

Fraunhofer WKI | Annual Report 2022

Research for sustainability and quality of life



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Research for
sustainability and
quality of life



Greeting

Dear customers, colleagues, and friends,

This annual report summarizes the achievements of the Fraunhofer WKI during 2022. The report is written in a concise form – detailed information can be found on our website.

Our institute was not an exception in being impacted by the events of 2022. As we are internationally active in research and in the service sector, we had to adjust to a new situation, which was accompanied by a significant loss of revenues. We are aligning ourselves to the new international conditions, but this

realignment will nevertheless require several more years. Our successes in the expansion of publicly funded research and the search for new fields of activity provide grounds for optimism. We have successfully established the strategic field of structural adhesion and this is reflected in our new accreditation in this area. We have further continued to make investments in new areas and equipment, especially at the Center for Light and Environmentally-Friendly Structures, ZELUBA®, which opened in 2021 and houses a state-of-the art material-analysis and structural-components testing facility.

The construction of our new pilot-plant facility was again delayed in 2022, with bureaucratic requirements and generally rising costs posing a major challenge. We must remain patient and continue to operate our old technical center for the time being. My respect and thanks go to the staff of the pilot facility and all employees for their dedication and patience in maintaining and successfully operating the pilot plant.

We have secured a strategic investment of nearly 2 million euros in a new fiber- and particle-morphology lab. This will allow us to better characterize fibers and particles that we use in the development of new products and technologies. The new laboratory should be operational before the end of this year.

At the end of 2022, the construction of a new office building for staff at the Application Center for Wood Fiber Research HOFZET®, was completed by the Hochschule Hannover, with an official opening planned for spring

2023. This will significantly improve working conditions in Hannover and further strengthen the cooperation between the Hochschule Hannover and the Fraunhofer WKI. My thanks go to the President of the Hochschule Hannover for his continued support.

One of our event highlights is the European Wood-based Panel Symposium in Hamburg that takes place every two years. We were forced to postpone the Symposium due to the COVID-19 pandemic but were able to organize it again in 2022. We had record participation, excellent presentations, and active discussions. The Symposium was a great success, once again demonstrating its great value to the industry and all our customers. We are already planning for 2024.

Overall, we fared well last year and have retained our position as one of the top ranked institutes within the Fraunhofer family. This is thanks to our team of dedicated, well-trained, and professional scientists and staff. My thanks go to all of you; we are well positioned for the future. Last but not least, I would like to express my appreciation to you – our customers and supporters – for your trust in our work.



Prof. Dr.-Ing. Bohumil Kasal
Director of the Fraunhofer WKI

Contents

Institute with Profile	6
Self-perfection	7
Organization Chart	8
Board of Trustees	9
Figures Data Facts	10
Innovative Fields of Research	12
Technology for Wood and Natural Fiber-Based Materials	13
Material Analysis and Indoor Chemistry	13
Binders and Coatings	14
Quality Assessment	14
Center for Light and Environmentally-Friendly Structures ZELUBA®	15
Application Center HOFZET®	15
Research Highlights	16
Public funding sources	20
Scientific excellence	21
Events	23
Groups, Alliances and Networks	24
International Association for Technical Issues Related to Wood e. V.	26
The Fraunhofer-Gesellschaft	27
Legal information	29
Image directory	29
Publisher	30



Are timber-concrete
composite systems an
alternative to steel-
reinforced concrete?

Long-term behavior of adhesive-bonded
wood-hybrid systems » Page 19.

Institute with Profile

Sustainability has formed the focus of the Fraunhofer WKI since its foundation in 1946.

The founder and eponym, Dr. Wilhelm Klauditz, sought solutions for the optimal exploitation of raw wood - a commodity which had become scarce as a result of the second world war - as well as for the technical utilization of waste wood and small-diameter wood. He is regarded as a co-founder of the modern wood-based materials industry.

Today, at the Fraunhofer WKI, we study a wide range of renewable raw materials and their holistic utilization from production through to recycling. One particular focus is thereby directed at sustainable lightweight construction solutions. Our holistic research approach also encompasses the development of material recycling processes, life cycle analyses, indoor air analysis, and other.

Virtually all the procedures and materials resulting from the research activities are applied industrially. Customers of the Fraunhofer WKI include companies from the wood and furniture industries, the construction industry, the chemical industry, the packaging industry and the automotive industry.

With its research and development activities, the Fraunhofer WKI makes an important contribution towards the development of a bio-based recycling economy (bioeconomy).

As an accredited testing body, the Fraunhofer WKI performs material-testing and quality monitoring tasks. It assesses cases of damage and provides advice on questions of damage remediation. The quality assurance of wood products and other materials by means of non-destructive procedures such as thermography, ultrasound or computer tomography enhance the institute's spectrum.

With the HOFZET® Application Center and the integration into the Open Hybrid LabFactory, the important and promising new field of fiber composites is currently being systematically augmented and expanded. In collaboration with the Technische Universität Braunschweig, the ZELUBA® Center for Light and Environmentally-Friendly Structures is reinforcing the subject areas of building construction and lignocellulose-containing materials.

Since October 2010, the Fraunhofer WKI has been headed by Professor Dr.-Ing. Bohumil Kasal. Professor Dr. Tunga Salthammer acts as his deputy. The institute was incorporated into the Fraunhofer-Gesellschaft in 1972 and, with currently around 175 permanent employees and an operating budget of ca. 16,5 million euros, is one of the largest institutions for applied wood research in Europe. Around 9,000 m² of offices, laboratories, technical center and workshops are available.

The Fraunhofer WKI is a member of the Fraunhofer Group for Materials and Components - MATERIALS, the Fraunhofer Alliances Vision, Building Innovation, Lightweight Design, and Technical Textiles, and the Fraunhofer Networks for Sustainability and Science, Art and Design as well as the Research Alliance for Cultural Heritage. Within the Fraunhofer-Gesellschaft, the Fraunhofer WKI occupies a unique position as regards its holistic research approach to the material usage of wood and lignocellulosic materials.

51F



Fraunhofer

WKI

Self-Perfection

Vision

Our vision is a globally successful research institute which addresses current and future issues concerning renewable raw materials in a customer-oriented manner whilst taking into account the socio-economic and ecological challenges.

Mission

We develop technologies and products and provide services for the responsible use of renewable resources, taking into account environment-related interactions and a sustainable improvement in the quality of life.

Sustainability

Since its foundation in 1946, the Fraunhofer WKI has been conducting applied research, the results of which are then utilized to develop new materials, products, services and technologies in collaboration with industry. These developments are focused on renewable resources and their sustainable use. The aim is an improvement in product

quality and safety as well as an increase in the competitiveness of our industrial partners. We strive to establish a long-term cooperation based on partnership.

In addition to the most important renewable raw material wood, the institute investigates numerous other lignocellulosic materials. These are, in all facets, key materials for a sustainable development and the solution of ecological and socio-economic challenges - from chemical applications, through industrial use, and on to recycling.

The effective utilization of complex materials requires highly specialized knowledge, the scope of which encompasses many disciplines of natural and engineering sciences.

The Fraunhofer WKI is the research institution in which the complexity of renewable raw materials is systematically documented and processed in the most diverse facets and interactions. This is the fundament which enables the WKI to occupy a leading position in research and development today.

Since
1946
in the pursuit of
sustainability.

Organization Chart

Institute Management

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Application Center HOFZET®

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Infrastructure Services

General Administration

Dipl.-Wirt.-Ing. Ulrike Holzhauer

Information Technology

Andreas Schlechtweg

Technical Services

Dipl.-Ing. (FH) Stephan Thiele

Board of Trustees

The Board of Trustees of the Fraunhofer WKI, which consists of qualified scientists and experts from industry, authorities and institutions, examines the research activities and advises the Institute's Management as well as the Executive Board of the Fraunhofer-Gesellschaft.

Dr. Markus Boos

Remmers GmbH, Lönigen

Christine Dübler

ZwickRoell GmbH & Co. KG, Ulm

Dorothee Flötotto

Sauerländer Spanplatten GmbH & Co. KG, Arnsberg

Dipl.-Ing. Hubertus Flötotto (Deputy Chair)

Sauerländer Spanplatten GmbH & Co. KG, Arnsberg

Prof. Dr. Eva Frühwald Hansson

Lund University, Faculty of Engineering, Sweden

Dipl.-Ing. Kai Greten (Chair)

Gronau (Leine)

Prof. Dr. Joachim Hasch

SWISS KRONO Tec AG, Luzern, Switzerland

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Pfleiderer Deutschland GmbH, Neumarkt i.d.OPf.

Dr.-Ing. Hans-Werner Hoffmeister

Technische Universität Braunschweig, Institute of Machine Tools and Production Technology

Dr. Sebastian Huster

Ministry for Science and Culture of Lower Saxony, Hanover,

Prof. Dr. Angela Ittel

Technische Universität Braunschweig

Dr. Helge Kramberger

Dr.-Robert-Murjahn-Institut GmbH, Ober-Ramstadt

Prof. Dr. Andreas Krause

Thünen-Institut für Holzforschung, Hamburg

Karl-Robert Kuntz

elka-Holzwerke GmbH, Morbach

Dr. Klaus Merker

Niedersächsische Landesforsten, Braunschweig

Prof. Dr. Holger Militz

Georg-August-Universität Göttingen, Wood Biology and Wood Products, Forest Sciences and Forest Ecology

Prof. Dr. rer. nat. Klaus Richter

Chair of Wood Science - Holzforschung München
Technical University of Munich, Germany

Anemon Strohmeier

Verband der Deutschen Holzwerkstoffindustrie e.V., Berlin

Prof. Dr.-Ing. André Wagenführ

TU Dresden, Institute of Natural Materials Technology,
Chair of Wood Technology and Fibre Materials
Technology

Dr. Stephan Weinkötz

BASF SE, Ludwigshafen

MR'in a. D. Dr. jur. Birgit Wolz

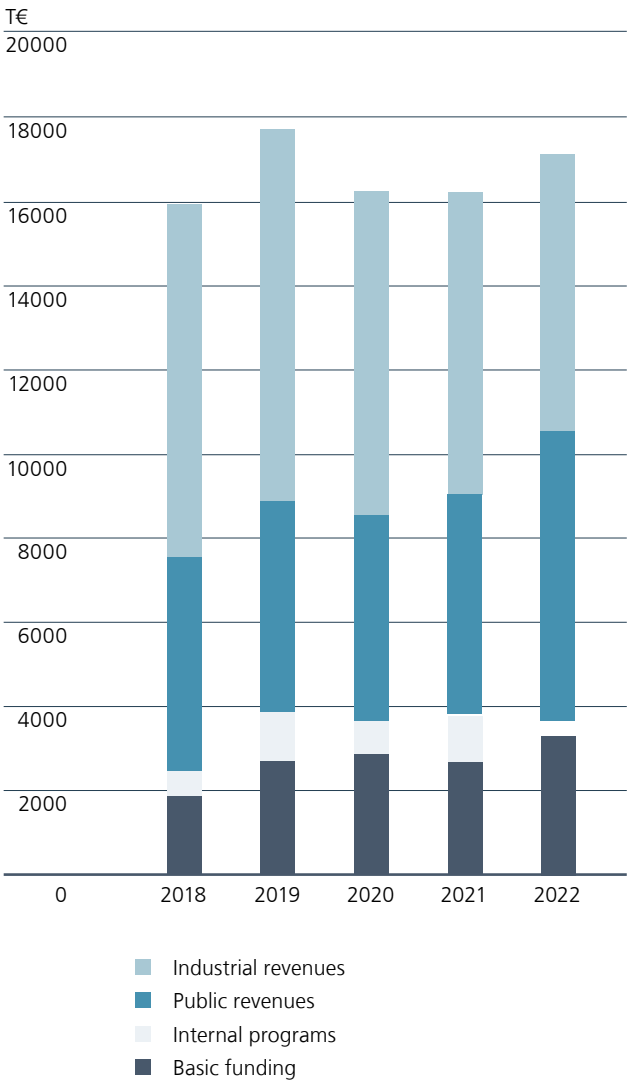
Bonn

Werner Zimmermann

Rhenocoll-Werk e. K., Konken

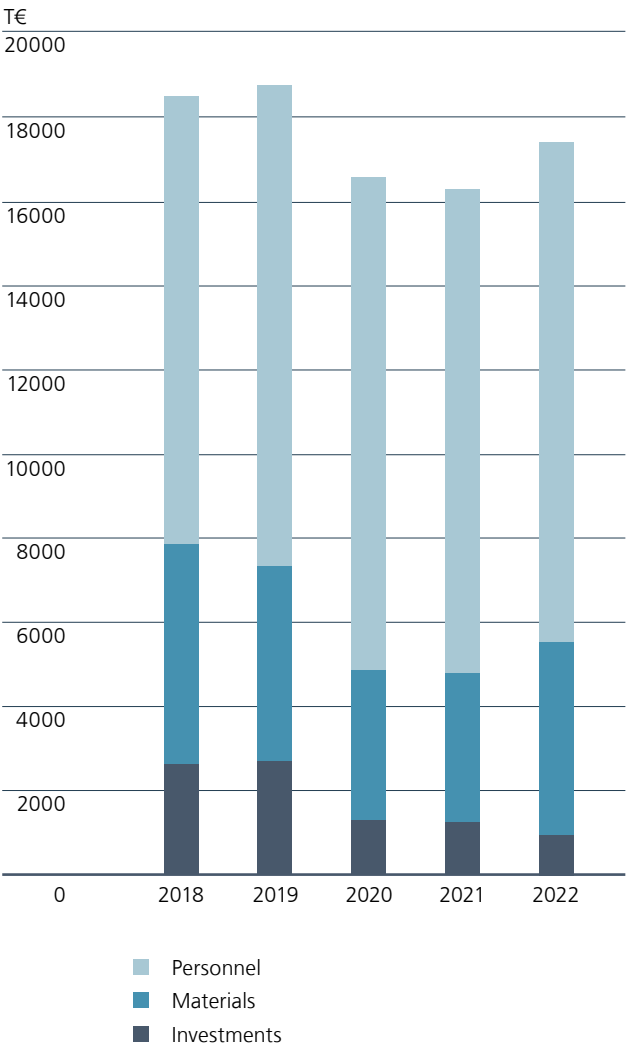
Figures | Data | Facts

Revenue Structure



In 2022, a total of € 13.5 million in external income was realized. Just over 40 % of the WKI's income is financed through industrial contracts; € 6.8 million was generated through public funding within our research projects.

Budget and Investments



In the reporting year 2022, the operating budget was just over € 16.5 million. Personnel expenses amounted to € 11.8 million, while material costs totaled € 4.7 million. The investment budget amounted to a total of € 0.8 million.



Locations

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Fraunhofer WKI | Center for Light and Environmentally-Friendly Structures ZELUBA®

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2



Fraunhofer WKI | Application Center HOFZET®

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3



Fraunhofer Project Center Wolfsburg

c/o Open Hybrid LabFactory e. V.
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4

Staff



In the reporting period, the Fraunhofer WKI employed around 175 staff, 30 percent of whom were scientists, engineers and doctoral students. 70 % of the employees come from the professional fields of technology, laboratory, administration and information technology. In addition, bachelor and master students and student assistants are employed to support the

research work carried out at the institute. The Fraunhofer WKI offers apprenticeships in the fields of IT specialist, office communication, and industrial and wood mechanics, as well as in the area of media and information services.



Innovative Fields of Research



**I find out what the
world needs. And
then I invent it.»**

Thomas Alva Edison

Technology for Wood and Natural Fiber-Based Materials

Composites made from wood and other lignocellulosic raw materials have a unique character: They are environmentally-friendly, degradable and exceptionally functional.

In the "Technology for Wood and Natural Fiber-Based Materials" department, we address the development of composite materials, the recycling of waste wood and biocomposites (WPC), and image-processing methods for process and quality control. The spectrum of our material developments ranges from classic wood-based materials (particle board, fiberboard, insulation board, OSB, plywood, LVL) through hybrid materials and on to biocomposites, 3D molded parts and material composites.

For the preparation and production of the materials and for the application of the binders, technical facilities are available which offer a direct industrial orientation. This allows us to map the complete process chains from raw commodity through to material.

In addition to the further development and optimization of existing process technologies and the combination of positive properties in the material production, we also perform testing on formaldehyde-free binders, bonding and modification processes. Our portfolio is completed through new sorting processes and utilization methods for an efficient recycling of waste wood, WPC and their coatings and constituents as well as non-destructive measuring and testing methods.

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Material Analysis and Indoor Chemistry

In the department "Material Analysis and Indoor Chemistry", we comprehensively address the measurement and evaluation of indoor air contaminants and consumer-related products. The spectrum of materials investigated ranges from classic wood-based materials, through plastics and building products, and on to products from the automotive, consumer goods, electronics, aircraft and food industries.

The development of new analysis and sampling techniques, olfactory examination methods and the construction of emission test chambers and cells are further important areas of our work. We address questions concerning indoor hygiene and room climate with respect to the environment, health and consumer protection. We investigate and evaluate real indoor environments in private and public buildings, educational and recreational facilities, and modes of transportation, including consideration of the air quality in display cases and in museum collection rooms. We measure and model the size and distribution of particles and bio/aerosols in indoor air and investigate the efficiency of air-purification devices. Furthermore, we develop model systems with the help of which the complexity of indoor areas and the resulting air hygiene can be calculated in dependence on widely differing parameters (climate, materials installed, chemical-physical reactions).

Current main topics concern the influences of short- and long-term climatic changes on indoor air quality for the Central European region, and the correlation between building-product emissions and indoor air quality. We contribute our expertise to the relevant bodies. Furthermore, we cooperate with numerous research institutions – both in Germany and abroad – within the framework of scientific exchange programs.

Head of Department

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Binders and Coatings

With a commitment to the environment, in our “Binders and Coatings” department we develop bio-based coatings, adhesives, printing inks and 3D-printing materials derived from vegetable oils, sugars, lignin and other vegetable residues. From binder synthesis, through formulation and on to processing, we are at your side as a competent research partner.

Wood hereby also forms the focal point for us. In addition to the development of wood coatings which protect wood from environmental influences, wear and fire, we also develop binders for adhesives used in the bonding of wood and other materials as well as in the production of wood-based materials. Connected to this is damage analysis, which involves rapid and unequivocal clarification of damage cases in coated woods, wood adhesives, wood-based materials and solid woods.

Our bio-based binders are also deployed in the field of printing inks and additive-manufacturing processes. In the printing-ink sector, we primarily substitute health-endangering ink constituents for diverse printing processes. For additive manufacturing, we develop novel polymeric materials for UV-curing and thermoplastic processes.

Standardized tests, damage analyses and the development of methods for the assessment and optimization of the weathering resistance of materials round off our profile.

Head of Department

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Quality Assessment

The focus of the research projects in the department “Quality Assessment” is directed at the assessment of bondings, evaluation of bonding processes, forestry-relevant issues for products made from wood, and the further development of test methods for measuring the formaldehyde emission of products with and from renewable raw materials.

In an interdisciplinary team, we elaborate and develop solutions for and with customers from, among others, the forestry and timber industry, the construction industry, the furniture industry and the chemical industry. The expertise we have gained through contact with manufacturers and from our research work is made available in certified advanced training courses at our **WKI | AKADEMIE®**.

We are furthermore internationally recognized as a testing, monitoring and certification body and are consequently a competent partner for all issues relating to testing, monitoring and certification.

Head of Department

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Center for Light and Environmentally-Friendly Structures ZELUBA®

At the "Center for Light and Environmentally-Friendly Structures ZELUBA®", we develop sustainable solutions for the construction industry. We provide industrial partners from the wood-based materials, construction and manufacturing industries, as well as companies from the skilled trades, with support in the development of new building materials and components.

One of our major competences is the transfer, within the construction industry, of fundamental research, through to applied research, and on to the finished product.

With the addition of building physics and mechanical-constructive research methods as well as the consideration of the complete life cycle of a product, our spectrum ranges from the development of innovative materials, through the complex issues of individual details, and on to entire building-material systems and their recycling.

A further research focus is the development of reactive fire-protection systems for the improvement of building-material behavior and the fire resistance of building elements and structures, as well as the development of hybrid building-material systems.

Furthermore, we also focus on advanced computer modeling, structural dynamics and vibrations.

Wood and other renewable raw materials form the primary focus of our activities.

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Application Center HOFZET®

The aim of the "Application Center HOFZET®" is, in collaboration with industrial partners, to identify new applications for sustainable composite materials and to develop pioneering products and technologies.

Our research fields extend from simple material developments through to complex complete solutions for products, components and semi-finished products. We develop sustainable solutions ranging from the selection of raw materials, material production and processing, through material-appropriate designs and simulations, and on to ecological evaluation and production maturity.

The emphasis is placed on the development of thermoplastic, extrusion-produced, short-fiber-reinforced compounds as well as the production of textile semi-finished products and their processing into thermoset and also thermoplastic composites. The focus in materials development is thereby directed at the utilization of cellulose-based fibers, yarns and fabrics as well as the incorporation of biopolymers and recyclates.

With a particular awareness of the need for an efficient recycling economy, current research activities are increasingly being oriented towards issues relating to the utilization of recycled and residual materials, as well as their extraction, characterization and definition for potential areas of application.

Our developments are always carried out under consideration of the corresponding impact categories of a life-cycle assessment, with the result that the topic of sustainability is taken into account from the selection of the raw materials, through component production and the life cycle, and on to recycling.

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Research Highlights



**If you lift your gaze,
you see no borders.«**

Chinese
Proverb

Strand-based hybrid materials for structural components

As a result of ever-stricter climate-protection guidelines as well as increased requirements regarding sustainability and the reduction or neutrality of CO₂ emissions from materials, manufacturing processes and end products, the aspiration to develop sustainable solutions for the automotive industry is intensifying.

In particular, renewable raw materials such as wood can fulfill the requirements of the automotive industry regarding the increase of resource efficiency and the improvement of recyclability. Raw materials containing lignocellulose are therefore gaining in attractiveness compared to conventional lightweight-construction materials. In order to achieve high mechanical properties whilst simultaneously realizing complex component geometries, the degree of decomposition of the wood is, however, decisive and must be selected specifically for the component. In the joint project "HyEnd-Wood", a strand-based hybrid material with a wood content of 60-80% is being developed for the automotive industry. The material, produced from a storable semi-finished product, is intended to close the gap between freely formable but non-structural WPC or MDF and load-bearing but not freely formable plywood and laminated wood. The goal is a structural component that is lighter or weight-neutral compared to the original component, with the same or higher functionality. The sustainable and resource-conserving usage of domestic beech wood as well as the consideration of a cascading utilization of residual and waste wood can furthermore improve the environmental balance of the vehicles. Through hybridization with aluminum or steel, both local reinforcements and compatibility with established joining processes are ensured. Hybridization with flax mats already achieves higher strengths than pure wood-based materials at comparable density and thickness.

Funding: German Federal Ministry of Food and Agriculture (BMEL) via Fachagentur Nachwachsende Rohstoffe (FNR)

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Building-product emissions and indoor air quality

In modern societies, people spend the majority of the day inside buildings. Indoor air quality is therefore a decisive factor for health and well-being. Foreign substances and odors can have a negative influence on air quality. In this project, we are investigating the relationship between building-product emissions and air quality in realistic model rooms and are developing simulation models.

Four model rooms of differing construction types will be erected in order to cover a variety of construction forms that are commonly offered. The selection of the constructions and the materials thereby incorporated is carried out in cooperation with planning offices on the basis of real construction projects for public buildings and residential housing as well as schools and kindergartens. In a first step, we examined the selected materials and building products regarding their emission behavior with respect to (highly) volatile organic compounds and odor-relevant substances. We perform the testing of the individual materials in accordance with the "AgBB scheme". This provides a uniform and comprehensible foundation for the health-related evaluation of building-product emissions in Germany. On the basis of the measurement data, it should be possible to draw conclusions regarding the concentrations of air pollutants measured in the model rooms. The dimensions of the model rooms correspond to the dimensions of the European reference room pursuant to DIN EN 16516:2020-10. On the basis of the experimentally acquired data, we are developing simulation models in order to enable a mapping of the relationship between emissions and immissions. The results of the project will be incorporated into a guideline that will provide planning and architectural offices with recommendations concerning the selection and utilization of building materials.

Funding: German Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMUV) via the German Federal Environment Agency (UBA)

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New materials for UV-curing processes

UV-curing materials for the additive manufacture of polymers are predominantly based on curing polyesters and polyurethanes. We are developing new materials for UV-curing additive manufacturing through the use of itaconic acid, which is obtained from residues generated during sugar production.

In the additive manufacturing of plastics, UV-curing processes play an important role. The material does, however, have some limitations, such as shrinkage, warping, or insufficient heat resistance. As a result, functional components can only be manufactured to a limited extent using commercial materials. In our research project, we developed novel radical-curing biogenic polymers for photopolymer-based resins with improved properties. Itaconic acid is thereby utilized as the UV-curing component. The polymer resins that are based on this biogenic building block replace the acrylic acid-based or methacrylic acid-based materials that are currently used. This enables the realization of UV-curable plastics that, due to the regular distribution of the UV-curing groups in the polymer backbone, exhibit improved properties compared to conventional materials for additive manufacturing. As a result, components can be produced that are characterized by significantly higher heat resistance and lower embrittlement. During the project, we produced initial material samples using the developed processes, which we then used as the basis for evaluating the potential of the materials for various applications. Through the successful implementation of the project, the Fraunhofer WKI is providing a contribution towards sustainability, as renewable raw materials can be increasingly utilized for material systems in additive manufacturing in the future.

Funding: German Federal Ministry of Education and Research (BMBF) via Project Management Jülich (PtJ)

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Material use of spruce calamity wood

The bark beetle has caused massive damage to spruce trees over huge areas. Enormous quantities of damaged wood are the result. In collaboration with four other research partners, we are investigating the material-utilization possibilities for spruce calamity wood, both as dead trees remaining standing in the forest and lying in dry storage.

In recent years, the mass reproduction of insect pests has led to extensive damage to spruce trees (*Picea abies* (L.) Karst.) over vast areas. Enormous quantities of damaged or calamity wood are the result, which cannot always be promptly removed from the forest due to a lack of storage and processing capacities. In the joint FNR project "NUKAFI", we are addressing, in collaboration with four research partners as well as supportive industrial companies, the question as to whether and for what periods of time the dead spruce trees can remain standing upright in the forest or lying in dry storage. Through systematic investigations at the locations "Harz" and "Sauerland", a record is to be compiled which demonstrates how the wood quality of spruce trees that have died as a result of bark-beetle infestation changes in dependence on the storage time and the respective location, and which value-creating material use of the wood – e.g. solid wood, OSB, particle board and fiberboard – is still possible depending on this. With the aim of an optimal material utilization of the calamity wood, a guideline for forest owners and wood utilizers is to be developed, from which recommendations for action for a product-specific "standing sorting" of the stock can be derived. Assuming a positive outcome, the research project can thereby contribute towards an increase in efficiency in the material utilization of spruce calamity wood.

Funding: German Federal Ministry of Food and Agriculture (BMEL) and German Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (BMUV) via Fachagentur Nachwachsende Rohstoffe (FNR)

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Long-term behavior of adhesive-bonded wood-hybrid systems

Resource conservation and energy efficiency determine construction for the future. Innovative wood-hybrid systems have better mechanical properties, higher durability and facilitate leaner component structures than conventional construction methods - and also expand the architectural leeway.

We are investigating timber-concrete composite systems (TCC systems) as an alternative to reinforced concrete. They are particularly suitable for utilization under bending load. Instead of steel, wood is used in order to absorb the tensile forces occurring in the composite. We develop, for example, ceiling slabs in which a beam structure is installed with a top layer of wood-based panels. The top layer is an integral part of the structure and simultaneously serves as formwork and possible support for the ceiling. It is coated with an adhesive and subsequently filled with fresh concrete. The concrete layer ensures a high degree of strength in the compression zone, while the wood absorbs tensile forces. TCC systems simplify processing at the construction site, as the formwork is not removed after the concrete has hardened.

Furthermore, wood possesses high strength in relation to its weight and also offers a high degree of adaptability and processability. The tensile and compressive strength of wood is, however, comparatively low, as a result of which its utilization in load-bearing structures has been limited until now. Through the combination with fiber-reinforced plastic, this disadvantage can be compensated. In the current project, we are developing suitable fiber-reinforced plastics and manufacturing processes for wood-fiber-reinforced plastic systems.

Funding: German Federal Ministry of Food and Agriculture (BMEL) via Fachagentur Nachwachsende Rohstoffe (FNR)

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Life-cycle analysis in plastic injection-molding simulation

The core objective of the project is the integration of sustainability-relevant data into the simulation software. This will enable the influence of material selection with regard to life-cycle impacts to be taken into account at an early stage in the design and construction phase of injection-molded components and tools.

The application possibilities for plastics are extremely diverse. Despite its low weight and unique material properties, this material is increasingly being critically scrutinized as a result of the disadvantageous CO₂ balance of predominantly petroleum-based plastics. Where there is no alternative to plastics, the focus is on the question as to which plastic can be meaningfully utilized, whereby not only technical properties but also environmental effects must be taken into account. Product design must serve functionality, economy and sustainability in equal measures. This challenge can be addressed with simulations, as virtual testing of differing parameters renders test series more meaningful than a prototype alone. Until now, sustainability aspects have not been hereby taken into account. If the results of life-cycle analyses are considered at the very beginning of a development, this facilitates material selection, component design and process management. Predictive life-cycle analyses will, however, only become practicable if they generate precise data in an uncomplicated manner with little outlay. The project therefore aims to extend the life-cycle analysis of injection-molding simulation. In collaboration with the IfBB of the HS Hannover, Simcon, bekuplast and GreenDelta, an interface will be created between the existing simulation software CADMOULD and the LCA software openLCA as well as the underlying databases. For this purpose, exemplary comparisons and the linking of injection-molding simulation, material characteristics and balance-sheet effects of the materials and processes are being performed.

Funding: German Federal Ministry of Education and Research (BMBF) via Project Management Jülich (PtJ)

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Public funding sources

75
public
funding
projects 2022

AiF	German Federation of Industrial Research Associations »Otto von Guericke«
BBSR	Federal Institute for Research on Building, Urban Affairs and Spatial Development
BBR	The Federal Office for Building and Regional Planning
BLE	Federal Office for Agriculture and Food
BMBF	Federal Ministry of Education and Research
BMEL	Federal Ministry of Food and Agriculture
BMUV	Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection
BMDV	Federal Ministry for Digital and Transport
BMWK	Federal Ministry for Economic Affairs and Climate Action
BÖLN	German Federal program for organic farming and other forms of sustainable agriculture
DBU	German Federal Environmental Foundation
DFG	German Research Foundation
DGUV	Deutsche Gesetzliche Unfallversicherung e. V.
DLR	German Aerospace Center
EBA	Federal Railway Authority
EU	Commission of the European Union
FNR	Agency of Renewable Resources
FZJ	Forschungszentrum Jülich GmbH
iVTH	International Association for Technical Issues related to Wood
KIT	Karlsruher Institute of Technology
Land NRW	State Government of North Rhine-Westphalia
PtJ	Project Management Jülich
UBA	German Environment Agency
VDI/VDE	VDI/VDE Innovation + Technik GmbH
WKF	Waldklimafonds



Scientific excellence

47	Publications
2002	Citations (Source: Scopus)
48	Presentations
5	In-house seminars
6	Webinars
6	Lecturers
16	Lectures
3	Training events by the WKI AKADEMIE®
2	Guest scientists
1	Doctoral thesis
5	Master theses
14	Collaborations with expert committees and working groups
61	Involvements in standardization committees
1	Patent application
2	Evaluated excellence research



Getting together is a start,
staying together is
progress, working together
is success.«

Henry Ford

Events

Funding decision regarding the construction of a new pilot plant for the use of beech-wood fibers

8th September 2022 | BMEL, Berlin

Beech-wood fibers are to be used in the future as a component of climate-friendly brick insulation materials. The German Federal Ministry of Food and Agriculture, via the FNR e. V. (Agency for renewable raw materials), is funding the construction of a pilot plant at the Fraunhofer WKI for the utilization of beech-wood fibers as a brick insulation material. The notification of funding was ceremoniously handed over to the Fraunhofer WKI on 8th September 2022.

Events/trade fair participations (selection)

Network meeting of research-funding foundations

10th May 2022 | Fraunhofer WKI, ZELUBA®, Braunschweig
"Achieving more together: Research funding for sustainable development" was the topic discussed by representatives of foundations and researchers from the Fraunhofer WKI and the Fraunhofer Future Foundation.

Salon der Wissenschaft (Salon of Science)

13th May 2022 | Braunschweig
The "Salon der Wissenschaft" is a new event format that provides members of the public with the possibility of engaging in conversation with researchers from the Braunschweig region. The Fraunhofer WKI was represented with the topic "How can building in the future be designed sustainably?".

Public planting event within the project "Grünes Wasser" (Green Water)

21st June 2022 | Hamburg
In collaboration with the design studio "morgen.", the Fraunhofer WKI has developed floating islands which can be filled with plants and which are made from a robust bio recycled lightweight-construction material. The project team organized a public hands-on event at Hamburg's Bleichenfleet, during which 16 floating islands were collaboratively filled with plants and then launched into the water.

Celebration event for the 75th anniversary of the Wilhelm-Klauditz-Institut

On 30th June 2022, the Fraunhofer Executive Board, the Fraunhofer WKI Board of Trustees and individuals from politics, business and research were invited to celebrate the 75th anniversary of the Fraunhofer WKI, which had been postponed by one year due to the pandemic. On the festive occasion, the guests were welcomed with greetings, retrospective views and outlooks. Following this, the guests were given a tour of the new building of the ZELUBA® and were provided with exclusive insights into research practice.

Festival "The Roofs"

11th – 21st August 2022 | Munich

InnoTrans 2022

20th – 23rd September 2022 | Berlin

12th European Wood-based Panel Symposium

12th – 14th October 2022 | Hamburg

For the 12th time, the Fraunhofer WKI organized the European Wood-based Panel Symposium in cooperation with the European Panel Federation, the iVTH e. V. and the company Hywax GmbH. In addition to interesting technical presentations and an accompanying exhibition, the successful networking event offered the approximately 320 participants from 30 countries ample opportunities for exchanging views on the most important trends and challenges in the wood-based materials industry.

The date for the next event has already been set. From 9th to 11th October 2024, the 13th European Wood-based Panel Symposium will once again take place in Hamburg (<https://www.european-wood-based-panel-symposium.org>).

K 2022

19th – 26th October 2022 | Düsseldorf

Webinars (in German)

Schwab, H.: Proof of suitability for the production of bonded load-bearing timber components according to DIN 1052-10
Rüther, N.: Insulating materials made from renewable raw materials and wood-fiber external thermal insulation composite systems (ETICS)
Eschig, S.: AdLigno – Formaldehyde-free condensation resins made from lignin and hydroxymethylfurfural
Hansen, O.: Environmentally-friendly vehicles thanks to bio-lightweight bodywork (Part 2)
Krenn, T.: FutureWood – Softwood quality in times of climate change
Wientzek, S.: Air purifiers – from chamber testing to real room measurement

In-house seminars (in German)

Kolb, T.: Non-combustible wood – Is that possible?
Christ, H.: Self-growing binders and coatings – fungal mycelium for the industrial production of bio-based insulation and materials
Schieweck, A.: Emissions of deceased persons in dependence on post-mortem changes
Aderhold, J.: The WKI Alpha Duo computer tomograph – what it can (and cannot) do
Vellguth, N.: Investigation of the long-term stability of PET-fiber-filled PP for utilization in small load carriers



Groups, Alliances and Networks

Institutions with differing competences collaborate within the Fraunhofer Groups, Alliances and Networks in order to mutually manage and promote a business segment.

The WKI is a member of the Group MATERIALS, of the Alliances Building Innovation, Vision, Lightweight Design and Technical Textiles as well as in the Fraunhofer Networks Sustainability and Science, Art and Design. Additionally, the Fraunhofer WKI is a member of the Cultural Heritage Research Alliance.

Fraunhofer Group MATERIALS

Fraunhofer materials research covers the entire value chain, from new material development and improvement of existing materials through manufacturing technology on a quasi-industrial scale, to the characterization of properties and assessment of service behavior. The same research scope applies to the components made from these materials and the way they function in systems. In all these fields, experimental studies in laboratories and technical institutes are supplemented by equally important numerical simulation and modelling techniques – across all scales, from individual molecules up to components and process simulation. As far as materials are concerned, the Fraunhofer MATERIALS group covers the full spectrum of metals, inorganic non-metals, polymers and materials made from renewable resources, as well as semiconductor materials.

www.materials.fraunhofer.de

Fraunhofer Network Science, Art and Design

How can science be inspired by art - and vice versa? What parallels exist in the work of researchers and creative minds? How can they benefit from mutual dialogue? The Network for Science, Art and Design, founded within the Fraunhofer-Gesellschaft in 2018, is addressing these questions.

www.art-design.fraunhofer.de

Fraunhofer Building Innovation Alliance

The objective of the Fraunhofer Building Innovation Alliance is to represent and process all scientific and research-relevant questions on the topic of construction from a single source within Fraunhofer. This will provide the construction industry with a central contact point for integral system solutions.

www.bau.fraunhofer.de



Fraunhofer Lightweight Design Alliance

Lightweight construction means the realization of a weight reduction with sufficient rigidity, dynamic stability and strength. Hereby must be ensured that the developed components and structures can safely fulfill their task throughout their service life. The material properties, the constructive design, the construction method and the manufacturing process significantly determine the quality of a lightweight structure. The entire development chain, from material and product development through series production to approval and product application, must therefore be considered.

www.leichtbau.fraunhofer.de

Fraunhofer Technical Textiles Alliance

In order to fully exploit the potential of high-performance fibers for textile-reinforced lightweight structures, innovations must be created through application-oriented and product-specific developments of textile-based technologies and systems with direct linkage to preform and component manufacturing. The entire textile manufacturing chain is covered by the Fraunhofer Textiles Alliance, starting from fiber production and functionalization.

www.textil.fraunhofer.de

Fraunhofer Vision Alliance

The Fraunhofer Vision Alliance combines the expertise of institutes in the field of image processing. The allied institutes offer services relating to applications of innovative sensors, from infrared to x-ray, plus the associated handling apparatus. Their work focuses particularly on optical sensing and automated inspection processes for quality assurance.

www.vision.fraunhofer.de

Cultural Heritage Research Alliance

The highest priority of this interdisciplinary alliance is the preservation of our cultural heritage through research and innovation in materials science. Documents, paintings, sculptures and historic buildings are not only invaluablely precious idealistically for society; they also represent an enormous economic factor.

www.forschungsallianz-kulturerbe.de

Fraunhofer Sustainability Network

The Fraunhofer Sustainability Network seeks to orient research and technical developments at the Fraunhofer-Gesellschaft more strongly towards the principle of sustainability and to develop a distinct image profile for this which is clearly recognizable both internally and externally. The Network is thus supporting the Fraunhofer-Gesellschaft's current strategy process involving twelve future-related topics under the title of "People need a future - the future needs research".

www.fraunhofer.de

International Association for Technical Issues Related to Wood e. V.

The shortage of wood as a raw material and the obligation to use the available timber economically provided the impulse for the founding of the Association for Technical Issues related to Wood in Braunschweig in 1946. Through its activities, the Association, renamed as iVTH - International Association for Technical Issues Related to Wood e. V., continues to contribute towards the deepening and sharing of knowledge concerning wood as a material as well as its utilization.

The Association is one of approx. 100 sector-orientated research associations which are members of the AiF (German Federation of Industrial Research Associations). We would like to transfer the knowledge from research projects practice-oriented into the timber industry, in order for procedures and products to be newly-developed or enhanced. The competitiveness of SMEs should thereby be strengthened. The focus of our activities is, after all, placed mainly upon small and medium-sized companies in the timber industry and their suppliers. Nationally and internationally, we maintain close contact with research bodies and businesses with practical involvement.

Our services at a glance:

- The iVTH promotes research and development work in the forestry and wood industries and associated fields, both nationally via cooperative industrial research (IGF) and internationally via CORNET (in each case BMWK via AiF),
- allocates research projects with currently-relevant objectives,
- organizes scientific events,
- awards the Wilhelm Klauditz Prize for wood research and environmental protection,
- contributes to advisory committees,
- is member of the German Federation of Industrial Research Associations AiF, the Austrian Society for Wood Research ÖGH, the Joint Committee on Adhesive Technology GAK, the Hardwood Research Interest Group IGLHF and
- is a cooperation partner for initiatives concerning wood as a resource.

If you have project ideas, are seeking a contact partner or would like to support our work, please do not hesitate to contact us:

International Association for Technical Issues Related to Wood - iVTH e. V.
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Phone: +49 531 2155-209 | Fax: +49 531 2155-334
contact@ivth.org | www.ivth.org

The Fraunhofer-Gesellschaft

The Fraunhofer-Gesellschaft based in Germany is the world's leading applied research organization. Prioritizing key future-relevant technologies and commercializing its findings in business and industry, it plays a major role in the innovation process. It is a trailblazer and trendsetter in innovative developments and research excellence. The Fraunhofer-Gesellschaft supports research and industry with inspiring ideas and sustainable scientific and technological solutions and is helping shape our society and our future.

The Fraunhofer-Gesellschaft's interdisciplinary research teams turn original ideas into innovations together with contracting industry and public sector partners, coordinate and complete essential key research policy projects and strengthen the German and European economy with ethical value creation. International collaborative partnerships with outstanding research partners and businesses all over the world provide for direct dialogue with the most prominent scientific communities and most dominant economic regions.

Founded in 1949, the Fraunhofer-Gesellschaft currently operates 76 institutes and research units throughout Germany. Over 30,000 employees, predominantly scientists and engineers, work with an annual research budget of €2.9 billion. Fraunhofer generates €2.5 billion of this from contract research. Industry contracts and publicly funded research projects account for around two thirds of that. The federal and state governments contribute around another third as base funding, enabling institutes to develop solutions now to problems that will become crucial to industry and society in the near future.

The impact of applied research goes far beyond its direct benefits to clients: Fraunhofer institutes enhance businesses' performance, improve social acceptance of advanced technology and educate and train the urgently needed next generation of research scientists and engineers.

Highly motivated employees up on cutting-edge research constitute the most important success factor for us as a research organization. Fraunhofer consequently provides opportunities for independent, creative and goal-driven work and thus for professional and personal development, qualifying individuals for challenging positions at our institutes, at higher education institutions, in industry and in society. Practical training and early contacts with clients open outstanding opportunities for students to find jobs and experience growth in business and industry.

The prestigious nonprofit Fraunhofer-Gesellschaft's namesake is Munich scholar Joseph von Fraunhofer (1787–1826). He enjoyed equal success as a researcher, inventor and entrepreneur.

Figures as of 2022
www.fraunhofer.de

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Shaking table.

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Aerial photograph of the Fraunhofer campus in Braunschweig.

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Page 2

Portrait photograph of Professor Bohumil Kasal.

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Pages 4/5

Timber-concrete composite systems (TCC systems) in long-term testing.

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Page 7

Entrance area of the “Center for Light and Environmentally-Friendly Structures ZELUBA®” in Braunschweig.

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Page 12

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Pages 20/21

Stained wood-foam samples.

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Page 22

12th European Wood-based Panel Symposium in the large ballroom of the Grand Elysée Hotel Hamburg.

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Pages 24/25

Creel of the Fraunhofer WKI double-ropier weaving machine.

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Cover image: Shaking Table

Through the research and development of sustainable construction methods and vehicle components, the Fraunhofer WKI is making a contribution towards the achievement of climate targets and the conservation of resources. This also includes the research and evaluation of dynamic behavior of new materials, components and structures.

With the help of a uniaxial dynamic vibration table ("shaking table"), we have the ability to investigate individual components and complete structural modules to achieve the highest level of safety.



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