



Fraunhofer
UMSICHT

FRAUNHOFER INSTITUTE FOR ENVIRONMENTAL, SAFETY, AND ENERGY TECHNOLOGY UMSICHT

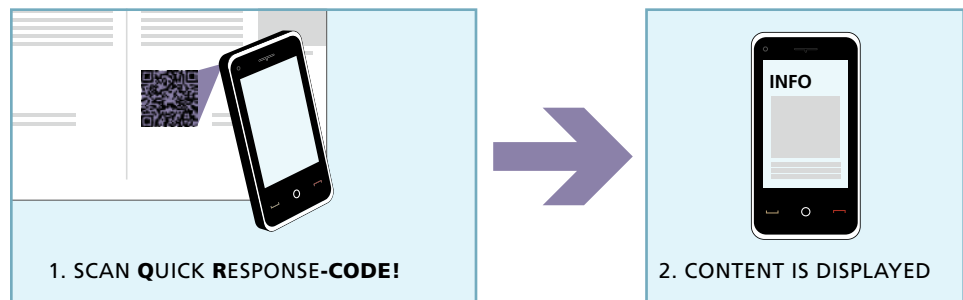
ANNUAL REPORT 2013 | 2014

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



ADDITIONAL INFORMATION

For some of our contributions, we have stored additional information that is accessible to you by smart-phone via a QR code. If you are working at your computer, please use the shortened URL.



SUSTAINABILITY AS A RECURRING THEME

The shift in sustainable energy and raw materials supply is the focus of our work. We would like to show you what contribution our products and services make to sustainable development. A symbol helps to find this information quickly. It runs like a golden thread through the report and – following the three pillars of sustainability – it structures the topics into the categories Ecology, Economy and Society.

SUSTAINABILITY: TALK TO US

The aspects of sustainability in this report are to be understood as highlights. In case of questions regarding the topic, please contact the institute's sustainability manager or the respective scientific contact.

MORE ABOUT SUSTAINABILITY AT FRAUNHOFER UMSICHT

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



We are looking forward to your feedback!



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



*Prof. Dr.-Ing. Görgo Deerberg,
Deputy Director of the Institute.*

PREFACE

Photos: Fraunhofer UMSICHT/PR-Fotografie Köhring



Dear readers,

The course is rightly set: with its divisions "Energy", "Processes", "Products" and "Organization", our institutional structure has become significantly more flexible. Thanks to the integration of our branch of the institute in Sulzbach-Rosenberg, we are now represented in two German states. This strengthens our networking capacities in science policy. We are also strategically positioning ourselves internationally. We have created optimal prerequisites to lay the path for the raw materials and clean energy shift and to contribute to its success.

TURN IDEAS INTO APPLICATIONS

Our tasks are diversified because the changeover to sustainable energy supply impacts many areas: topics on our roadmap include electricity, heat, mobility, buildings, raw materials supply, process and material development. We perform original research and provide innovation thrusts for the economy. We apply ideas, and present our thoughts and scientific research to the public. A prime example is our successful development of a large, high-performance redox-flow battery with a cell size of 0.5 square meters and a stack performance of 25 kilowatts: this breakthrough for a novel electricity accumulator was presented at the Hanover Trade Fair and disseminated through the specialist and public media.

SUSTAINABILITY IN RESEARCH

Our research fields include regenerative energy, renewable raw materials, energy efficiency, innovative materials, water and sewage engineering as well as knowledge and resources management. We have consistently demonstrated how our business activity, products and services can contribute to sustainable development in previous sustainability reports since 2009. The fourth edition will be issued already in mid-2014. We take pleasure in presenting a summary of our projects on the following pages. More detailed information is readily available on our website and we would gladly share more information in a personal discussion.

We wish you stimulating reading!

Cordial greetings



Eckhard Weidner


Görgen Deerberg

INSTITUTE

THE BASIC DATA OF FRAUNHOFER UMSICHT.

Profile, Key Performance
Indicators, Organizational Chart,
Awards.



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Photo: shutterstock

PROFILE OF FRAUNHOFER UMSICHT

Fraunhofer UMSICHT actively participates in the shift in energy and raw materials supply. As a pioneer for technical innovations in the divisions "Energy", "Processes" and "Products", Fraunhofer UMSICHT wants to encourage sustainable business practices and environmentally friendly technologies as well as innovative behavior to improve the quality of life for people and to support the innovation capacity of the domestic economy. As one of 67 institutes and entities with separate legal status of the Fraunhofer-Gesellschaft, we are networked world-wide and promote international cooperation. Fraunhofer is the largest organization for applied research in Europe.

KEYNOTES

<i>Founded:</i>	<i>June 1990</i>
<i>Main site:</i>	<i>Oberhausen, NRW (Germany)</i>
<i>Branch office:</i>	<i>Willich, NRW (development of plastics made of renewable resources, manufacturing in pilot series and small batches)</i>
<i>Institute branch:</i>	<i>Sulzbach-Rosenberg (in the Nuremberg metropolitan region of Bavaria) (power generation from biomass and waste, waste management/resources management, materials for energy technology, system analysis and energy storage at the "Center for Energy Storage")</i>
<i>Total staff*:</i>	<i>528 employees, of which 427 are located in Oberhausen and Willich as well as 101 in Sulzbach-Rosenberg</i>
<i>Total budget:</i>	<i>35.2 million Euro (2013), of which 29.5 million Euro are allocated to Oberhausen and 5.7 million Euro to Sulzbach-Rosenberg</i>
<i>Customers:</i>	<i>Small or medium-sized enterprises, major enterprises, public institutions</i>
<i>International markets:</i>	<i>Europe (primarily), Africa, Asia, South America</i>

*As of December 31, 2013



Institute's complex in Oberhausen.

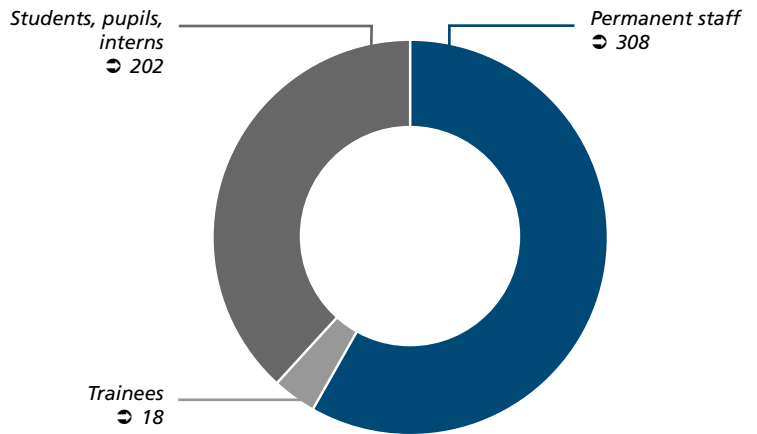


Institute's complex in Sulzbach-Rosenberg.

FACTS AND FIGURES

STAFFING STATISTICS 2013

	OB	SURO *
Permanent staff	245	63
Scientific	192	44
Administrative	53	19
Other staff	182	38
Trainees	16	2
Students, pupils, interns	166	36
Total staff	427	101

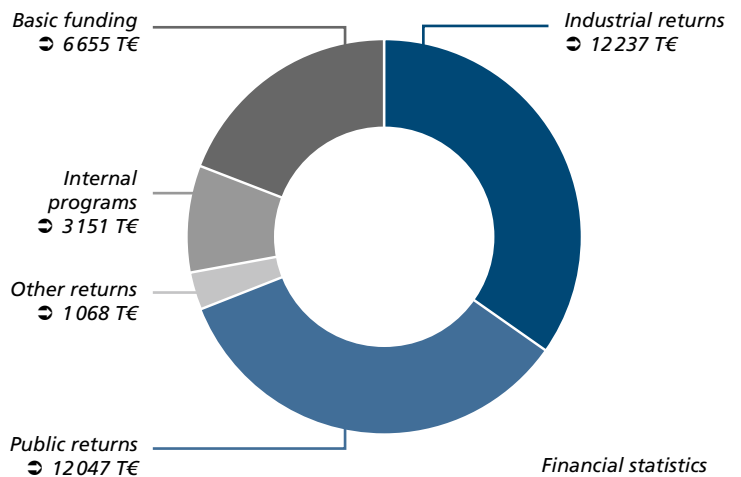


Staffing statistics
Fiscal year 2013; including all sites.

FINANCIAL STATISTICS 2013

[in thousand euros]

	OB	SURO *
Operating budget	26983	5263
Other costs	13029	1920
Staff costs	13954	3343
Investment budget	2489	422
External project investments	1158	398
Internal investments	1331	24
Total returns	29472	5685
Industrial returns	11823	414
Public returns	6986	5060
Other returns	857	211
Internal programs	3151	0
Basic funding	6655	0



Financial statistics
Fiscal year 2013; including all sites.

DIRECTORATE

Director | **Prof. Dr.-Ing. Eckhard Weidner**

Deputy Director | **Prof. Dr.-Ing. Göрге Deerberg**

ENERGY

.....
Division Director: **Dr.-Ing. Christian Dötsch**
Deputy Division Director: **Dr. Thomas Marzi**

ENERGY SYSTEMS ENGINEERING

Head: **Dr.-Ing. Wilhelm Althaus**

- Waste Heat to Power
- Compressed Air Energy Storage

ENERGY SYSTEMS

Head: **Carsten Beier**

- Energy Supply Systems
- Energy System Optimization

CHEMICAL ENERGY STORAGE

Head: **Dr. Thomas Marzi**

- Electrochemical Storage
- Catalytic Processes
- Biogas

THERMAL ENERGY STORAGE

Head: **Dr.-Ing. Barbara Zeidler-Fandrich**

- Thermochemical Storage
- Thermal Energy Storage and Systems

THINK TANK: ENERGY

Head: **Dr.-Ing. Anna Grevé**

PROCESSES

.....
Division Director: **Prof. Dr.-Ing. Göрге Deerberg**

BIOREFINERY/BIOFUELS

Head: **Dr.-Ing. Axel Kraft**

- Bio-based Chemicals
- Biofuels, Hydrocarbons
- Thermochemical Conversion
- Speciality Chemicals, Formulations

PROCESS INTENSIFICATION

Head: **Dr.-Ing. Ilka Gehrke**

- Water Processes
- Adsorption Processes
- Active Surfaces

INFORMATION TECHNOLOGY

Head: **Thorsten Wack**

- IT Infrastructure
- IT Services
- Application Development
- Modelling and Simulation

PROCESS ENGINEERING

Head: **Josef Robert/Hans-Jürgen Körner**

- Environmental Biotechnology
- Bioprocess Engineering and Fluid Separation
- Biomass and Residue Utilization
- Membrane and Food Technology

THINK TANK

Head: **Prof. Dr.-Ing. Göрге Deerberg**

- International Projects
- Urban Production
- Group Environmental and Process Technology (RUB*)

PRODUCTS

.....
Division Director: **Prof. Dr.-Ing. Eckhard Weidner**

MATERIAL SYSTEMS

Head: **Jürgen Bertling**

- Synthesis and Functionalization
- Processing and Testing
- Prototype, Design, Interaction

BIO-BASED PLASTICS

Head: **Dr.-Ing. Stephan Kabasci**

- Polymer Chemistry
- Material Development
- Processing and Applications
- Production Scale-Up and Testing

LEATHER AND HIGH PRESSURE TECHNOLOGY

Head: **Manfred Renner**

- Leather Technology
- High Pressure Impregnation
- Product Design by Pressure (RUB*)

RESOURCES AND INNOVATION MANAGEMENT

Head: **Dr.-Ing. Hartmut Pflaum**

- Sustainability Assessment and Management
- Material Flow Systems
- EU, IPR, Strategy

THINK TANK: FUTURE PRODUCTS

Head: **Jürgen Bertling**

- Additive Manufacturing, FabLab
- Sustainable Polymer Products

*Ruhr-University Bochum

**ORGANIZATIONAL
CHART**
AS OF FEBRUARY 1, 2014

ORGANIZATION

.....
Division Director: **Andreas Weber**

ADMINISTRATION

Head: **Nina Junen**

- Projects
- Controlling
- Human Resources Administration
- Travel and Central Services

PUBLIC RELATIONS

Head: **Iris Kumpmann**

- Press and Media Relations
- Events
- Internal Communications

UMSICHT ACADEMY

Head: **Anja Gerstenmeier**

- Further Academic Education
- Human Resources Development

ANALYTICS

Head: **Dr.-Ing. Edda Möhle**

TECHNICS

Head: **Richard Sprick**

- R&D Workshop
- Construction and Facility Management

OCCUPATIONAL SAFETY AND ENVIRONMENTAL PROTECTION

Head: **Dr.-Ing. Ulrich Seifert**
Jürgen Stein

LIBRARY

Head: **Kerstin Höscher**

INSTITUTE BRANCH SULZBACH-ROSENBERG

.....
Division Director: **Prof. Dr. Andreas Hornung**

Deputy Division Director: **Gerold Dimaczek**

RENEWABLE ENERGY

Head: **Samir Binder**

- Catalytic Conversion Processes
- Energy Efficiency and Systems Research

THERMAL PROCESS TECHNOLOGIES

Head: **Dr.-Ing. Michael Jakuttis**

- Energy from Biomass
- Thermal Storages

RECYCLING MANAGEMENT

Head: **Dr.-Ing. Matthias Franke**

- Waste Management and Recycling Technologies

BIOLOGICAL PROCESS TECHNOLOGIES

Head: **Fabian Stenzel**

- Biogas Technologies
- Wastewater Treatment and Phosphorous Recovery
- Systems Research

NEW MATERIALS

Head: **Dr. HDR Patrick J. Masset**

- Corrosion and Wear Protection
- Surface Engineering
- Metallurgical Processes

INFRASTRUCTURE

Head: **Gerold Dimaczek**

- Administration
- Corporate Communications
- Central Technical Services

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CONTACT
.....

**Fraunhofer UMSICHT,
Oberhausen, Germany**

Phone +49 208 8598-0

E-mail info@umsicht.fraunhofer.de

Division Energy

Phone +49 208 8598-1270

E-mail energie@umsicht.fraunhofer.de

Division Processes

Phone +49 208 8598-1450

E-mail prozesse@umsicht.fraunhofer.de

Division Products

Phone +49 208 8598-1227

E-mail produkte@umsicht.fraunhofer.de

Division Organization

Phone +49 208 8598-1140

E-mail organisation@umsicht.fraunhofer.de

Institute branch Sulzbach-Rosenberg

Phone +49 9661 908-400

E-mail info-suro@umsicht.fraunhofer.de



Dr.-Ing. Christian Dötsch
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 528 employees who work in four areas at the Oberhausen site and in five departments in a branch of the institute 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 systems as well as in analytical system studies.

Dr.-Ing. Christian Dötsch,
Division Director Energy, Fraunhofer UMSICHT

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 procedure 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 of Fraunhofer UMSICHT, Division Director Processes

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, bionic approaches and technologies of individualized and generative production for optimized processing technologies.



Andreas Weber

Photo: Fraunhofer UMSICHT/PR-Fotografie Köhring



Prof. Dr. 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 Fraunhofer UMSICHT, Division Director Processes*

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, Fraunhofer UMSICHT*

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 five departments of the institute branch illustrate 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.

*Prof. Dr. Andreas Hornung,
Director of the Sulzbach-Rosenberg branch of the institute*



AWARDED!

Fraunhofer UMSICHT and its employees received five awards in 2013. Whether for the entire institute, the professional performance of an individual employee, or for especially innovative projects – these awards demonstrate the institute’s high scientific and social standards especially for the shift in energy and raw materials.

CLIMATE WEEK AWARD FOR PYROLYSIS TECHNOLOGY

The concept for power generation from residual materials was awarded the British "Climate Week Award" in the category "Best Breakthrough Technology" in March. The innovative concept permits the most diverse composition of organic waste products to be turned into heat, gas, fuel and bio-coke. The technology is now close to marketability and offers an environmentally friendly contribution toward an energy turnaround. In Great Britain, "Climate Week" is a significant national venue for presenting efforts to mitigate climate change to the broad public. It began last year with the conferment of the "Climate Week Awards" on March 4th, 2013.

The core of the new technology is the decomposition of organic compounds in a reactor for mid-rapid pyrolysis. The system was developed by Prof. Andreas Hornung and nominated by Aston University in Birmingham for the "Best Breakthrough Award". It can exploit up to 100 kilogram biomass per hour and, in connection with a gasification unit, generate up to 400 kilowatt electricity.

FERCHAU INNOVATION PRIZE FOR TANNING PROCESSES

In April, Manfred Renner, Prof. Eckhard Weidner and Helmut Geihlsler received the Ferchau Innovation Prize at the Hannover Trade Fair. Their development of an innovative tanning process

makes it possible to reduce the contaminated chromium wastewater by more than 95 percent, the chrome tanning material by up to 50 percent and tanning time by up to 75 percent relative to conventional processes.

The tanning industry annually produces about 2,000 square kilometers of leather. More than 90 percent of it is tanned with chromium-III salts to achieve the desired high leather quality. Through the use of compressed carbon dioxide, leather can be tanned almost free of residual water with the newly-developed processes. Furthermore, the tanning time is vastly reduced and chemical inputs lowered. A tanning plant on a pre-industrial scale is already built up at the Oberhausen site where up to 500 kilograms of hide can be tanned in one step.

Roughly 20 billion liters of wastewater, 160,000 tonnes of chromium tanning agent and 500,000 tonnes of salt can be saved if the process developed by Fraunhofer UMSICHT is employed world-wide.

INTERDISCIPLINARY DISTANCE LEARNING PROGRAM IN ENVIRONMENTAL SCIENCES IS A "LOCATION OF PROGRESS 2013"

The "Interdisciplinary Distance Learning Program in Environmental Sciences (infernium)", offered by the FernUniversität [distance university] in Hagen and Fraunhofer UMSICHT in Oberhausen, is a "Location of Progress 2013". The distinc-



3



4

Photo: private



5

tion of the Ministry of Innovation, Science and Research of the State of North-Rhine-Westphalia honors pioneering thinkers from North Rhine-Westphalia who connect the economy, ecology and social issues to innovations. Among those who contribute to social progress are researchers. *infernum* is a continuing education course of studies for professionally-qualified specialists with and without a first university degree.

2013 DISSERTATION AWARD FOR SVENJA BENNING

In December the Westphalian University of Applied Science distinguished the most successful graduates of the study year 2012/2013. Among the four best is Svenja Benning (23) who received an award in the field of chemistry. She received the 2013 dissertation award for her bachelor thesis supervised at Fraunhofer UMSICHT, about heat storage for the protection of electronic components.

In her final thesis, Benning sought a suitable material that can

- 1 *Pyrolysis is environment and climate-friendly.*
- 2 *The UMSICHT team wins the Ferchau Innovation Prize 2013.*
- 3 *infernum is a universal training course offered for professionally qualified specialists and has existed since 2000.*
- 4 *Svenja Benning with the*

- supervisor of her Bachelor thesis: Prof. Franziska Traeger, Westphalian University, and Dr. Jorge Ivan Salazar Gomez, Fraunhofer UMSICHT.*
- 5 *Dr. Stefan Kaluza (r.) receiving the Werner von Siemens Next Generation Prize.*

utilize released heat for a chemical reaction. Applied as a layer, it should optimally protect components in the long run. To ensure that this heat storing film works repeatedly, the chemical reaction must also be reversible.

WERNER VON SIEMENS NEXT GENERATION PRIZE FOR DR. STEFAN KALUZA

The Werner-von-Siemens-Ring Foundation in December conferred its Next Generation Prize on eight young researchers. Dr. Stefan Kaluza (33), who at Fraunhofer UMSICHT heads the Group Catalytic Processes, is one of the award winners. He was distinguished for his achievements about catalysis in synthesis gas chemistry, a field which is currently experiencing a renaissance with the development of new technologies for the disposition of synthesis gas from regenerative sources – primarily biomass.

Synthesis gas is one of the most important platforms for the creation of fuels and raw chemical materials. Even though many processes within synthesis gas chemistry are already very well-known and tested on an industrial scale, there are still significant optimization potentials both for catalyst development as well as for process control. Furthermore, there are a multitude of additional very promising reactions whose development have yet to extend beyond the laboratory scale. This is where Dr. Kaluza's work starts.



PROJECTS

THIS IS WHAT WE DO FOR YOU.

Fraunhofer UMSICHT has been providing guaranteed fresh ideas since 1990.
In the annual report, we are presenting an excerpt of the projects worked on.



- ¹⁸ Spinning yarn from algae oil
- ¹⁹ Algae-based fuels for aviation
- ²⁰ EU-Project SUSMILK – "Green Dairy"
- ²¹ Environmentally friendly recycling of strategic metals
- ²² Door seals reduce CO₂ and costs
- ²³ Valuable substances from metallurgical plant dumps reduce raw materials imports
- ²⁴ Injection molding opens markets for fiber-reinforced plastics
- ²⁵ Phthalate-free plasticizers: also completely bio-based
- ²⁶ Redox-flow battery secures a constant power supply
- ²⁷ Energy balancing demand in Germany
- ²⁸ Heat storage: more than just warm water
- ²⁹ Energy-efficient hospitals
- ³⁰ The bio battery: efficient energy utilization
- ³¹ Decentrally expanding resource protection
- ³² Effective corrosion protection in power plants
- ³³ Nanomaterials in waste incineration?
- ³⁴ Broad catalytic positioning
- ³⁵ Efficiently rinsing off dangerous substances



Photo: photoease.com

SPINNING YARN FROM ALGAE OIL

1 *Algae oil for the creation of synthetic monomers.*



SUSTAINABLE

Ecology/Economy/Product responsibility:

Botryococcus braunii is of potentially great significance for the generation of regenerative energy. The green fresh-water seaweed is one of the few known species that can accumulate large quantities of hydrocarbons. It possesses the unique and outstanding ability of producing and eliminating large quantities of long-chain hydrocarbons, and contains an interesting group of polysaccharides that can be converted into biochemicals.

Fibers for yarns, ropes and nets are often made of synthetics, usually produced from primary raw materials such as crude oil. If crude oil extraction dries up, an alternative will be required. A future-oriented technology is a synthetic extraction made of algae oil. Supported by the accompanying 7th EU Framework Programme for research, technological development and demonstration activities, Fraunhofer UMSICHT is involved in the project "SPLASH – Sustainable Polymers from Algae Sugars and Hydrocarbons". SPLASH is devoted to the extraction of sugar and hydrocarbons from algae oil. Fraunhofer UMSICHT investigates the processing of the algal hydrocarbons from which synthetic monomers can be obtained.

MILKING ALGAE

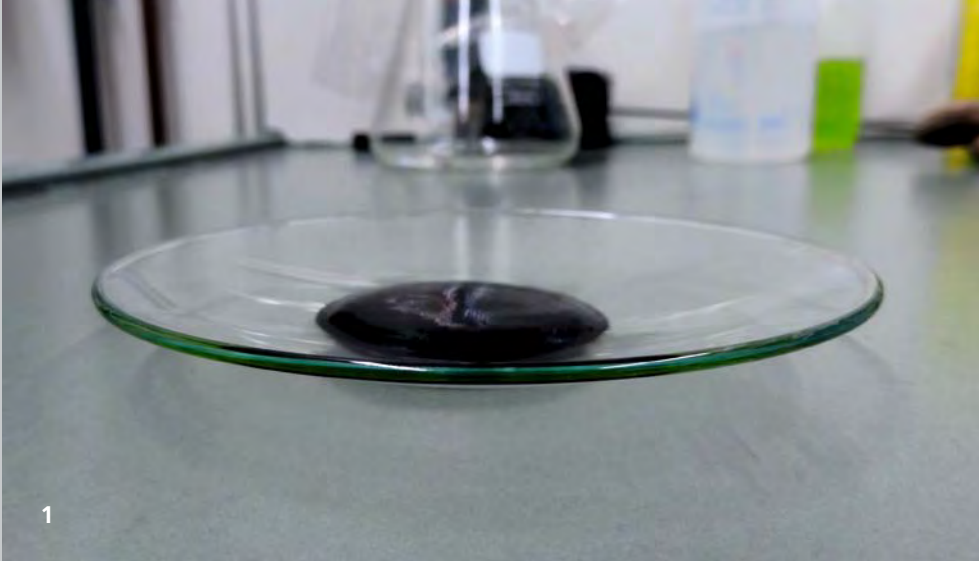
In the manufacture of synthetic monomers, Fraunhofer UMSICHT processed the hydrocarbon route in the project. Its starting materials are found in the form of lipids, for instance in the membranes of seaweed; the cells usually must be broken open in order to reach their valuable constituents. Not so for the green seaweed "Botryococcus braunii". Its distinction: it can be "milked". This means that the desired raw materials can be extracted using reverse osmosis membranes without destroying the algae cell. An algae cell can consequently produce more oil in the course of its life with less energy.

KNOWLEDGE PLATFORM FOR INDUSTRY SUPPORT

The SPLASH four-year project covers the entire process chain from the optimized production of biomass from algae to product development and production of synthetic monomers. Its goal is the development of high-quality end products such as fibers for yarns, ropes and nets from algae sugars and hydrocarbons. Under the direction of Wageningen UR Food & Biobased Research, the project partnership is comprised of companies (55 percent) and universities and research facilities (45 percent). For the future, the project consortium plans a platform that will offer knowledge, tools and technologies. An industry that wishes to employ algae as starting materials for the production of polymers is thereby decisively supported.

CONTACT

Dr. Volker Heil | Group Manager Biofuels, Hydrocarbons | Phone +49 208 8598-1163 |
volker.heil@umsicht.fraunhofer.de



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ALGAE-BASED FUELS FOR AVIATION

Air travel cannot be replaced in a global society. To reduce aviation's CO₂ footprint, CO₂-neutral fuel source alternatives must be identified. Bio-based kerosene is at this time the only practical alternative to fossil fuels. The cooperative project AUFWIND examines ways to convert algae products into airplane fuels. Apart from the technical implementation, economic and sustainable bio-kerosene production is of particular significance. Fraunhofer UMSICHT is involved in this project with regard to the topic of algae extraction.

VIEWING THE ENTIRE VALUE-ADDED CHAIN

Microalgae provide the biomass basis of the cooperative project AUFWIND, supported by the Federal Ministry of Food, Agriculture and Consumer Protection (BMELV). They show high productivity and can, for example, exploit carbon dioxide from the fumes of power plants as a raw material. Test flights with algae-based biofuel have already shown its fundamental feasibility. Initial conversion processes for bio-kerosene creation have in fact been created, however these must be made considerably more efficient. For this purpose, the technology, the general economic climate and economic scaling effects must be optimized. The twelve affiliated partners in AUFWIND are therefore integrating the entire value-added chain of biomass production up to the creation of standardized fuels according to ASTM (American Society for Testing and Materials). A sub-project is for the first time independently comparing several photobioreactor technologies for the cultivation of algae. Early conclusions about the economic and technical feasibility of production under Central European conditions can be derived in this way.

FRAUNHOFER UMSICHT ANALYZES THE QUALITY OF ALGAE OIL

In the next step of downstream processing, the lipids are extracted from the algae mass by various processes that must be evaluated. "At Fraunhofer UMSICHT, the algae oil extracted by the project partners is analyzed with regard to its suitability as a starting material for the subsequent conversion to bio-kerosene," explains sub-project manager Dr. Anna Fastabend.

CONTACT

Dr. Anna Fastabend | Deputy Head of Analytics | Phone +49 208 8598-1166 | anna.fastabend@umsicht.fraunhofer.de

1 Algae extract obtained by different processes.



SUSTAINABLE

Ecology/Economy/Product responsibility:

The analysis of the sustainability of all process steps economically, ecologically and socially is another focus of the project: the potential to generate new value from by-products is likewise examined as is the use of renewable raw materials with high productivity and minimum consumption of resources.

MORE INFO

[s.fhg.de/algae-based-fuels](https://www.fhg.de/algae-based-fuels)





EU-PROJECT SUSMILK – "GREEN DAIRY"

1 *Optimized procedures in the milk industry for the more sustainable processing of dairy products.*



SUSTAINABLE

Project responsibility/Ecology: *The project shows how energy and resources can be more efficiently employed through modifications or adaptations in the milk industry. Apart from lowering emissions and a reducing the consumption of fossil resources, positive workplace effects from new and adapted technologies result. The milk industry thereby assures the distribution of healthy foodstuffs and becomes more competitive by saving resources.*

Milk, curd and cheese are among our daily foods. How CO₂-emissions, energy and water can be minimized in the production of such food is shown by the EU project SUSMILK. Under the direction of Fraunhofer UMSICHT, the 21 project partners develop components that contribute to the sustainable processing of milk and a reorganization of the milk industry by their use in existing dairy infrastructures. The EU project SUSMILK is funded up to 2016 by the 7th Research Framework Programme (FP7) of the European Commission.

An overall concept of a green dairy is worked out on the basis of five dairies of different sizes. This includes the development of technical components, their installation and examination in partner dairies, as well as process simulation and an eco-assessment. An across-the-board solution for dairies is not aspired to, but rather an optimization of individual systems, adapted to the unique situation of each dairy. Solar thermal and absorption cooling have, among others, the potential to save energy on location. Additionally, heat pumps can be employed for optimized heat utilization in the dairy.

REORGANIZATION OF THE MILK INDUSTRY

To reduce water and energy consumption, Fraunhofer UMSICHT is focusing on the energy-efficient production of milk concentrate with improved quality in a sub-project. This measure will reduce transport energy and tank sizes in the dairy. The waste water, which necessarily arises in production and systems cleaning, is organically highly polluted. It is cleaned up by means of membrane technology and thereby finds repeated use in closed water cycles. It is additionally imaginable that energy in the form of biogas or bioethanol can be gained from waste utilization and employed to generate heat and electricity for the dairy. There is also the possibility of recycling the universally valuable substance lactic acid from residual material streams.

MORE INFO

s.fhg.de/green-diary



CONTACT

*Dr.-Ing. Christoph Glasner | Biomass and Residue Utilization | Phone +49 208 8598-1133 |
christoph.glasner@umsicht.fraunhofer.de*



ENVIRONMENTALLY FRIENDLY RECYCLING OF STRATEGIC METALS

The demand for metals from rare earths (REM) or platinum group elements (PGE) continuously increases. The scarcity of these strategic raw materials, which in part are highly import-dependent and may be inadequately recycled, was the motivation for S-Sieve, a cooperative project of Fraunhofer UMSICHT with the Helmholtz-Center Dresden-Rossendorf (HZDR) and the Institute for Process, Environment and Mining Research IVUB e.V. The goal is the development of a bio-compound material (S-Sieve) for the recovery of PGE and SEM.

Very generally, various processes have been employed to recover dissolved metals from aqueous systems, especially strategic metals: among others, liquid-liquid extraction, flotation, and binding of the metals to ion-exchange materials, inorganic or biological materials. Disadvantages of these processes are their high chemicals consumption, technical, time and energy outlays; need for waste disposal of exhausted materials; as well as the low selectivity. The majority of processes, moreover, only work when metal concentrations are high in aqueous media. The significant idea of the research project (funded by the AiF) is the development of a bio-compound material (S-Sieve) made of S-layers (protein layers) and micro sieves for the recovery of PGE and REM. S-Sieves can also separate very small metal concentrations from liquids.

INITIAL EXPERIMENTS ALREADY SUCCESSFUL

For this purpose, bacterial surface proteins (S-layer proteins) that, for example, come from isolates from mine dumps, are applied on galvanized micro sieves manufactured with laser technology. These can bind metals such as platinum, palladium or gold. Good binding characteristics are also expected for various representatives of the REM. In first attempts, in process water with a platinum content between 3 and 60 mg/l, up to 60 percent of the platinum could be recovered. In an additional step, the characteristics of S-layer and the micro sieve can be directed in such a way that an individual adaptation to the respective application is possible. Coated micro sieves become reusable by means of pH lowering or various rinsing methods.

CONTACT

Dr.-Ing. Ilka Gehrke | Head of Department Process Intensification | Phone +49 208 8598-1260 | ilka.gehrke@umsicht.fraunhofer.de

1 Many of the metals important for high-tech industry could be recycled.



SUSTAINABLE

Ecology/Economy: In contrast to previous separation processes, which demand intensive use of chemicals and where the separation-active material must frequently be disposed as waste, the use of proteins is environmentally friendly because of their potential for reuse. The relatively high production costs of micro sieves are compensated by their long service life and possibility of reuse.



DOOR SEALS REDUCE CO₂ AND COSTS

1 How efficient and environmentally friendly are door seals?



SUSTAINABLE

Ecology/Economy:

Fraunhofer UMSICHT offers sustainability evaluations and management with their knowledge of resources and technologies. This includes decision-making support in product development and information about resources, eco-assessment (Life Cycle Assessment), carbon footprint, sustainability management and strategy development (for reporting, among others). Climate protection concepts, potential studies and spatial balances with geo-information systems round off the portfolio.

Energy saving and carbon dioxide emission limits are two significant challenges within the scope of an energy turnaround. Fraunhofer UMSICHT has developed a country-specific calculation tool for balancing greenhouse gas emissions and energy costs in closed rooms. A new development is the inclusion of the use phase of products. Companies and architects in particular profit from these results.

There is an increasing demand for an ecological balance that records the waste, resources and energy consumption in manufacture and transport. Many companies employ life cycle assessments in order to analyze the environmental impact of their products. Normally they include manufacture, transport and waste disposal, since no emissions arise in the usage phase. With its CO₂ climate calculator, Fraunhofer UMSICHT has developed a balancing tool that, beyond the manufacturing and transport phase, also includes the use phase. For this purpose, the effects of automatic door seals on greenhouse gas emissions and associated energy consumption was examined.

ECONOMIC AND ECOLOGICAL RETURNS

A room must be air-conditioned or heated to maintain the desired appropriate temperature. However, a gap where the door swings above the floor makes air circulation between rooms possible and can thereby influence room temperatures. Automatic door seals prevent this type of air circulation. Door seals also reduce carbon dioxide emissions and simultaneously help in saving energy costs. The balancing tool developed by Fraunhofer UMSICHT makes it possible to calculate how much greenhouse gas emissions can be saved in a room or a building defined with respect to size and air volume if automatic door seals are installed. Climatic data from 21 countries as well as appropriate heat and electricity prices were implemented. Data for the production of the door seals at the production site in the Sauerland region as well as for their transport to the appropriate target country are integrated in the final step. The greenhouse gas balance of the door seals can be portrayed over the entire lifetime of the system.

CONTACT

Boris Dresen M. A. | Sustainability Assessment and Management | Phone +49 208 8598-1190 |
boris.dresen@umsicht.fraunhofer.de



VALUABLE SUBSTANCES FROM METALLURGICAL PLANT DUMPS REDUCE RAW MATERIALS IMPORTS

Germany is highly dependent on raw materials imports, especially for high-technology products. Dumps from iron and steel manufacture, so-called metallurgical plant dumps, include especially valuable metallic raw materials. Since comprehensive data about the precise valuable substance potential of the dumps is missing, such substances have hitherto usually been unused. The cooperative project "REStrateGIS" starts at this point: under the direction of Fraunhofer UMSICHT, researchers are developing a multi-scale resources register for ironwork dumps as well as new concepts for the recovery of valuable substances.

Ironwork dumps are composed of residual materials such as dusts, slurries, unexploited slags and other ironwork debris. In order to determine the data gaps about valuable substance potential for a multi-scale register, the team sifts archive data and employs methods for remote exploration and prototypes of innovative laboratory methods. The multi-scale register forms three spatial levels the content resolution and detail depth of which increases from level to level. The design and development of a Germany-wide overview register is planned which will be available online and will present the existing dumps in Germany spatially in an overview. Moreover, the modelling of dump locations of the iron and steel industry will have excellent spatial and content resolution.

NEW PROCESSES FOR RECOVERING VALUABLE SUBSTANCES

The practical work in the development of processes for the recovery of valuable substances takes place in Unterwellenborn, Thuringia. The dump on location has a long iron and steel history. Samples withdrawn from the deposited material were analyzed in chemical and pyrometallurgical laboratory tests to evaluate their valuable substance content. Terrestrial and airplane-supported investigations by means of optical sensors round off the research work. The results of the investigations and fly-overs are interlinked in a 3D model of the associated dump. The recorded data and derived information presents the foundation for the development of processes for the recovery of valuable substances. "REStrateGIS" is funded for three years by the program r^3 of the German Federal Ministry of Education and Research (BMBF): Innovative Technologies for Resource Efficiency – Strategic Metals and Minerals".

CONTACT

Dipl.-Lök. Michael Jandewerth | Material Flow Systems | Phone +49 208 8598-1419 |
michael.jandewerth@umsicht.fraunhofer.de

1 Valuable raw materials such as metals and minerals are found in the dumps.



SUSTAINABLE

Economy: Germany and the EU are almost 100 percent dependent on imports of high-tech metals. These frequently come from geopolitically insecure regions. There is furthermore a danger of trade and competition restrictions as well as the rise in price of raw materials by speculation. The extraction of indigenous raw materials from hitherto unemployed, deposited residual materials can dampen fluctuations in the supply and in the price.

MORE INFO

[s.fhg.de/restrategis-en](https://www.fhg.de/restrategis-en)





INJECTION MOLDING OPENS MARKETS FOR FIBER-REINFORCED PLASTICS

1 Lower part of a coffee can of 500 gram size.



SUSTAINABLE

Economy/Ecology/Project responsibility:

The creation of injection molding products should ensure bio-based DuraPulp® access to attractive markets. The project provides a blueprint for introducing additional natural fiber-reinforced bio-synthetics into durable applications; expanded product diversity will strengthen marketability.

A wood-polymer material that is 100 percent based on renewable raw materials, has good mechanical characteristics and pleasant haptics and can be enhanced with brilliant colors has been available on the market for about three years. Previously, however, a practical and economical production process by which to manufacture formed parts from the material without changing its advantageous material characteristics was lacking. A multidisciplinary team from Sweden, Finland and Germany has now been successful within the scope of the research project "MouldPulp" funded by the German Federal Ministry of Education and Research (BMBF) under the leadership of Fraunhofer UMSICHT.

DuraPulp® is a wood-polymer material made of cellulose fibers and polylactic acid (PLA). It is among the wood-plastic composite (WPC) compound materials made from various combinations of wood, plastics and additives. Significant fields of application for WPC are the building and garden sectors as well as automobile interiors. Because of its good mechanical characteristics, agreeable haptics and good dyeing characteristics, the material of the Swedish companies Innventia and Södra is open for applications for products designs in the area of furniture and consumer goods. However, an economical industrial manufacturing process for creating the corresponding products is still lacking. The goal of the ERANET project "MouldPulp" of the WoodWisdom network was to make the injection molding of DuraPulp® possible without changing its natural material characteristics.

CONVINCING RESULTS

A cellulose fiber PLA preliminary product was developed in the project. The subsequent compounding step combined a gentle mixing process with a high fiber content, homogeneous fiber distribution, and efficient extruder throughput. The granulate was injection-molded to testing bodies and technical parts where the material and molding characteristics were tested and evaluated. The development process was accompanied by a technical-economic evaluation and an environmental impact assessment. The injection molded parts in the form of test plates and boxes demonstrated the excellent injection molding process and the good coloring characteristics of the granulate in bright tones. The MouldPulp samples proved superior to polypropylene (PP) in haptics tests.

MORE INFO

s.fhg.de/mouldpulp



CONTACT

Dipl.-Ing. Thomas Wodke | Deputy Head of Department Bio-based Plastics | Phone +49 208 8598-1263 | thomas.wodke@umsicht.fraunhofer.de



PHTHALATE-FREE PLASTICIZERS: ALSO COMPLETELY BIO-BASED

Plasticizers are among the most often sold chemicals world-wide. As additives, they improve the characteristics and processing profile of plastics. The dominance of softening plasticizers containing phthalates has declined due to some members of this plasticizer class having characteristics that are reprotoxic (having a toxic effect on the process of reproduction). Of the alternatives free of phthalate only a few are in part bio-based. Through the development of a process for producing bio-based alcohols, Fraunhofer UMSICHT could broaden their range with medium-chain alcohols, and create access to completely bio-based softening agents.

The majority of softening agents belong to the ester product category, compounds made of acids and alcohols. Among the phthalate-free plasticizers some are bio-based in part. These include esters of fatty acids, citric acid, the glycerins or esters of dicarboxylic acids derived from fat. However, usually either the acid or the alcohol is bio-based, not both. The bottleneck is the availability of bio-based alcohols. While short and long-chained alcohols may be bio-based, development of bio-based alcohols with three to up to ten carbon atoms (mid-chain) has not been cost-effective. A process developed by Fraunhofer UMSICHT makes C3-C10 alcohols economically accessible through thermo-chemical conversion of bio-based short-chained alcohols (e.g. bioethanol) with the aid of a heterogeneous catalytic gas phase reaction. This development has significantly broadened the pallet of fully bio-based esters.

EFFICIENCY AND TOLERANCE OF PLASTICIZERS VERY PROMISING

These C3-C10 alcohols can be transformed to esters from a mixture or a pure substance, e.g. with carbon or dicarboxylic acids manufactured through fermentation. Completely bio-based esters (succinates) made from ethanol and succinic acid offer a fully "green" plasticizer. The tolerance and plasticizing efficiency of different succinates was examined in selected polymers (PVC, PS, PLLA, CA). The first results are very promising. Additional investigations must show how well the low-molecular plasticizer is suited for specific applications. The project is funded by the Federal Ministry of Food, Agriculture and Consumer Protection (BMELV).

CONTACT

Dr. Rodion Kopitzky | Polymer Chemistry | Phone +49 208 8598-1267 | rodion.kopitzky@umsicht.fraunhofer.de

1 Plasticizers are found in many everyday products: the rubber duck is a classic example.



SUSTAINABLE

Ecology/Project responsibility:

By 2018, the demand for plasticizers will climb to more than 7.6 million tonnes per year according to a marketing study from Ceresana Research. The development of bio-based process chains synthesized from alcohols and acids will in the future enhance the range of sustainable products.

MORE INFO

s.fhg.de/bioethanol-en





REDOX-FLOW BATTERY SECURES A CONSTANT POWER SUPPLY

1 The new battery design makes larger and more efficient battery stacks possible.



SUSTAINABLE

Ecology/Project responsibility:

The greatest problem for the proper waste disposal of batteries is the separation of the materials. For redox-flow batteries, the metal-containing energy storage component can be separated from the energy capacity component – which is mainly made of plastics – by the simple pumping of the liquids. Since the electrolyte shows no ageing symptoms, a direct reutilization of the storage component in new facilities is possible. The performance component consists primarily of plastics and graphite and is added to the normal disposal route.

Wind and sun are ever more important energy suppliers. However, they do not deliver consistently, potentially leading to capacity bottlenecks. Among other solutions, high-performance electrical energy storage can close developing gaps in the future.

Researchers from Fraunhofer UMSICHT have developed a redox-flow battery with a cell size of 0.5 square meters (m²). The cells can build up a total stack performance of 25 kilowatt (kW).

The German Federal Government intends that our power requirements will be completely covered by renewable sources by 2050. To achieve this end, the growing quantities of solar and wind energy must be stored at night or over periods of weak winds. Redox-flow batteries could assume this function in the future. Electrical energy is stored in electrolyte solutions that flow from tanks through a cell in which a current is produced in a chemical process. Several cells are rowed to stacks which previously delivered 2.3 kW power for a size of about one DIN-A4 sheet. Researchers from Fraunhofer UMSICHT could now significantly enlarge the individual cells to 0.5 m² and thereby also the stacks. The outcome is an increase in performance to 25 kW per stack. The prototype has an efficiency of 80 percent and can be loaded with currents of up to 500 amperes.

NEXT COMPLETION STAGE ALREADY IN PLANNING

A completely new battery design is responsible for the increase in performance. At first, new membrane materials had to be tested and battery management likewise evaluated. Current simulations helped to optimize the design of the cells. Within the scope of the project funded by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU), the redesign of the battery stacks is an important successful step on the path toward developing redox-flow batteries that can provide power for up to 2000 households. About two megawatts of power would be necessary. The next specific goal is therefore the development of stacks that are 2 m² large with a capacity of 100 kW.

MORE INFO

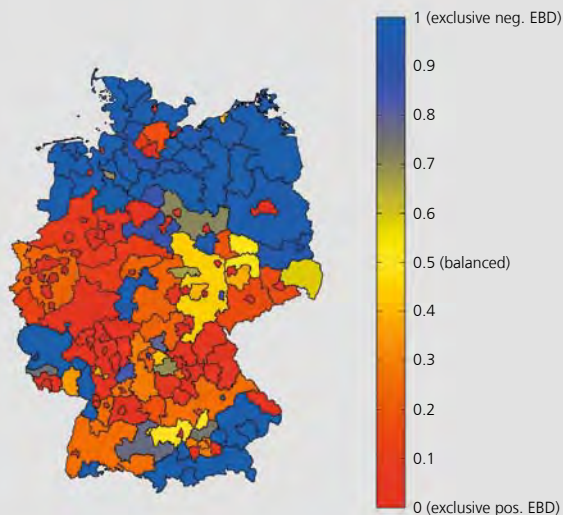
[s.fhg.de/redox-flow-battery](https://www.fhg.de/redox-flow-battery)



CONTACT

Dr. rer. nat. Jens Burfeind | Group Manager Electrochemical Storage | Phone +49 208 8598-1268 | jens.burfeind@umsicht.fraunhofer.de

1



ENERGY BALANCING DEMAND IN GERMANY

Even though supply and demand should balance, temporary disequilibriums develop between the quantity of electricity produced and the quantity in demand. This increasingly occurs in the course of the expansion of fluctuating renewable energy in Germany. There are possibilities for balancing the energy demand, however, the local distribution system as well as the type of the imbalance must be known. In cooperation with Fraunhofer IOSB-AST, Fraunhofer UMSICHT has developed a method of presenting the local energy balancing demand as a model.

Germany was subdivided into 146 regions differing in population density and share of industry and commerce, to determine their energy balancing demand. If too little power is available to balance the required load, this is a positive energy balancing demand; and if there is surplus power it is a negative demand.

POWER PLANT FLEET MODELLING WITH MELENA

The model "MELENA" developed at UMSICHT hourly simulates the regional electrical load profiles, the feed-in from geothermal, water and biomass power plants and cogeneration systems as well as the generation of fossil, nuclear and pumped-storage power plants. The future spatial distribution of the renewable systems (photovoltaics and wind) is modelled dependent on the spatial distribution of the resource quality and thus depending on the possible plant capacity utilization. Based on the difference between generation and demand, MELENA calculates the regional energy balancing demand. Fraunhofer IOSB-AST has developed a physical network model based on these results that determines the power flows, losses, and resources capacity utilization limits nation-wide. Using these detailed simulations of the high and extra-high voltage grid, the simulation shows in which regions which type of energy balancing demand with network restrictions is required in the years 2020, 2030 and 2050. The project was funded by the German Ministry of Economics and Technology. Based on the results, examinations about measures for the compensation of the balancing demand can now be employed. Possible options are load and/or generation management, building of an energy storage as well as the expansion of the electrical power network. The acceptance of energy balancing concepts is being further examined in an ongoing research project.

CONTACT

Dipl.-Ing. Patrick Wrobel | Energy Systems | Phone +49 208 8598-1380 | patrick.wrobel@umsicht.fraunhofer.de

1 Germany is divided into 146 regions for the determination of energy balancing demands.



SUSTAINABLE

Ecology/Economy: The German energy turnaround increases the share of fluctuating electricity producers and thereby also the disparities between power generation and consumption. The project shows the extent of the imbalance on the regional level in Germany, in order to serve as the basis for necessary compensation measures (e.g. energy storage). Only a balanced relationship between electrical availability and demand can guarantee a secure and reliable electrical supply.



HEAT STORAGE: MORE THAN JUST WARM WATER

1 Thermo-analytical characterization of thermo-chemical reaction systems with ITC (isothermal titration calorimetry).



SUSTAINABLE

Project responsibility:

One possibility for reducing primary energy consumption is the use of surplus heat from energy conversion and industrial processes. This, however, frequently fails due to temporal and local discrepancies between heat generation and heat demand. Thermal storage with improved material and storage characteristics can be a remedy and a key to the increased use of surplus heat.

No sun means a cold shower? The solution: storage – collect the energy surpluses and store the electricity and heat – possibly free from losses – until they are required. This is of interest for renewable energy sources. New heat accumulator materials provide interesting options such as the storage of thermal energy in the smallest of spaces, low-loss long-term storage or the storing of heat at a specific temperature level.

For the storage of heat, Fraunhofer UMSICHT investigates the use of thermo-chemical materials and their heat of reaction. Thermo-chemical materials offer a greater energy storage density than other possibilities for thermal heat storage. The energy can also be stored in small volumes over long time periods. One process variant is based on organic starting materials. For instance, if one separates organic acids and bases by a supply of energy, the materials take up heat. In the experimental reactor, this reaction can be reversed. If one brings the separated materials together at a later time in an exothermal recombination reaction, then the heat is released without great losses. Organic heat storage materials are particularly suitable for the low temperature range (below 200 degrees centigrade) such as in the utilization of waste heat in the food industry.

INORGANIC AND ORGANIC REACTION SYSTEMS

Some industrial companies are already paying close attention to research work on thermo-reversible reaction systems. There are two different variants. Predominantly gas-solid matter reactors are employed for high temperature heat storage for inorganic reaction systems. Organic materials allow the development of homogeneous liquid phase storage systems which can also be employed in pump circuits. Another benefit of organic reaction systems: the chemical structure of the starting materials can be more easily changed.

MORE INFO

[s.fhg.de/heat-storage](https://www.s.fhg.de/heat-storage)



CONTACT

Dr.-Ing. Barbara Zeidler-Fandrich | Head of Department Thermal Energy Storage | Phone +49 208 8598-1143 | barbara.zeidler-fandrich@umsicht.fraunhofer.de



Photo: shutterstock

Energy

ENERGY-EFFICIENT HOSPITALS

As complex, highly technical buildings, hospitals have high energy consumption. This is often raised further by outdated technology and non-optimal operating modes. Considering higher energy prices and increased pressure on costs, it is essential to use saving potentials in energy supply. Within the scope of the Hospital Engineering research project, Fraunhofer UMSICHT is developing a model that can visualize consumption structures and effects from savings measures. The project is funded by the State Government of North Rhine-Westphalia and the European Funds for Regional Development.

There are about 2,000 hospitals in Germany. Of the total costs of hospitals in 2011, 38 percent were tangible costs; 6.5 percent were spent on water, energy and fuels. The energy costs of a hospital on average were one million euros. According to studies, energy saving potentials of between 10 and 40 percent are possible. However, these potentials remain unused since knowledge about distribution of energy consumption and costs in a hospital is usually insufficient. This makes the cost effectiveness of possible measures difficult to estimate.

MODEL GENERATES KNOWLEDGE ABOUT ENERGY CONSUMPTION AND STRUCTURES

Fraunhofer UMSICHT is developing a model for the simulation of buildings and systems in order to show energy consumption and the effects of savings measures. In two hospitals, measurements of energy quantities (heat and cooling quantities as well as electrical performance measurements) are being carried out in systems and devices; climatic data and additional data are taken and bundled in the energy model. With an energy and systems simulation the model calculates the energy flows linking supply and consumption. Since the objects modelled, such as a room air unit, are assembled in predefined building blocks, various savings measures can be outlined by variation of the possible parameters and can be compared to the current state. This will contribute to the more efficient management of hospitals, which are continuously challenged to flexibly adapt the energy supply in response to needed refurbishing and re-construction measures, and serves as a basis for determining the execution of savings measures and the use of new technologies. Cogeneration systems and regenerative energy should be cited for their great potential for the economic use in hospitals.

CONTACT

Dipl.-Ing. Carsten Beier | Head of Department Energy Systems | Phone +49 208 8598-1416 | carsten.beier@umsicht.fraunhofer.de

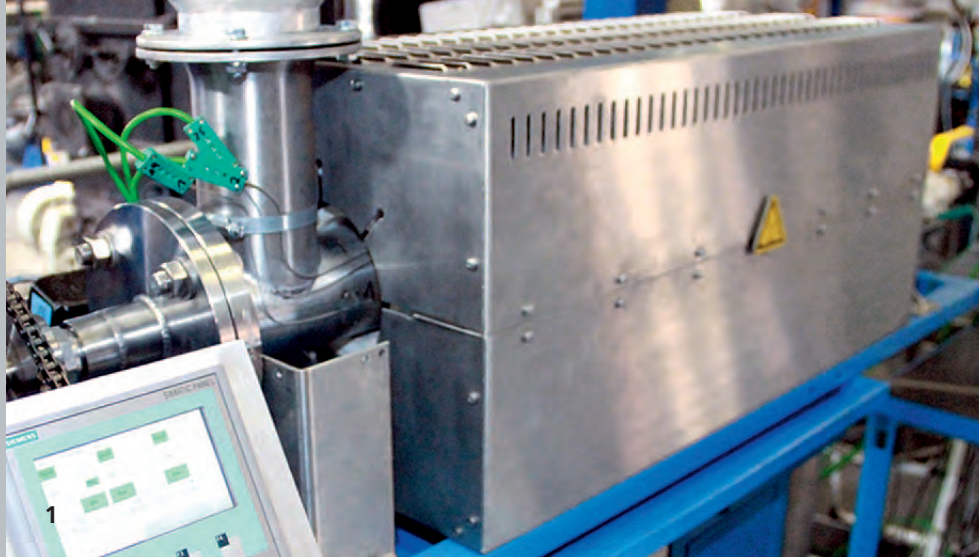
1 Hospitals need technology. Technology requires energy. A computer model makes saving potentials visible.



SUSTAINABLE

Ecology/Economy:

Potential energy savings of 10 to 40 percent remain to be captured in hospitals. This waste is coupled with avoidable carbon dioxide emissions. Only those well-informed about energy supply and energy consumption can make and implement ecologically appropriate investment decisions in a cost-efficient manner.



THE BIOBATTERY: EFFICIENT ENERGY UTILIZATION

¹ Thermo-catalytic reforming is the focus of the biobattery concept.



SUSTAINABLE

Economy/Ecology:

The biobattery is actually a pool of various environmentally friendly technologies.

The concept focuses on biogas plants, thermal storage, gasification units, pyrolysis systems and motors for generating electricity.

Fraunhofer UMSICHT converts electrical energy into an advantageous storable form. In addition, the Sulzbach-Rosenberg branch of the institute identifies additional application possibilities for surplus energy and optimizes them.

¹ Estimate of the Federal Association of the German Energy and Water Industry (BDEW) for 2013, as of January 14, 2014

MORE INFO

s.fhg.de/biobattery-suro



The announced and planned energy shift represents a special challenge to Germany as an attractive business location. Today, renewable energy already easily meets a fifth of the nation's electrical demand. However, energy from these fluctuating sources alone does not yet allow the complete transformation of energy systems. Solutions are needed that deliver energy reliably or that allow a decoupling such that power can be generated and consumed at different times. The biobattery renders a contribution that makes it possible to store and optimally use energy.

ENERGY STORAGE BY ENERGY CONVERSION

Surplus electricity from renewable sources such as sun and wind on the one hand, as well as biogenic residue materials or other organic waste products on the other hand, is the basis of the biobattery concept. By combining thermal-catalytic decomposition and integrated reforming, residual biomass and surplus electricity are converted to oil, gas and coke. The reforming steps are the key to an efficient and economical increase in gas and oil product qualities. The produced and processed fuels can be stored and hence saved in almost any manner, until they are needed to generate electricity and heat by a generator in a CHP system. The solid residue is likewise suitable for power generation, as a reducing agent or as soil conditioner.

EFFICIENT DECENTRALIZED ENERGY STORAGE

Well over 7,000 biogas plants in Germany alone present a great potential for the biobattery. The residues from anaerobic fermentation can be transformed by thermo-catalytic reforming in connection with combined gasification, and then transformed into liquid, solid, and gaseous products. Alternatively, it is possible to supply the gas product as well as the oil product for gasification. The resulting gas has a high calorific value and is utilized energetically in a CHP system. The efficiency of the concept can be increased by the use of mobile latent heat storage. The locally unusable low temperature heat is transported and used at a location where it is needed which increases the efficiency of the entire system.

CONTACT

Prof. Dr. Andreas Hornung | Director of Institute Branch Sulzbach-Rosenberg | Phone +49 9661 908-403 | andreas.hornung@umsicht.fraunhofer.de



1

DECENTRALLY EXPANDING RESOURCE PROTECTION

About 0.6 million tonnes¹ of used electric and electronic devices containing a multitude of critical metals accrue annually in Germany. However, for the most part these strategic metals are lost in the procedures for extracting copper and precious metals.

Therefore researchers at the Sulzbach-Rosenberg branch of the institute are developing processes for the efficient recovery of rare metals. At the heart of the idea is a decentralized supplement to the existing recycling chains to improve the value added at regional recycling facilities.

RECOGNIZE WASTE AS VALUABLE SUBSTANCE POTENTIAL

Increasing raw material requirements, as well as a strong trend towards a high market concentration, contribute to ever greater fluctuations in global prices. Import-dependent countries with a significant share of national production in high-technology products face considerable uncertainties in supply. But large quantities of metals such as gallium, indium or rare earths are present in electrical and electronic waste, and much of this value is lost using the current reprocessing methods. An innovative technology developed in Sulzbach-Rosenberg that can be integrated into existing reprocessing chains is to enable the decentralized recycling of these metals.

KEEP THE ENTIRE CHAIN IN VIEW

Fractions from the mechanical reprocessing of old electric and electronic devices are subjected to a pyrolysis process in order to separate the metals from the plastics. The oil and gas produced in this process can be used in engines to supply the process with energy. The metal-enriched residue is subsequently fractionated by electrolysis. The resulting metals can again flow back into the manufacture of new products. The entire process is simultaneously evaluated with respect to its economic, ecological and social impacts. Since appropriate and effective recycling concepts begin with collection, additional interesting waste streams are identified in material flow considerations; for these collection methods that best ensure end material homogeneity are developed.

CONTACT

Dipl.-Ing. Katharina Reh | Waste Management and Recycling Technologies | Phone +49 9661 908-431 | katharina.reh@umsicht.fraunhofer.de

1 Residues from the mechanical treatment of electric and electronic waste.



SUSTAINABLE

Project responsibility/Ecology: Especially for Germany, as a country poor in raw materials, strategies for resource efficiency and improved recycling management are gaining in significance. The promotion of secondary raw materials reduces dependency on countries that export such materials. A lower demand for primary raw materials moreover spares natural deposits and reduces environmental impacts. It strengthens the concept of regional creation of value and secures jobs.

¹ Statistisches Bundesamt: Ergebnisbericht Abfallentsorgung, Erstbehandlung von Elektro- und Elektronikaltgeräten 2011. Wiesbaden, 2013 (Federal Statistical Office: Report on Waste Management, Initial Treatment of Electrical and Electronic Waste Equipment 2011).



EFFECTIVE CORROSION PROTECTION IN POWER PLANTS

1 In the practical test, the modified layer shows a significantly greater resistance in the waste incineration plant.



SUSTAINABLE

Project responsibility/Ecology: The measure "Materials for a Resource Efficient Industry and Society – Mat-Ressource" of the BMBF supports the exploration and development of innovative technologies and processes for improved use of resources by material innovation. Research projects can sustainably reduce the dependency on raw material imports, improve international competitiveness by reducing energy and material costs, and help protect the environment.

High temperatures and a chemically aggressive environment prevail in waste incineration plants and biomass power plants. The surfaces of the installed components more rapidly deteriorate by corrosion at such sites than elsewhere. Within the scope of the initiative "MatRessource" funded by the Federal Ministry of Education and Research (BMBF), Fraunhofer UMSICHT is researching new concepts for protective layers in order to improve the corrosion resistance and hence the service life of the components. Fraunhofer UMSICHT tests modified materials for corrosion protection in the direct operation of the refuse incineration plant in Schwandorf and in the in-house incineration pilot plant.

THERMAL SPRAYING AS IDEAL ALTERNATIVE

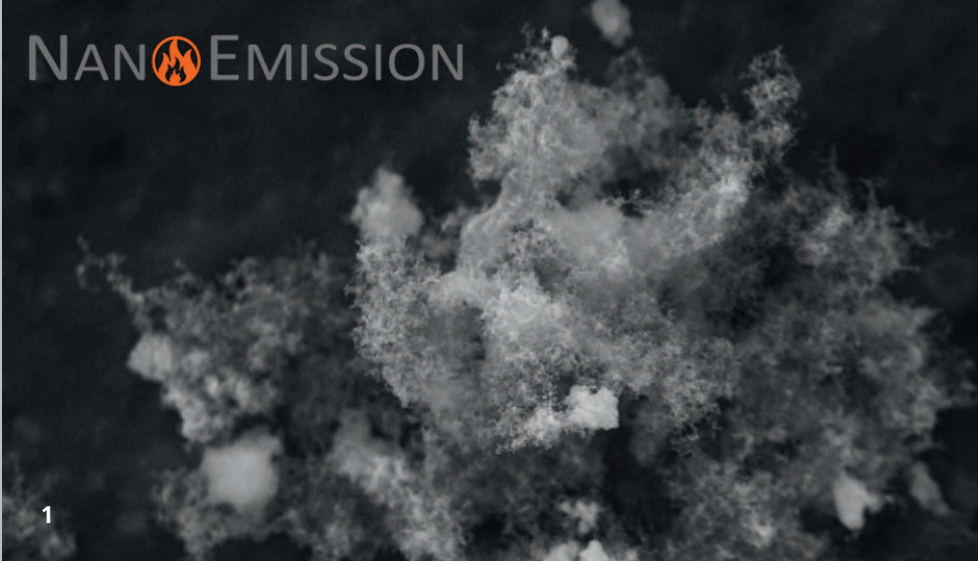
The corrosion protection concepts currently employed in waste incineration plants are predominantly based on millimeter-thick welded protective metallic layers. Savings of material means a reduction of costs. Thus, thermal spraying is the obvious alternative coating technology: its operation is comparatively cost-effective, and the application allows for considerably thinner layers. It is also possible to coat with ceramics by thermal spraying. Due to their chemically inert behavior, ceramics are in principle very well suited to resist the flue gas conditions in power plants. However, conventional thermal-sprayed ceramics can show deficits in the form of inadequate leak tightness or poor bonding characteristics.

THE COMPRESSION OF THE CERAMICS IS CRUCIAL

The sprayed metal and ceramic layers are modified by solvo-thermal procedures in such a manner that they satisfy the high requirements. Specifically, this means the compression of the ceramic in the transition zone to the metal, thus increasing the layer bonding and corrosion resistance. Partners are integrated in the research projects over the entire value-added chain of the waste incineration. Apart from Fraunhofer UMSICHT and the Ludwig-Maximilian University Munich, the Deutsche Edelstahlwerke GmbH and Rohrwerk Maxhütte GmbH, two manufacturing companies from the metal industry, are also involved. Additional project partners are the Zweckverband Müllverwertung Schwandorf (Waste Usage Association) as well as Martin GmbH.

CONTACT

Dr. HDR Patrick Masset | Head of Department New Materials | Phone +49 9661 908-472 | patrick.masset@umsicht.fraunhofer.de



1

NANOMATERIALS IN WASTE INCINERATION?

The high functionality of nanomaterials can be observed in many diverse everyday products: suntan lotions which appear transparent on the skin, water-repellent textiles, and antimicrobial cooking implements. However, even these essential commodities containing nanomaterial reach the end of their service life at some point. The nanoparticles then become a part of our domestic waste. In Germany, our urban waste largely goes into thermal utilization. However, what happens to the very small, invisible particles during and after waste incineration?

A nanometer (nm) corresponds to 10^{-9} meter, i.e. a millionth of a millimeter. Materials of this size often show a completely different behavior than their larger sized counterparts. These characteristics can be exploited to make products more functional and simultaneously reduce the consumption of raw materials. Nanomaterials have not been limited to high-tech applications for some time. To supply the consumer with products having ever greater functionality, nanomaterials are increasingly used in a wide array of commercial products. It therefore appears logical that we examine the impacts of these very small invisible particles on our environment and on ourselves.

NANO RESEARCH HITHERTO ONLY FROM THE CRADLE TO THE GRAVE

The focus of nanomaterial research has hitherto covered their creation and processing through their end uses. The thermal recycling waste disposal path of consumer goods containing nanomaterial has not been examined. It is uncertain whether nanomaterials remain in the ash upon incineration or whether they pass over into the flue gas where they could be effectively separated out by filtration media. The research alliance of the Federal Ministry for Education and Research (BMBF) "NanoEmission" was established in 2013. Under the overall responsibility of Fraunhofer UMSICHT, eight scientific and industrial partners are examining the entire post-use journey of the nanomaterials, from residual material to incineration, to the filtering of the exhaust gases. Also under investigation are their potential toxicological impacts on humans and the environment. Moreover, apart from the gain in knowledge, the project is contributing to advances in the development and optimization of filtration media for the separation of nanomaterials.

CONTACT

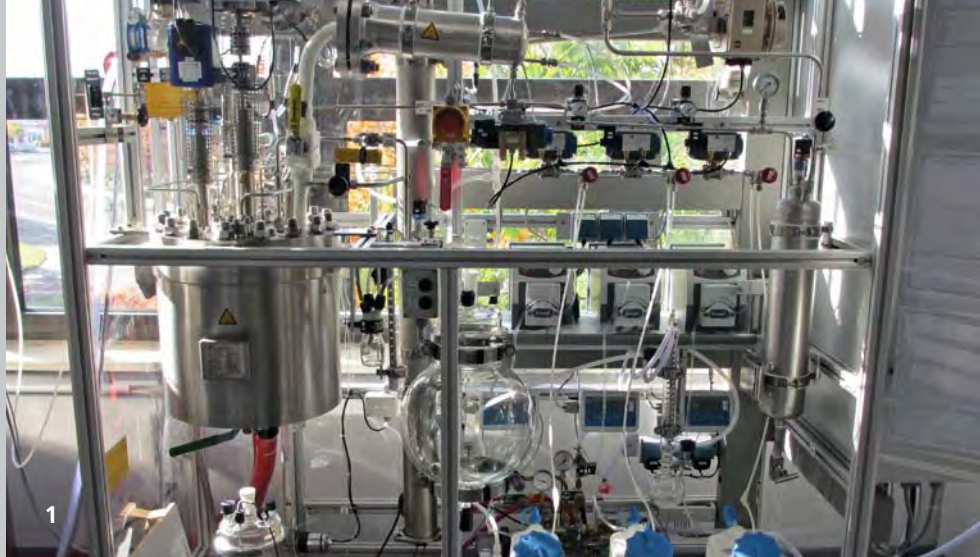
Dipl.-Ing. (FH) Julia Zach | Energy from Biomass | Phone +49 9661 908-418 | julia.zach@umsicht.fraunhofer.de

1 Flue gas particles under the electron microscope: REM photograph of a dust sample with agglomerated nanoparticles.



SUSTAINABLE

Ecology: A recommendation for action for operators of waste incineration plants is to be developed based on the research results. If it can be shown that human toxicological effects of recycling waste with nanoparticles is unobjectionable, social acceptance of disposal of products containing nanoparticles could be attained.



BROAD CATALYTIC POSITIONING

1 Plant for the large-scale preparation of catalysts.



SUSTAINABLE

Ecology/Economy: Catalysis increasingly is involved in all aspects of power generation and storage. This technology makes a key contribution to the energy and raw material shift and is inseparably associated with the sustainable creation of value.

Fuels and basic chemicals will be manufactured increasingly from biomass. The changes in the raw materials base require adaptations in the value-added chain and the development of effective catalyst-supported chemical process. Fraunhofer UMSICHT develops heterogeneous catalytic concepts to create platform chemicals from synthesis gas, then scales them up for industrial-scale use and maps out strategies for the sustainable and competitive production of fuels, energy and chemicals over the long term.

Synthesis gas is a platform for creating fuels and chemical raw materials. Produced by gasification from natural gas, coal or biomass, in essence it contains carbon monoxide (CO) and hydrogen (H₂). Heat, electricity, and carbonic substances can be obtained from this product. With close reference to basic research Fraunhofer develops new catalysts in a process of preparation, characterizing and testing. This is done in order to convert synthesis gas to platform chemicals (methanol, ethanol, dimethyl ether) and to further process these into co-products (dimethyl carbonate, butadiene). The synthesis paths are subsequently scaled up and the catalysts examined under industrial conditions. The catalytic removal of tar and the cleaning of synthesis gases made from biomass gasification is the topic of an international cooperative research project (p. 51).

BIO-BASED CHEMICALS, BIO FUELS AND HYDROCARBONS

The development of catalytic processes involves the conversion of fermentatively manufactured bio-based raw and residue materials (oils, fats, alcohols, sugar, cellulose, algae etc.) into chemicals and fuels. Analyses and testing of product applications and the basic design for procedures which can be centrally or decentrally integrated into the chemical industry round off the portfolio. A heterogeneous catalytic gas phase reaction for the thermo-chemical conversion of short-chained bio-based alcohols (bioethanol) to higher bio-based alcohols was also developed in this context. Esterification with fermentatively-manufactured succinic acid yields a 100 percent bio-based plasticizer (p. 25).

CONTACT

Dr. Stefan Kaluza | Group Manager Catalytic Processes | Phone +49 208 8598-1425 |

stefan.kaluza@umsicht.fraunhofer.de

Dr.-Ing. Andreas Menne | Bio-Based Chemicals | Phone +49 208 8598-1172 |

andreas.menne@umsicht.fraunhofer.de

1

EFFICIENTLY RINSING OFF DANGEROUS SUBSTANCES

Lyes, acids, solvents: numerous dangerous substances are used in chemical laboratories. If a lab technician inadvertently spatters a caustic substance on his or her body, every second counts. Emergency showers offer a remedy. But how effectively do the showers wash off the substances, and what water flow rate is necessary and appropriate for this purpose? To date in-depth studies have been conducted only on the extinguishing behavior of emergency showers in case of fire. The available studies are hardly helpful with respect to the rinsing off of hazardous substances. Fraunhofer UMSICHT has now examined the rinsing effects of overhead emergency showers with respect to chemicals.

For this purpose, Fraunhofer UMSICHT tested fifteen normal emergency shower heads, through which between 20 and 110 liters of water flowed per minute. A display mannequin simulating a contaminated human was fitted with numerous conductivity sensors. Instead of using genuine hazardous substances, the researchers "contaminated" the mannequin with a salt solution that sometimes contained an added thickening agent. On showering, the sensors recorded the electrical conductivity of the applied liquid at various "body" points; from this data the researchers derived the speed at which the contamination was washed off. The principle is based on the fact that salt solution conducts electricity significantly better than water. The declining conductivity indicated to what extent the salt solution was diluted by the water in the course of the showering.

DEGREE OF WETTING: IMPORTANT FOR EFFICIENT SHOWERING

The unexpected outcome: If the water flow is increased, then indeed for some shower heads the required rinsing time drops; however, for others it increases, in some cases significantly. And for the fastest rinsing shower heads, the spray pattern, or distribution of the water, did not meet the stipulations of the German and European standards. The study demonstrated that the efficiency of the rinsing effects of a shower can be determined by how completely and uniformly the shower is able to wet the body surface. The degree of wetting had not been taken into account in developing the standards. The results of the investigation were recently published and have already generated great interest among industry experts as well as standards authorities.

CONTACT

Dr.-Ing. Ulrich Seifert | Head of Department Occupational Safety and Environmental Protection |
Phone +49 208 8598-1127 | ulrich.seifert@umsicht.fraunhofer.de

1 Sensors determine how rapidly the salt solution is washed off.



SUSTAINABLE

Project responsibility/

Society: The investigation contributes to the further development of requirements for emergency showers as proven safety facilities in laboratories and production facilities, so that in case of a chemical contamination, the affected person can be helped as rapidly and effectively as possible.

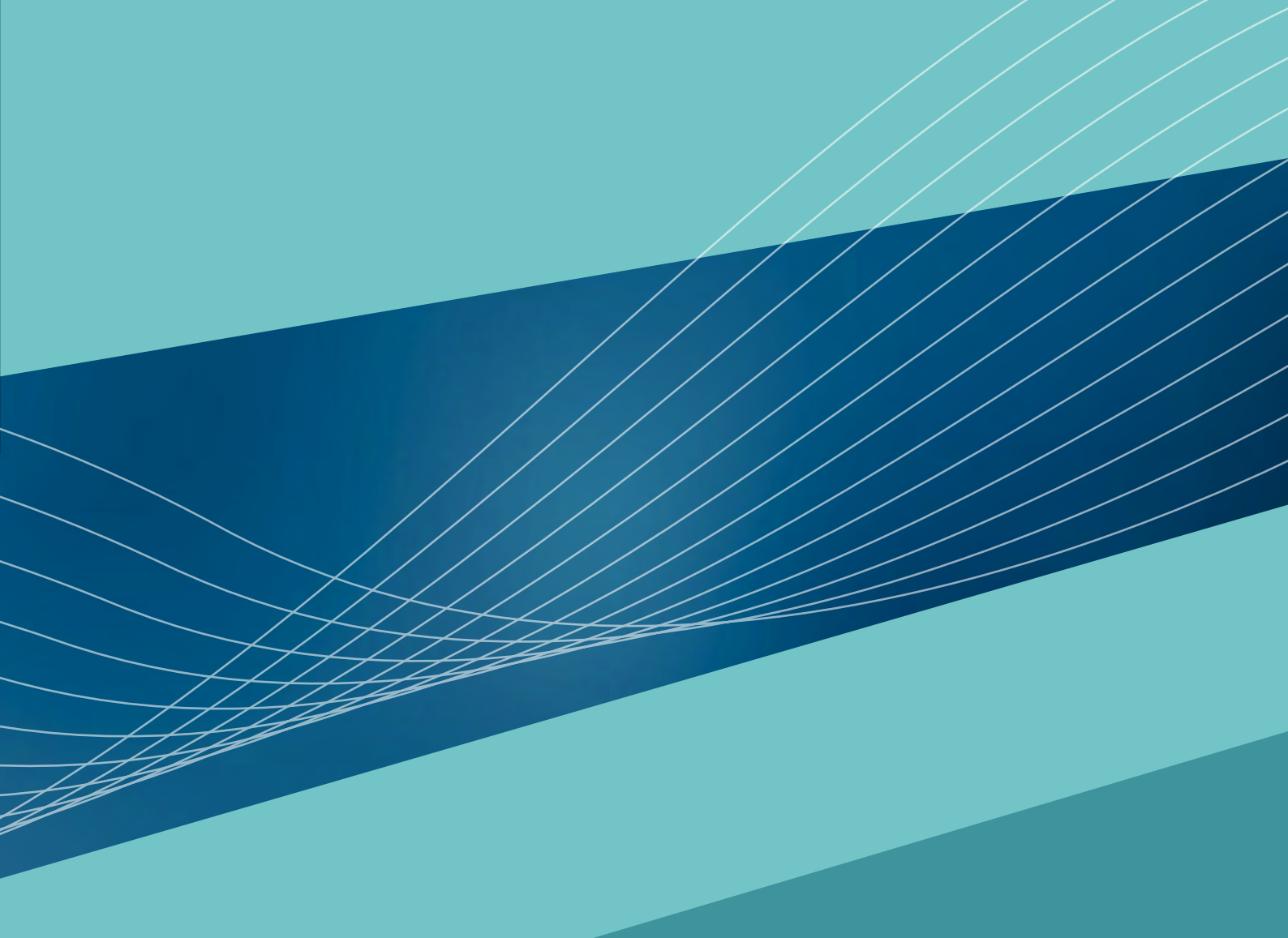
¹ Brock, Thomas; Heil, Volker; Seifert, Ulrich: Einfluss des Wasservolumenstroms auf die Abspülvirkung von Körpernotduschen [Influence of water volumetric flow on the rinsing effects of emergency body showers]. In: Chemie-Ingenieur-Technik 85 (2013), No. 6, pp. 926-933.



PEOPLE IN RESEARCH

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.



- 
- ³⁸ STEFANIE REIL
First Fraunhofer TALENTA participant in Sulzbach-Rosenberg
 - ³⁹ DR.-ING. ESTHER STAHL
With "UMSICHT" to success
 - ⁴⁰ ANDRÉ REINECKE UND MARTIN DISTELHOFF
Individual apps for research
 - ⁴¹ JÜRGEN BERTLING
Coupling of materials, sustainability and innovations



FIRST FRAUNHOFER TALENTA PARTICIPANT IN SULZBACH-ROSENBERG

Stefanie Reil has been working for Fraunhofer UMSICHT as Group Manager Thermal Storages in the Institute Branch Sulzbach-Rosenberg since January 2014. She furthermore participates in the Fraunhofer TALENTA speed up-program that specifically supports female scientists in applied research and enhances their careers by offering qualification programs.

You have been working for Fraunhofer UMSICHT since the beginning of 2014. What is your first impression?

My first impression was of a very good working environment with the possibility of working creatively and independently. From my overall viewpoint, it is very exciting to work in a large research institution which directly offers many possibilities with regard to the existing network. I already had close contact with Fraunhofer UMSICHT in Sulzbach-Rosenberg in my former scientific work at the East Bavarian Technical University Amberg-Weiden. It was all the nicer that just when I had concluded my research project and the experiments for my Doctorate, this interesting position was posted.

You are participating in the Fraunhofer TALENTA program. How did this possibility come about?

Subsequent to my application, my supervisor approached me with this possibility. The application was then quickly written. The Fraunhofer TALENTA speed up-program gives my new interesting activity an especially motivating dynamic. Directly after gaining my first professional and managerial experience and as I completed the final phase of my doctorate in the area of thermo-chemical gasification of biomass, the program offers additional highly promising development and qualification possibilities.

What would you like to concentrate on in your work as Group Manager Thermal Storages?

Apart from continuing the current work and projects, I would like to orient this team in the next few years so that the entire group becomes an innovative contact point for the industry,

particularly for small and medium-sized companies. The existing expertise should additionally be expanded so that the term "heat storage" is always associated with Fraunhofer, and ideally with the work of my group. Since thermal storage is only of use when embedded in systems, I am particularly stimulated by the necessity for system-comprehensive thinking.

What do you do in your free time as compensation for work?

Right now, completing my doctorate assumes a large part of my free time. Otherwise I love to do things with friends and family or relax by working in the garden or doing sports. I also have a passion for traveling and good food.

CONTACT

M.Sc. Stefanie Reil

Thermal Storages

Phone +49 9661 908-418

Fraunhofer UMSICHT, Institute Branch Sulzbach-Rosenberg

stefanie.reil@umsicht.fraunhofer.de

MEHR INFOS

s.fhg.deltasks



1 *Stefanie Reil participates in the TALENTA speed up-program.*



WITH "UMSICHT" TO SUCCESS

In her early thirties Dr.-Ing. Esther Stahl already looks back on an eight-year career at Fraunhofer UMSICHT. Apart from coordinating the Fraunhofer Innovation Cluster Bioenergy, her duties also include the management of the Biomass Group and the exploitation of residual material.

How did you come to Fraunhofer UMSICHT?

At the end of my studies I accepted an internship at Fraunhofer UMSICHT in what then was called the Waste Management/Technology Department. I immediately found the topics exciting. Since I grew up in the region, the Oberhausen site was another benefit. To this day, I have remained loyal to the institute: after my internship followed my thesis project and doctorate – a classical "UMSICHT career". Since 2012, I have been directing the branch office of the Fraunhofer Innovation Cluster Bioenergy and since 2013 the Group Biomass and Residue Utilization.

What is the goal of the Fraunhofer Innovation Cluster Bioenergy?

The goal is to better utilize biomass and biogenic residue materials. Waste products from the food industry, agriculture etc. can be converted to energy and raw materials. We work on various technologies such as biomass pretreatment, pyrolysis

or hydrothermal carbonization. The generated products or intermediate products such as pyrolysis oil (a type of bio crude oil) or biocoal are interesting for various applications. Moreover, because of the higher energy density, they are more efficient to transport and better to store than the starting materials. The pyrolysis oil, for instance, could be employed as an energy carrier or as a working medium for a refinery.

What are your duties as the person responsible for the cluster?

One of my duties as head of the branch office is to coordinate our work, and moreover I am in regular contact with our partners and represent the cluster to the outside world. Good communication with all participants is very important for retaining an overview of the project, and it is a great challenge. Apart from the total organizational part, I am still responsible for one of four lighthouse projects within the scope of the cluster, which has as its goal the development of recycling paths for intermediate products.

You successfully played volleyball for a long time.

How can you reconcile profession and sport?

In Aachen, I played some years at a high level until 2010, the final two years in the First Federal League. This was possible because I used my vacation days and had reduced my working hours at UMSICHT. In the long run, however, that was no longer possible, particularly because of the distances and the increasing professionalization, and I have stopped doing competitive sport. This was also okay, because although I enjoyed the intensive time greatly, I had a desire for more free time.

CONTACT

Dr.-Ing. Esther Stahl

Group Manager Biomass and Residue Utilization

Phone +49 208 8598-1158

esther.stahl@umsicht.fraunhofer.de

MORE INFO

[s.fhg.de/bioenergy-pdf](https://www.s.fhg.de/bioenergy-pdf)



1 *Dr.-Ing. Esther Stahl, Head of the Branch Office of the Fraunhofer Innovation Cluster Bioenergy*



INDIVIDUAL APPS FOR RESEARCH

"Apps", application software for mobile devices or mobile operating systems, are everywhere. Whether on the smartphone or tablet, clicking is universal. Dipl.-Ing. (FH) Martin Distelhoff, Ing. André Reinecke and Dipl.-Phys. Thorsten Wack, all employed in the Fraunhofer UMSICHT Application Development, founded the spin-off "viteso" in Oberhausen almost a year ago. The highlight of their work: that apps bring more than just fun.

Which apps does viteso develop?

Martin Distelhoff: We develop apps for Android or Apple smartphones and other mobile terminal devices such as tablet PCs. In contrast to many others, we do not create strictly "fun apps", but rather would like to convey scientific content and offer higher-valued services. Our target groups are hence less apt to be the broad popular market than companies that want to be able to access company-internal data and services by mobile terminal equipment.

How did you think of founding a spin-off?

André Reinecke: Some time ago I began to develop apps for mobile phones out of private interest. Together with colleagues, we had the idea of further developing this idea as part of a spin-off and to create apps with higher-quality content. Finding a suitable name for the spin-off was an interesting challenge. On the one hand, something positive needed to be connected with the sound of the name, on the other hand, the name had to be as yet unassigned. With "viteso", we have created a new name that satisfies both requirements.

How is "viteso" currently developing?

Martin Distelhoff: The corporate development is currently still in its infancy. In order to position ourselves apart from the mass market in apps and because of the relatively restricted number of users, other financing possibilities than advertising or sales prices in the cent range are required. The aim is to acquire customers in this sector who recognize the potential of individual apps and are ready to pay the development costs.

This is a gap that we first must close by suitable applications and demonstrators.

Do you also see a future for "viteso" at Fraunhofer UMSICHT?

André Reinecke: The idea of an app that can evaluate energy comparisons arose in collaboration with Fraunhofer UMSICHT. For instance, the energy content of a product can be presented and compared to the energy effort of daily activities. The outcome is an app that should sensitize people playfully and without a moralizing undertone about when, for instance, a trip to the waste paper container is worthwhile from an energy point of view. We are currently developing it. The idea of forming a spin-off always involves a symbiotic relationship. Employees in other departments have already come to us and brought along interesting ideas for app developments, for instance as supplements in R&D projects. We are always open to such suggestions.

CONTACT

ing. André Reinecke

Phone +49 208 8598-1318

andre.reinecke@umsicht.fraunhofer.de

1 André Reinecke and Martin Distelhoff
(from left to right): founders of the spin-off viteso.

MORE INFO

s.fhg.de/spin-offs-en





Photo: Fraunhofer UMSICHT/Ika Drnovsek

COUPLING OF MATERIALS, SUSTAINABILITY AND INNOVATIONS

Shortly after finishing his chemical technology studies, Dipl.-Ing. Jürgen Bertling made his way to Fraunhofer UMSICHT. He has headed the Department of Material Systems and the Idea Factory of the Product Division since 2012. In this interview he explains what he means by participative innovation as compared to open innovation.

Which topics are you primarily occupied with at Fraunhofer UMSICHT?

The Department of Material Systems is engaged with material development and applications. The spectrum is very diversified: self-sharpening cutting tools; the creation and application of powder coatings and sinter powders; façade vegetation with mosses; and new cleaning systems for dental care at home. In the Idea Factory we work on a new understanding of innovation in which experimentation is the center focus, and openness, participation and sustainable development are fruitfully integrated.

On participation: you reformulate the term "open innovation" as "participative innovation". What does that mean?

Business economists and innovation theorists often ask: How does that benefit the companies? The point is about bringing ideas and know-how from the outside into companies in order to generate more successful innovations. From my point of view, this is a one-way street that only heats up innovation activity. The competitive advantage disappears in the long term because other companies duplicate these paths, which means increased global material turnovers and consumption

of resources. This is not a very promising way to go. If one sees open innovation more comprehensively, understands the consumer as a rightful idea supplier, and includes him in the innovation and production processes as a responsible consumer of technologies, then this raises the probability of contributions for sustainable development. Therefore I prefer to speak about participative innovation rather than open innovation.

Is there a conflict between "open innovation" and intellectual property?

If one posts ideas on internet platforms as a scientist, they are open and can no longer be patented in this form. This likewise applies to citizens: everything that one posts is public. Accordingly, open innovation always means that one is informed about who the player on the other side is. A symmetrical relationship between inventor and idea collector is important to me. If the latter is a large agency, there is no symmetrical relationship since I often do not know what happens with my idea. We want to protect the symmetric principle on our open innovation website [sustainnovate®](#). Our focus is on sustainability.

What does [sustainnovate®](#) offer?

[sustainnovate®](#) is a web page of Fraunhofer UMSICHT that focuses on aspects of sustainability. People can ask questions, request solutions, or present ideas. Everything is relatively open and everyone can participate in the further development of ideas within communities and networks. One's own ideas always remain accessible. We furthermore offer help with patents, distribution issues, intellectual property and information about sustainability issues. In 2014 we would like to successfully position the platform.

CONTACT

Dipl.-Ing. Jürgen Bertling

Head of Think Tank Future Products

Phone +49 208 8598-1168 | juergen.bertling@umsicht.fraunhofer.de



1 Jürgen Bertling, advocate of participatory innovation.



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 to you.

- 
- 
- ⁴⁴ Research and teaching/institutions of higher learning
 - ⁴⁵ Interdisciplinary distance learning program (infernum)
 - ⁴⁶ Fraunhofer Environmental Talent School
 - ⁴⁷ Eight-fold start of vocational training at Fraunhofer Umsicht
 - ⁴⁸ UMSICHT Science Award
 - ⁴⁹ The Fraunhofer-Gesellschaft
 - ⁵⁰ Spin-off: solar cooling in India
 - ⁵¹ International issues



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. Via the Fraunhofer Academy, we also make a contribution to external continuing education.

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 Bochum since January 2011. This expands the involvement with the Ruhr University.

Prof. Dr. Andreas Hornung, Director of the Institute Branch in Sulzbach-Rosenberg, is founder of the European Bioenergy Research Institute EBRI at the Aston University in Birmingham.

FURTHER EDUCATION WITH FRAUNHOFER

The Fraunhofer Academy is an institution of the Fraunhofer-Gesellschaft for external further education. The Academy offers excellent courses of study, certificate course and seminars to specialists and executives, based on the research activities of the Fraunhofer institutes, in cooperation with select and reputable partner universities and partner institutions of higher learning. The infernum study program is one of the founding courses of study of the Academy which has developed into a permanent fixture and recognized institution in the German further education landscape.

MORE INFO

www.umsicht.fraunhofer.de/en/partnerships





Photo: Lucian Tutu/fotolia.com

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 "infernium" transmits the knowledge necessary for this purpose and builds fluency in the "languages" of various disciplines. *infernium* is distinguished by its interdisciplinary curriculum, professional breadth, and organizational flexibility; it is unique in the landscape of German university continued education programs.

The sustainability aspects of economic performance capability, social responsibility and ecological tolerance are taken into account, so that the students – even those without a university degree – receive a quality education in sustainable development.

As a distance learning program, *infernium* makes it possible for students to continue their scientific education and to improve their opportunities in the job market as they continue working in their profession and meeting family obligations. Individual tutorials can be configured 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

infernium is a joint program of the FernUniversität (distance learning university) in Hagen and Fraunhofer UMSICHT.

1 *Study where and whenever one likes: Master course of studies *infernium*.*



SUSTAINABLE

Society:

infernium has been recognized three times by UNESCO as an Official Project of the UN Decade "Education for Sustainable Development". Furthermore, the distance learning program of studies can call itself "Place of progress 2013". The title is a distinction of the Ministry of Innovation, Science and Research of the German State of North Rhine-Westphalia for pioneering thinkers from NRW who connect the economy, ecology and social institutions to innovations.

MORE INFO

www.umsicht.fraunhofer.de/en/infernium



CONTACT

Dipl.-Ing. Anja Gerstenmeier | Head of Department UMSICHT Academy | Phone +49 208 8598-1111 | anja.gerstenmeier@umsicht.fraunhofer.de



Photos: Fraunhofer UMSICHT/Ika Dimovsek

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FRAUNHOFER ENVIRONMENTAL TALENT SCHOOL

1 Pupils of the Fraunhofer Environmental Talent School 2013.

An important foundation for the innovations of tomorrow is to maintain active contact today with creative, team-capable and performance-motivated young people. From October 21 to 23, 2013 the Fraunhofer Environmental Talent School event took place at UMSICHT. In three workshops, the twenty-five pupils focused on the topics of biomass, biofuels and biomimetics.



BIOMASS INES FUHRMANN (15)* from the Essen Comprehensive School Holsterhausen

"I saw on Facebook that the Environmental Talent School would take place in Oberhausen. I am actually more interested in biomimetics. In the biomass topic group I would like to see whether or not this area might also come into question as my choice of vocation. I was also curious to learn how the people worked here."



BIOFUELS HENNING VAN DEN BOOM (16)* from Heiden, Gymnasium Borken

"My parents gave me the tip of using a part of my holidays to participate in the Environmental Talent School. We also happened to treat the topic of biofuels in class at school, so the subject was totally appropriate."



BIONICS SARA DIAGBON (16)* from Bremen, Freie Ev. Bekenntnisschule

"This year at the state competition of the Youth Science Competition I won a place in the Environmental Talent School event as a special prize. I'm looking forward to getting to know the scientific approach somewhat better. We may build robots ourselves and contribute our own ideas. I have gotten many ideas for new projects, and might even do something again for the Jugend forscht competition."

*As of 2013

The Fraunhofer Talent School is a program for talented and technically interested youngsters at the tenth to thirteenth grade level (upper grammar school levels). In each three-day workshop, the pupils work on interesting topics in the environment and sustainability sector. The next Fraunhofer Talent School will take place from October 8 to 10, 2014 at Fraunhofer UMSICHT.

CONTACT

Dipl. Betriebsw. (FH) Kristiane von Imhoff | Group Manager Human Resources Management |
Phone +49 208 8598-1443 | kristiane.von-imhoff@umsicht.fraunhofer.de



Photo: shutterstock

EIGHT-FOLD START OF VOCATIONAL TRAINING AT FRAUNHOFER UMSICHT

At the Oberhausen institute site, Fraunhofer UMSICHT offers vocational training in twelve lines of profession and three in the Sulzbach-Rosenberg branch of the institute. The spectrum extends from scientific/technical oriented job descriptions to non-technical administrative professions. In 2013, Fraunhofer UMSICHT welcomed a total of eight new apprentices: six in Oberhausen and two in the Sulzbach-Rosenberg branch of the institute.

MARIUS GEWANDT *will become an IT specialist for systems integration.*

Before his training, Marius attended a professional college in Oberhausen and completed a three-year academic training program as an Information Technical Assistant.

TIMO HEMMER *will become a physics laboratory technician.*

The good reputation of the Fraunhofer-Gesellschaft motivated the 18-year-old to send his application. In his free time, this young man from Essen practices endurance sports and hones his sense of balance on a slackline.

HENDRIK HEUWING *will become an IT specialist in applications development.*

After an internship at the institute, the 19-year-old was convinced that he wants to be trained at Fraunhofer UMSICHT to become more qualified for a job.

MÜMIN KÜCÜK *will become a cutting machine operator.*

Since the 17-year-old Mümin does not live far from the institute, he can ride to work on his bicycle. Mathematics and technology courses especially interested him at school.

MARVIN PAPE *will become a mechanical process technician for plastics and rubber technology.*

The possibility for personal development was the focus of the decision for this 18-year-old. After his training he plans to continue his education in his subject area.

ANJA PIEHLER *will become a specialist for office management in Sulzbach-Rosenberg.*

In the summer, Anja successfully completed her secondary education degree at the commercial school. The young woman from Amberg can thus shorten her training by two years.

ANTONIO SCARANO *will become an electronics technician for industrial engineering.*

An internship in the field of electronics helped the 18-year-old to determine his chosen occupation. In his free time the young man from Duisburg plays soccer and jogs.

VIKTOR TRUPP *will become an industry mechanic in Sulzbach-Rosenberg.*

After the two-year training period as machinery operator, Viktor still wants more. He will do an apprenticeship as an industrial mechanic for the next-one-and-a-half years.

CONTACT

Dipl. Betriebsw. (FH) Kristiane von Imhoff | Group Manager Human Resources Management |
Phone +49 208 8598-1443 | kristiane.von-imhoff@umsicht.fraunhofer.de

MORE INFO

www.umsicht.fraunhofer.de/en/pupils-students.html





UMSICHT SCIENCE AWARD

The "Verein zur Förderung der Umwelt-, Sicherheits- und Energietechnik e. V." (UMSICHT Friends and Patrons Group) awarded the UMSICHT Science Award for the fourth time. Dr. Benjamin Simstich received the prize in the category of research for his work on wastewater treatment in the paper industry. Nina Lindlahr and the duo Jürgen Bischoff and Jörn Auf dem Kampe are the award winners in the journalism category, in recognition of their comprehensive coverage of energy and environmental topics. The patron Prof. Dr. med. Dietrich Grönemeyer, Executive Board of the Wissenschaftsforum Ruhr e. V., conferred the prizes on July 16 at Fraunhofer UMSICHT in Oberhausen.

AWARD WINNERS

Nina Lindlahr *Journalism category*

Nina Lindlahr was awarded for her TV contribution "Country down under – are the Netherlands sinking?" In her nine-and-a-half minute film for the broadcast show neuneinhalb on WDR she intelligibly presented climate change for children in the age range of 8 to 13 years. Using the example of a flooding plane in the Netherlands, she explained why this danger will become ever greater. She was especially successful in communicating technical and scientific information.

Jürgen Bischoff, Jörn Auf dem Kampe *Journalism category*

Jürgen Bischoff and Jörn Auf dem Kampe shared the prize in the journalism category. Their article "What to do with it?" considers the consequences of nuclear energy. Their report gives an overview of the state of the search for safe final storage and introduces possible strategies for nuclear waste handling. They show the strengths and weaknesses of solutions proposed both nationally and internationally with respect to this exceedingly current topic.

Dr. Benjamin Simstich *Research category*

Dr. Benjamin Simstich received the UMSICHT Science Award for his dissertation "Use of immersed MBR technology for the

thermophilic aerobic treatment of recirculation water in paper production". As an example for the water and energy-intensive paper industry, he develops a concept for wastewater treatment that saves water and energy by process-integrated recycling. Using membrane bioreactor technology, he employs classical processes and uses them in a thermophilic manner.

ALSO BECOME A MEMBER

The Science Award conferred by the UMSICHT Friends and Patron Group promotes the dialog between research and society on current topics in the fields of environment and safety in process and energy technology. The Friends and Patrons Group rewards research work as well as journalistic contributions with a total of 15,000 euros. The annual deadline for applications for the prize is March 31.

1 *Award ceremony of the UMSICHT Science Prize 2013 (from the left): Nina Lindlahr, Jörn Auf dem Kampe, Jürgen Bischoff, Dr. Benjamin Simstich.*

MORE INFO

www.umsicht.fraunhofer.de/en/friendsandpatrons



CONTACT

Christina Demmer | Information/Secretariat (vormittags) | Phone +49 208 8598-1152 | foerderverein@umsicht.fraunhofer.de



Photo: Fraunhofer

THE FRAUNHOFER-GESELLSCHAFT

Fraunhofer is the largest organization for application-oriented research in Europe. Our fields of research are based on the needs of the people: health, safety, communication, mobility, energy and environment. And because of this, the work of our researchers and developers has a great impact on the future life of people. We are creative, we design technology, we develop products, we improve processes, we open up new paths. We invent the future.

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 business and to the advantage of society.
- currently maintains 67 institutes and research institutions in Germany.
- has approx. 23,000 employees, primarily with degrees in the 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 affiliated representative offices ensure contact to the most important current and future scientific and economic areas.

FRAUNHOFER AS EMPLOYER

As an employer, the Fraunhofer-Gesellschaft offers its staff the opportunity to develop the 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-OFF: SOLAR COOLING IN INDIA

The goal of the Fraunhofer-Gesellschaft is to develop innovative technologies leading to marketable products. These are then placed on the market by customers who license this technology, or by our own employees who take the step to independence; this is the Fraunhofer model. There are thirteen startups at Fraunhofer UMSICHT, the so-called spin-offs. VSM Solar Private Ltd. wants to capture the Indian market for solar building cooling.

In January 2011, employees of Fraunhofer UMSICHT joined the company VSM Solar Private Limited, founded in the previous year by an Indian cooperation partner. The company is located in Bangalore and wants to introduce the solar cooling of large buildings with energy-efficient technology to the Indian market.

SOLAR-OPERATED BUILDING COOLING

The requirements for air conditioning of buildings and IT systems are continuously increasing in India. Especially problematic for regular air conditionings are the high stresses of the electrical network caused by simultaneous heavy load consumption in midday and afternoon. The power grid is furthermore very unstable in India, since there is not enough power plant capacity. Frequent electrical downtimes are the consequence.

Andreas Weber, as head of the division Organization at Fraunhofer UMSICHT, is responsible for the commercial part of the collaboration with the spin-off. He reports: "Solar-operated cooling demonstrates its significant advantages from a certain building size and cooling capacity. Then its higher investment costs compared with conventional electrically driven cooling are quickly recovered by lower operating costs. It is therefore corporate strategy to equip large building complexes such as offices, shopping centers, hotels and event halls with solar-operated refrigeration technology. VSM Solar Privat Limited purchases components such as collectors, cooling towers,

refrigeration units etc., combines them into an overall facility, and installs and services them at the customers' premises."

DEMONSTRATION PLANT AT THE COMPANY OFFICE

In order to demonstrate the advantages of solar-operated cooling to customers, Fraunhofer UMSICHT was commissioned by the spin-off to plan and design a pilot plant for the solar-operated cooling of the headquarters. The company office in Bangalore was expanded at the same time. A plot of land and a building were thoroughly refurbished and transformed into an office complex with workshops. One unit now meets 100 percent of the demand for air-conditioning and demonstrates in daily operation that all of the buildings can be sufficiently cooled despite the frequent instability of the Indian power grid. In September 2012, two of the four engineers of the company came to Fraunhofer UMSICHT for practical training in the equipment systems. Now everything is ready to implement the projects.

CONTACT

Dr.-Ing. Clemens Pollerberg
Group Manager Thermal Energy Storage
Phone +49 208 8598-1418
clemens.pollerberg@
umsicht.fraunhofer.de

MORE INFO

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



1 *Headquarters of the spin-off*
VSM Solar Private Limited.



Photo: shutterstock

INTERNATIONAL ISSUES

Fraunhofer UMSICHT is actively committed to multinational project development. Strategic international cooperations are formed in Europe and throughout the world with the objective of extending the scientific added value for Fraunhofer and positive effects for Germany and its respective partner countries. The cooperation with the University of British Columbia in Canada is an example of the international activities of the institute.

The changing energy sources of the 21st century require sustainable concepts for energy generation and supply in the future. Since December 2012, the Fraunhofer-Gesellschaft and the University of British Columbia (UBC) have been developing appropriate concepts for Germany and Canada. The collaboration takes place within the scope of the Fraunhofer line of funding "ICON – International Cooperation and Networking". ICON supports bilateral cooperative programs with international centers of excellence. Its Canadian research partner is the Clean Energy Research Centre of the UBC. Apart from Fraunhofer UMSICHT, the Fraunhofer Institute for Solar energy Systems ISE (Freiburg) and for Machine Tools and Forming Technology IWU (Chemnitz) are involved.

EFFICIENT CONVERSION OF BIOMASS

Fraunhofer UMSICHT coordinates research to efficiently convert biomass. A main focus is the development of a cost-effective cleaning method for product gases of biomass gasification. Tars formed in gasification impede using the gas product as a source of energy. For gas cleaning, the hitherto inert gas catalysts used can easily be deactivated, making the cleaning process expensive. A process that employs low-priced,

residual-based materials as catalysts in a pre-cleaning stage keeps the consumption of precious metal-based catalysts modest. The cleaned synthesis gas can supply internal combustion engines for the combined generation of heat and energy or a raw material base for creating basic chemicals for the chemical industry or fuels.

Another main focus is the development of new fuels from various biomasses. The process development is based on a thermal treatment at low temperatures (torrefaction) or medium temperatures (pyrolysis). The fuels thereby generated have a higher energy content (heating power), are pulverizable with coal, and more similar to fossil coal in their combustion characteristics than the original biomass. The research work encompasses the development of suitable decentralized torrefaction and pyrolysis processes and fundamental investigations for improved process understanding.

CONTACT

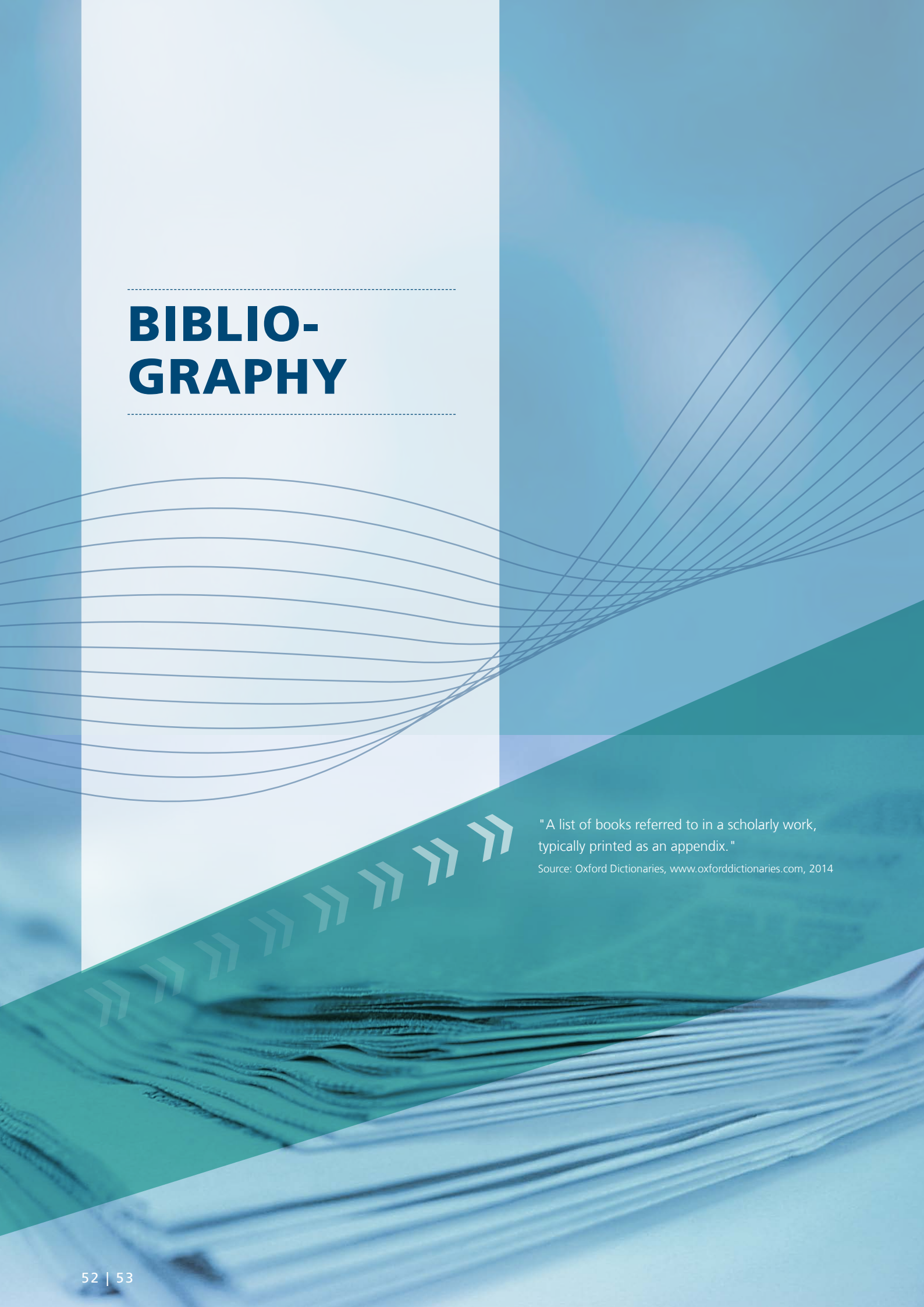
*Dipl.-Geogr. Simone Krause | EU, IPR, Strategy | Phone +49 208 8598-1136 | simone.krause@umsicht.fraunhofer.de
Dr.-Ing. Anna Greve | Head of Department Think Tank Energy | Phone +49 208 8598-1271 | anna.greve@umsicht.fraunhofer.de*

MORE INFO

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



BIBLIO- GRAPHY

The background features a light blue and white vertical stripe on the left. The right side is a gradient of blue and teal. A series of thin, curved lines sweep across the middle. At the bottom, there is a stylized, teal-tinted image of a stack of books with white arrows pointing right along the top edge.

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

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

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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

**Fraunhofer Institute for Environmental, Safety,
and Energy Technology UMSICHT**

Osterfelder Strasse 3
46047 Oberhausen
Germany

Phone +49 208 8598-0
Fax +49 208 8598-1290
E-mail info@umsicht.fraunhofer.de
Internet www.umsicht.fraunhofer.de



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

How to reach us (PDF)

**Fraunhofer UMSICHT
Institute Branch Sulzbach-Rosenberg**

An der Maxhütte 1
92237 Sulzbach-Rosenberg
Germany

Phone +49 9661 908-400
E-mail info-suro@umsicht.fraunhofer.de
Internet www.umsicht-suro.fraunhofer.de



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

How to reach us (PDF)

**Fraunhofer UMSICHT
Willich Branch**

Siemensring 79
47877 Willich
Germany

Phone +49 2154 9251-0
Fax +49 2154 9251-61

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EDITORIAL NOTES

EDITORIAL TEAM

Dipl.-Chem. Iris Kumpmann (responsible)

Bianca Schacht M. A.

Sebastian Hagedorn M. A.

Matthias Herms M. A.

presse@umsicht.fraunhofer.de

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Anja Drnovsek

Silvia Lorenz

Dipl.-Des. (FH) Barbara Vatter

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SELF-PUBLISHER AND PUBLISHER

*Fraunhofer Institute for Environmental,
Safety, and Energy Technology*

UMSICHT

Osterfelder Strasse 3

46047 Oberhausen

Germany

Phone +49 208 8598-0

Fax +49 208 8598-1290

Internet www.umsicht.fraunhofer.de

E-mail info@umsicht.fraunhofer.de

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Hansastraße 27c

80686 Munich, Germany

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