ thermochemical biomass digestion
_ hydrothermal synthesis, carbonisation and liquefaction
_ hydrotreatment of biogenic oils
_ fixed bed gasification
_ synthesis gas processes
_ gas cleaning
_ solid-liquid/liquid-liquid separation processes for biogenic resources from aqueous media

→ **Further information:**
**www.dbfz.de/en/services/technical-and-scientific-services**

**Tab. 6:** Tabular overview of contact persons in the laboratories, test beds and technical facilities of the DBFZ

| Department | Description | Contact person |
|---|---|---|
| **Biochemical Conversion Department** | Research Biogas Plant | Florian Geyer<br>E-mail: florian.geyer@dbfz.de<br>Christian Krebs<br>E-mail: christian.krebs@dbfz.de |
| | Biogas lab | Dr. Nils Engler<br>E-mail: nils.engler@dbfz.de<br>Katrin Strach<br>E-mail: katrin.strach@dbfz.de |
| | Emission measurement | Lukas Knoll<br>E-mail: lukas.knoll@dbfz.de |
| **Thermo-chemical Conversion Department** | Combustion lab | Michael Junold<br>E-mail: michael.junold@dbfz.de |
| | Fuel Conditioning lab | Dr. Claudia Kirsten<br>E-mail: claudia.kirsten@dbfz.de |
| **Biorefineries Department** | Biorefineries Technical Centre | André Hermann<br>E-mail: andre.herrmann@dbfz.de |
| **Bioenergy Systems Department** | Databases/Research data | Dr. Marco Selig<br>E-mail: marco.selig@dbfz.de |
| | Assessment methods | Stefan Majer<br>E-mail: stefan.majer@dbfz.de |
| | Potential analyses | Dr. Friederike Naegeli de Torres<br>E-mail: friederike.naegeli@dbfz.de |
| **All departments** | Analytical lab | Dr. Jana Mühlenberg<br>E-mail: jana.muehlenberg@dbfz.de<br>Igor Adolf<br>E-mail: igor.adolf@dbfz.de |

**Contact**
**Karen Deprie**
Phone: +49 (0)341 2434-118
E-mail: karen.deprie@dbfz.de

# 14

# Networks, Research Associations and Committee work



The DBFZ is a member of numerous networks and research alliances related to the topics of bioeconomy and bioenergy. From the outset, strong networking within the national and international research landscape and with industry has been of great importance in order to be able to solve the complex challenges of the energy and raw materials transition comprehensively and sustainably.

## Ccientific cooperation with universities and research institutes

Scientific cooperation with universities and other research institutions is an essential part of the DBFZ's network activities. The focus is on implementing the defined research objectives in the context of applied research and development (R&D). For questions regarding the system evaluation of bioenergy and the microbiological fundamentals of biochemical processes, there is a long-standing cooperation with the neighbouring Helmholtz Centre for Environmental Research – UFZ. In the field of energy recovery from organic wastes and residues, there is also a strategic partnership between the DBFZ's research focus areas and the Rostock Chair of Waste and Material Flow Management (ASW), represented by the DBFZ's Scientific Managing Director Prof. Dr. Michael Nelles.

DBFZ scientists contribute significantly to the visibility of the DBFZ and to the expansion of scientific networks through their teaching activities at a total of 13 universities and colleges (including the University of Leipzig, the University of Rostock, the University of Hamburg-Harburg, the Technical University of Chemnitz, the Technical University of Dresden, the Anhalt University of Applied Sciences, the Merseburg University of Applied Sciences and the Leipzig University of Applied Sciences). Cooperation with non-European countries, particularly China, has been continuously expanded in recent years. DBFZ scientists are guest professors at Hefei University and other renowned universities in China.

## IEA Bioenergy

For more than 45 years now, the IEA Bioenergy has been networking international experts with the aim of advancing bioenergy research. Around 200 scientists from all over the world work together in its working groups (tasks) – including the DBFZ, which successfully participated in five out of eleven tasks during the triennium 2022–2024. The year 2024 was marked by a large number of scientific publications, including country reports and open-access articles with DBFZ participation. In addition, the DBFZ was actively involved in several webinars. A particular highlight was the closing conference in Brazil in October 2024, at which DBFZ experts gave technical presentations and participated in a panel discussion. On 22 May 2024, the work package leaders of the IEA Bioenergy Inter-Task Project "Synergies of Green Hydrogen and Bio-Based Value Chains Deployment" met for a workshop in Leipzig. The discussion focused on the progress of the

case studies, the results of which will be published in one of several reports. The DBFZ is continuing its involvement and expanding its activities in the new triennium 2025–2027: In addition to continuing its involvement in Tasks 37, 39, 40, 44 and 45, it is taking over the leadership of Task 40 and is participating in Task 42 “Biorefining in a Circular Economy” for the first time.

**→ Further information:**
**www.ieabioenergy.com**
**www.dbfz.de/en/feature/iea-bioenergy**

## Committee activities of DBFZ scientists

The DBFZ’s scientists are represented as experts on a wide range of scientific committees, advisory boards, working groups, networks and panels, and as (visiting) professors in Germany and abroad. The aim of their committee work is to foster an intensive exchange with the scientific community.


**Fig. 60:** IEA Bioenergy Inter-Task Project Workshop: “Synergies of green hydrogen and bio-based value chain development” at the DBFZ (22 May 2024)



**Tab. 7:** DBFZ committee activities (as of February 2025)

| Commitee | Function | Country | Since |
|---|---|---|---|
| Association for the Promotion of Exhaust Gas Aftertreatment Technologies for Combustion Engines (FAD) | Member of the Advisory Board | Germany | 2013 |
| Austrian Biomass Association | Member of the scientific committee | Austria | 2022 |
| BEST – Bioenergy and Sustainable Technologies GmbH (Best Research Austria) | Member of the interna-tional scientific advisory board (ISAB) | Austria | 2024 |
| BioEconomy Cluster of BioEconomy e. V. | Member of the advisory board | Germany | 2012 |
| Biomass to Power and Heat | Member of the Programme Committee | Germany | 2014 |
| Circular Economy 4 Africa | Member of the Executive Board | Germany | 2020 |
| Dechema (Energy, Chemistry and Climate Section) | Member of the Management Board | Germany | 2024 |
| Doctoral Colloquium BIOENERGY AND BIOBASED PRODUCTS | Patron/Member of the Scientific Advisory Board & the Programme Advisory Board | Germany | 2018 |
| Energy and Climate Protection Advisory Council of the Saxon State Ministry for Environment and Agriculture (SMUL) | Member | Germany | 2021 |
| Energy and Environment Foundation Leipzig | Member of the Board of Trustees | Germany | 2013 |
| European Biogas Association (EBA) | Member of the Scientific Advisory Board | Belgium | 2019 |
| Export initiative RETech “Recycling & Waste Management in Germany” of the German Federal Government (BMUV, BMWK, BMZ) | Member of the Board and Head of the China Working Group | Germany | 2014 |
| German Association for Waste Management e. V. (DGAW) | Member of the Management Board | Germany | 2014 |
| Helmholtz Centre for Environmental Research – UFZ | Member of the scientific advisory board | Germany | 2013 |
| IEA Bioenergy, Task 37 “Energy from Biogas” | Member | International | 2019 |
| IEA Bioenergy, Task 39 “Biofuels to Decar-bonize Transport” | German Management | International | 2014 |
| IEA Bioenergy, Task 40 “Deployment of biobased value chains” | Co-task leader, German Management | International | 2019 2009 |
| IEA Bioenergy, Task 42 “Biorefining in a Circular Economy” | German Management | International | 2025 |
| IEA Bioenergy, Task 44 “Flexible bioenergy and system integration” | Co-task leader, German Management | International | 2019 |
| IEA Bioenergy, Task 45 “Climate and sus-tainability effects of bioenergy within the broader bioeconomy” | German Management | International | 2019 |
| Institute for Non-Classical Chemistry e. V. at the University of Leipzig (INC) | Member of the Advisory Board | Germany | 2013 |
| International Solid Waste Association (ISWA) | Coordinator of Germany’s activities | Netherlands | 2022 |

| Commitee | Function | Country | Since |
|---|---|---|---|
| ISWA Germany (RETech & DGAW) | Board spokesperson | Germany | 2022 |
| IWWG – International Waste Working Group | Member of the Managing Board | Italy | 2023 |
| LaNDER3–Hochschule Zittau/Görlitz | Member of the Advisory Council | Germany | 2017 |
| Mecklenburg-Western Pomerania State Energy Council | Member and Head of the F&L Working Group | Germany | 2012 |
| Ministry of Agriculture, Environment and Consumer Protection Mecklenburg-Western Pomerania | Member of the scientific advisory board | Germany | 2017 |
| Renewable Energy Research Association (FVEE) | Member of the Directorate | Germany | 2015 |
| Research Steering Committee of the Federal Ministry of Food and Agriculture (BMEL) | Member | Germany | 2012 |
| Scientific journal “Müll & Abfall” | Member of the Advisory Council | Germany | 2007 |
| Strategy Council for Business and Science Mecklenburg-Western Pomerania | Member of the Strategy Council for Business and Science | Germany | 2014 |
| verbio Biofuel and Technology “Straw in the Tank” Conferences | Member of the Scientific Advisory Board | Germany | 2017 |
| Yes-Programm “Young Entrepreneurs in Science” | Member | Germany | 2021 |



## Working groups

| Commitee | Function | Country | Since |
|---|---|---|---|
| Agru Interlaboratory Test, Board of Trus-tees for Technology and Building in Agriculture (KTBL) | Member | Germany | 2018 |
| Bioeconomy WG of the Structure-Related Commission on Technology Assessment and Design (Saxon Academy of Sciences in Leipzig) | Member | Germany | 2020 |
| BMWK Dialogue Platform “Industrial Bioeconomy”, WG4 “Communication” | Member | Germany | 2021 |
| DECHEMA | | Germany | |
| _ Expert Group “Industrial Use of Renewable Resources” | Member | | 2020 |
| _ Expert Group “Measurement and Control in Biotechnology” | Member | | 2018 |
| _ ProcessNet-Sustainable Production, Energy and Resources (SuPER), “Alternative Fuels and Combustibles”* | Member | | 2014 |
| _ ProcessNet–Sustainable Production, Energy and Resources (SuPER), “Energy Process Engineering”* | Member | | 2015 |
| EERA Bioenergy Subprogramme | | EU/Belgium | |
| 1: Sustainable production of biomass | Member | | 2019 |
| 2: Thermochemical platform | Member | | 2019 |
| 3: Biochemical platform | Member | | 2019 |
| 4: Stationary bioenergy | Member | | 2019 |
| 5: Sustainability/Techno-economic analysis/ Public acceptance | Member | | 2019 |
| 6: Digitalization for Energy | Member | | 2023 |
| European Biofuels Technology Platform (ETIP Bioenergy) | | EU/Belgium | |
| WG1 Biomass availability | Member | | 2007 |
| WG4 Policy and Sustainability | Member | | 2008 |
| German RETech Partnership “Recycling & Waste Management in Germany” | Member of the International Working Group (Emerging and Developing Countries)) | Germany | 2017 |
| Taskforce Biomethane | Member | EU/Belgium | 2022 |
| WG Biogas of VGB PowerTech e. V. | Member | Germany | 2019 |
| WG “Drive systems for agricultural machinery” (KTBL) | Member | Germany | 2022 |
| WG “Library concepts” of the BMEL departmental research institutions | Member | Germany | 2016 |
| WG on Substance-Specific Waste Treatment (ASA) e. V. | Member of the Advisory Board | Germany | 2009 |
| WG “OpenAgrar” of the BMEL departmental research institutions | Member | Germany | 2016 |
| “WIR!” Innovation cluster Waste to Value | Member | Germany | 2022 |

* ProcessNet is an initiative of Dechema and VDI-GVC

## Networks/associations/platforms (selection)

| Commitee | Function | Country | Since |
|---|---|---|---|
| BioEconomy e. V. | Member | Germany | 2012 |
| BioWEconomy of the European Commission | Member Core Group/Initiators | EU/Belgium | 2020 |
| Committee on the Sustainability of Biofuels and Bioliquids of the European Commission | Member | EU/Belgium | 2017 |
| DENA (German Energy Agency) Biogas partner – the platform for biogas feed-in | Member, Advisory Board Platform for Sustainable Heavy Goods Transport | Germany | 2017 |
| DFBEW German-French Office for the Energy Transition | Member | Germany/France | 2016 |
| Energy Committee of the Leipzig Chamber of Industry and Commerce (IHK) | Member | Germany | 2016 |
| Energy Saxony e. V. | Member | Germany | 2013 |
| European Biogas Association (EBA) | Member | EU | 2023 |
| Förderverband Humus e. V. (FVH) | Member of the Scientific Advisory Board | Germany | 2019 |
| Network Energy and Environment e. V. (NEU e. V.) – Bioenergy Cluster | Member of the Advisory Board | Germany | 2014 |
| Network for Carbon Cycle Economy (NK2) | Member | Germany | 2019 |
| PREVENT Waste Alliance | Member | Germany | 2020 |
| Renewable Energies Research Association (FVEE), Hydrogen expert committee | Member | Germany | 2020 |
| Sustainable Development Solutions Network (SDSN) of the German Devel-opment Institute | Member of the Extended Steering Committee | Germany | 2016 |

Universität Rostock Traditio et Innovatio

HTWK Hochschule für Technik, Wirtschaft und Kultur Leipzig

TUHH Technische Universität Hamburg

Hochschule Zittau/Görlitz University of Applied Sciences

## DIN/ISO – Standdard commitees (selection)

| Commitee | Function | Country | Since |
|---|---|---|---|
| Association of German Engineers e. V. (VDI) | | Germany | |
| _ VDI 3670 “Flue gas cleaning – downstream dust abatement equipment for small combustion plants for solid fuels” | Chairman | | 2014 |
| _ VDI 3670 “Flue gas cleaning – downstream dust abatement equipment for small combustion plants for solid fuels” | Member | | 2014 |
| _ VDI 4630 “Fermentation of organic substances – substrate characterisation, sampling, substance data collection, fermentation tests” | Member of the Policy Committee | | 2019 |
| _ VDI 4635 “Power-to-x: $CO_2$ provision” | Member | | 2020 |
| CEN–European Committee for Standardization TC 454 Algae and algae products | Chairman WG 3 “Productivity” | Belgium | 2015 |
| German Institute for Standardisation e. V. (DIN) | | Germany | |
| _ Municipal Technology Working Committee (NKT), NA 051 BR 05 SO “Autonomous sanitary facilities” | Contributors | | 2023 |
| _ Working committee “Requirements for liquid fuels”, NA 062-06-32 AA | Member | | 2020 |
| _ Working committee “Liquefied gases, requirements and testing”, NA 062-06-31 AA | Member | | 2021 |
| _ Working Group “Dust separator testing”, DIN 33999 | Member | | 2012 |
| _ Working committee “Biogas”, NA 032-03-08 AA | Member | | 2015 |
| _ Working committee “Pyrogenic carbons”, NA 062-02-85 AA | Chairwoman | | 2021 |
| _ Working committee “Biogenic solid fuels”, NA 062-05-82 AA | Member | | 2019 |
| International Organization for Standardization (ISO) | | Switzerland | |
| _ ISO 19867-1:2018 Part 1 “Clean cookstoves and clean cooking solutions” | Contributors | | 2023 |
| _ ISO TC 238 Solid Biofuels WG 1 “Terminology” | Convenor | | 2022 |
| _ ISO TC 238 Solid Biofuels WG 2 “Fuel specifications and classes” | Task leader | | 2020 |
| _ ISO TC 238 Solid Biofuels WG 7 “Safety of solid biofuels” | Member | | 2019 |
| _ ISO/TC 238 Task Group 1 “Biochar” | Member | | 2021 |
| _ ISO TC 255 Biogas WG 1 “Terms, definitions and classification scheme for the production, conditioning and utilization of biogas” | Member | | 2015 |
| VDI/DIN Commission on Air Pollution Control (KRdL) | | Germany | |
| _ WG 3933 “Production of biomass carbonisates” | Member | | 2013 |
| _ Committee for Basic Guidelines “Bioeconomy, bio- 2021 logical transformation – terms, methods, definitions” | Contributor | | 2021 |
| _ Guideline Preparation Committee VDI 3475 Sheet 8, “Emission Reduction; Digestate Treatment Plants” | Chair | | 2021 |
| _ Guideline Preparation Committee VDI 3475 Sheet 9 “Emission Reduction; Manure Processing Plants” | Chair | | 2021 |

## Professorships

| Commitee | Function | Country | Since |
|---|---|---|---|
| Anhui University Hefei | Visiting Professorship | China | 2023 |
| Department of Energy, Buildings, Environment (teaching and research area: process engineering, waste and recycling management), University of Applied Sciences Münster | Professorship | Germany | 2023 |
| Faculty of Agricultural and Environmental Sciences, University of Rostock | Professorship | Germany | 2006 |
| Faculty of Energy and Environmental Science, Shenyang Aviation University | Visiting Professorship | China | 2011 |
| Faculty of Environmental and Biotechnology, Hefei University | Visiting Professorship | China | 2002 |
| Faculty of Natural and Environmental Sciences, Zittau/Görlitz University of Applied Sciences | Professorship | Germany | 2023 |
| Institute for Renewable Energy, Petroleum University Beijing | Visiting Professorship | China | 2014 |
| Leipzig University of Applied Sciences (HTWK Leipzig) | Professorship | Germany | 2020 |
| National Centre of International Scientific and Technological Bioenergy Research (iBEST), Chinese Agricultural University (CAU), Beijing | Associate professor | China | 2017 |
| Technichal University of Hamburg-Harburg | Honorary professorship | Germany | 2024 |

**Contact**
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E-mail: elena.angelova@dbfz.de

**Fig. 61:** Prof. Dr. Michael Nelles at the 18th Rostock Biomass Forum 2024

# 15

# Organisational structure of the DBFZ

To carry out the wide range of research tasks, the DBFZ is organised into four research departments, reflecting the various energy sources the DBFZ is working on. While the departments of biochemical conversion, thermochemical conversion and biorefineries mainly work on applied research tasks in the field of bioenergy and bioeconomics, the bioenergy systems department, in addition to policy advice, includes potential analyses, acceptance studies, a wide range of scenarios for biomass use and database-driven web applications.

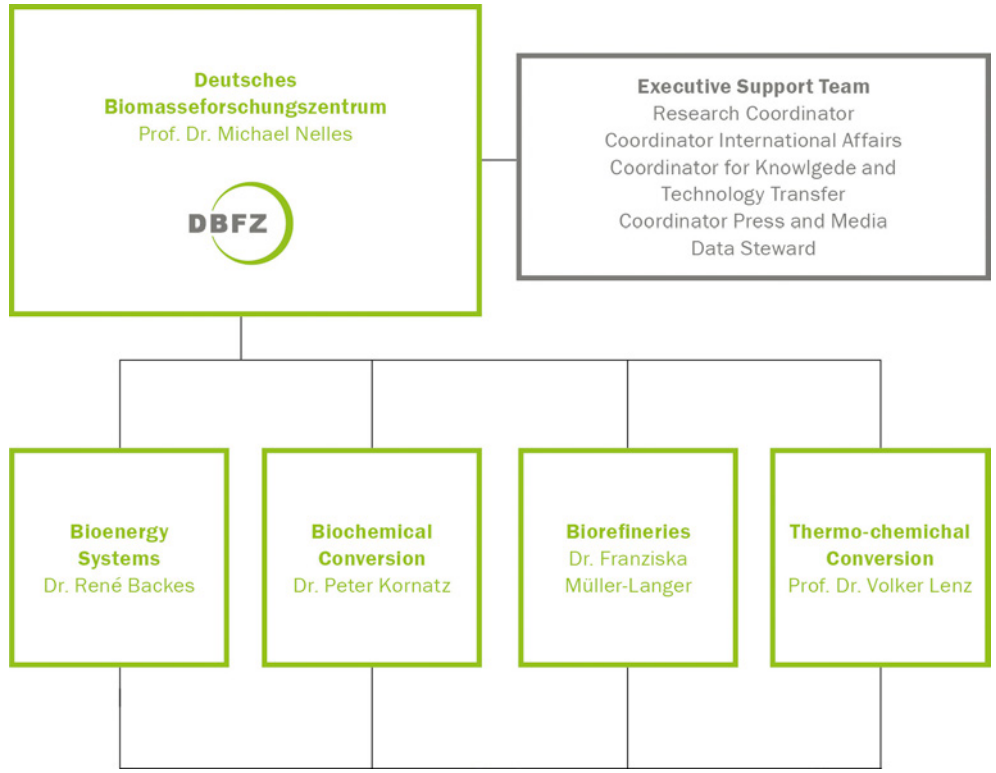


**Fig. 62:** The four research departments of the DBFZ and the scientific executive staff units

# 15.1 Management, staff units and controlling bodies

Since its establishment in 2008, the DBFZ has been managed jointly by two managing directors, who have divided their responsibilities between research and administration. The DBFZ's key scientific objectives are defined in close collaboration with the heads of the five main research focus areas and the executive support team, and are evaluated and further developed in regular strategy meetings together with the Supervisory Board and the Research Advisory Council.

## The general management

**Scientific Managing Director**
**Prof. Dr. mont. Michael Nelles**
Phone: +49 (0)341 2434-112
E-mail: michael.nelles@dbfz.de

**Administrative Managing Director**
**Dr. rer. nat. Christoph Krukenkamp, MBA**
Phone: +49 (0)341 2434-111
E-mail: christoph.krukenkamp@dbfz.de



## Heads of the research focus areas

**Systemic Contribution of Biomass**
**Dr. rer. nat. René Backes**
Phone: +49 (0)341 2434-555
E-mail: rene.backes@dbfz.de

**Anaerobic Processes**
**Dr. agr. Peter Kornatz**
Phone: +49 (0)341 2434-716
E-mail: peter.kornatz@dbfz.de

**Biobased Products and Fuels**
**Dr.-Ing. Franziska Müller-Langer**
Phone: +49 (0)341 2434-423
E-mail: franziska.mueller-langer@dbfz.de

**SmartBiomassHeat**
**Prof. Dr. Volker Lenz**
Phone: +49 (0)341 2434-450
E-mail: volker.lenz@dbfz.de

**Catalytic Emission Control**
**Prof. Dr. rer. nat. Ingo Hartmann**
Phone: +49 (0)341 2434-541
E-mail: ingo.hartmann@dbfz.de

## Executive Support Team

**Research Coordinator**
**Dr. rer. nat. Elena H. Angelova**
Phone: +49 (0)341 2434-553
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**Coordinator for international Knowledge- and Technology Transfer**
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**Coordinator for Knowledge- and Technology Transfer**
**Karen Deprie**
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**Coordinator Press and Media**
**Paul Trainer**
Phone: +49 (0)341 2434-437
E-mail: paul.trainer@dbfz.de

**Data Steward**
**Dr. rer. nat. Torsten Thalheim**
Phone: +49 (0)341 2434-136
E-mail: torsten.thalheim@dbfz.de



## Controlling Bodies

### The Supervisor Board

The Supervisory Board, chaired by the Federal Ministry of Food and Agriculture (BMEL), makes the content-related and organisational decisions for the strategic and organisational development of the DBFZ. Other members include the Federal Ministry of Education and Research (BMBF), the Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMUV), the Federal Ministry for Digital and Transport (BMDV), the Federal Ministry for Economic Affairs and Climate Action (BMWK) and the Saxon State Ministry for the Environment and Agriculture (SMUL).

The Supervisory Board convened at the DBFZ on 21 May and 19 November 2024.

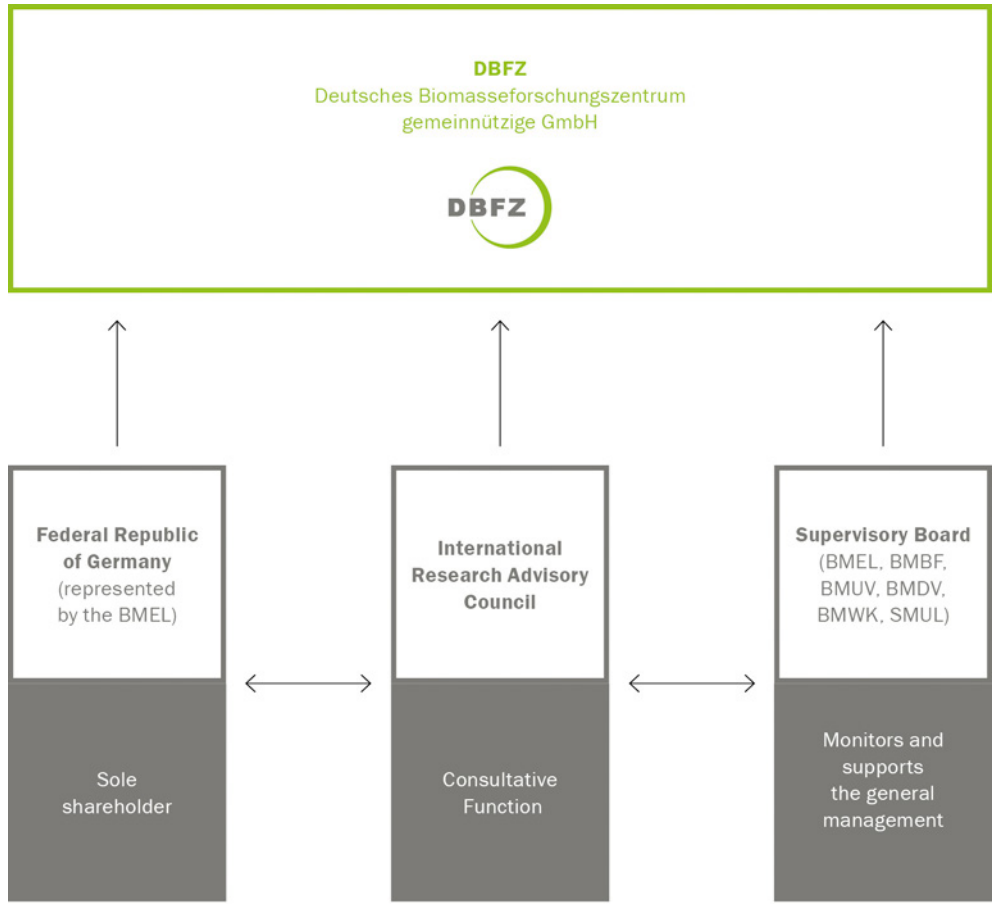



**Fig. 63:** The controlling bodies of the DBFZ (as of February 2025)

## The representatives of the Supervisory Board are the persons named below: (as of 1 February 2025)

**Olaf Schäfer (Chair)**
MinDirig.
Head of Sub-Department “Climate protection, biodiversity, sustainability and bioeconomy” Federal Ministry of Food and Agriculture

**Katharina Schwarz**
MinDirig’in
Head of working group NII5, Natural and environmental affairs in genetic engineering and the bioeconomy Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection

**Daniel Gellner**
Head of Department 3 “Agriculture”
Saxon State Ministry for the Environment and Agriculture

**Martin Waldhausen**
Head of division
KB7 “Climate protection in agriculture and forestry, biomass”
Federal Ministry for Economic Affairs and Climate Action

**Dr. Kerstin Zimmermann**
Senior Government Councillor
Department 7 (Provision for the Future), Department 722 “Energy, Hydrogen Technologies”
Federal Ministry of Education and Research

**Birgit Breitfuß-Renner**
MinDirig’in
Subdepartment G1, Policy Issues and Strategies for Passenger and Freight Transport
Federal Ministry for Digital and Transport

**Fig. 64:** Annual meeting of the Research Advisory Council at the DBFZ (29 October 2024)

## The Research Advisory Council

The Research Advisory Council (RAC), which is made up of nationally and internationally renowned bioenergy experts, has been advising the DBFZ on the direction of its diverse scientific activities since its foundation in 2008. The Council’s advice ensures that the research realised with institutional funding is scientifically sound and highly relevant to the current and future use of bioenergy in the energy system. The current council’s term of office is from 2023–2026.

**Tab. 8:** Representatives of the Research Advisory Council (as of February 2024)

**Chiaramonti, Prof. Dr. David**
Polytechnic University of Turin – DENERG – Department of Energy “Galileo Ferraris”; RE-CORD – Renewable Energy Consortium for Research and Demonstration
Turin, Italy

**Dong, Prof. Dr. Renjie (Deputy Chairman)**
China Agricultural University (CAU) – National Center for International Research of BioEnergy Science and Technology
Bejing, China

**Dornack, Prof. Dr. Christina (Chair woman)**
Technical University of Dresden – Institute of Waste Management and the Circular Economy
Dresden, Germany

**Hartmann, Dr. Hans**
Technology- and Support Centre (TFZ) at the Competence Centre for Renewable Resources
Straubing, Germany

**Kemfert, Prof. Dr. Claudia**
German Institute for Economic Research (DIW)
Berlin, Germany

**Kothe, Prof. Dr. Erika**
Friedrich-Schiller-University Jena, Professorship for Mikrobial Communication
Jena, Germany

**Moos, Prof. Dr. Ralf**
University of Bayreuth, Fakulty of Engineering
Bayreuth, Germany

**Murphy, Prof. Dr. Jerry**
University College Cork
Professorship of Civil Engineering
Cork, Irland

**Thiffault, PhD Evelyne**
Laval University – Department of Wood and Forest Sciences
Québec, Canada

**Thrän, Prof. Dr. Daniela**
Helmholtz Centre for Environmental Research – UFZ
Leipzig, Germany

**Wagemann, Prof. Dr. Kurt**
DECHEMA – Society for Chemical Engineering and Biotechnology
Frankfurt am Main, Germany

**Walter, Prof. Dr. Arnaldo**
University of Campinas – Department of Energy
Campinas, Brazil

# 15.2 Financial Report 2024

The DBFZ was founded in 2008 as a limited liability company in its current form as an institutional recipient of funding within the BMEL and is recognised as a non-profit organisation in accordance with § 52 para. 2 no. 1 AO. The aim is to make flexible and transparent use of public research funding and to be able to work on behalf of third parties in a research and consulting capacity. The DBFZ is financed by an institutional shortfall financing of the Federal Ministry of Food and Agriculture as well as by project funding, contract research and services acquired in a competitive process. In 2024, the DBFZ was financed with 13.4 million euros by the BMEL. In addition, approximately 17.7 million euros in third-party funding was acquired. On the expenditure side, personnel and material costs were the main items, at 11.2 million euros. A further 2.7 million euros was spent on investments and the construction of the new technology centre. The increase in funding from the Federal Ministry of Digital and Transport (BMDV) in 2024 results from the final payment 1A and payment 1B for the Pilot-SBG project.

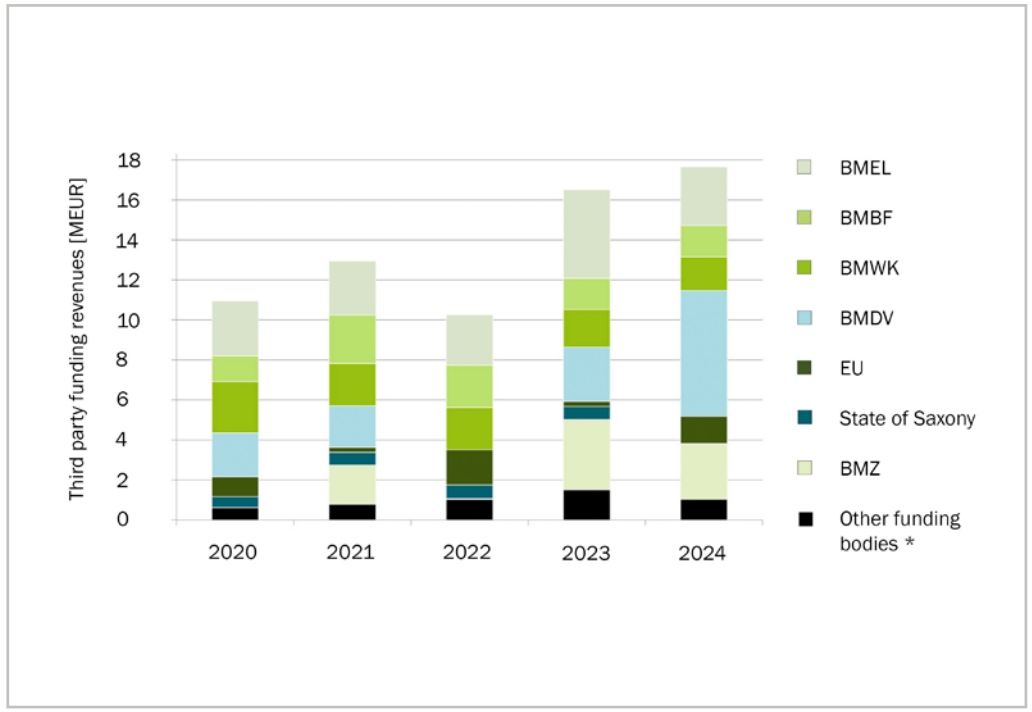



**Fig. 65:** Overview of third-party funding from 2020–2024 (provisional figures)
* Contract research and services for private and public clients



# 15.3 Personnel/Training

On the cut-off date of 31 December 2024, 271 people were employed at the DBFZ. Of these, 207 (including staff positions) were in the scientific/technical field and 64 in the administrative field (including the departments for infrastructure and property management as well as IT). In 2024, the proportion of women in the total workforce was 45.76 percent. With a rate of over 93 percent, administration was clearly in the lead (see Table 9).

In 2024, a large number of theses were again supervised at the DBFZ. In total, 12 internships and student research projects were supervised, along with 30 bachelor's, master's and diploma theses. In addition, a total of 28 guest scientists, foreign interns and scholarship holders worked at the DBFZ.

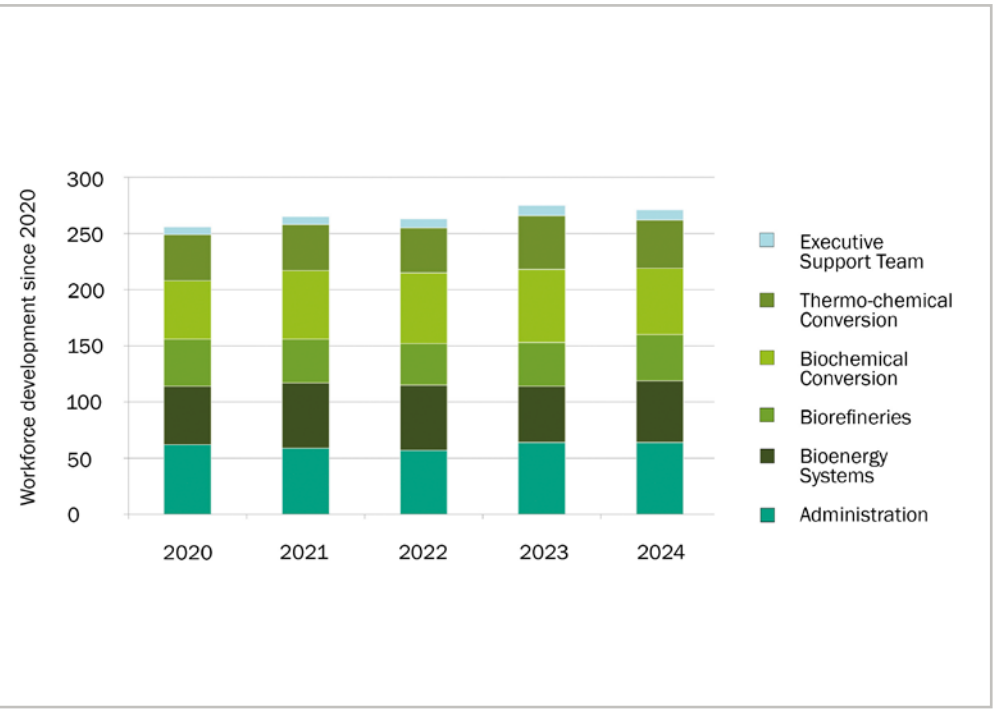



**Fig. 66:** Workforce development at the DBFZ (as of 31 December 2024)

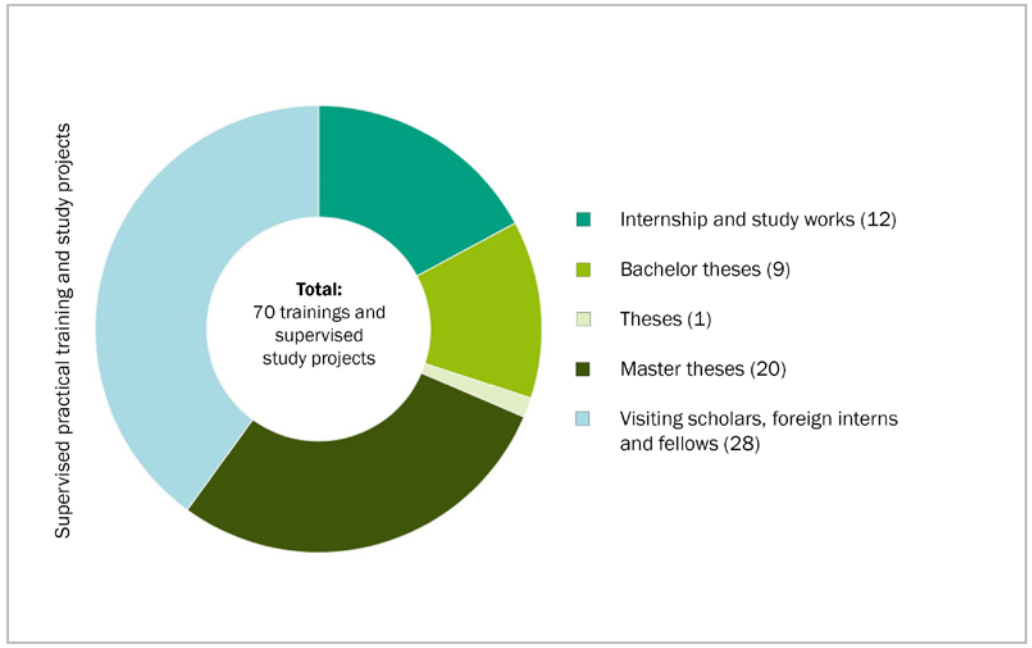



**Fig. 67:** Overview of work supervised at the DBFZ in 2024 (as of 31 December 2024)

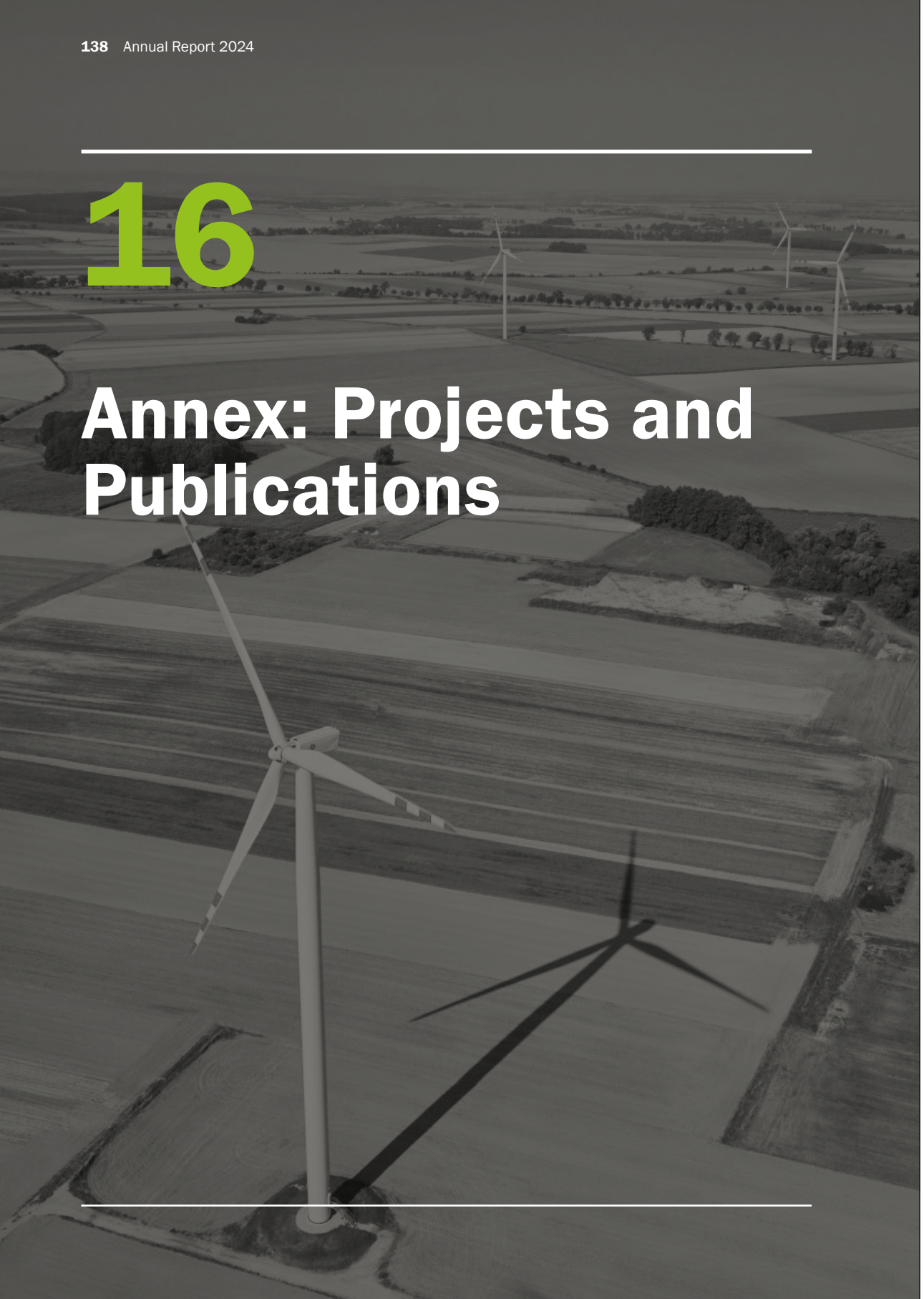
**Tab. 9:** Overview of the proportion of women in the areas (as of 31 December 2024)

| Departments | Number of employees | of which female | proportion of women |
|---|---|---|---|
| Scientific staff | 121 | 54 | 44.63 % |
| Executive Support Team | 6 | 2 | 33.33 % |
| Administration | 30 | 28 | 93.33 % |
| Infrastructure and property management | 12 | 2 | 16.67 % |
| IT | 13 | 3 | 23.08 % |
| Technical staff/assistants | 55 | 20 | 36.36 % |
| Apprentice/assistant | 34 | 15 | 44.12 % |
| **Total** | **271** | **124** | **45.76 %** |


## Jobnewsletter

If you are enthusiastic about a job or training in the field of research and science and are interested in energy and environmental issues, please sign up for our job newsletter. We look forward to receiving your application!

→ **Further information:**
**www.dbfz.de/en/career/jobnewsletter**
**www.dbfz.de/en/career/**



# 16

# Annex: Projects and Publications



Major projects and publications from 2024 are listed below to illustrate the current working areas of the DBFZ. The language of the title reflects the language of the project/publication.

## Projects (Selection)

**Federal Ministry of Food and Agriculture (BMEL)**

AntbioHK – Auswirkungen des verstärkten Einsatzes von Geflügelexkrementen in BGA auf die Belastung der Gärreste durch Tierarzneimittel/ Schwerpunkt Antibiotika, Federal Ministry of Food and Agriculture, 01.05.2022–30.09.2025 (FKZ: 2221WD002A)

BCLOOKUP – Pyrolyse sekundärer landwirtschaftlicher Biomassen: Datenbank zu Pflanzenkohle-Eigenschaften und agronomische Bewertung, Federal Ministry of Food and Agriculture, 01.09.2023–31.08.2029 (FKZ: 2823HUM005)

BiberZym – Identifikation von Enzymen aus dem Verdauungstrakt des Eurasischen Bibers und Möglichkeiten der Anwendung zur Vergärung von lignifizierter Biomasse, Federal Ministry of Food and Agriculture, 01.02.2023–31.12.2025 (FKZ: 2221NR031A)

BioSim – Modellbasierte Zustandsüberwachung und Prozessführung an Biogasanlagen, Federal Ministry of Food and Agriculture, 01.11.2020–31.12.2025 (FKZ: 2219NR333)

BIOSTRAT – BIOSTRAT – Bausteine für eine Biomassestrategie: Biomassepotenziale und Erwartungen an ihre künftige Nutzung, Federal Ministry of Food and Agriculture, 01.01.2023–30.04.2024

BiTop – Prozessoptimierung eines Bioraffinationsverfahrens zur Gärrestaufbereitung mit dem Ziel der Gewinnung von Torfersatzstoffen unter Praxisbedingungen an Biogasanlagen, Federal Ministry of Food and Agriculture, 01.12.2024–31.12.2026 (FKZ: 2224MT005B)

ELEVATOR – Elektrochemische Valorisierung furanreicher Prozessströme aus dem hydrothermalen Aufschluss landwirtschaftlicher Reststoffe; Teilvorhaben 2: HMF-Bereitstellung, Federal Ministry of Food and Agriculture, 01.05.2023–30.04.2026 (FKZ: 2221NR027B)

EmMinA – Quantifierung und Minderung von Methanemissionen an Biogasaufbereitungsanlagen in der Praxis, Federal Ministry of Food and Agriculture, 01.09.2021–31.08.2024 (FKZ: 2220NR151A)

EmmiLa – Biogaserzeugung aus Wirtschaftsdünger -emissionsminimierte, kosteneffiziente Gärrestlager, Federal Ministry of Food and Agriculture, 01.10.2024–30.09.2027 (FKZ: 2224NR031A)

FlexApp – Fütterungsmanagement für flexible Biogasanlagen im Praxisbetrieb; Teilvorhaben 1: Anlagesimulation und ökonomische Bewertung, Federal Ministry of Food and Agriculture, 01.01.2023–30.09.2025 (FKZ: 2221NR043A)

GülleKOM – Kombiverfahren zur Gülleaufbereitung, Federal Ministry of Food and Agriculture, 01.11.2021–31.10.2024 (FKZ: 2220WD004A)

Güllemon – Wirkungsmonitoring der BMEL/FNR Investitionsförderrichtlinie Wirtschaftsdünger, Federal Ministry of Food and Agriculture, 01.08.2022–31.12.2024

GÜLLEÖA – Entwicklung und Erstellung eines Manuskripts zur Herstellung einer Broschüre zur Vergärung von Wirtschaftsdünger in landwirtschaftlichen Biogasanlagen, Federal Ministry of Food and Agriculture, 01.12.2023–30.06.2024 (FKZ: 223WD002A)

HYTORF2 – Herstellung und Bewertung von Torfersatzstoffen auf Basis der hydrothermalen Umwandlung aus biogenen Reststoffen; Teilvorhaben 1: Durchführung der hydrothermalen Umwandlung und deren physikochemische und techno-ökonomische-ökologische Bewertung, Federal Ministry of Food and Agriculture, 01.11.2022–31.10.2025 (FKZ: 2221MT014A)

KIDA – KI- und Daten-Akzelerator, Federal Ministry of Food and Agriculture, 05.04.2022–31.12.2025 (FKZ: 28KIDA005)

LangEFel – Langzeitmonitoring und Funktionalität von Staubabscheidern für Einzelraumfeuerungen im Feld; Teilvorhaben 2: Recherche, Prüfstandsuntersuchungen, Zählende und Online-Messverfahren, Katalysatoralterung, Federal Ministry of Food and Agriculture, 01.01.2023–31.12.2025 (FKZ: 2220NR108B)

MeBiKo – Metastudie Biokohle zur Identifizierung und Auswertung des aktuellen Stands von Wissenschaft und Technik zur Thematik Biokohle, Federal Ministry of Food and Agriculture, 12.07.2022–31.07.2024 (FKZ: 2222NR033X)

MEMO – Methanemissionsmodell für offene Gärprodukt-/Güllelager, Federal Ministry of Food and Agriculture, 01.11.2021–30.06.2026 (FKZ: 2220WD003X)

MethaMin – Minimierung von Methanemissionen bei der Lagerung von Wirtschaftsdüngern; Teilvorhaben 1: Anlagenauswahl, Emissionsmessungen und Bewertung, Federal Ministry of Food and Agriculture, 01.10.2022–30.09.2025 (FKZ: 2221WD004A)

MoBi_II – Monitoring Bioökonomie – Aktualisierung Reststoffmonitoring, Federal Ministry of Food and Agriculture, 01.11.2021–31.01.2025 (FKZ: 2221NR062B)

Nährwert – Energetische Nutzung von Scheitholz

durch die Entwicklung einer effizienten und emissionsarmen, kleinen Scheitholzfeuerung mittels kontinuierlicher Brennstoffzuführung, Federal Ministry of Food and Agriculture, 01.07.2021–30.12.2024 (FKZ: 2220NR255A)

OptiFood – Entwicklung nachhaltiger und wettbewerbsfähiger Insektenlebensmittel, Federal Ministry of Food and Agriculture, 15.04.2024–14.04.2027 (FKZ: 281A808A21)

Stoffstroeme-BK – Analyse zum Rohstoff-, Technologie- und Nachhaltigkeitspotential biobasierter Kunststoffe in Deutschland, Federal Ministry of Food and Agriculture, 01.09.2024–31.08.2026 (FKZ: 2223NR075B)

TRANSBIO – Transfergruppe für Bioenergieanlagen im zukünftigen Energiesystem; Teilvorhaben 1: Datenkonsolidierung und Methodenharmonisierung, Federal Ministry of Food and Agriculture, 01.05.2021–30.04.2024 (FKZ: 2220NR128A)

WDSonic – Steigerung der Effizienz der Wirtschaftsdüngervergärung durch Einsatz von Ultraschall-Desintegrationsverfahren, Federal Ministry of Food and Agriculture, 01.05.2023–30.04.2025 (FKZ: 2222WD105B)

**Federal Ministry for Economic Affairs and Climate Action (BMWK)**

BeForce – BeForce – Begleitforschung Bioenergie, Federal Ministry for Economic Affairs and Climate Action, 01.04.2021–31.03.2026 (FKZ: 03EI5400)

BioBeton – Entwicklung eines wirtschaftlichen, nachhaltigen und für die bauaufsichtliche Zulassung geeigneten alternativen Bindemittelzusatzstoffes auf Basis von Biomasseasche für die Zement- und Betonherstellung, Federal Ministry for Economic Affairs and Climate Action, 01.01.2021–30.06.2024 (FKZ: KK5045102KI0)

BioFeuSe – Neue Sensorik für die Prozessoptimierung von SCR-Verfahren und Partikelabscheidung an Biomasseverbrennungsanlagen Teilvorhaben: Untersuchungen zur Eignung der entwickelten Sensortechnik für die Abgasreinigung und das Monitoring an Biomasseanlagen, Federal Ministry for Economic Affairs and Climate Action, 01.07.2021–30.06.2024 (FKZ: 03EI5436A)

BioH2 – Klimaneutrale Wärmenutzung und Wasserstofferzeugung aus biogenen Rest- und Abfallstoffen; Teilvorhaben: Gasqualität, Vergasungseignung weiterer Brennstoffe, THG-Bilanzen, Zertifizierung, Federal Ministry for Economic Affairs and Climate Action, 01.01.2024–30.06.2026 (FKZ: 03EI5472D)

BioHybrd – Verbundvorhaben: BioHybrid – Entwicklung eines systemdienlichen biomassebasierten Hybridsystems; Teilvorhaben: Integration biomasse-basierter Wärmeerzeugung in das Hybridsystem, Federal Ministry for Economic Affairs and Climate Action, 01.04.2024–31.03.2027 (FKZ: 03EI5474A)

CapUp – Chemikalienproduktion an Biogasanlagen – Up-Scaling eines Verfahrens zur Herstellung mittelkettiger Carbonsäuren aus regionalen Reststoffen (CapUp)-Teilvorhaben: Up-Scaling und Bewertung der Downstream-Kaskade, Federal Ministry for Economic Affairs and Climate Action, 01.02.2023–30.06.2024 (FKZ: 13BDA30012)

CarboFe – Entwicklung und Validierung eines innovativen Kohlenstoff-Eisen-Präparates zur Gasreinigung und Effizienzsteigerung des Biogasprozesses; TV DBFZ: Herstellung und Test der Kompaktate, Federal Ministry for Economic Affairs and Climate Action, 01.01.2023–31.12.2025 (FKZ: 03EI5453A)

DeDiaPro – Verbundvorhaben Demonstration von Methoden zur Diagnose, Prognose und Behebung von nicht-nominalen Betriebszuständen in biomassebasierten Versorgungssystemen; Teilvorhaben: Entwicklung von Methoden, Modellen und Werkzeugen zur Fehlerdiagnose und -prognose mit Fokus auf brennstoffbezogene Fehler, Federal Ministry for Economic Affairs and Climate Action, 01.02.2024–31.07.2026 (FKZ: 03EI5471A)

FLXsynEr – Flexible und vollenergetische Nutzung biogener Rest- und Abfallstoffe: Faulungen und Biogasanlagen als Energieverbraucher, -speicher und -erzeuger; Teilvorhaben: Wissenstransfer und Modellvergleich, Federal Ministry for Economic Affairs and Climate Action, 01.10.2020–31.03.2024 (FKZ: 03EI5420C)

GreenFee – Verbundvorhaben: GreenFeed- Green Feedstock for a Sustainable Chemistry: Energiewende und Ressourceneffizienz im Kontext der dritten Feedstock-Transformation der chemischen Industrie; Teilvorhaben: Biopolymerproduktion, Federal Ministry for Economic Affairs and Climate Action, 01.03.2022–28.02.2025

H2Verg – Wasserstoff aus der Vergasung von Biomasse – Feldmessungen, Ermittlung von Anwendungsbedingungen und Prozessbewertungen, Federal Ministry for Economic Affairs and Climate Action, 01.08.2022–31.07.2025 (FKZ: 03EI5445A)

HanfNRG – Verbundvorhaben: HanfNRG – Untersuchungen der energetischen Nutzungsoptionen von Hanffaserreststoffen zur exemplarischen Einbindung in das Energiekonzept eines Verarbeitungsstandort; Teilvorhaben: Vergleichende Untersuchung der energetischen Nutzungsoption von Hanffaserreststoffen, Federal Ministry for Economic Affairs and Climate Action, 01.10.2022–30.09.2025 (FKZ: 03EI5448A)

HyCSBio – Nutzung eisenbasierter Module zur Versorgung mit hochreinem Wasserstoff unter Druck auf der Basis der Luftvergasung biogener Reststoffe; Teilvorhaben: Bereitstellung wasserstoffhaltiger Reduktionsgase aus der Biomassevergasung für den Speicher- und Reinigungsprozess, Federal Ministry for Economic Affairs and Climate Action, 01.11.2024–31.10.2027

KeVergAv – Verbundvorhaben: Brennstoffspezifische Kennzahlen zum Vergasungs- und Ascheverhalten unterschiedlich aufbereiteter Holz- und Strohbrennstoffe, Federal Ministry for Economic Affairs and Climate Action, 01.02.2021–31.03.2024 (FKZ: 03EI5416)

KONDITOR – Verbundvorhaben: Industrielle Prozesswärmeerzeugung durch katalytische Konditionierung von biomassebasierten Synthesegasen; Teilvorhaben II: Katalytische Konditionierung von Synthesegasen aus der autothermen Vergasung, Federal Ministry for Economic Affairs and Climate Action, 01.09.2020–31.01.2025 (FKZ: 03EI5417B)

MeKat – Entwicklung eines Methanoxidationskatalysators auf Basis von biogenem Silica für die Entfernung von Methan im Abgas von Biogas-BHKW; Teilvorhaben: Katalysatorherstellung und Demonstration der Einsatzfähigkeit unter realen Bedingungen, Federal Ministry for Economic Affairs and Climate Action, 01.01.2023–31.12.2025 (FKZ: 03EI5456A)

PaCoSil – Verbrennung regional verfügbarer Reststoffe zur energetischen Nutzung von Biomasse und zur gekoppelten Erzeugung von biogenem Silika für Feinstaubfilter-Prozesse, Federal Ministry for Economic Affairs and Climate Action, 01.07.2021–30.06.2024 (FKZ: 03EI5436A)

PUELPE! – Entwicklung einer Pilotanlage zur Vollverwertung von Weizenpülpe und automatisierte Systemintegration in die Industrielle Stärkeproduktion, Federal Ministry for Economic Affairs and Climate Action, 01.05.2022–31.10.2025 (FKZ: 03EI5442B)

TRANSBIB – Nationales Transfer- und Beschleunigungsnetzwerk Industrielle Bioökonomie, Federal Ministry for Economic Affairs and Climate Action, 01.10.2023–30.09.2026 (FKZ: 13BDI10019)

TWOx – Entwicklung eines preisgünstigen und ressourceneffizienten Systems zur Abgasnachbehandlung für Holzgas-BHKW; TV: Erweiterung einer mobilen Katalysatortestapparatur zur Katalysatorvermessung und Insitu-Alterung sowie Laborversuche zur Katalysatorcharakterisierung, Federal Ministry for Economic Affairs and Climate Action, 01.01.2024–31.12.2025 (FKZ: 03EI5470A)

**Federal Ministry for Education and Research (BMBF)**

AltCell – Alternative zellulosehaltige Rohstoffe für man-made Cellulosefasern; TP3: Herstellung und Bereitstellung von Zellstoff aus alternativen Rohstoffen und Benchmark-Versuchen, Federal Ministry for Education and Research, 01.08.2023–31.07.2025 (FKZ: 03WIR3806C)

BiogeniV – WIR! – biogeniV – Basiskonzept Bioraffinerie; Analyse und Bewertung der Reststoffe zur Nutzung in einer Vergasungsanlage, Federal Ministry for Education and Research, 01.12.2022–31.03.2024 (FKZ: 03WIR4903C)

Biolube – Entwicklung biobasierter und biologisch abbaubarer Hochleistungsschmierstoffe auf Basis von Insektenfett für die industrielle Anwendung; TP2, Federal Ministry for Education and Research, 01.05.2021–31.07.2024 (FKZ: 031B1111B)

BioNET – Verbundprojekt CDR: Mehrstufige Bewertung von biobasierten Negativ- Emissionstechnologien (BioNET) – Teilprojekt 2: Datenmanagement und Beschreibung lokaler Umsetzungsanforderungen an NET-Konzepte, Federal Ministry for Education and Research, 01.01.2022–30.06.2025 (FKZ: 01LS2107B)

BIOZ-RP – Rahmenprojekt III: Life Cycle Assessment/ Nachhaltigkeitsbewertung & Wirksamkeitsanalyse, Federal Ministry for Education and Research, 01.03.2022–31.08.2025 (FKZ: 03WIR5303)

DiP Agro – Digitalisierung zur Förderung der Etablierung von Agroforstsystemen auf der Landschaftsebene als Beitrag zur Klimaresilienz Süd-Sachsen-Anhalts und Dekarbonisierung seiner chemischen Industrie, Federal Ministry for Education and Research, 01.04.2024–31.12.2028 (FKZ: 031B14571)

DiPisum – Digitalisierungsgetriebene Entwicklung Sachsen-Anhalts zu Innovationszentrum für Erbsenzucht, Federal Ministry for Education and Research, 01.04.2024–31.12.2028 (FKZ: 031B1444I)

E-Boot2 – Entwicklung einer Ernteprozesskette mit Erntetechnologie zur umweltschonenden Ernte von Wasserpflanzen, Federal Ministry for Education and Research, 01.08.2021–31.07.2025 (FKZ: 031B1095)

HeRoTogo – Entwicklung einer Roadmap für die nachhaltige Wärmeerzeugung mit Biomasse in Togo und Demonstration ausgewählter Technologien entlang des gesamten Nutzungspfades, Federal Ministry for Education and Research, 01.03.2024–28.02.2026 (FKZ: 03SF0749)

LabCon2 – Consolidation and continuation of the biomass lab in Togo, Federal Ministry for Education and Research, 01.03.2024–31.12.2025 (FKZ: 03SF0742A)

LABTOGO – Aufbau eines Biogasforschungslabors an der Uni Lomé/Togo, Federal Ministry for Education and Research, 15.11.2019–30.06.2025

Liglue – Formaldehydfreie Bindemittel auf Basis biobasierter Ligninpolymere – Teilvorhaben D, Federal

Ministry for Education and Research, 01.04.2024–31.12.2028 (FKZ: 031B1450D)
ProPec – WIR! – BioZ Maßgeschneiderte Pektine aus Zuckerrüben, Federal Ministry for Education and Research, 01.04.2023–31.03.2024 (FKZ: 03WIR5312C)
STROHase – Nutzbarmachung der Restströme Stroh und Gärrest als Substrat für die Biogaserzeugung durch Co-Silierung, Federal Ministry for Education and Research, 01.04.2023–31.03.2026 (FKZ: 031B1373C)
SYMOBIO2 – Konsolidierung des Systemischen Monitorings und der Modellierung der Bioökonomie, Federal Ministry for Education and Research, 01.01.2022–31.03.2025 (FKZ: 0311129C)
WaSSGhan – Hybrid Energie aus Abfall als nachhaltige Lösung für Ghana, Federal Ministry for Education and Research, 01.01.2020–31.03.2025 (FKZ: 03SF0591D)
ZAZIkI – Zukunftfähige Anbausysteme Zuckerrübe – Innovationen und künstliche Intelligenz – Teilprojekt C, Federal Ministry for Education and Research, 01.04.2024 – 31.12.2028 (FKZ: 031B1460C)
ZirkuBar – REGION.innovativ – zirkulierBAR: Interkommunale Akzeptanz für nachhaltige Wertschöpfung aus sanitären Nebenstoffströmen, Teilprojekt 8, Federal Ministry for Education and Research, 01.06.2021–31.12.2024 (FKZ: 033L242H)

**Federal Ministry for Digital and Transport (BMDV)**
INNOFUELS – Vernetzung, Weiterentwicklung und Rahmenbedingungen zum Hochlauf strombasierter Kraftstoffe und fortschrittlicher Biokraftstoffe, Federal Ministry for Digital and Transport, 01.02.2023–31.08.2026 (FKZ: 16RK34002F)
PilotSBG – Forschungs- und Demonstrationsvorhaben | Bioressourcen und Wasserstoff zu Methan als Kraftstoff – Konzeptionierung und Realisierung einer Anlage im Pilotmaßstab, Federal Ministry for Digital and Transport, 01.09.2018–01.01.2024
Pilot-SBG1b – Pilot-SBG Phase 1b zum Betrieb einer Pilotanlage zur Bereitstellung von erneuerbarem Methan, Federal Ministry for Digital and Transport, 01.01.2023–31.12.2026
REF4FU – Erneuerbare Kraftstoffe aus Grünen Raffinerien der Zukunft; Teilvorhaben 3, Federal Ministry for Digital and Transport, 01.12.2022–30.11.2025 (FKZ: 16RK24001C)

**Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMUV)**
BMWood – Entwicklung von Mechanismen zur Darstellung der Klimawirkung bei der energetischen Nutzung von Holz, Bundesministerium für Umwelt, Naturschutz, nukleare Sicherheit und Verbraucherschutz, 01.11.2024–30.11.2027 (FKZ: 37K2 44 102 0)
OSchein – Erstellung von Schulungsmaterial zum richtigen Heizen mit Holz (Ofenführerschein), Bundesministerium für Umwelt, Naturschutz, nukleare Sicherheit und Verbraucherschutz, 05.11.2021–29.02.2024 (FKZ: Z 1.5-37 510/0027 3721 53 3030)
UFP-MESS – Messung ultrafeiner Partikel aus Kleinfeuerungsanlagen, Bundesministerium für Umwelt, Naturschutz, nukleare Sicherheit und Verbraucherschutz, 01.08.2022–30.11.2025
WEPart – Untersuchung der Wirkung bestehender primärer und sekundärer Emissionsminderungstechniken, Bundesministerium für Umwelt, Naturschutz, nukleare Sicherheit und Verbraucherschutz, 28.02.2022–31.03.2025

**EU Projects**
AGROECOL – European partnership on accelerating farming systems transition – agroecology living labs and research, European Commission, 01.01.2024–31.12.2030 (FKZ: 10113249)
BIOMETHAVERSE – Demonstrating and Connecting Production Innovations in the Biomethane Universe, European Commission, 01.10.2022–31.03.2027 (FKZ: GA 101084200)
BOOST4BI – BOOSTing the bioeconomy transformation FOR (4) the BIOEAST region, European Commission, 01.01.2024–31.12.2026 (FKZ: 101133398)
CARINA – CARinata and CamelINA to boost the sustainable diversification in EU farming systems, European Commission, 01.11.2022–31.10.2026 (FKZ: GA 101081839)
GreenMeU – GREEN bioMEthane market Uptake, European Commission, 01.08.2022–31.07.2025 (FKZ: GA 101075676)
HARMON – Harmonisation and monitoring platform for certification schemes and labels to advance the sustainability of biobased systems – Harmonitor, European Commission, 01.06.2022–31.05.2025 (FKZ: GA 101060133)
HURRICAN – Sector-coupling hub for circular use of thermal and industrial waste, European Commission, 01.01.2024–31.12.2028 (FKZ: 101138494)
ICARUS – International cooperation for sustainable aviation biofuel, European Commission, 01.10.2023–30.09.2026 (FKZ: 101122303)
NEXTSTEP – Next-gen of sustainable biobased chemical platforms, European Commission, 01.06.2024–31.05.2028 (FKZ: 101157081)
SEMPRE-BIO – SEcuring doMestic Production of cost-Effective BIOmethane, European Commission, 01.11.2022–30.04.2026 (FKZ: GA 101084297)



SURFs UP – Safe and sustainable by design microbial and lignin-based biosurfactants sourced from sustrainable feedstock for home, personal care and agrochemical application, European Commission, 01.05.2024–31.10.2027 (FKZ: 101157586)
SUSTRACK – Supporting the identification of policy priorities and recommendations for designing a sustainable track towards circular bio-based-systems, European Commission, 01.11.2022–31.10.2025 (FKZ: GA 101081823)

**State of Saxony**
BioFe – Biomassenutzung in der Eisenerzeugung unter wirtschaftlichen und CO2-mindernden Randbedingungen, Saxon Development Bank, 16.05.2024–31.05.2027 (FKZ: 100704873)
RegioH2O – Naturbasierte lokale Aufbereitung von kommunalem Abwasser für sichere und multifunktionale Wiederverwendung, Saxon Development Bank, 10.01.2024–30.06.2026 (FKZ: 100702923)

**Other funding bodies**
AGEEstat – wiss. Analyse zu ausgewählten Aspekten der EE-Statistik für AGEE-Stat, Market project, 01.04.2019–15.12.2024
bEONergy – bEONergy – Rolle von Bioenergie in einem dekarbonisierten Energiesystem, Market project, 01.12.2023–31.07.2024
Bio2x – Bio2x – Metaanalyse zu nachhaltigen Biomassepotenzialen für die Mineralölwirtschaft, Market project, 12.05.2023–30.04.2024
Biogasn – Biomassepotenziale für die reststoffbasierte Biogasproduktion, Market project, 05.06.2023–30.04.2024
BioMeSyn – Dezentrale Bio-Methanol-Herstellung als Substituent in der fossilen Synthesegaschemie und Wertschöpfungsalternative zur Biogasverstromung, Market project, 01.09.2024–31.08.2026
BÖStrBB2 – Begleitung der Bioökonomie-Strategie für das Land BB, Market project, 01.09.2023–15.12.2025
BioSmoke – Smoke and bioaerosols in a changing climate, Market project, 01.10.2024–30.09.2028
DiP-BR – Begleitforschung der Digitalisierung der pflanzenbasierter Wertschöpfungsketten zur Entwicklung eines partizipativen und lernenden Nachhaltigkeits-Monitorings, Market project, 01.08.2024–31.12.2028
EEGMon – Begleitung bei der Erstellung eines Erfahrungsberichts zur Stromerzeugung aus Biomasse, Market project, 01.11.2023–30.11.2027
ETH-Soil – Bodenverbesserung in Äthiopien durch die energetische und materielle Nutzung landwirtschaftlicher Rückstände mit besonderem Schwerpunkt auf Bildung und Ausbildung, Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung, 01.07.2021–31.12.2026
Grundi – Literaturstudie zu Speicherfeuerstätten, Market project, 21.02.2022–28.02.2025
FS-BMKW – Strohpotenziale Biomassekraftwerk Weißenborn, Market project, 02.01.2024–30.06.2024
H2Zert – Biomasse für die Produktion von Wasserstoff – Verwendbarkeit und Zertifizierung, Market project, 29.01.2024–09.03.2024
HemiCoat – Konversion von Hemicellulose zu Beschichtungen, Market project, 01.09.2024–31.08.2026
MethVers – Untersuchung eines Katalysators, Market project, 14.09.2023–05.02.2024
MethVer2 – Methanisierungsversuche für Industriepartner II, Market project, 15.04.2024–30.06.2024
PanBio23 – Evaluating the anaerobic digestibility of liquid effluents, Market project, 06.11.2023–31.07.2024
PAPER – Ressourcenscreening & Entwicklung einer Mobilisierungs-/Einkaufsstrategie, Market project, 13.10.2020–31.12.2024
Sargasso – Sargassum utilization and treatment in the Carribean, GIZ – Deutsche Gesellschaft für Internationale Zusammenarbeit, 22.05.2024–30.06.2025
Schlempe – Kombiniertes Verfahren zur Schlempe-Vergärung und aerober Behandlung der Gärreste, Market project, 01.09.2024–31.03.2025
SpikyAD – Verwertung von Reststoffen aus der Kultivierung von Kaktusfeigen in ariden Gebieten, Market project, 01.11.2024–30.06.2025
STARCH2E – Starch2E – Support biogas project, Market project, 01.01.2023–07.07.2024
StrohGas – Wirtschaftlichkeitsanalyse zur Strohvergärung mit Vermarktungsoption Biomethan, Market project, 01.08.2023–31.12.2024
SYNCON – Bakterien als neuer Biomarker zur besseren Überwachung und Steuerung von Biogasfermentern mit Rest- und Abfallstoffen, Market project, 01.09.2024–28.02.2027

## Publications

**Monographs**
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**Conference Proceedings/ Conference Readers**

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*4. Fachgespräch Staubmessverfahren an Kleinfeuerungsanlagen: 7. Februar 2024, Leipzig* (2024). Leipzig: DBFZ. 117 S. (Tagungsreader, 29). ISBN: 978-3-949807-08-4. [4. Fachgespräch Staubmessverfahren an Kleinfeuerungsanlagen, Leipzig, 07.02.2024]. DOI: 10.48480/10kf-kz81.
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**Book Contributions**

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**Contributions to Conference Proceedings**

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**Presentations**

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**Poster**

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**Research data**

Mühlenberg, J. (2024). *Characterisation of recycled fertilisers from dry toilet contents: analysis of nutrients, hygiene and harmful substances* (Version 1) [Data set]. Mendeley Data. https://doi.org/10.17632/fjv2bf6mh2.1

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## Imprint

**Published by:**
DBFZ Deutsches Biomasseforschungszentrum
gemeinnützige GmbH, Leipzig,
an enterprise of the German government with funding from the Federal Ministry of Food and Agriculture pursuant to a resolution by the german Bundestag

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**General Management:**
Prof. Dr. mont. Michael Nelles (Scientific Managing Director)
Dr. Christoph Krukenkamp (Administrative Managing Director)

**Concept and editing/Responsible under German press law:**
M.A. Paul Trainer
Coordinator Press and Media
The publisher is responsible for the content of the brochure.

**Editorial deadline:** 31 March 2025
**Design/Desktop Publishing:** Stefanie Bader Grafikgestaltung

For sustainability reasons, this publication is exclusively available as a PDF.

**ISBN:** 978-3-949807-21-3
**DOI:** 10.48480/gnd4-he39

**Pictures:**
If not indicated on the picture: DBFZ, Jan Gutzeit, Jürgen Lösel, Kai & Kristin Fotografie, Johannes Amm, Matthias Eimer, Adobe Stock, Freepik



With support from
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