



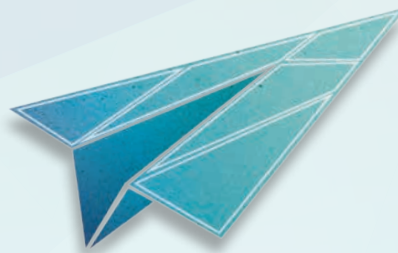
Fraunhofer
UMSICHT

FRAUNHOFER INSTITUTE FOR ENVIRONMENTAL , SAFETY, AND ENERGY TECHNOLOGY UMSICHT

> 25 YEARS OF
FRAUNHOFER UMSICHT
BRINGING IDEAS
TO LIFE

ANNUAL REPORT

2014 | 2015



A REPORT FOR YOU ABOUT
US, OUR PRODUCTS,
OUR SERVICES AND OUR
RESPONSIBILITY FOR THE
FUTURE.



SUSTAINABILITY AS A RECURRING THEME

The subject area of sustainable energy and raw materials management is the focus of our work. Ever since 1990, our founding year, it has been our objective to carry out sustainable research in the areas of environmental, safety, and energy technology. At Fraunhofer UMSICHT, the sustainability strategy was created holistically and is anchored in the institute as a whole. The employees, management and the institute's directorate are equally involved in the implementation.

We would like to show all of our interested parties (customers, the public, job applicants) specifically which contribution our R&D products and services make to sustainable development. We want to get in touch with them in order to jointly further these objectives and to improve the quality of life of society as a whole.

In case of questions regarding the topic or if you would like to order our sustainability report, please contact Dr.-Ing. Markus Hiebel, the Sustainability Manager of the institute:

nachhaltigkeit@umsicht.fraunhofer.de

MORE ABOUT SUSTAINABILITY AT FRAUNHOFER UMSICHT

www.umsicht.fraunhofer.de/en/sustainability.html



We are looking forward to receiving your feedback!

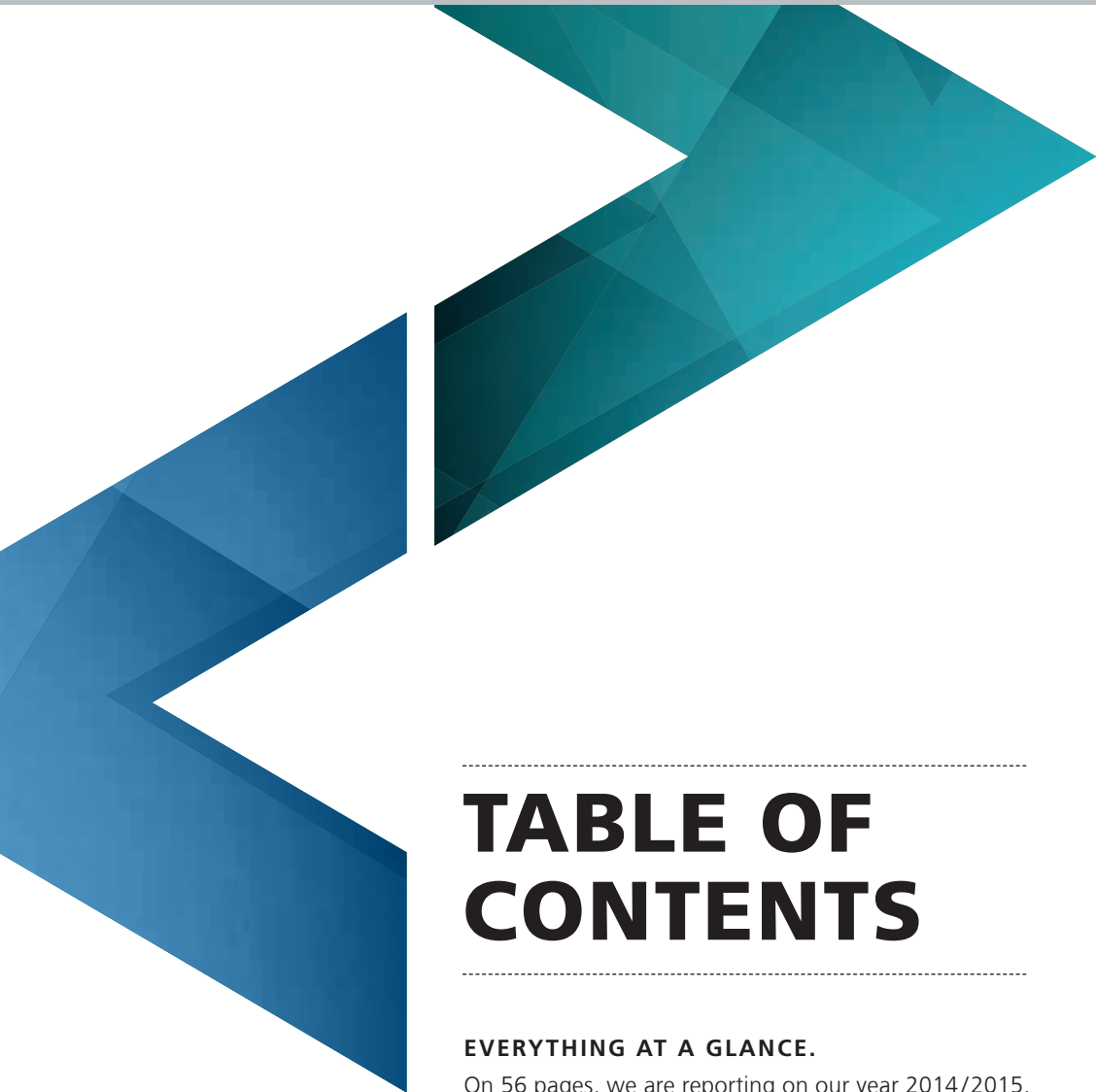
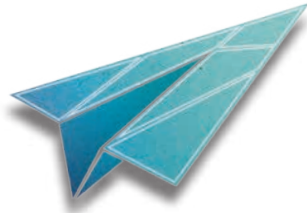


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On 56 pages, we are reporting on our year 2014/2015, our projects, the people behind the projects and the prospects.





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*Prof. Dr.-Ing. Eckhard Weidner,
Director of the institute.*

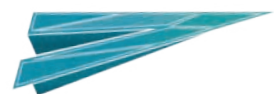


*Prof. Dr.-Ing. Göрге Deerberg,
Deputy Director of the institute.*

PREFACE

Photos: Fraunhofer UMSICHT/PR-Fotografie Köhring

Fraunhofer UMSICHT in Oberhausen is celebrating its 25th birthday on June 24, 2015. A paper plane is giving wings to the anniversary slogan "25 years of Fraunhofer UMSICHT: bringing ideas to life".



www.umsicht.fraunhofer.de/en/25years
CLICK, EXPLORE, DISCOVER
25 Years of Fraunhofer UMSICHT



Dear readers

2015 has been an important and exciting year to us. Under the motto "Bringing ideas to life", we are celebrating our 25th birthday in June. As is well known, a lot of value is placed on tradition here in the Ruhr district and we, too, can look back at 25 years of applied research. The future requires heritage, the future requires tradition, but "Tradition is not the holding on to the ashes, but rather the passing on of the torch."*

The future of Fraunhofer UMSICHT rests within the areas of expertise of our employees in the areas of energy, processes, products, and within a powerful organization. With sustainable solutions, we work on shaping the energy transition and raw materials shift in the business units Polymer Materials, Chemistry, Environment, Biomass, and Energy. We are introducing our five business units to you in this annual report – as well as the heads associated therewith. They and the whole team of Fraunhofer UMSICHT pass on the torch. They all work on sustainable innovations and deal with challenges that always start with an idea.

"If you want to have good ideas you must have many ideas. Most of them will be wrong, and what you have to learn is which ones to throw away." – Linus Pauling

This sentence of US-American chemist and two-time Nobel laureate Linus Pauling is characteristic of what UMSICHT stands for – for a wealth of ideas, for "bringing ideas to life", and for the competences and the knowledge to convert these ideas into solutions for market-oriented and applied research.

We wish you an exciting read and are looking forward to our anniversary year.

Cordial greetings

Handwritten signature of Eckhard Weidner in blue ink.

Eckhard Weidner

Handwritten signature of Görgo Deerberg in blue ink.

Görgo Deerberg

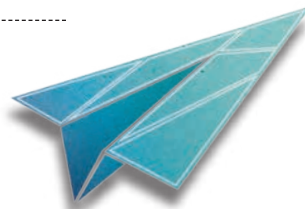
** free adaptation from the French philosopher and politician Jean Jaurès*



INSTITUTE

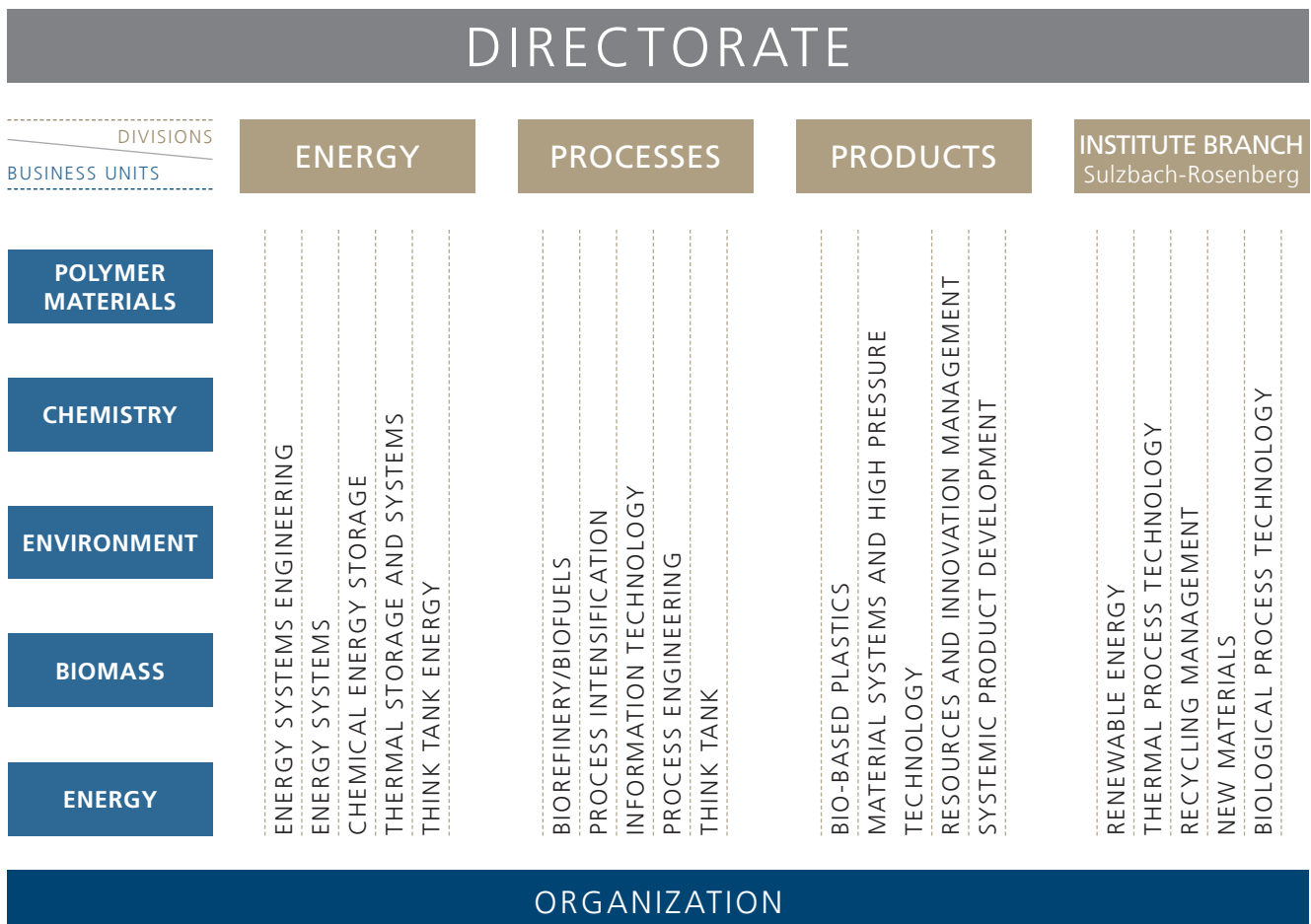
**THE BASIC DATA OF
FRAUNHOFER UMSICHT.**

Organizational Structure, Profile,
Key Performance Indicators, Divisions,
Business Units.



ORGANIZATIONAL STRUCTURE

The organizational structure of Fraunhofer UMSICHT is based on the divisions Energy, Processes, and Products in Oberhausen and the institute branch Sulzbach-Rosenberg. The divisions with their departments and groups bundle the scientific know-how of the institute based on functional criteria. The Organization division combines the technical and administrative departments of the institute. One of the results of the last strategy audit was to supplement this organizational structure with five industry-oriented business units. They customize the specialized knowledge and the research and development expertise of the divisions and departments to the customers' needs in the business units. This matrix structure is meshing the institute's know-how in the best possible manner and ensures the strategic alignment of our research with the business units. This enables us to respond quickly and flexibly to changes in the markets and to shape the challenges our customers are facing in the future.



ORGANIZATION

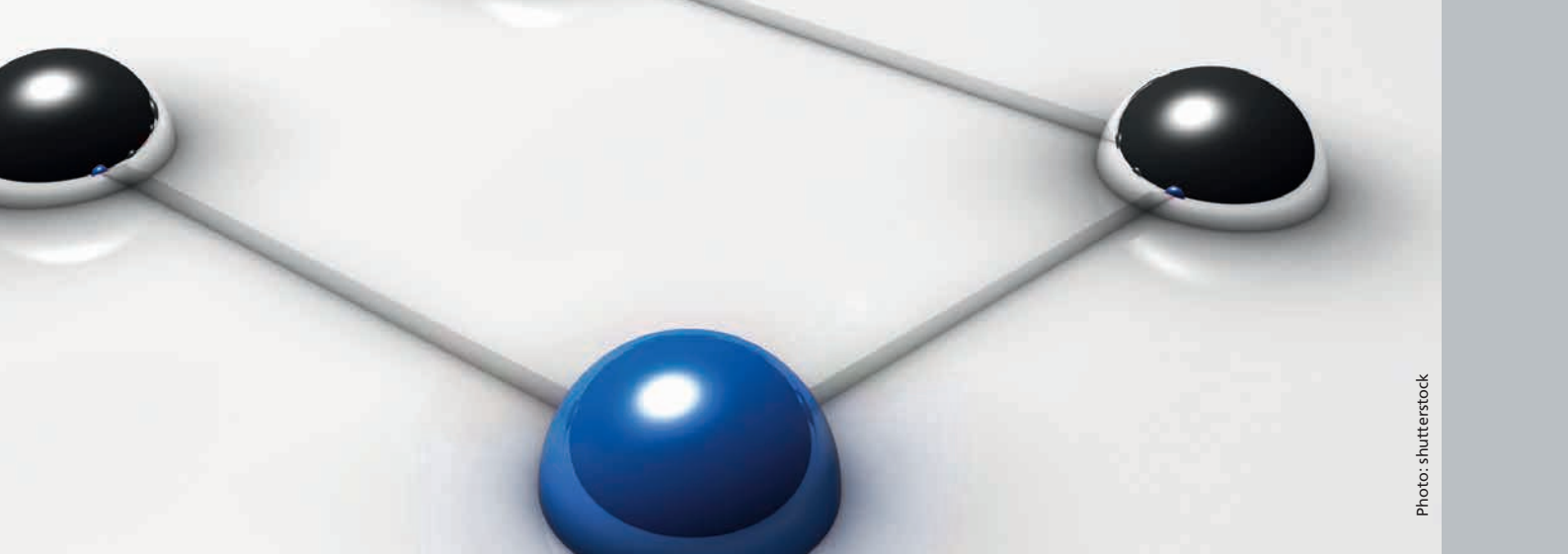


Photo: shutterstock

PROFILE OF FRAUNHOFER UMSICHT

Fraunhofer UMSICHT regards itself as a pioneer for sustainable energy and raw materials management. The institute provides scientific results and transfers them to businesses, society, and politics. Fraunhofer UMSICHT, together with its partners, does research and develop sustainable products, processes, and services that are exciting. As one of 66 institutes and research institutions of the Fraunhofer-Gesellschaft, the largest organization for applied research in Europe, we are networked world-wide and promote international cooperations.

KEYNOTES

Founded:	June 1990
Main site:	Oberhausen, NRW (Germany)
Branch office:	Willich, NRW (development of plastics made of renewable resources, manufacturing in pilot series and small batches)
Institute branch:	Sulzbach-Rosenberg (in the Nuremberg metropolitan region of Bavaria) (business-oriented concepts and processes for the manufacturing and utilization of energy, raw materials and materials, thermal and chemical energy storage, energy conversion from biomass and waste, raw materials, materials and surfaces for power engineering and resources management)
Total staff*:	559 employees, of which 435 are located in Oberhausen and Willich as well as 124 in Sulzbach-Rosenberg
Total budget:	38.1 million euros (2014), of which 31.5 million euros are allocated to Oberhausen/Willich and 6.6 million euros to Sulzbach-Rosenberg
Customers:	Small and medium-sized enterprises, major enterprises, public institutions
International markets:	Europe (primarily), Africa, Asia, South America

*As of December 31, 2014



Institute's complex in Oberhausen.

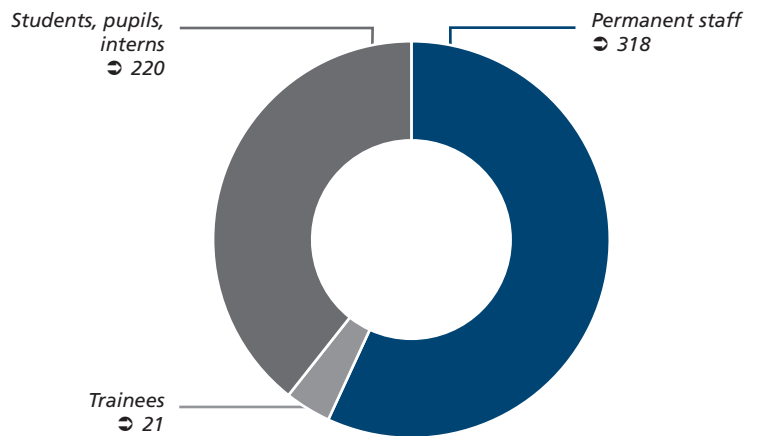


Institute's complex in Sulzbach-Rosenberg.

FACTS AND FIGURES

STAFFING STATISTICS 2014

	OB	SURO *
Permanent staff	247	71
Scientific	192	51
Administrative	55	20
Other staff	188	53
Trainees	18	3
Students, pupils, interns	170	50
Total staff	435	124

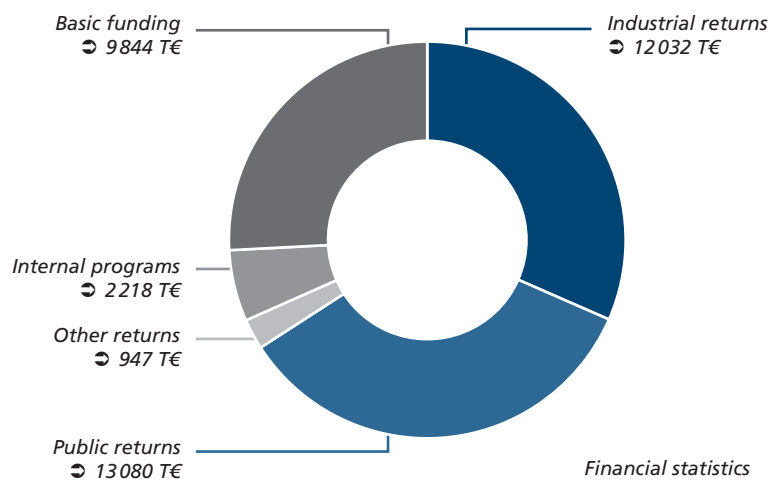


Staffing statistics
Fiscal year 2014; including all sites.

FINANCIAL STATISTICS 2014

[in thousand euros]

	OB	SURO *
Operating budget	30 196	6 164
Other costs	14 802	2 212
Staff costs	15 394	3 952
Investments budget	1 286	474
External project investments	268	474
Internal investments	1 018	0
Total returns	31 482	6 639
Industrial returns	11 494	538
Public returns	7 098	5 982
Other returns	828	119
Internal programs	2 218	0
Basic funding	9 844	0



Financial statistics
Fiscal year 2014; including all sites.



Prof. Dr.-Ing. Christian Doetsch
Photo: Fraunhofer-UMSICHT/PR-Fotografie Köhring



Prof. Dr.-Ing. Göрге Deerberg
Photo: Fraunhofer-UMSICHT/PR-Fotografie Köhring



Prof. Dr.-Ing. Eckhard Weidner
Photo: Fraunhofer-UMSICHT/PR-Fotografie Köhring

OUR DIVISIONS – OUR BRANCH

Fraunhofer UMSICHT has 559 employees who work in four areas at the Oberhausen site and in departments in the institute branch in Sulzbach-Rosenberg. An overview of our areas of focus follows.

ENERGY

The rebuilding of the energy economy on the renewable resources of sun, wind and biomass requires sustainable solutions for society, industry and citizens in order to harmonize energy supply and requirements among the energy sectors. Effective and efficient energy processes, new storage technologies and intelligent system solutions are required.

We develop and optimize energy systems, prepare solutions for the storage of electricity or heat and optimize energy or energy supply systems. Our competencies lie in the development of novel technologies and their implementation in pilot and demonstration plants as well as in system analytical studies.

*Prof. Dr.-Ing. Christian Doetsch | Division Director Energy |
Phone +49 208 8598-1195 | christian.doetsch@umsicht.fraunhofer.de*

PROCESSES

Modern and efficient production requires technologies for manufacturing products from starting materials using chemical, physical or biological processes. Economical, resource and energy-efficient, hence sustainable processes are our goal.

Through the adaptation and optimization as well as the development of new individual components, we enhance the spectrum of possible conversion processes. Optimized total processes mean more than interconnecting optimized individual steps. We therefore view complex production processes as well as process and environmental technology holistically. We offer process technological procedures from laboratory test up to demonstration plants and pilot production based on models for analysis and development.

*Prof. Dr.-Ing. Göрге Deerberg | Deputy Director, Division Director Processes |
Phone +49 208 8598-1107 | goerge.deerberg@umsicht.fraunhofer.de*

PRODUCTS

Material and product innovations today must address targets of sustainable development. For us this means a drastic increase in resource efficiency as well as the reorganization of human-technology interactions and an innovation culture based on openness, participation and interdisciplinary thinking. We develop materials based on raw materials that are regenerative and recyclable. We employ supercritical fluids, biomimetic approaches and technologies of individualized and additive manufacturing for optimized processing technologies.



Andreas Weber

Photo: Fraunhofer UMSICHT/PR-Fotografie Köhring



Prof. Dr. rer. nat. Andreas Hornung

Photo: Matthias Heyde

For product development, we follow the guiding principles of co-design and integrate citizens as users, innovators, and stakeholders for the environment.

Prof. Dr.-Ing. Eckhard Weidner | Director of the institute, Division Director Products | Phone +49 208 8598-1102 | eckhard.weidner@umsicht.fraunhofer.de

ORGANIZATION

The Organization division unites the entire administrative and technical infrastructure of Fraunhofer UMSICHT. Five departments render high-quality services and create outstanding working conditions for our scientists. We competently and reliably support these areas at all sites with the goal of contributing to the long-term scientific and economic success of the institute.

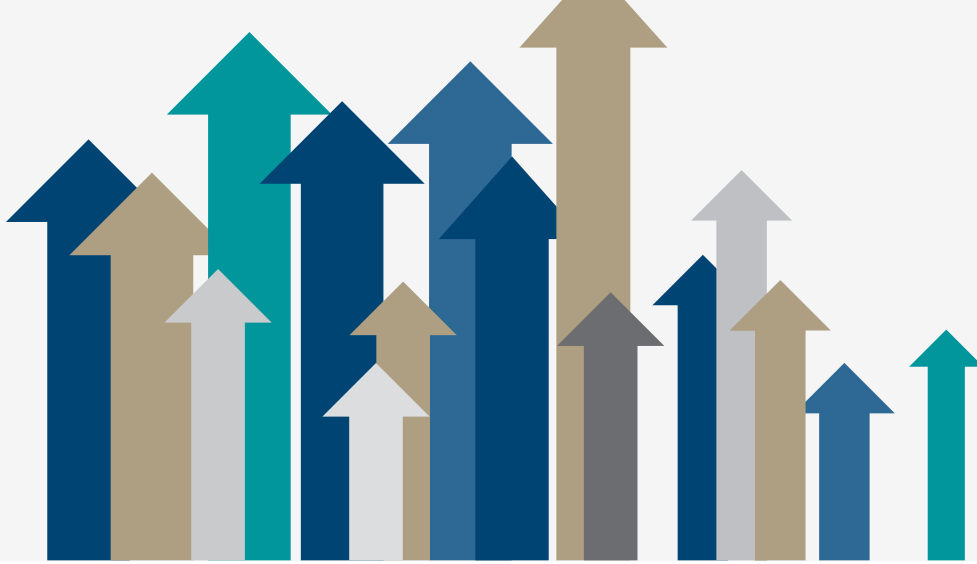
Andreas Weber | Division Director Organization | Phone +49 208 8598-1226 | andreas.weber@umsicht.fraunhofer.de

INSTITUTE BRANCH SULZBACH-ROSENBERG

Fraunhofer UMSICHT in Sulzbach-Rosenberg develops economy-applied concepts and processes for the provision and use of energy, raw materials, and components. The topics include thermal and chemical energy storage, energy conversion of biomass and waste, raw materials, materials and surfaces for energy technology, and resource management.

The departments of the institute branch complement the topical diversity of Fraunhofer UMSICHT in Oberhausen. The institute accompanies its customers from the process idea to the pilot plant and from product development to pilot production, focusing on integrated process assessment for efficient, economic and sustainable solutions.

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OUR BUSINESS UNITS

For achieving the declared objective of Fraunhofer UMSICHT – to offer the best research service – an eye for the whole is important, in addition to excellent performance. It is only this way that topics can be assessed, custom solutions can be provided, and an industry-oriented development can take place. In this, five newly created business units will help in the future which – supported by business developers – have been tailored to the needs of select industry segments. A holistic understanding of markets and customers' needs brings the specialized departments of the institute together with the objective to utilize resources more efficiently and to increase the productivity of Fraunhofer UMSICHT and of its partners.



POLYMER MATERIALS

For decades, Fraunhofer UMSICHT has been a strong partner to small and medium-sized enterprises all the way up to large-scale industry in the areas of the development and processing of plastics.

Our specialties include the development of materials of bio-based plastics and recycle-based plastics. We are representative of product and process developments, simulation, production scale-up and additive manufacturing of plastics. In the area of consumer products, we have proven expertise in high pressure technology and coating technology. As an application-oriented development partner, we also transfer our material, process, and product innovations to the construction and leather industries.

CONTACT

Dr.-Ing. Manfred Renner | Phone +49 208 8598-1411 | manfred.renner@umsicht.fraunhofer.de



CHEMISTRY

We offer process engineering research and development services as well as products and processes incl. industrial property rights. These help meet the increasing demands for affordable sustainability and innovation in chemistry, petrochemistry and refinery. Our know-how encompasses the areas of fine and specialty chemicals (organic acids, peptides, sugars, tensides), polymers (monomer syntheses, polymerization, polycondensation) as well as chemical mass products (alcohols, naphtha) and biofuels (diesel, kerosene). Biomass, synthesis gas and select residues constitute the portfolio of raw materials from which we suggest process-specific solutions. Know-how regarding the upstream and downstream processing as well as product formulation round out our expertise.

We are points of contact for the whole value added and logistics chains, develop sustainability assessments and strategies. We are glad to bundle internal and external competences to fit your project.

CONTACT

Dr.-Ing. Axel Kraft | Phone +49 208 8598-1167 | axel.kraft@umsicht.fraunhofer.de
Dr.-Ing. Hartmut Pflaum | Phone +49 208 8598-1171 | hartmut.pflaum@umsicht.fraunhofer.de





ENVIRONMENT

Our service portfolio includes consulting, applied studies, innovative technology development up to pilot plant scale as well as support of the technical implementation at industrial scale. We provide clear communication paths with a central contact person who looks across our business units for the ideal solution for the customers' demands and who supports the joint realization. We deliver basics for strategic decisions; we improve competitiveness through optimization of energy flows, raw material flows and waste streams through sustainability assessments and through optimization of processes and plants.

We as a reliable and strong partner for our customers aim at establishing long-term business partnerships.

CONTACT

*Dipl.-Ing. Gerold Dimaczek | Mobile +49 172 8156183 |
gerold.dimaczek@umsicht.fraunhofer.de*



BIOMASS

Provision of bioenergy and biogas, utilization of residues, nutrient management and recovery as well as decentralized production and marketing of bio-based conversion products (biochar, synthesis gas, and pyrolysis condensate) are among our focal points. We develop and optimize thermochemical and biological conversion and distribution processes and the corresponding plant technology. With the objective to recover nutrients from municipal and industrial process chains and the conversion processes, we develop concepts and methods for nutrient management in biomass management. In this,

we take into consideration raw materials potentials as well as logistic issues and integrate the technologies developed into established or novel value added chains.

CONTACT

*Dipl.-Phys. Thorsten Wack | Phone +49 208 8598-1278
thorsten.wack@umsicht.fraunhofer.de*



ENERGY

The growth of renewable, decentralized and distributed energies in the supply mix as well as the increased use of energy storage, smart technologies and services are characteristic of new energy systems. We research efficient solutions for the energy supply and distribution of the future. In this, our primary approach is at the decentralized combined generation. We support companies of the industry in the handling of technical and system analysis issues in urban and regional energy supply structures as well as in the industrial environment (e. g. decentralized power generation, cross-energy technologies, application of energy storage systems).

We are specialized in the technical development and utilization of innovative technologies as well as in decentralized power generation and energy storage.

CONTACT

*Dr.-Ing. Wilhelm Althaus | Phone +49 208 8598-1186 |
wilhelm.althaus@umsicht.fraunhofer.de*



BUSINESS UNIT

POLYMER MATERIALS



Photo: Shutterstock

SERVICE PORTFOLIO

For decades, Fraunhofer UMSICHT has been a strong partner to small and medium-sized enterprises all the way up to large-scale industry in the areas of the development and processing of plastics. Our specialties include the development of materials of bio-based plastics and recycle-based plastics. We are representative of product and process developments, simulation, production scale-up and additive manufacturing of plastics. In the area of consumer products, we have proven expertise in high pressure technology and coating technology. As an application-oriented development partner, we also transfer our material, process, and product innovations to the construction and leather industries.

RESEARCH AND DEVELOPMENT SERVICES

- Materials development (focus on bio-based plastics)
- Product and process development, manufacturing processes
- Product design, CAD design, and sample production
- Surface modification and surface structuring
- Foaming of plastics
- Component and system development
- Coating development
- Studies and consultation
- Multiphysics simulations of components and products
- Technical and economic feasibility studies
- Sustainability assessments
- Analytics, chemistry, biology, environmental analysis
- Determination of the biodegradability of materials and products

MARKETS AND INDUSTRIES

- Plastics and plastics processing industry
- Manufacturers of household articles, consumer care and clothing
- Leather and leather processing industry
- Manufacturers and users of additive manufacturing/ 3D printing
- Construction industry

MORE INFO

www.umsicht.fraunhofer.de/polymermaterials





Photo: Fraunhofer UMSICHT/Iilka Drnovsek

1

BUSINESS DEVELOPER MANFRED RENNER

1 *Dr.-Ing. Manfred Renner,
Business Developer Polymer
Materials.*

Manfred Renner has a fresh view of his topic. The process engineer's pronounced tendency to lend a hand himself in the technical shops is exceeded only by his enthusiasm in the development of ideas with and for his customers.

THIS IS WHAT IS MOVING MARKETS AND INDUSTRIES

The polymer materials industry is split into the production of mass-market consumer goods at costs that are as favorable as possible and of consumer goods that are characterized by their functionality (e. g. anti-bacterial features) or their specific material (e. g. bio-based). The demands posed to both segments are increasing both from a domestic as well as an international perspective.

TRENDS AND OUR RESPONSES TO THEM

On the globalized world market, the positive differentiation from competitors is of essential importance both to SMEs as well as major enterprises. As both development partner and bearer of know-how specific to the discipline and of the corresponding intellectual property (IP), we implement company-specific and requirements-specific solutions in our target markets and industries. This applies to both innovative as well as completely novel developments of processes and materials.

A LOOK AHEAD

The future of polymer materials is multi-faceted. What is certain is that these materials are and will remain essential building blocks of our civilization. Bio-based and functionalized polymers as well as their combination with conventional plastics in the form of sandwich or multi-component systems supplement the portfolio of materials. In the future, they will be dominating the research market.

MORE INFO

s.fhg.de/bd-polymermaterials



CONTACT

Dr.-Ing. Manfred Renner | Business Developer Polymer Materials, Head of Department Material Systems and High Pressure Technology | Phone +49 208 8598-1411 | manfred.renner@umsicht.fraunhofer.de

HIGHLIGHTS OF THE BUSINESS UNIT

cleantan®-process: Resource-efficient tanning of leather without wastewater

The innovative leather tanning process developed by Fraunhofer UMSICHT, in comparison to conventional tanning, allows for a reduction of chromium-contaminated wastewater by more than 95 percent, a savings of more than half of the chromium tanning agent, and a 75 percent reduction of the tanning time. At the Oberhausen site, a tanning system on a pre-industrial scale has already been set up, in which up to 500 kilograms of hide can be tanned in a single step.

CONTACT

Dr.-Ing. Manfred Renner | Business Developer Polymer Materials, Head of Department Material Systems and High Pressure Technology | Phone +49 208 8598-1411 | manfred.renner@umsicht.fraunhofer.de

Impregnation: Plastic surfaces free of bacteria thanks to carbon dioxide

Fraunhofer UMSICHT combines the advantages of compounding and surface coating by impregnating plastics with supercritical carbon dioxide. Based on this manufacturing process, silver particles can be introduced in surfaces such as door handles close to the surface and with material efficiency stopping the multiplication of bacteria.

CONTACT

Dr.-Ing. Manfred Renner | Business Developer Polymer Materials, Head of Department Material Systems and High Pressure Technology | Phone +49 208 8598-1411 | manfred.renner@umsicht.fraunhofer.de

The right bio-based plastic for each application

Be it the entry into the manufacturing of bio-based plastics or the expansion of the product portfolio, Fraunhofer UMSICHT supports its customers from the planning of the recipe, via the process, all the way to the finished product made of bio-based plastics. The compounds and composites developed at the institute offer a specific, often even novel set of characteristics that corresponds to those of fossil-based polymer materials or exceeds them. All products can be processed on conventional machines and are cost-optimized with a concurrent eye on market opportunities as well as availability of resources.

CONTACT

Dr.-Ing. Stephan Kabasci | Head of Department Bio-based Plastics | Phone +49 208 8598-1164 | stephan.kabasci@umsicht.fraunhofer.de

MORE INFO

www.cleantan-fraunhofer.de



MORE INFO

s.fhg.de/nVS (in German only)



MORE INFO

s.fhg.de/zYC



BUSINESS UNIT **CHEMISTRY**



SERVICE PORTFOLIO

We offer process engineering research and development services as well as products and processes incl. industrial property rights. These help to meet the increasing demands for affordable sustainability and innovation in chemistry, petrochemistry and refinery. Our know-how encompasses the areas of fine and specialty chemicals (organic acids, peptides, sugars, tensides), polymers (monomer syntheses, polymerization, polycondensation) as well as chemical mass products (alcohols, naphtha) and biofuels (diesel, kerosene). Biomass, synthesis gas and selected residues constitute the portfolio of raw materials from which we suggest process-specific solutions. Know-how regarding the upstream and downstream processing as well as product formulation round out our expertise. We are points of contact for the whole value added and logistics chains, develop sustainability assessments and strategies. We are glad to bundle internal and external competences to fit the customer's project.

RESEARCH AND DEVELOPMENT SERVICES

- Synthesis routes from fossil and biogenic raw materials and residues incl. consulting regarding the sustainable shift in raw materials
- Optimization of process chains through integration of biotechnological and chemical-catalytic process steps
- Development and optimization of scalable processes incl. upstream and downstream processing
- Product development and formulation as well as production scale-up
- Development and screening of catalysts all the way up to kg scale
- Optimization of bioconversion steps with conversion of material by microorganisms, enzymes or enzyme systems
- Development, sizing, operation, provision as well as optimizations of laboratory and technical shop systems with capacities of up to 20 kg product per week
- Analytics service: analyses in accordance with standard processes, special analytics, development of methods
- Technological consulting: sustainability assessments, economic feasibility analyses, concept studies all the way to basic engineering, studies regarding the potential of utilizing alternative raw materials and residues, topic and trend scouting, strategic concepts for action, innovation road- maps

MARKETS AND INDUSTRIES

- Chemical industry
- Biotechnology
- Process engineering plant construction

MORE INFO

www.umsicht.fraunhofer.de/chemistry





BUSINESS DEVELOPERS

DR. AXEL KRAFT | DR. HARTMUT PFLAUM

1 *Dr.-Ing. Axel Kraft (left) and Dr.-Ing. Hartmut Pflaum (right), Business Developers Chemistry.*

The two business developers excel with many years of expertise. Axel Kraft's roots are in chemistry. He is bringing 13 years of industry experience and 8 years of experience with him. Hartmut Pflaum is the allrounder with an eye for the whole. For 25 years of research and development activity, the chemical engineer's focus has been on sustainable business practices, resource strategies and innovation processes.

THIS IS WHAT IS MOVING MARKETS AND INDUSTRIES

Currently, we are expecting innovations in process intensification, in the development of catalysts and of functional materials. In the past years, global investments in the utilization of alternative raw materials and residues have taken place. The fermentation technology of residues and synthesis gas to mass products (ethanol, butanol, acetone and terpenes) is experiencing a new upswing. The best market opportunities are experienced by new products if they feature sustainable and compatible substitute solutions for processes (drop-in) and products (fully fungible).

TRENDS AND OUR RESPONSES TO THEM

As short-term trends, we pursue in projects the utilization of multi-product plants for the manufacturing of fuels and mass chemicals, sustainability management (for risk minimization) as well as the optimization of the value added network (forward/backward integration). Furthermore, we are building up capacities for the renaissance of electrochemistry ("Power-to-Products").

A LOOK AHEAD

At present, subsidies, large investors, and political agendas control the utilization competitions for food, fossil as well as bio-based raw materials and residues. To solve or even avoid conflicts such as food vs. fuels vs. materials, we need synergies. In this, it will be decisive whether the value added chain for bio-based fuels – in particular kerosene – is developed separately or integrated into the chemical industry. These challenges can be mastered only through system-oriented and internationally networked large projects. This is what we are working on with our partners.

MORE INFO

s.fhg.de/bd-chemistry



CONTACT

Dr.-Ing. Hartmut Pflaum | Business Developer Chemistry, Head of Department Resources and Innovation Management | Phone +49 208 8598-1171 | hartmut.pflaum@umsicht.fraunhofer.de

Dr.-Ing. Axel Kraft | Business Developer Chemistry, Head of Department Biorefinery/Biofuels | Phone +49 208 8598-1167 | axel.kraft@umsicht.fraunhofer.de

HIGHLIGHTS OF THE BUSINESS UNIT

Fuels made of oil and fat

Oils and fats are biogenic raw materials and play an important role in the raw materials shift. Fraunhofer UMSICHT has developed and patented a chemical-catalytic process with which hydrocarbons can be manufactured sustainably as blend components for diesel, kerosene and naphtha. Vegetable oils as well as residues containing fat, including animal fats, constitute the raw materials base for the process. The Greasoline® process works at normal pressure, requires virtually no hydrogen, and can be economically realized in comparatively small system sizes of 10 - 20 000 t/a.

CONTACT

Dr.-Ing. Volker Heil | Group Manager Thermochemical Processes and Hydrocarbons | Phone +49 208 8598-1163 | volker.heil@umsicht.fraunhofer.de

Plasticizers for plastics – 100 percent bio-based

The share of bio-based plasticizers is steadily increasing, wherein – in particular – applications for foodstuffs packaging and toys are of interest. Fraunhofer UMSICHT has developed a process that can produce a blend of alcohols with up to ten carbon atoms from fermentatively generated ethanol. Their subsequent esterization with fermentatively produced succinic or citric acid leads to 100 percent bio-based plasticizers – a substitute for the phthalates in PVC which have been categorized as dangerous.

CONTACT

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From synthesis gas to basic chemicals – Nothing goes without catalytic processes

Synthesis gas is an important blend of substance for the production of basic chemicals. In the chemical conversion of synthesis gas, efficient catalytic processes play a key role for the production e. g. of methanol, higher alcohols, or dimethyl ether (DME). Fraunhofer UMSICHT develops new catalysts and optimizes their interaction with the corresponding process flow. This way, it was possible in the context of the BETSY (bio-ethanol from synthesis gas) project to achieve a 300 percent increase of the ethanol selectivity in cooperation with partners from industry and higher education.

CONTACT

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MORE INFO

www.greasoline.com



BUSINESS UNIT **ENVIRONMENT**



SERVICE PORTFOLIO

Our service portfolio includes consulting, applied studies, innovative technology development up to pilot plant scale as well as support of the technical implementation at industrial scale. We provide clear communication paths with a central contact person who looks across our business units for the ideal solution for the customers' demands and who supports the joint realization. We deliver basics for strategic decisions; we improve competitiveness through optimization of energy flows, raw material flows and waste streams, through sustainability assessments and through optimization of processes and plants. We as a reliable and strong partner for our customers are willing to establish long-term business partnerships.

RESEARCH AND DEVELOPMENT SERVICES

- Preparation of eco-assessments and sustainability assessments in accordance with DIN EN ISO 14040/14044 for products, processes and services
- Analysis of complex energy and raw materials supply systems (systems analysis) in order to support business policy/political decisions
- State-specific, industry-specific and company-specific strategies and concepts for the supply with primary and secondary raw materials
- Technological consulting regarding strategic company decisions
- Concepts, processes, and products for
 - Recycling, utilization of residues – recovery and generation of reusable materials and critical raw materials
 - Removal of pollutants and recovery of reusable materials from (waste) water
 - Removal of pollutants from waste gases
- Development, engineering, erection and operation of plants and technologies for recycling, (waste) water treatment and reduction of emissions at various orders of scale (testing plants, demonstration plants, industrial scale implementation)
- Scientific-technical support in the implementation of new technologies in practice

- Customer-tailored safety and hazardous material management software
- Analytics services with problem-oriented assessment and action recommendations
- Economic feasibility studies for processes, methods and products

MARKETS AND INDUSTRIES

- Waste disposal, circular economy, and recycling
- Raw materials industry
- Energy supply (incl. the supply of heat and cold)
- Water supply and wastewater disposal
- Manufacturing industry and plant construction
- Industrial facility management
- Engineering and planning offices
- The public sector

MORE INFO

www.umsicht.fraunhofer.de/environment





Photo: Fraunhofer UMSICHT/Ilka Drnovsek

BUSINESS DEVELOPER GEROLD DIMACZEK

1 *Dipl.-Ing. Gerold Dimaczek,
Business Developer Environ-
ment.*

Gerold Dimaczek, chemical engineer, represents a more than 25 year experience in the technical/financial management of an applied research institute (energy, environment and new materials) combining technical and business know-how. He is familiar with the demands of the industry and strongly interested in developing innovative solutions for SMEs.

THIS IS WHAT IS MOVING MARKETS AND INDUSTRIES

The energy transition and raw materials shift are significant key topics of the industry. The industry located in the environmental sector deals with services and technologies for the generation/provision of regenerative energies and raw materials and/or secondary raw materials as well as for emission protection. As such, the closing of material cycles is also at the focus of the industry, in addition to the climate protection efforts.

TRENDS AND OUR RESPONSES TO THEM

Sustainable business practices and also energy and resource efficiency are increasingly gaining in importance in the manufacturing industry. They constitute a decisive competitive advantage in a globalized market. For this, we develop sustainable strategies and innovative technologies for the provision of primary and secondary raw materials, for the recycling of scarce and valuable raw materials, as well as for emission protection.

A LOOK AHEAD

The industries and markets covered by the business unit show a steady growth, on average generally in the single digit percentage range, also driven by the objectives of the German federal government and of the EU-2020 strategy. The claim to drive forward business performance with lower energy and material intensity and the decoupling of resource consumption and growth in combination with the demographic change and climate change requires new ways of thinking and innovative solutions. This is where the Business Unit Environment is at home.

CONTACT

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[s.fhg.de/bd-environment](https://www.fhg.de/bd-environment)



HIGHLIGHTS OF THE BUSINESS UNIT

How much does recycling save in terms of resources and greenhouse gases?

Fraunhofer UMSICHT carries out greenhouse gas assessments, eco-assessments, and analyses regarding the resource costs for companies of the circular economy. With specially developed methods, process chains and secondary raw materials are assessed as well as optimization potentials opened up. Company-specific real data ensures topicality and practical relevance of the results which industry customers aggressively utilize in public relations as well as for decisions regarding strategic direction. Fraunhofer UMSICHT consults with methods of innovation management and innovation marketing.

CONTACT

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Ensuring the raw material supply

Old dumps provide a high reusable materials potential. Fraunhofer UMSICHT is heading the BMBF project "REStrateGIS" and is, among other things, working on the questions: Which dumps are located where? Which reusable materials are contained in residues, and where are these located on the dump? At which costs can the value be increased? In order to increase the supply safety for companies using critical raw materials, the researchers are, furthermore, developing regional raw material strategies that are based on demand analyses and which identify suitable recycling concepts. Currently, a think tank for industry and resource policy and a de-installation factory are being conceptualized under participation of Fraunhofer UMSICHT.

CONTACT

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Eliminating micropollutants in water

The micropollutant problem is the new global challenge in water management. Pharmaceutical residues or industrial chemicals are increasingly polluting the water and cannot be decomposed in conventional wastewater treatment plants. Fraunhofer UMSICHT is developing multi-barrier systems based on a metallic microfilter (microsieves) with a functional surface which – in a single process step – mechanically retain certain impurities and additionally can decompose and/or destroy micropollutants. At present, research is being carried out on new bio-based adsorbents and energy-efficient regeneration processes for active charcoal.

CONTACT

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MORE INFO

www.ressourcenkataster.de
(in German only)



s.fhg.de/nSr (in German only)



MORE INFO

www.nano-water.de (in German only)



BUSINESS UNIT

BIOMASS



Photo: Shutterstock

SERVICE PORTFOLIO

Provision of bioenergy and biogas, utilization of residues, nutrient management and recovery as well as decentralized production and marketing of bio-based conversion products (biochar, synthesis gas, and pyrolysis condensate) are among our focal points. We develop and optimize thermochemical and biological conversion and distribution processes and the corresponding plant technology. With the objective to recover nutrients from municipal and industrial process chains and the conversion processes, we develop concepts and methods for nutrient management in biomass management. In this, we take into consideration raw materials potentials as well as logistic issues and integrate the technologies developed into established or novel value added chains.

RESEARCH AND DEVELOPMENT SERVICES

- Concept and system development for the provision of raw materials and energy from biogenic raw materials and residues, including process development, component development, and plant development – even by means of storable, carbon-rich intermediate products
- Concepts, construction, operation, and optimization of laboratory systems, technical shop systems and demonstration plants, incl. trace gas analytics
- Development of methods for reduction of emissions, flue gas purification
- Catalyst and bioprocess development
- Development of concepts and technical systems for nutrient management and for nutrient recovery (e. g. nitrate, phosphate) including (sustainability) assessments; treatment of fermentation residues
- Strategy development and techno consulting

MARKETS AND INDUSTRIES

- Agriculture
- Energy supply (focus: bioenergy)
- Water supply
- Treatment/elimination of non-hazardous waste (focus: bioenergy)
- Agricultural engineering/agricultural machine construction

MORE INFO

www.umsicht.fraunhofer.de/biomass





Photo: Fraunhofer UMSICHT/Iilka Drnovsek

BUSINESS DEVELOPER THORSTEN WACK

1 *Dipl.-Phys. Thorsten Wack,
Business Developer Biomass.*

Thorsten Wack has been working for Fraunhofer UMSICHT for almost 20 years and is looking back at comprehensive experience in research and development projects. As a skilled theoretical physicist, he has a profound understanding of the natural science principles. In this, the focus of the project work is always on the solution for the customer.

THIS IS WHAT IS MOVING MARKETS AND INDUSTRIES

As part of the economy, agriculture is an important business sector in Germany. With means of production from the upstream business sectors, it generates vegetable and animal raw materials that are further processed by the food trade and industry. New business models and the increased demand of consumers for ecological, regional products require sustainable technologies.

TRENDS AND OUR RESPONSES TO THEM

The legal amendments in the field of biomass (promotion of biomass technologies, amendments to Renewable Energy Sources Act (EEG) and Fertilizer Ordinance) and the necessity to utilize biogenic residues require holistic approaches that raise new potentials for value creation. For this, Fraunhofer UMSICHT develops innovative technologies and concepts such as fermentation residue treatment methods with an eye on the conversion of the nutrients into a sellable form worth transporting.

A LOOK AHEAD

New developments in electronics and sensors lead to "smart farming" technologies that can make processes even more efficient, precise, environmentally friendly and cost-saving. New market potentials will also open themselves up internationally through an increased demand for advanced biomass technologies "made in Germany". In particular, the material utilization of renewable raw materials and biological residues for industrial production will open up an interesting field of activity in the future.

MORE INFO

s.fhg.de/bd-biomass



CONTACT

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HIGHLIGHTS OF THE BUSINESS UNIT

Biobattery provides high quality sources

An important step towards sustainable business practices consists of the efficient utilization of biogenic residues. With the modular concept of the "biobattery" developed at Fraunhofer UMSICHT, a larger bandwidth of biomass can be energetically utilized than was possible before. At the heart of this is the Thermo Catalytic Reforming (TCR®) process, in which residual biomass is converted into oil, gas, and char. The products have a variety of uses as fuel, for power generation, or as soil conditioner.

CONTACT

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CO₂-neutral substitute for fossil fuels

Wet biomass that, in the past, was not usable – from sludge via green waste all the way to bio-wastes – can be refined through hydro-thermal carbonization (HTC). HTC coal serves as CO₂-neutral substitute for fossil fuels. Fraunhofer UMSICHT prepares material and energy assessments for the raw materials utilized and develops perfect process engineering solutions for the producing of HTC coal. In light of sustainable business practices, the objective is to drive forward the conversion of low value raw materials and residues into higher value products.

CONTACT

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Fraunhofer Innovation Cluster "Bioenergy"

Massive amounts of biomass are generated worldwide. The spectrum ranges from grass and green waste via harvesting residues, processing wastes from agricultural and silvicultural production to organic wastes from private households. As part of the Fraunhofer Innovation Cluster "Bioenergy", methods for the efficient utilization of wet biomass and of biogenic residues are being developed. The objective is to open up optimization potentials in the collection, transport, storage, and conversion, in order to make available a novel range of biogenic intermediate products for material and energetic utilization.

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[s.fhg.de/rba](https://www.fhg.de/rba) (in German only)



MORE INFO

[s.fhg.de/Zpv](https://www.fhg.de/Zpv) (in German only)



MORE INFO

[s.fhg.de/QGd](https://www.fhg.de/QGd) (in German only)



BUSINESS UNIT **ENERGY**

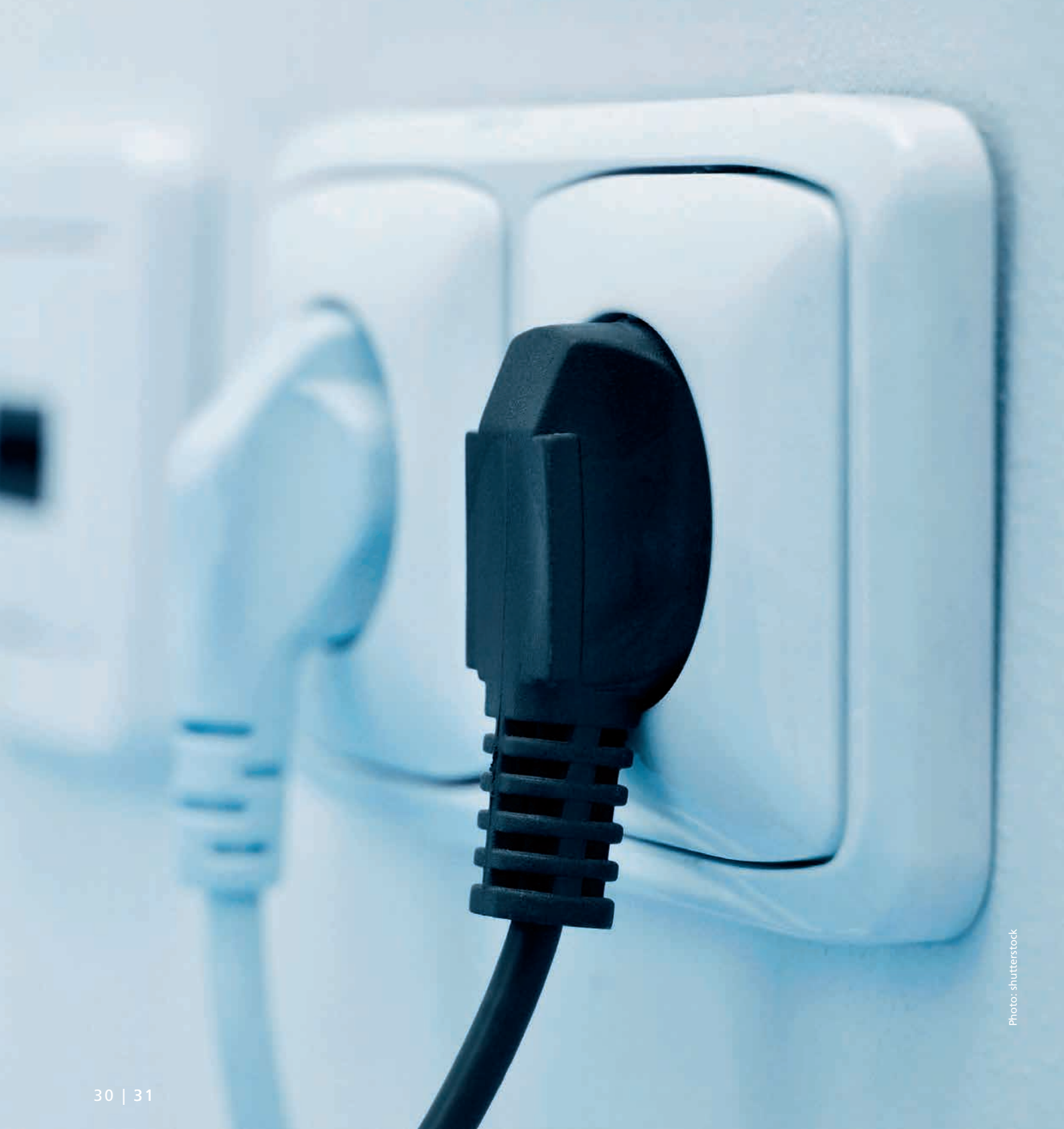


Photo: shutterstock

SERVICE PORTFOLIO

The growth of renewable, decentralized and distributed energies in the supply mix as well as the increased use of energy storage, smart technologies and services are characteristic of new energy systems. We are researching efficient solutions for the energy supply and distribution of the future. In this, our primary approach is at the decentralized combined generation. We support companies of the industry in the handling of technical and system analysis issues in urban and regional energy supply structures as well as in the industrial environment (e. g. decentralized power generation, cross-energy technologies, application of energy storage systems). We are specialized in the technical development and utilization of innovative technologies as well as in decentralized power generation and energy storage.

RESEARCH AND DEVELOPMENT SERVICES

- Energy system analysis (urban and regional structures): technical/economic optimization, demand analysis of electric energy storage systems, raw material demand for the shift in energy, review of energy supply networks, utilization of cross-energy technologies
- Development of thermal, electrical and chemical energy storage technologies: phase change materials (PCM, PCS), thermochemical storage, redox flow batteries, compressed air energy storage
- Storage sizing and dispatch optimization
- Development of cross-energy technologies: power-to-gas, power-to-products, power-to-heat
- Development, construction, operation and monitoring of automated testing and demonstration plants
- Decentralized power generation: bioenergy plants, waste heat recovery and waste heat to power conversion, trigeneration power-heat-cold, ORC, steam power plants, steam-jet ejector chillers
- Studies and consultation: decentralized bioenergy (conversion) processes, strategy, and scenario development, technical and economic feasibility studies; concept design, customer-specific calculation, layout, detail design and integration of energy systems and/or development and assessment of technical concepts

MARKETS AND INDUSTRIES

- Energy supply with
 - electricity
 - gas
 - heat and cold
 - compressed air
- Municipal or regional bodies
- Operators of decentralized systems
- Industrial customers with higher energy demand/energy balancing demand
- Plant engineering and construction for energy systems
- Combined generation systems
- Energy storage systems

MORE INFO

www.umsicht.fraunhofer.de/energy





Photo: Fraunhofer UMSICHT/Ilka Drnovsek

BUSINESS DEVELOPER DR. WILHELM ALTHAUS

¹ *Dr.-Ing. Wilhelm Althaus,
Business Developer Energy.*

As a chemical engineer, Wilhelm Althaus has for almost 25 years been working in leadership functions in energy technology within applied research and development projects. He is technically positioned broadly, communicative, well networked, and has already successfully developed innovative technologies and products for the most diverse of customers.

THIS IS WHAT IS MOVING MARKETS AND INDUSTRIES

The shift in energy represents an enormous change. Driven by the threat of scarcity of resources, climate change and the exit from nuclear power as well as politically enforced, the share of primary energy sources is changing drastically and with increasing speed. The integration of fluctuating renewable energies requires a retrofit of infrastructures and business models, too. Storage systems as fundamental system elements gain in importance. New technologies and organizational forms are an absolute necessity in order to prevail as a company in the changed energy market.

TRENDS AND OUR RESPONSES TO THEM

Whereas in the past load coverage through fossil power plants was pursued, now the control of regional loads and the satisfying of remaining residual loads are being strived for. For this, we develop decentralized combined power generation plants, thermal and electrical energy storage as well as cross-energy technologies. Intelligent systems analyses, optimized design and optimized dispatch, combined with intelligent information and communication technology allows for the efficient operation of the supply and demand pools of many market actors.

A LOOK AHEAD

Prognoses of the future show that in parts of Europe (e. g. Germany) the excess energy will be up to 25 times as high as the deficit in energy in times with little wind or a clouded sky. This makes Germany a net exporter of energy. In the future, the "energy refinement", the conversion of excess electricity into higher value products such as fuels or intermediate products for the chemical industry will be of increasing economic interest. We develop the solutions.

MORE INFO

[s.fhg.de/bd-energy](https://www.s.fhg.de/bd-energy)



CONTACT

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HIGHLIGHTS OF THE BUSINESS UNIT

Novel, powerful electrical storage: Redox flow battery

Powerful energy storage systems can compensate for fluctuations in renewable energies and ensure a constant supply of electricity. Fraunhofer UMSICHT has developed a redox flow battery with a cell size of 0.5 m² that features a stack output of 25 kW in total. The next objective is the development of a 2 m² sized stack with an output of 100 kW. In the in-house battery test laboratory, new applications for lithium-ion batteries are being tested in addition. In the future they could not only be used in cellular phones or notebooks but also as battery packs in electric vehicles or in other stationary applications.

CONTACT

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The city as storage

Efficiently adjusting existing decentralized storage systems and thus minimizing the expansion of new grids for an energy system of the future – that is the objective Fraunhofer UMSICHT pursues with the project "The hybrid urban energy storage". Cities as virtual storage feature an enormous potential to store energy and to balance energy supply and demand for the generation of electricity and heat. An essential advantage is that a lot of systems such as heat pumps or CHPs already have been installed. Fraunhofer UMSICHT develops technologies relevant to an optimized storage and load balancing, assesses them systematically and perfects them.

CONTACT

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Cooling buildings, processes or batteries with phase change slurries

Phase change slurries are suitable for the storage of heat and cold. Fraunhofer UMSICHT researches their areas of application and has developed a dispersion made of water and paraffin that is suitable for the cooling of car batteries, miscellaneous processes or even buildings: CryoSol[®]PLUS. When the dispersion absorbs heat, the solid tiny paraffin balls melt into paraffin droplets and store the heat. Once the solution cools down, the droplets become solid again. In a temperature range from 5 to 20 degrees Celsius, CryoSol[®]PLUS is a good alternative to cold water, since it features a two to three times higher energy density.

CONTACT

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MORE INFO

battery-lab.umsicht.fraunhofer.de
(in German only)



MORE INFO

www.hybrider-stadtspeicher.de
(in German only)



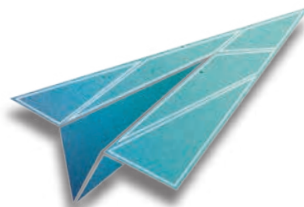


PEOPLE

PRIZES AND AWARDS

RESEARCH INVOLVES LOTS OF PEOPLE.

Behind our work there are people; we would like to introduce some of them to you, since without them we would be nothing.





ADJUSTING CATALYSTS TO CHANGING FRAMEWORK CONDITIONS

Dr. rer. nat. Stefan Kaluza came to Fraunhofer UMSICHT in 2012 through the Fraunhofer Attract program for the promoting of promising young scientists. He is Head of the Catalytic Processes Group and deals with heterogeneously catalyzed synthesis gas chemistry and synthesis gas downstream chemistry.

Where does the expertise of Fraunhofer UMSICHT in the area of catalysis lie?

Catalysis in general is a very wide field. Our group works in the area of heterogeneous catalysis which is of high significance for the manufacturing of basic and platform chemicals. In this field, we optimize existing processes and develop new catalytic processes. For this, we have available a multitude of systems for the preparation, characterization, and testing of catalysts.

You have already been dealing with the topic of catalysis for nine years. How did the tasks of catalysts and the requirements posed to them change over the course of time?

The production of important chemical products is, to date, strongly dependent on fossil raw materials. But in recent years a rethinking has been taking place in this area, too, towards an increasingly sustainable production based on regenerative sources of energy and raw materials. This requires the optimization of existing and development of new catalysts with high efficiency while adapting in the best possible way to the changed framework conditions.

Do you work more oriented towards the fundamentals or more industry-oriented? Who are your customers/partners?

In the area of catalysis, we consider ourselves to be the connecting link between basic research and industrial application. So among our research partners are both institutions of higher

learning and research institutes as well as companies of the chemical industry. In addition, we are offering to customers the manufacturing of sample batches, the characterization and the testing of catalysts.

Which project are you currently conducting research in?

At present, we are primarily conducting research in the area of synthesis gas chemistry. In this, our work ranges from the catalytic cleaning of synthesis gas from biomass gasification via the conversion to platform chemicals such as methanol, ethanol or dimethyl ether all the way to their processing into further important products. In addition, we are, in cooperation with other groups at Fraunhofer UMSICHT, increasingly dealing with the research topic of electro-catalysis.

1 *Dr. rer. nat. Stefan Kaluza is an expert in the area of heterogeneous catalysis.*

MORE INFO

[s.fhg.de/catalysis-laboratory](https://www.s.fhg.de/catalysis-laboratory)

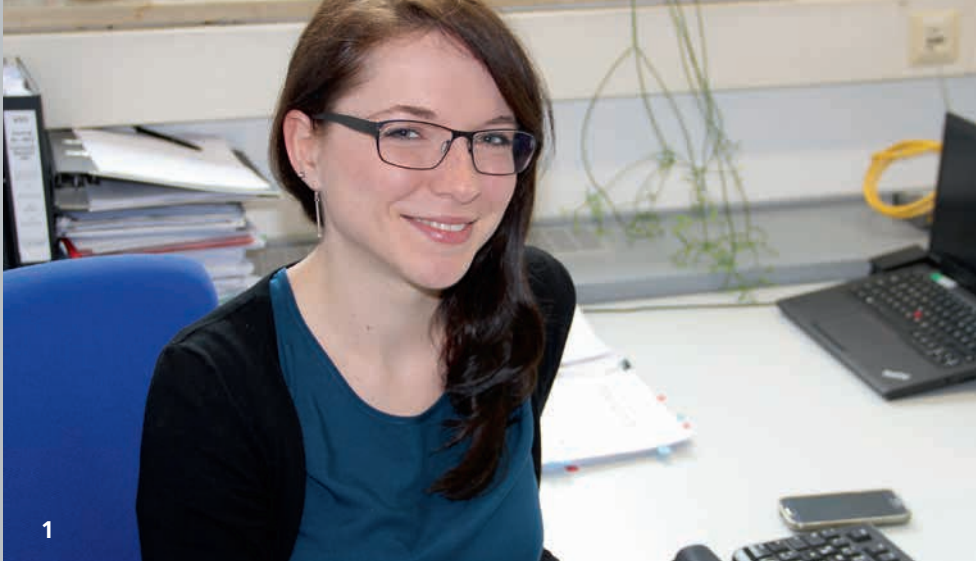


CONTACT

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IN SEARCH FOR THE BEST RECYCLING TECHNOLOGIES

Katharina Reh came to Fraunhofer UMSICHT, institute branch Sulzbach-Rosenberg – back then still ATZ – in 2011, directly after her course of study at the TU Dresden. Initially, she worked in the Recycling Management department as a research assistant. Since April 2014, she has been heading the Waste and Resources Strategy Group.

What are your main tasks?

In my group, we deal with three core topics: classic waste management, which is – for example – about the development of waste management concepts for municipalities or for the industry, eco-assessments, and the development of new recycling technologies. My main tasks include the acquisition of projects and the coordination of their handling. In addition, I establish new customer contacts. The project work is then characterized by jointly finding creative solutions. Taking over of the leadership of the group means, of course, that more administrative tasks due to the personnel responsibilities have been added. The group includes five research assistants.

What gives you particular pleasure in your work?

What I like about my work is that we do something for the environment and that we take interdisciplinary action in this. We ensure that fewer primary raw materials are being utilized. Through our concepts, more reusable materials can be collected in the right systems and recovered thereafter. In this, I particularly enjoy working together with colleagues on new ideas and to jointly arrive at a solution.

Which current challenges do you see in your area?

For the control and utilization of certain waste streams there is still potential for improvement in Germany, e. g. for small old electrical and electronic equipment. Contained in these are finely distributed technological metals that currently are lost, for the most part. Also, there are numerous challenges for us

in the recycling of packaging, for instance of plastics. Here, too much material is passed off to incineration or a "down-cycling", meaning a recycling into a lower value product. In addition, we also want to become more active internationally because abroad, utilization systems for wastes are quite often still missing. Eastern Europe or the Middle East are regions of interest here, among others.

What helps you best to relax and where would you like to travel to?

I do, very much, like to relax in nature and at the theater, but also doing things with friends. Since I have not yet been to the Baltic States nor to Japan, these will be my next travel destinations. And for longer treks, I would also like to fly to Nepal at some point.

1 *Katharina Reh develops waste management concepts and recycling technologies – preferably in a team.*

CONTACT

Dipl.-Ing. Katharina Reh

Group Manager Waste and Resources Strategy

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SYSTEMATICALLY EXPLORING COMPOSITIONS

Fraunhofer UMSICHT has a widely varied laboratory infrastructure in which cross-functional teams from science and technology work on a wide range of analytical, chemical, biotechnological, physical, and materials engineering questions. Dr.-Ing. Edda Möhle has, as Head of Analytics in Oberhausen, since 2006 primarily dedicated herself to the systematic exploration of compositions. After having completed her dissertation in Stuttgart, the native inhabitant of Essen returned to the Ruhr district in order to shortly thereafter carry out research in the laboratory at Fraunhofer UMSICHT.

What is the portfolio of services of Analytics like?

Our focal points are in the areas of chromatography and element analytics, including the preparation of samples. As such, for instance newly synthesized materials or materials cleaned up via downstream processes are analyzed by us with respect to content and purity. The identification of unknown compounds is carried out via mass spectrometry. Analytical methods are being developed, optimized, and validated. We verify the quality of our work by participating in round robin tests. In addition to analytical diagnostics, we also take care of the ordering of chemicals, consumables, and gases, the disposal of chemical wastes, and the training of employees in the proper handling of hazardous substances.

What are the advantages of in-house analytics for a research institute?

To talk directly, in person, to the persons ordering the analyses is of particular advantage for tailored analytical work. We select suitable analytical methods and equipment and develop specific methods. The on-site analytics are, furthermore, characterized by short distances. A transport of potentially unstable samples is not necessary. Details of the measured values are available and can be looked at (chromatograms, standard deviations, calibrations, etc.). Different matrixes are taken into consideration through control measurements. In addition, we offer analytical testing also to external customers.

You also serve as a mentor, don't you?

Yes, that's true. Employees of the "DiMento – Diversity Mentoring for Students" program of the University of Duisburg-Essen asked me whether I'd be willing to take care of a mentee. My mentee is looking for advice regarding her own professional career. I was selected by her because I decided on a career at Fraunhofer UMSICHT and not in the industry.

That sounds like you don't have a lot of time to get bored. At what type of vacation do you relax?

I actually very much like to go to the coast. The most important thing is that it's not too hot. I don't particularly like sweltering heat.

1 *Dr.-Ing. Edda Möhle,*
Head of Department
Analytics.

MORE INFO

[www.umsicht.fraunhofer.de/en/
laboratories](http://www.umsicht.fraunhofer.de/en/laboratories)



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FIRST SUSTAINABILITY MANAGER WITHIN THE FRAUNHOFER-GESELLSCHAFT

As Head of the Sustainability Assessment and Management Group, Dr.-Ing. Markus Hiebel provides decision-making help in product development and information about assessment of mass and energy with his team. He has been Sustainability Manager of Fraunhofer UMSICHT since September 2012 – at that time the first within the Fraunhofer-Gesellschaft.

How did the importance of sustainability change in recent years?

The topic of sustainability has become highly important in society so that our conventional approach to business is reaching its ecological and societal limits. In recent years, science has made large advances with respect to insights into the capturing of the complex interdependencies between products and environmental impacts (e. g. climate change) and societal impacts (e. g. acceptance of systems/plants for renewable energies).

What are the responsibilities of a Sustainability Manager at Fraunhofer UMSICHT?

My responsibilities include the support and implementation of concrete improvement measures with respect to sustainability at the institute, the coordination and conceptual continuation of the sustainability report, which is published every two years, and the participation in panels. Recently, the progress report of our Utopia Changemaker Manifesto was published, a voluntary self-commitment to a sustainable business management.

What were the first important objectives that were achieved since you started your job?

We show more of an external presence with our sustainability topics. The sustainability report for the year 2012/2013 was, for the first time, prepared in accordance with the GRI G4 standard. What is making me particularly happy is that the topic is gaining in importance within the Fraunhofer-Gesellschaft. Jointly with Fraunhofer IGB, Fraunhofer UMSICHT

worked on the Fraunhofer-wide project for the development of a guideline for sustainability reports last year.

How do you integrate sustainability into your life?

I am, for example, a member of a solar energy cooperative, I separate waste, and I obtain eco-electricity. To kick off change processes, I am – as mentioned above – also quite active at the institute. This includes, for example, the participation in organizing public debates at the institute, e. g. regarding the topic of fair trade, or the supervision of a student course for the secondary level Sophie-Scholl-Gymnasium in Oberhausen in which the students are introduced to the topic of sustainability.

1 Dr.-Ing. Markus Hiebel:

“Research must contribute towards shaping the future such that Earth remains worth living for the current as well as for future generations.”

MORE INFO

www.umsicht.fraunhofer.de/en/sustainability.html



CONTACT

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Group Manager Sustainability Assessment and Management

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UMSICHT SCIENCE AWARD

In early July 2014, the UMSICHT Friends and Patrons Group, for the fifth time in a row, awarded the UMSICHT Science Award which, in total, has a value of 15,000 euros. Dr. Thomas Mayer-Gall was awarded in the science category for his work on the topic of the recovery of valuable metals. Gábor Paál and Dr. Bernhard Albrecht are the award winners in the journalism category. They received the award for their comprehensible communication of societally relevant topics from the fields of environmental, safety in process engineering, and energy technology.

AWARD WINNERS

Dr. Thomas Mayer-Gall *Science category*

Dr. Thomas Mayer-Gall received the UMSICHT Science Award for his work on the topic of "Recovery of valuable metals from aqueous residue streams through polyelectrolyte-modified textiles". The objective of the research project was to recover reusable materials such as palladium from industrial residue streams diluted with water. *(center)*

Gábor Paál *Journalism category*

Gábor Paál received the award for his radio report "Rice from skyscrapers. With urban agriculture against scarcity of food". In his piece for the broadcast format "Knowledge" of the SWR2 radio station, he describes the methods of urban agriculture as approaches to solutions for food and supply problems. *(left)*

Dr. Bernhard Albrecht *Journalism category*

Dr. Bernhard Albrecht devotes himself in the report "The necessity (to relieve oneself) is the mother of invention" to going to the toilet. Nowadays, the latter typically means utilizing fresh water and generating wastewater, accordingly. Albrecht describes how hygienic requirements and environmental requirements are approached in different cultures and, in this, sheds a light on aspects of process engineering. *(right)*

MEMBER IN THE UMSICHT FRIENDS AND PATRONS GROUP

The "Association for the Promotion of Environmental, Safety and Energy Technology (UMSICHT Friends and Patrons Group)" (Verein zur Förderung der Umwelt-, Sicherheits- und Energietechnik e. V. (UMSICHT-Förderverein)) is an essential element of a lively and powerful environment of Fraunhofer UMSICHT. The members of the association support the institute in the realization of research and development ideas regarding environmental, safety, and energy technology. Furthermore, the association participates in the organization of congresses and seminars, supports promising young scientists and guest scientists, and each year awards the UMSICHT Science Award with a prize money of 15,000 euros.

1 *Speakers, award winners, jury and supporters of the UMSICHT Science Award 2014.*

MORE INFO

www.umsicht.fraunhofer.de/en/friendsandpatrons



CONTACT

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Phone +49 208 8598-1152 | foerderverein@umsicht.fraunhofer.de



1



2

Photo: Fraunhofer UMSICHT/Ilika Dimperek



3

AWARDED!

In 2014, Fraunhofer UMSICHT and its team received five awards. Whether it was for the whole institute, the scientific performance of an individual employee, or for particularly successful projects: the prizes illustrate the high scientific level and the societal claim of the institute, especially in the day and age of the energy transition and the raw materials shift.

VDI AWARD FOR SECURING THE RAW MATERIALS OF THE DOMESTIC INDUSTRY

In April, the VDI Society Energy and Environment (VDI-GEU) presented to Peter Hense the "Award for environmentally relevant bachelor's, master's, and diploma theses" for his contribution to securing raw materials. As part of a research project at Fraunhofer UMSICHT, the promising young scientist had developed a methodology tool for the assessment of recycling processes for mineral residues that, for the first time, also took into consideration socio-economic criteria.

Hense's new approach, called "Resource Efficiency Potential (REP)", allows for an eco-assessment consideration of recycling processes for mineral residues from the ashes of waste incineration. By now, Hense is a doctoral candidate at Fraunhofer UMSICHT and continues to conduct research in the area of the recycling of metals.

More info: s.fhg.de/rohstoffsicherung-vdi-preis (only in German)

INTERDISCIPLINARY DISTANCE LEARNING PROGRAM ENVIRONMENTAL SCIENCES IS THE "PLACE OF PROGRESS 2014"

In October, the "interdisciplinary distance learning program Environmental Sciences (infernium)", which is carried by the FernUniversität in Hagen (distance learning university) and

Fraunhofer UMSICHT in Oberhausen, received the award as "Place of Progress 2014". The award by the Ministry for Innovation, Science, Research and Technology of the German state of North Rhine-Westphalia (NRW) recognizes guiding intellectual forces from NRW that combine economy, ecology and social issues and this way trigger change processes. *infernium* combines the aspects of economic performance, social responsibility and ecological compatibility and this way provides the students – even those without a prior degree from an institution of higher learning – with a qualified continuing education in the spirit of an education about sustainable development.

More info: page 47

"EXCELLENT SITES IN THE LAND OF IDEAS" 2014 / 15

With the demonstration plant for the incineration and fermentation of brewer's grains, Fraunhofer UMSICHT, jointly with its project partners, is among the award winners of the "Excellent Sites in the Land of Ideas" competition 2014/15. Under the motto "Cross-country Innovations – Rural Areas Rethought", ideas and projects were recognized in this context that provide solutions for the challenges of rural regions.

With its project, Fraunhofer UMSICHT is delivering a contribution to the conversion of energy from residues at brewery



sites. For the mechanical dehydration of the brewer's grains – leached out malt residues from the brewing process – a screw press is being utilized. The press water with the components that biodegrade well, such as fats and proteins, subsequently can be utilized for manufacturing biogas. With the process by Fraunhofer UMSICHT, brewers can utilize the brewer's grain directly on-site in their own biomass heating plants for the brewery's heat production – an added value not only for the company but also for the climate and for the environment.

More info: s.fhg.de/treber-ausgezeichneter-ort (in German only)

"BEST STUDENT AWARD" FOR VENKATA KRISHNAN RAJENDRAN

In the context of his master's thesis at Fraunhofer UMSICHT, Venkata Krishnan Rajendran participated for one year in the "Social Responsibility and Sustainability Programme" in Birmingham

1 Peter Hense, winner of the VDI prize.
2 For the second time, infernum received the award as "Place of Progress".
3 With the "Heat Production from Brewer's Grain" project, Fraunhofer UMSICHT is among the "Excellent Sites in the Land of Ideas" 2014/15.

4 Venkata Krishnan Rajendran is the recipient of the "Best Student Award".
5 Sebastian Drabben at his workplace.
6 Viktor Trupp at the prize award: he and Sebastian Drabben were among the best trainees of the Fraunhofer-Gesellschaft.

ham in order to further his education in the combination of social and scientific perspectives. The promising young scientist did, in the context of the "Best Student Award", receive an award from the Aston Business School in Birmingham for his excellent degree.

At Fraunhofer UMSICHT, he also continues to work, even after his master's thesis, in the Biorefinery and Biofuels Department where he primarily participates in the development of regenerative fuels from bio-based raw materials such as microalgae.

HONORING OF THE BEST FOR VIKTOR TRUPP AND SEBASTIAN DRABBen

Since November, Viktor Trupp and Sebastian Drabben can consider themselves to be among the twelve best of more than 500 trainees of the whole Fraunhofer-Gesellschaft.

Viktor conducted his cooperative education to become a "machine and equipment operator" at the institute branch Sulzbach-Rosenberg. Sebastian enjoyed his excellent final exam to become a "process mechanic for plastics and rubber technology – focal point semi-finished products" at the Oberhausen site. The prize was presented to both of them as part of the "Honoring of the Best" event in Munich.

More info: www.umsicht.fraunhofer.de/en/pupils-students.html



NETWORK

**LUCKILY, WE ARE NOT ALONE ON
THIS EARTH.**

We construct networks, link into existing networks, work in cooperation with partners, friends and patrons. We are happy to introduce some of them.

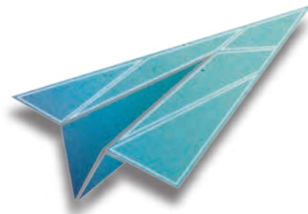




Photo: Fraunhofer

THE FRAUNHOFER-GESELLSCHAFT

With its focus on applied research and key technologies of the future, the Fraunhofer-Gesellschaft plays a prominent role in the European innovation process. Customers are not the only ones to profit from the effect of applied research: with research and development work, the Fraunhofer Institutes contribute to the competitiveness of the region, of Germany, and of Europe. They promote innovations, strengthen the technological performance capability, and ensure the training and continued education of the urgently needed future generation of scientists and engineers.

FACTS AND FIGURES AT A GLANCE*

Research of practical utility is the central task of the Fraunhofer-Gesellschaft which was founded in 1949. Fraunhofer ...

- conducts application-oriented research for the benefit of the economy and to the advantage of society,
- currently maintains 66 institutes and research institutions in Germany,
- has approx. 24,000 employees, primarily with degrees in natural sciences or engineering,
- has an annual research budget of 2 billion euros, of which 1.7 billion euros are generated in contract research. More than 70 percent of these are derived from contracts with industry and from publicly financed research projects. Almost 30 percent are contributed by the German Federal and Länder Governments in the form of base funding, enabling the institutes to work ahead on solutions to problems that will not become acutely relevant to industry and society for another five or ten years.
- Our contractual partners and clients are: industry companies, service providers as well as the public sector.

*As of January 31, 2014

FRAUNHOFER INTERNATIONAL

International cooperations with excellent research partners and innovative companies worldwide ensure direct access to the most important current and future areas of science and economy.

FRAUNHOFER AS EMPLOYER

As an employer, the Fraunhofer-Gesellschaft offers its staff the opportunity to develop professional and personal skills that will allow them to take up positions of responsibility within their institute, at universities, in industry and in society.

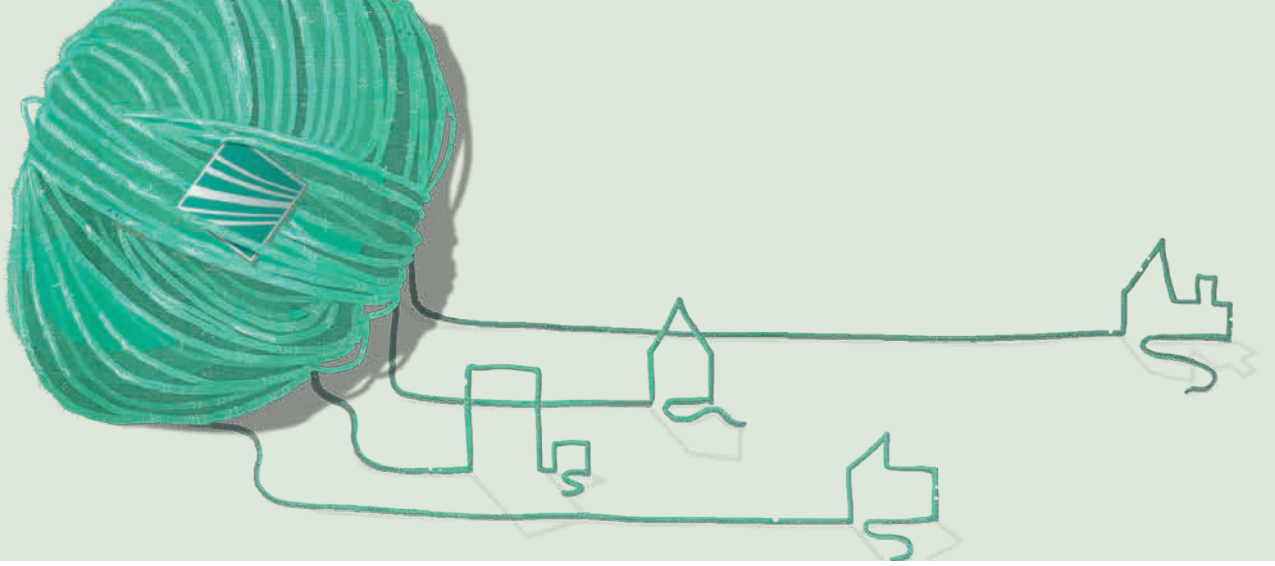
Students who choose to work on projects at the Fraunhofer Institutes have excellent prospects of starting and developing a career at companies due to the practical training and experience they have acquired.

1 The building of the Fraunhofer-Gesellschaft (FhG) in Munich.

MORE INFO

www.fraunhofer.de/en/about-fraunhofer.html





SPIN-OFFS AT A GLANCE

The objective of the Fraunhofer-Gesellschaft is to develop innovative technologies that lead to products ready for market. One way to bring a development into application and to market the institute's own technologies is to found a spin-off. In addition to a good business idea, areas such as financing, investment, and business management must be implemented in a way that promises success. At Fraunhofer UMSICHT there are presently twelve spin-offs, more are in the planning stage.

A-TEC ANLAGENTECHNIK GMBH

A-TEC is among the worldwide experts in the field of coal mine methane (CMM) utilization and degasification. The company deals with safety technology issues and with power generation from CMM under climate protection aspects.

Foundation: 1998 | ba@atec.de | www.atec.de

DATAPPOOL ENGINEERING GMBH

DataPool Engineering is a partner for software solutions in process engineering and safety technology. In addition to simulations, the company offers documentation in the form of safety analyses and knowledge-based legal advice systems.

Foundation: 2001 | webmaster@datapool-engineering.com | www.dp-e.de

CARBON-TF B.V.

Carbon-TF has many years of experience in the technical, organizational, and financial development of worldwide emissions reduction projects. The company furthermore deals with the trading of emissions allowances generated in this.

Foundation: 2004 | info@carbon-tf.com | www.carbon-tf.com

DESIGN4SCIENCE GBR

D4S combines industrial design and technical sciences with a sustainable development. This includes projects as well as people-oriented knowledge platforms regarding materials, technologies, and products.

Foundation: 2011 | uschimoering@web.de

CATFISH SOLUTIONS UG (LIMITED LIABILITY)

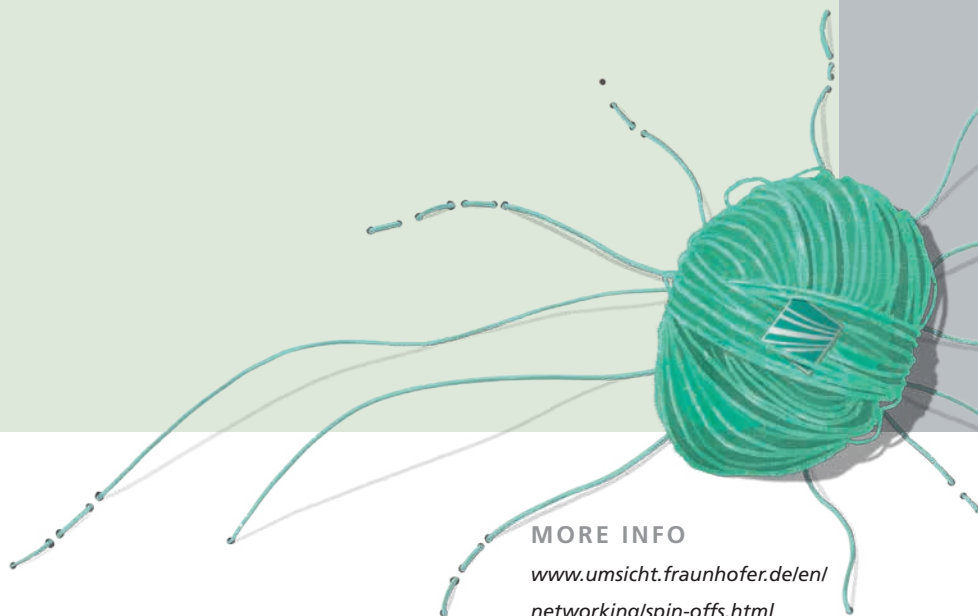
The Catfish Solutions company is a manufacturer-neutral and industry-independent IT consulting company with a focus on basic technologies such as network, storage, virtualization, and server operating systems as well as back-office products.

Foundation: 2011 | info@catfishsolutions.com | www.catfishsolutions.com

FKUR KUNSTSTOFF GMBH

Under the motto "Plastics – but naturally!", FKUR Kunststoff GmbH developed, jointly with UMSICHT, a broad range of bio-based plastics that primarily consist of natural raw materials: Bio-Flex®, Biograde® and Fibrolon®.

Foundation: 2003 | info@fkur.com | www.fkur.com



MORE INFO

www.umsicht.fraunhofer.de/en/networking/spin-offs.html



GREASOLINE GMBH

The Greasoline® process converts old fats into blends of hydrocarbons as they are also found in gasoline, kerosene, and diesel fuels of fossil origin. The products can be utilized as fuels, as fuel components, and as chemical raw materials.

Foundation: 2011 | contact@greasoline.com | www.greasoline.com

RUHR COMPOUNDS GMBH

Ruhr Compounds processes rubber residues into high quality plastics. The innovative and ready for market materials EPMT® (elastomer powder modified thermoplastics) save raw material costs and enable customers to increase their efficiency with respect to materials.

Foundation: 2011 | info@ruhr-compounds.de | www.ruhr-compounds.de

SUSTEEN TECHNOLOGIES GMBH

Susteen Technologies converts biomass residues through thermo-catalytic reforming into high quality energy sources such as biooil, biochar, and synthesis gas. More than 70 percent of the energy potential of industrial or municipal waste products can be utilized this way.

Foundation: 2014 | info@susteen.de | www.susteen.de

VITESO UG (LIMITED LIABILITY)

Viteso is a service provider for IT solutions with a focus on the development of high quality apps for mobile end devices. In addition to mobile applications of their own, the company also develops apps for customers with specific requirements.

Foundation: 2012 | info@viteso.de | www.viteso.de

VSM SOLAR PRIVATE LIMITED

VSM Solar develops, produces, and installs solar-powered air conditioners, refrigerators, and walk-in coolers in India, Sri Lanka and Bangladesh. This is intended to increase the awareness for the sustainability of solar energy in these regions.

Foundation: 2011 | info@vsm solar.com | www.vsm solar.com

WAGRO SYSTEMDICHTUNGEN GMBH

WAGRO Systemdichtungen develops and produces innovative sealing systems based on substances capable of swelling. The systems are being utilized in all areas of technology, wherein the main areas of application are civil engineering and pipeline construction.

Foundation: 1999 | info@wagro-systemdichtungen.de |

www.wagro-systemdichtungen.de



Photo: simonh/photocase.com

RESEARCH AND TEACHING/ INSTITUTIONS OF HIGHER LEARNING

¹ *Applied research requires scientific proximity.*

Fraunhofer UMSICHT takes part in academic research and is nurturing a new generation of scientists.

The research and development market is fast-paced. As an institute that, with its application and market-oriented services and products, is acting at the intersection of research at the university and industrial practices and products, we particularly rely on strategic partnerships with institutions of higher learning in Germany and Europe. There is an active exchange between institutions of higher learning, students, and Fraunhofer UMSICHT. In addition to joint projects, many employees teach at colleges or universities in the region.

RESEARCH AND TEACHING

Prof. Dr.-Ing. Eckhard Weidner

Manages both Fraunhofer UMSICHT and the Chair of Process Engineering Transport Processes at the Ruhr University Bochum, where he also teaches. This provides the institute with a direct connection to the university and strengthens the scientific network of both research facilities.

Prof. Dr.-Ing. Görgo Deerberg

Deputy Director of the institute of Fraunhofer UMSICHT, has been holding the adjunct professorship "Environmental and Process Technology" at the Faculty of Mechanical Engineering of the Ruhr University of Bochum since January 2011. This expands the involvement with the Ruhr University.

Prof. Dr. rer. nat. Andreas Hornung

Director of the institute branch in Sulzbach-Rosenberg, is Professor in High Temperature Process Technologies at the Friedrich-Alexander-Universität Erlangen-Nürnberg, Chair in Bioenergy at the University of Birmingham and Adjunct Professor at the University of Bologna.

Prof. Dr.-Ing. Christian Doetsch

Director of the Energy Division and honorary professor at the Faculty of Mechanical Engineering at the Ruhr University of Bochum for the topics of energy storage and refrigeration engineering.

MORE INFO

www.umsicht.fraunhofer.de/en/partnerships





INTERDISCIPLINARY DISTANCE LEARNING PROGRAM INFERNUM

The successful and scientifically-substantiated solution of complex challenges in the fields of environment and sustainability presupposes interdisciplinary thinking and approaches. The interdisciplinary distance learning program in environmental sciences "infernum" transmits the knowledge necessary for this purpose and builds fluency in the "languages" of various disciplines. infernum is distinguished by its interdisciplinary curriculum, professional breadth, and organizational flexibility; it is unique in the landscape of German university further education programs.

infernum combines the aspects of economic performance, social responsibility and ecological compatibility and this way provides the students – even those without a prior degree from an institution of higher learning – with a qualified further education in the spirit of an education about sustainable development.

Since 2000, infernum – as a distance learning program – allows students to work independently and in a structured way, to obtain scientific further education in parallel to job and family, and to improve their chances in the job market. Individual teaching programs can be compiled from (inter)disciplinary modules and the course of studies can be started at any time.

THE FOLLOWING DEGREES CAN BE OBTAINED:

- Master of Science (M.Sc.)
- University Certificate Environment Manager
- University Certificate of Environmental Sciences
- Certificates for individual modules

infernum is a joint offer of the FernUniversität in Hagen (distance learning university) and Fraunhofer UMSICHT under the auspices of the Fraunhofer Academy.

CONTACT

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anja.gerstenmeier@umsicht.fraunhofer.de

1 *The distance learning program pursues the right path with its novel orientation and this is not the least of the reasons why it is allowed to call itself "Place of Progress 2014". The title is an award by the Ministry for Innovation, Science, Research and Technology of the German State of North Rhine-Westphalia (NRW) for guiding intellectual forces from NRW that combine economy, ecology and social issues. In addition, infernum received rewards from the German UNESCO commission as "Official Project" of the "UN Decade of Education for Sustainable Development" three times.*

MORE INFO

www.umsicht.fraunhofer.de/en/infernum





Photos: Fraunhofer UMSICHT/Ilika Driņovsek

FRAUNHOFER TALENT SCHOOL

1 Pupils of the Fraunhofer Talent School 2014.

It is an important basis for the innovations of tomorrow to get into contact with creative and highly motivated young people already today. In October, 25 students who were eager to learn and who were thrilled by natural sciences embarked on the path to Fraunhofer UMSICHT in Oberhausen in order to test themselves within the framework of the Fraunhofer Talent School in the research areas of computer sciences and biofuels. The Fraunhofer Talent School is an annually held workshop program for talented and technically interested adolescents of grades 9 to 13.



COMPUTER SCIENCES – BIOMIMETICALLY INSPIRED SOLUTIONS IN ROBOTICS

The support of experienced scientists in the workshops was particularly appreciated by 18-year old Andrea Möhring from Bergkamen: "At the Talent School, I liked the relaxed atmosphere. Everybody was in good spirits and supported us with their knowledge. The Fraunhofer Talent School provided me with the perfect opportunity to get some orientation with respect to my Abitur school leaving examination next year." In the computer sciences workshop, the participants learned basic biomimetic knowledge and higher-level skills of scientific work using the example of prototypes of Lego® Mindstorms® robot technology.

BIOFUELS – CHALLENGES AND HOW TO DEAL WITH THEM

Some participants already had pre-existing technical or natural sciences knowledge which they wanted to expand. Among them 17-year old Jan Hendrik Blanke from Essen: "I am very interested in natural sciences. Since I have already done an internship in the area of fuel technology, I decided on the biofuels workshop." Rosa Marie Müller is 15 years old and hails from near Koblenz. She chose the biofuels workshop due to her technical paper: "I am currently writing a seminar paper regarding the topic of fuels from algae and wanted to know even more about biofuels. I like very much that we got access to scientific articles that I otherwise wouldn't have been able to read." The workshop identified manufacturing processes for biofuels and illustrated testing plants and biogas plants.

The next Fraunhofer Talent School will take place at Fraunhofer UMSICHT in Oberhausen **October 14 - 16, 2015.**
Application deadline: **September 4, 2015.**

MORE INFO

www.umsicht.fraunhofer.de/talent-school (in German only)



CONTACT

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1 2 3 4 5 6 7 8

START

Photo: shutterstock

FIVEFOLD START OF JOB TRAINING AT FRAUNHOFER UMSICHT

Twelve different cooperative education programs are being offered at Fraunhofer UMSICHT at the Oberhausen institute site, and another three at the Sulzbach-Rosenberg branch of the institute. From the field of natural sciences and technology via computer sciences all the way to administrative professions: the research institute offers a diverse set of exciting job training opportunities. Five new trainees have been supporting the institute since August 1, 2014.

ALEXANDRA EMMERICH

will become a management assistant for IT

The Oberhausen native found out about the job training at Fraunhofer UMSICHT via the job marketplace. Due to her completed course of studies, the 28-year old is able to shorten the job training to two years.

ANDREAS KOCH

will become an office management assistant

The 21-year old was already interested in commercial processes while attending business school. The job posting of Fraunhofer UMSICHT convinced him: at the institute in Oberhausen he does, additionally, gain insights into applied research.

KAI CHRISTIAN SIEG

will become an IT specialist for system integration

The 20-year old found out about the job training at Fraunhofer UMSICHT via a job opening listed on the homepage. The customer contact and working with hardware are of particular interest to him.

EVREN YILDIZ

will become an IT specialist for application development

As early as age 14, he already dealt with programming and learned programming languages. He can apply this knowledge well in the IT department of Fraunhofer UMSICHT. In his job training, the 21-year old is working on the development and maintenance of software.

BENEDIKT VAN KAMPEN

will become a technical product designer

The opportunity for personal development was at the center of the decision of the 18-year old: subsequent to his job training, he is planning on further educating himself in his field of specialization.

CONTACT

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anja.gerstenmeier@umsicht.fraunhofer.de

MORE INFO

[www.umsicht.fraunhofer.de/
en/pupils-students.html](http://www.umsicht.fraunhofer.de/en/pupils-students.html)



INTERNATIONAL ISSUES

Fraunhofer UMSICHT actively participates in cross-country project development. There are strategic cooperations with other countries in Europe and worldwide in order to expand the scientific value generation for Fraunhofer and to achieve positive effects for Germany and for the respective partner country. The ECLIPSE project as well as the BIORICE project are examples of the institute's international activities.

BIORICE

With the objective of improving human health and human well-being, science and industry are working on the manufacturing of bioactive peptides that are generated from ancillary products of industrial rice starch manufacturing. These peptides can be utilized in foodstuffs, cosmetics, or dietary supplements. The manufacturing process is based on enzymatic or microbial protein hydrolysis followed by physical and environmentally friendly separating techniques, without the utilization of any chemical agents. Active peptide fractions are isolated and tested with respect to their physiological and sensitizing activity. After half of the project's duration, the project has arrived at the successful completion of the laboratory phase and is just prior to transfer to industrial scale. Companies (SMEs) as well as partners from research and development are united in the BIORICE project consortium. The six partners are from three EU member states as well as one associated country. BIORICE is funded by the 7th Research Framework Program of the European Union.

Dr.-Ing. Jürgen Grän-Heedfeld

juergen.graen-heedfeld@umsicht.fraunhofer.de

www.biorice.eu/default.aspx

ECLIPSE

In the ECLIPSE project, twelve partners from research and industry are developing a novel packaging concept that forfeits the utilization of fossil raw materials and the utilization of biomass that might be in competition with the food industry. Rather, waste materials and algae-based biomass are being used for the production of the polylactic acid nano-composites. As an alternative biomass source for bio-based plastics, algae neither compete with foodstuffs nor with existing industrial applications. Their cultivation is possible in sea water and saves fertile land and fresh water for foodstuffs cultivation. The polylactic acids (PLAs) extracted from algae are functionalized with polysaccharide-based nano-fillers from biological wastes such as cellulose (banana and almond peels) and/or chitin from crustaceans, or with inorganic nano fillers. The bio-based nano-plastics manufactured this way are processed into bio-based as well as biodegradable plastics packaging. ECLIPSE is funded by the 7th Research Framework Program of the European Union.

Dipl.-Ing. Thomas Wodke

thomas.wodke@umsicht.fraunhofer.de

www.eclipseproject.eu/homepage

MORE INFO

www.umsicht.fraunhofer.de/en/international.html



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anna.greve@umsicht.fraunhofer.de



BOARD OF TRUSTEES

Since December 2002, a Board of Trustees with members from science, industry, politics and administration has been providing advice to the institute.

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*Association of the municipal RWE-Aktionäre GmbH
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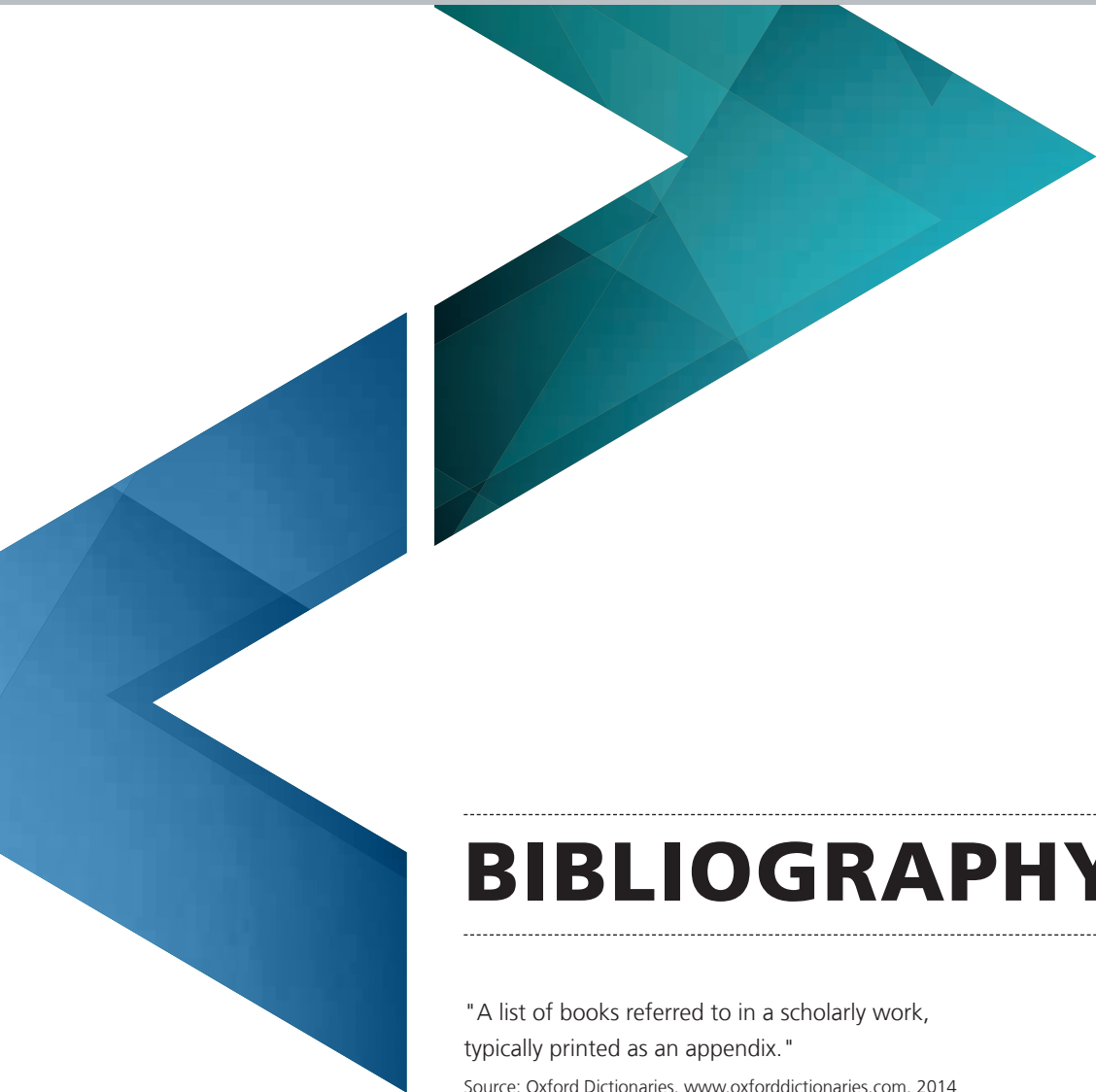
Dr.-Ing. Andreas Schütte

*FNR Fachagentur Nachwachsende Rohstoffe e. V.,
Managing Director*

MORE INFO

[www.umsicht.fraunhofer.de/en/
networking/board-of-trustees.html](http://www.umsicht.fraunhofer.de/en/networking/board-of-trustees.html)



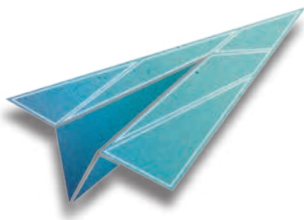


BIBLIOGRAPHY

"A list of books referred to in a scholarly work, typically printed as an appendix."

Source: Oxford Dictionaries, www.oxforddictionaries.com, 2014





FRAUNHOFER SPECIALIZED PUBLICATIONS
AND PATENTS

The publications and patents that result from the research activity of the Fraunhofer Institutes are documented in the "Fraunhofer-Publica" database.

At **www.publica.fraunhofer.de**, you can find pointers to papers, conference presentations and proceedings as well as research reports, studies, publications of institutes of higher learning and patents and/or registered designs. Documents available electronically can be retrieved directly from the database in full text.

Information regarding specialized publications is available from our specialized information service:
fachinformation@umsicht.fraunhofer.de

Information regarding industrial property rights is available from our industrial property rights officer:
srb@umsicht.fraunhofer.de

MORE INFO

www.umsicht.fraunhofer.de/en/publications.html

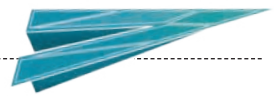




CONTACT

**WE LOOK FORWARD TO HEARING
FROM YOU!**

If you have any questions, suggestions or project ideas, please contact us. You can reach us in several different ways.



HOW TO REACH US

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www.umsicht.fraunhofer.de/en/how-to-reach-us

How to reach us (PDF)

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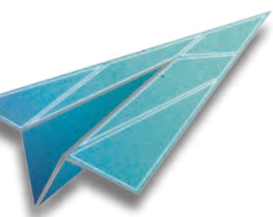


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