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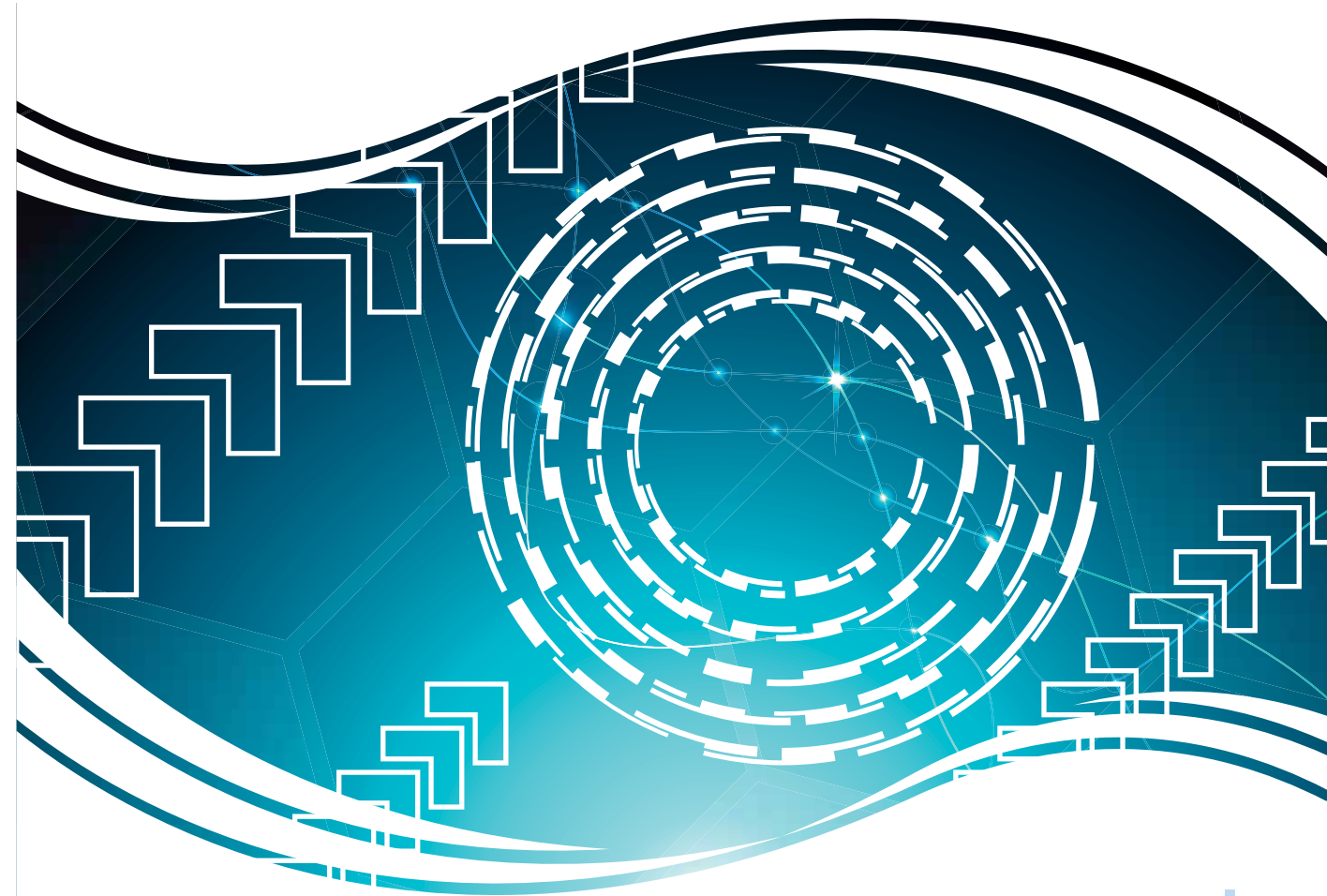
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Concept and promotion: **EKSH**

Energy research in Schleswig-Holstein



Research projects and courses
on energy and climate protection at
universities and research institutes

2nd expanded edition 2014

REPORT

Foreword

- 4
- Foreword, Prof. Dr. Hans-Jürgen Block,
Managing Director Gesellschaft für Energie und Klimaschutz Schleswig-Holstein GmbH
- 6
- Introduction, Rolf Fischer, State Secretary for Science
Ministry of Education and Science of Land Schleswig-Holstein

Energy courses in Schleswig-Holstein

Energy courses

- 8
- University of Flensburg
- 9
- Flensburg University of Applied Sciences
- 11
- Kiel University
- 15
- Kiel University of Applied Sciences
- 17
- Lübeck University of Applied Sciences
- 19
- West Coast University of Applied Sciences

Energy research in Schleswig-Holstein

Centres of competence and large-scale energy research projects

- 22
- Centre of Competence at the Institute of Mechatronics
- 24
- Forschungs- und Entwicklungszentrum Fachhochschule Kiel GmbH (FuE)
- 26
- ANGUS+ research network
- 27
- KIEL EARTH INSTITUTE
- 28
- Centre of Excellence of Biomass in Schleswig-Holstein
- 29
- Schleswig-Holstein Electromobility Centre of Excellence
- 31
- E-Mobility Coordination Schleswig-Holstein
- 32
- Raceyard
- 33
- Competence Center for Power Electronics Schleswig-Holstein
- 35
- Smart Energy Centre of Excellence
- 36
- CE WindEnergy SH
- 38
- Wind Energy Technology Institute
- 39
- Wissenschaftszentrum für intelligente Energienutzung
- 40
- Center for Sustainable Energy Systems

Research institutes with energy research

- 44
- Fraunhofer Institute for Silicon Technology (ISIT)
- 45
- Helmholtz-Zentrum Geesthacht – Centre for Materials and Coastal Research (HZG)
- 46
- GEOMAR Helmholtz Centre for Ocean Research Kiel
- 50
- The Kiel Institute for the World Economy

Energy research at universities

- 56
- University of Flensburg
- 59
- Flensburg University of Applied Sciences
- 78
- Kiel University
- 106
- Kiel University of Applied Sciences
- 130
- Lübeck University
- 134
- Lübeck University of Applied Sciences
- 144
- West Coast University of Applied Sciences

Project support provided by the EKSH

- 148
- Gesellschaft für Energie und Klimaschutz Schleswig-Holstein GmbH (EKSH)
- 152
- SHeff-Z: The energy exhibition in Neumünster

Enclosure

- 153
- Index of names

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Prof. Dr. Hans-Jürgen Block

Managing Director
Gesellschaft für Energie und
Klimaschutz Schleswig-Holstein GmbH

Energy also affects...

research and education in Schleswig-Holstein. Scientists are tackling energy topics in a wide range of specialist disciplines: from climate protection via reducing CO₂ to the production of renewable energy from the wind, sun or biomass right up to heat insulation, energy efficiency and electromobility. In view of the dynamic nature of this field of research and the growing number of energy research projects, it is not easy to maintain an overview of the scientists working in this field and their current projects. However it is important to know who is working on which energy research projects in Schleswig-Holstein for the purpose of networking between the main players, for collaboration and also transfer activities.

During the first half of 2013 the EKSH carried out a survey in a pilot project of the scientists working in energy research together with their projects. In the meantime new players have entered this area of research owing to its dynamism and a large number of new projects have started. Following requests from universities and politicians, we therefore decided to update the survey and also translate it into English.

The report entitled “Energy research in Schleswig-Holstein” provides information about:

Who is working in one or more areas of energy research with what core competences?

What projects have been worked on during the last few years or are on-going?

What networks and major research projects deal with energy issues?

The brochure can be used for communication within the scientific community and at the same time is intended to give business, funding organisations, associations, politicians and the general public an up-to-date picture of public energy research in Schleswig-Holstein.

How did we approach this? The basis for the individual portraits in this brochure is an electronic questionnaire, which was completed with the support of the university management and their staff dealing with technology transfer by the “energy researchers”. Fortunately participation in this voluntary survey was good. Over three-quarters of the projects completed in 2012 and those still on-going in 2014 have been able to be included since 2012. The collection rate is certainly lower for Master’s theses and smaller consultancy contracts, but it is higher for major projects with external funding.

“However it is important to know who is working on which energy research projects in Schleswig-Holstein for the purpose of networking between the main players, for collaboration and also transfer activities.”

“However it is important to know who is working on which energy research projects in Schleswig-Holstein for the purpose of networking between the main players, for collaboration and also transfer activities.”

In addition to R&D projects and transfer services we asked university managers and deans about their courses that focus on energy issues. This brochure therefore gives prospective students as well as potential employers the latest information about where one can “study energy” in Schleswig-Holstein with up-to-date details on course content, degree programmes as well as the number of students and graduates for these “energy courses”, some of which are still being developed.

“When dealing with energy issues, then one abbreviation is mentioned increasingly frequently in Schleswig-Holstein: EKSH”, the Kieler Nachrichten newspaper discovered in a brief portrait of the EKSH to mark the fact that our non-profit-making company, the EKSH, had been in existence for nearly two years. Information about us, our sponsorship programmes and on-going energy projects round off the brochure. The EKSH does not carry out its own research. However, it sponsors projects in applied energy research and the latter’s transfer, supports pilot projects and networks and organises specialist conferences with and for energy experts from universities, companies, associations and management.

Promoting education and training on energy and climate protection form part of the responsibilities of the EKSH. Our national economy needs a committed new generation in the profession, which wants to make a career in the topics of the future such as energy houses, electricity storage facilities, intelligent energy use, electromobility or renewable energy. We want to make a contribution to using energy more consciously and efficiently as well as taking climate protection and sustainability seriously through special educational programmes for school pupils such as the “Energy Checker” in the Schleswig-Holstein Energieeffizienz-Zentrum (SHeff-Z) in Neumünster.

I invite you to discover the exciting energy research scene in Schleswig-Holstein!

Prof. Dr. Hans-Jürgen Block



Rolf Fischer

State Secretary for Science
Ministry of Education and Science
of Land Schleswig-Holstein

Wind and waves are an intrinsic part of Schleswig-Holstein, and similarly topics like energy transition, electromobility or reduction in CO₂ are subject of important public and scientific discussions in the Federal State. Schleswig-Holstein's universities tackle the issues arising from all the different aspects of these topics concerning the energy transition. Research is carried out at our universities and universities of applied sciences into all forms of renewable energy, options for storing energy, safeguarding energy generation plants against corrosion and natural phenomena, optimising steering, measuring and control technology as well as business issues.

Therefore Schleswig-Holstein is well positioned in playing a high profile role in energy transition. Everyone involved in this subject in Schleswig-Holstein is working to ensure that this remains the case and will even increase in the future. The EKSH brings scientists from different disciplines together, initiates collaboration between science and business and ensures that energy research is undertaken not only in an ivory tower, but for the benefit of all of us. We need a secure, affordable and sustainable supply of energy. The Ministry of Education and Science will therefore campaign for energy transition and the environment jointly with the other Ministries involved in this field and use the strengths and potential available in Schleswig-Holstein as successfully as possible.

The information brochure entitled "Energy research in Schleswig-Holstein", which is already in its second edition, makes an extremely valuable contribution by summarising the research activities of the various institutions. As a result – and this is the special merit of this brochure – anything that happens in the field of energy research in Schleswig-Holstein is accessible to all interested parties from the world of science, business and civil society. The brochure will therefore help to promote the public debate about energy issues. May everyone involved continue working towards the success of the energy transition!

Rolf Fischer
State Secretary for Science
Ministry of Education and Science of Land Schleswig-Holstein

Energy courses in Schleswig-Holstein



University of Flensburg
Flensburg University of Applied Sciences
Kiel University
Kiel University of Applied Sciences
Lübeck University of Applied Sciences
West Coast University of Applied Sciences

University of Flensburg

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Europa-Universität
Flensburg



Canteen

Photos: Christoph Schellhaus

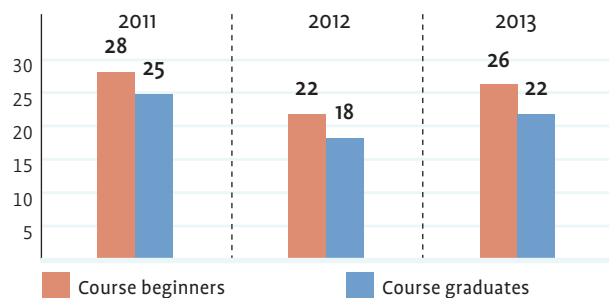
Energy and Environmental Management in Industrial Countries (M.Eng.)

The course focusses on energy management, environmental economics, economics and legal sciences, engineering computer science and selected business engineering subjects. This form of specialisation in energy and environmental management is the only one of its kind in the Federal Republic. Graduates are in a position to work in the following professional fields at national and international level:

- › Energy supply companies
- › Manufacturers of energy technology
- › Service companies and engineering offices in the energy and environmental sector
- › Major companies in manufacturing industry
- › Energy and environmental research institutions
- › Associations in the energy and environmental sector
- › Authorities, Ministries and parliaments

The admission requirement for this Master's course is an above-average degree from the Bachelor's course in Energy and Environmental Management at Flensburg UAS, including one semester spent abroad or a comparable qualification.

Duration: 3 semesters

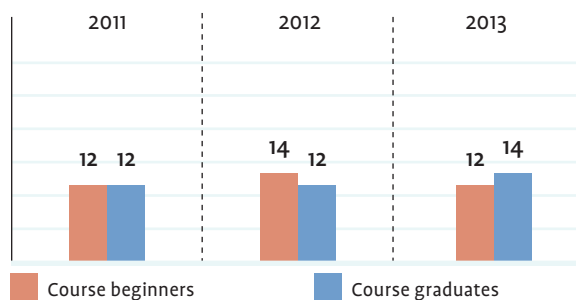


Library

Energy and Environmental Management in Developing Countries (M.Eng.)

This course with 15 places is based on the content of the "Energy and Environmental Management in Industrial Countries" course. The admission requirements also apply accordingly here. Specific knowledge is imparted for worldwide use in the field of energy and management. The language of instruction is English.

Duration: 3 semesters



Information for Summer Semester (SS) and the subsequent Winter Semester (WS)

Flensburg University of Applied Sciences



Fachhochschule Flensburg
Flensburg University of Applied Sciences

Course guidance team

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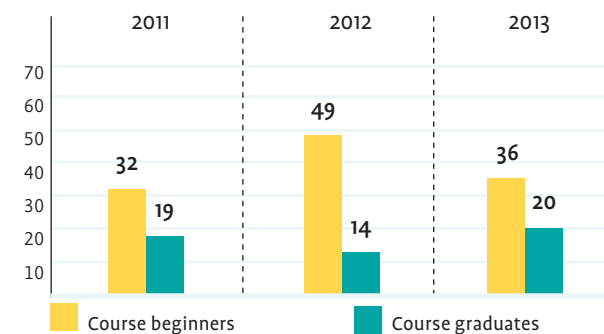
Electrical Energy Systems Engineering (B.Eng.)

Electrical energy systems engineering is omnipresent in both in our private lives and industry in the form of supply facilities, drives, sensors, control devices and equipment. There is a corresponding range of content on the course and the later professional activity of graduates. A major part of the course features cooperation with industry. The basic skills from electrical engineering, mathematics and physics are components of the first course semester. The course therefore prepares students for technologies of the future. In the 6th semester a choice can be made between two main subjects:

- › Electrical energy systems engineering with problems from control technology, control and management as well as model creation and simulation in complex power plants
- › Renewable energy engineering: Technology and operation of wind energy plants, photovoltaic and solar power plants, small power plants and the use of biomass

Duration: 7 semesters

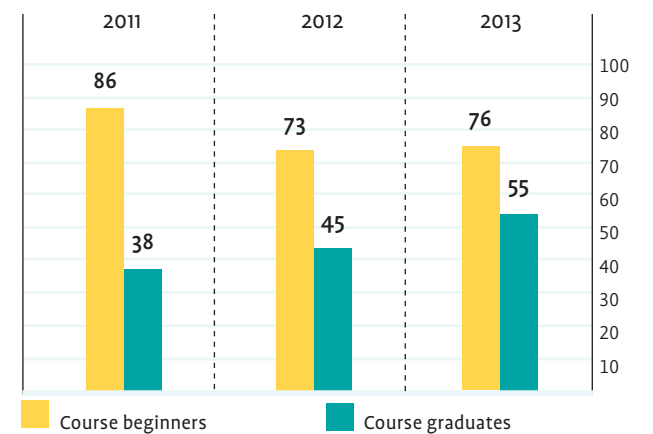
The three-semester Master's course in systems techniques builds on this Bachelor's course. It incorporates skills from mechanical engineering into electrical energy systems engineering.



Energy and Environmental Management (B.Eng.)

The course run in collaboration with the University of Flensburg combines business engineering with technical aspects of the energy and environmental sector. The integral features are in particular interdisciplinarity, internationality and practical aspects. After the scientific fundamentals have been taught in natural sciences, technology as well as business and economics, specialisation starts as of the 4th semester. This includes the specialist fields of electrical energy engineering, structure and design of energy and environmental engineering plants, environmental engineering as well as energy and environmental project management. A compulsory stay abroad and a three-month placement in a company or an authority round off the three and a half year course.

Duration: 7 semesters



Information for WS and the subsequent Summer Semester SS



Flensburg University of Applied Sciences

Renewable Energy Engineering (B.Eng.)

The increasing importance of renewable energy engineering is also reflected in the main subjects on the course. With regard to the latest developments in industry, the following topics are covered in depth:

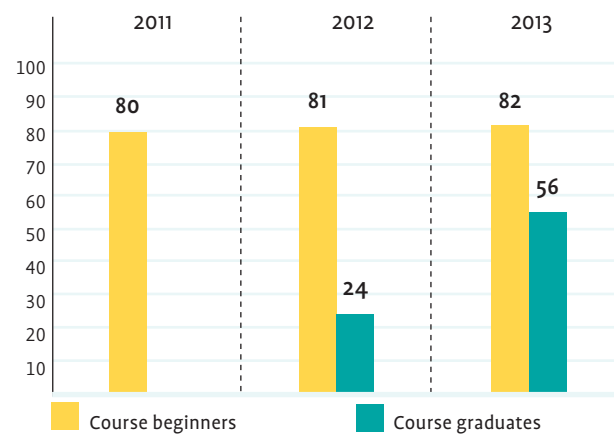
- › The use of wind energy
- › Solar and geothermal energy
- › The use of biomass to produce energy
- › Conventional energy engineering
- › Energy efficiency and application

In the first part of the three and a half year course the basics of mechanical engineering, electrical engineering and other subjects are covered. The second part will deal with the application of energy technology. Students can choose to specialise in:

- › Mechanical and industrial engineering or
- › Systems and grid integration for the generation of renewable energy

A placement in the energy industry is intended to prepare students in applying their scientific knowledge.

Duration: 7 semesters



Flensburg university campus.

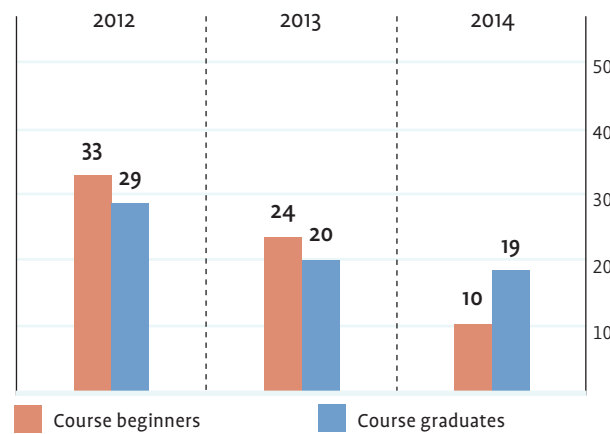
Photo: Uwe Schomburg



Wind Engineering (M.Sc.)

This course run in English at Flensburg UAS is offered in co-operation with the universities and universities of applied Sciences in Kiel and Flensburg, the West Coast UAS and the Nordakademie. It paves the way for engineers that have specialised in mechanical engineering, civil engineering or electrical engineering to become multi-disciplinary generalists with individual specialisations. Graduates will have the ability to understand wind energy plants and systems in their entirety. Their later fields of activity will include in particular the planning, construction and operation of wind turbines and their components. Admission requirements are an above-average Diplom or Bachelor qualification in engineering sciences, mechanical engineering/electrical energy systems engineering/renewable energy engineering or associated subjects as well as an excellent knowledge of English.

Duration: 4 semesters



Information for WS and the subsequent Summer Semester SS

Kiel University

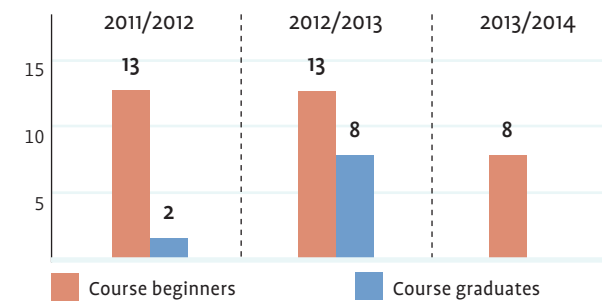


Christian-Albrechts-Universität zu Kiel

Climate Physics (M.Sc.)

The Climate Physics course (meteorology and physical oceanography) that is taught in English is intended to provide students with advanced knowledge of the terms and laws of atmospheric physics, the ocean and the climate system, familiarise them with experimental and theoretical methods and introduce them to current research. Students will be prepared to present physical facts, critically assess scientific questions and make optimal use of modern experimental or theoretical working methods. This course builds on the Bachelor's course in "Physics of the Earth System: Meteorology – Oceanography – Geophysics" and is offered in cooperation with the Helmholtz Centre for Ocean Research in Kiel (GEOMAR).

Duration: 4 semesters



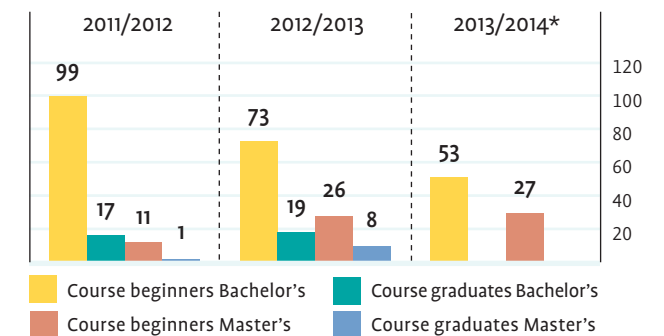
Information for Summer Semester (SS) and the subsequent Winter Semester (WS)

Electrical Engineering and Information Technology (B.Sc. and M.Sc.)

In addition to traditional electrical engineering, the subject has above all developed further in the field of computer technology into general systems engineering. This concerns applications in almost all technical fields, therefore also in the energy sector. The course is supplemented by mathematical and theoretical system-based concepts as a basis for interdisciplinary collaboration with the subjects of computer science, biotechnology, medical engineering and nanotechnology. One main subject is electrical energy engineering, dealing with the generation, transmission and distribution of electrical energy as well as its application. The field of power electronics concerns its use in wind turbines and vehicles with electric or hybrid drives amongst other things.

Bachelor's: 7 semesters

Master's: 3 semesters



* At the time of going to print no up-to-date information on the graduates was available.

Photo:
CAU



Course guidance team

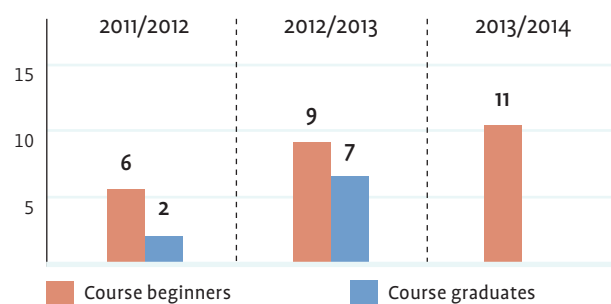
Tel +49 (0)431-880-7440
zsb@uv.uni-kiel.de
www.uni-kiel.de

Kiel University

Marine Geosciences (M.Sc.)

The interdisciplinary course run in English teaches all the main subject areas that deal with geological, biological, geochemical and physical processes in the oceans. As well as basic research, marine geosciences also pursue application-related objectives, including the investigation of resources such as hydrocarbons or hydrothermal stores in the ocean. The changes in the climate system can also be reconstructed using geoscientific methods. Model calculations can be developed from these findings to forecast the world's climate. Students benefit from the close collaboration between the Faculty of Mathematics and Natural Sciences at Kiel University and the Helmholtz Centre for Ocean Research in Kiel (GEOMAR), in particular in the subjects of meteorology and oceanography.

Duration: 4 semesters



Physics of the Earth System: Meteorology – Oceanography – Geophysics (B.Sc.)

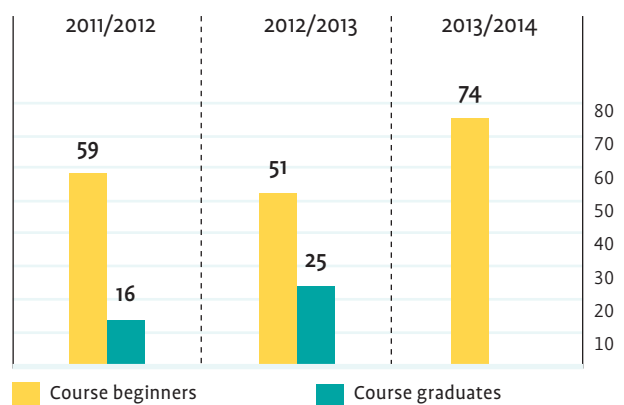
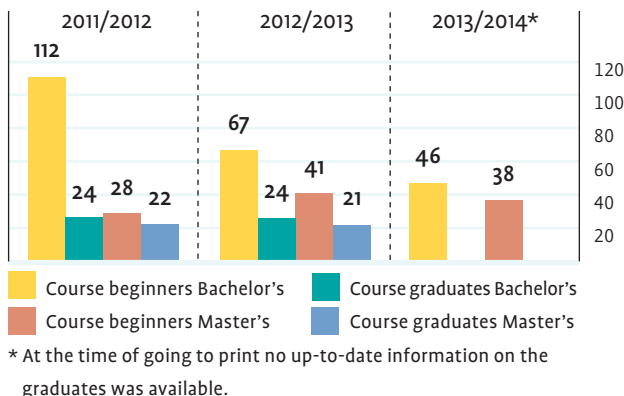
The “Earth System” is the research subject of physical earth sciences with its physical-chemical processes that occur in the atmosphere, in the ocean, in the lithosphere and on the earth's surface as well as deep in the earth's core, its natural resources, dynamism and living environment. In addition to pure basic research, the geosciences also follow applied objectives. The course teaches all the most important fundamentals to forecast the world's climate and weather, investigate and extract raw materials, use natural resources, determine the condition of the ocean, forecast storm surges and sea conditions as well as safeguard the environment. The course is offered in collaboration between Kiel University and the Helmholtz Centre for Ocean Research in Kiel (GEOMAR).

Duration: 6 semesters

Materials Science (B.Sc. and M.Sc.)

The main subject concerns functional materials made of metal, semi-conductors, ceramics and polymers. Composite materials, in which various materials are combined, are also covered. Modern materials are used extensively in almost all technologies of the future. Solar cells, computer processors and the latest generation of medical engineering would be unthinkable without the latest materials. They make it possible to lower the energy consumption of vehicles or aircraft through lighter construction techniques with improved functionality. Alternative energy generation as part of the energy transition in Germany is also inconceivable without the latest functional materials. The course combines natural and engineering sciences.

Duration: 6 semesters



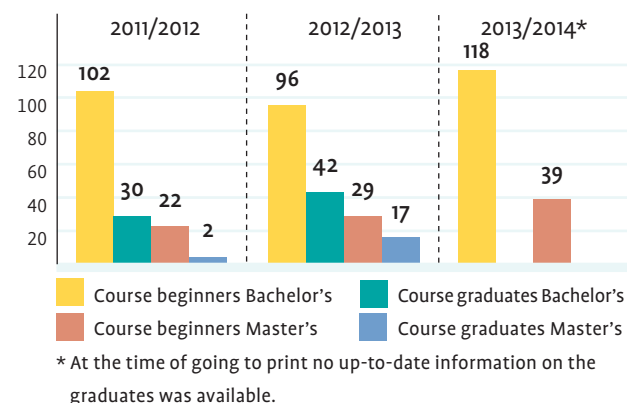
Information for WS and the subsequent Summer Semester SS

Electrical Engineering, Information Technology and Business Management (B.Sc. and M.Sc.)

The Bachelor's course in Electrical Engineering, Information Technology and Business Management is an interdisciplinary course at the interface between industry and technology. The course focusses on the technical side. In the first few semesters the basics of natural sciences and technology are taught – including physics and mathematics above all, but also computer science, in addition to an introduction to electrical engineering. As of the third semester, the economics modules then follow additionally. At the same time students will increase their technical knowledge with the modules on technical systems, electronics, control technology or information transmission. The Master's course has electives to learn more about the research subjects of nanosystem technology, information engineering, renewable energy engineering and energy efficiency, biomedical and biotechnical systems together with maritime systems.

Duration B.Sc.: 7 semesters

Duration M.Sc.: 4 semesters



Information for WS and the subsequent Summer Semester SS



Hunger for education in the Audimax.

Photo: CAU



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YooWeeDoo Changemaker Campus

The YooWeeDoo project has been built up since 2010 at the School of Sustainability at Kiel University. As of the winter semester 2013 participation is open to all those students who are interested. Students at universities in Germany, Austria and Switzerland can take part in the YooWeeDoo ideas competition.

The aim of the project is empowerment: With YooWeeDoo students can learn to what extent they can change the world through their own projects. Young people should learn on the course that they can contribute to solving the challenges facing society. This is because in order to cope with their responsibility for a sustainable development of society, universities must teach more than disciplinary specialist knowledge and the methods to work scientifically. They must teach their students the skills required to solve future problems in society. This is where YooWeeDoo comes into its own.

The project consists of a one-year online teaching programme, in which students plan and implement their own change projects to solve social problems, as well as an ideas competition, in which the participants can win start-up capital to implement their change projects. YooWeeDoo started at Kiel University and is currently being extended to other universities.

Tackling climate change together

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The change in climate is very likely to also change the Baltic Sea coastline of Schleswig-Holstein. Against this background the municipalities and institutions formed the Klimabündnis Kieler Bucht (Bay of Kiel Climate Alliance) in 2010. Academics and students at Kiel University support research and development projects in the municipalities.

The unusual collaboration came about thanks to the initiative of Prof. Dr. Horst Sterr, who manages the Coastal Geography and Climate Impact Research working group in the Institute of Geography at Kiel University, and the former mayor of Schönberg, Wilfried Zurstraßen. “One thing is certain: Climate change can no longer be held back. This will probably also have noticeable consequences for Baltic Sea tourism, both positive and negative”, explains Prof. Sterr. On the one hand, owing to the increasing number of heatwaves in the Mediterranean destinations and the hotter, longer summers on the Baltic Sea, higher numbers of visitors are expected during an extended holiday season. “On the other hand, as a result of the rising sea level and an increase in storm surges, coastal erosion will continue, which means greater investment in coastal protection.”

20 municipalities around the Bay of Kiel and a large number of scientific and tourist institutions have joined the Climate Alliance. “We want to initiate measures that will help the players on site to adjust to the effects of climate change”, says Professor Sterr.

Examples of this are:

- › the transmission of current research results to the tourist municipalities
- › specific support in the development of adjustment strategies for municipalities (currently with the Land Capital Kiel)
- › environmental education: How can the general public, but also the decision-makers be made more aware of the subject?
- › beach management after extreme weather events
- › marketing as a climate-aware travel region
- › initiating sensible climate protection measures, e.g. a plan for an E-bike region around the Kiel Fjord.

As part of the course Geography students are repeatedly

given the opportunity to deepen their scientific knowledge on individual topics in study projects or in Bachelor's and Master's theses. As a result 28 students started the “Climate adjustment in the Bay of Kiel” project in the 2013/14 winter semester. This deals with the application of geographical specialist knowledge in practical situations. Amongst other things the students work on the following subjects in small groups:

- › Compiling an audio guide and information material for the Climate Pavilion in Schönberg
- › Developing a climate and coastal experience path for the municipalities of Strande and Laboe
- › Planning and implementing the KLIMALE; a coast-climate-art event (held for the first time in July 2014 in Laboe)
- › What does private climate adjustment look like? What risk prevention options are available to the citizens of Kiel against extreme weather events?

In Master's theses students cover topics such as the effects of climate change on water tourism in the Kiel region. In another study students of Kiel University investigated the carbon dioxide emissions from households in the municipalities of Schönberg and Strande.



Climate Pavilion: The six metre high coastal model was made by hand.
Photo: Klimabündnis Kieler Bucht

A visible tourist education project of the Climate Alliance is the Climate Pavilion that was built in 2012, which provides information in the Kalifornien district in the municipality of Schönberg about the effects of climate change on the coast as well as the options for coastal protection and climate-friendly tourism. (An der Kuhbrücksau 2, 24217 Schönberg).

Kiel University of Applied Sciences



Course guidance team

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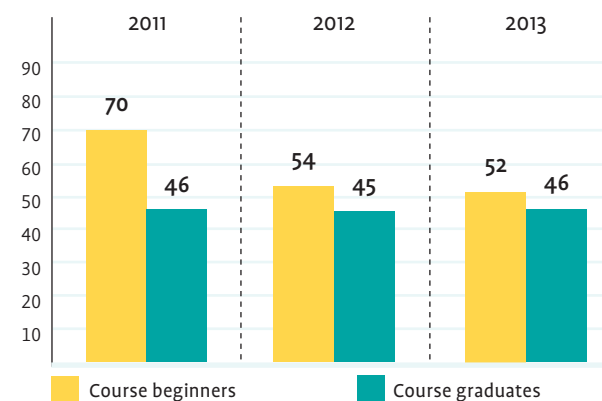
Electrical Engineering/Electrical Energy Engineering (B.Eng.)

“Electrical Energy Engineering” is one of the three main subjects on the Electrical Engineering course. The course offers in-depth teaching on the engineering and natural sciences basic subjects of electrical engineering and is structured in modules in line with international engineering education. The main subject of Electrical Energy Engineering includes:

- › High voltage technology
- › Energy generation and application
- › Renewable energy
- › Networks and plants
- › Drive technology
- › Electromagnetic compatibility

In the Competence Center for Power Electronics Schleswig-Holstein (KLSH) at Kiel UAS (see page 33) students have the opportunity to carry out research in teams with professors and engineers on new technologies.

Duration: 7 semesters



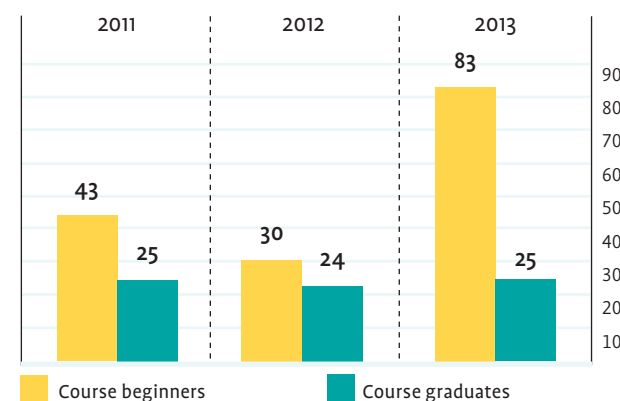
Mechatronics/Electromobility (B.Eng.)

Mechatronics is an interdisciplinary field combining mechanics, electronics, optics and computer science. Mechatronic systems include for example CD players or mobile transport vehicles with automated navigation. The course first teaches the basics of mechatronics, including mathematics, physics, electrical engineering, programming, design, technical mechanics and computer-aided design (CAD). The subject of Electromobility involves these areas:

- › Development of electric vehicles
- › Power electronics in engine controls
- › Circuit simulation and manufacture of electronic components
- › Basics of power electronics
- › Micro controller technology
- › Modelling and simulation
- › Bus systems in vehicle technology
- › Sensor technology

In the Schleswig-Holstein Electromobility Centre of Excellence at Kiel University of Applied Sciences (see page 29) students work with professors and engineers on forward-looking solutions for electric vehicles.

Duration: 7 semesters



Information for SS and the subsequent WS

Photo: Irina Nünning



Kiel University of Applied Sciences

Technology Management and Marketing/ Renewable Energy (B.Eng.)

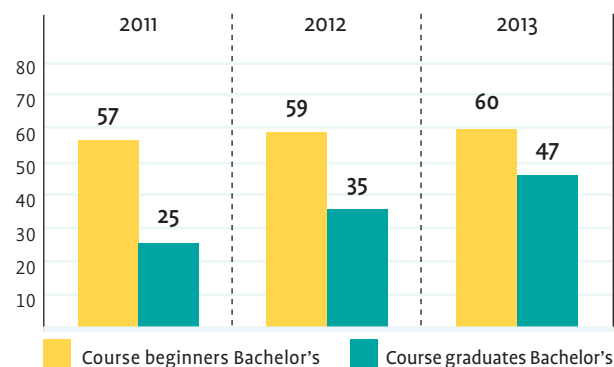
The interdisciplinary course offers a balanced combination of technology and business. It includes all the technical and business aspects that are close to the market in the various fields of work and in this way prepares students for work in management and marketing interfaces. These include:

- › Product and system development
- › Manufacturing and sales
- › Purchase of products and systems
- › Consultancy and training

The course is structured in modules and offers two main subjects. The main subject of "Renewable Energy" primarily includes these areas:

- › Solar energy systems
- › Wind energy
- › Energy from biomass
- › Sustainability/climate protection

Duration: 7 semesters



Wind Engineering (M.Eng.)

This course run in English is offered in collaboration with Flensburg UAS (see page 10).

Online course in Business Management (M.A.)

The overwhelming proportion of this course that started in 2014 with 21 students is provided online. Students learn with dedicated course modules and together with other students on an online learning platform. Face-to-face events are voluntary and are held on Fridays and Saturdays. Through this model it is easy for students to combine the course with work or with other commitments. The content areas covered in depth include the energy industry module with the sub-disciplines of energy engineering, energy policy, energy trade and energy law.

Duration: 4 semesters full-time, correspondingly longer part-time

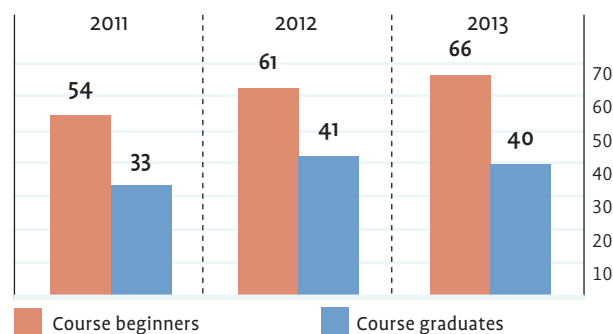
Info: www.oncampus.de

Electrical Technologies (M.Eng.)

The modules on this course deepen knowledge from the courses in electrical engineering and mechatronics with specific content in energy engineering, communication technology or mechatronics. This will enable students to acquire various skills:

- › managing sustainable energy systems
- › expanding worldwide communication networks
- › controlling projects
- › developing mechatronic systems
- › linking technical areas through interdisciplinarity

Duration: 3 semesters



Information for SS and the subsequent WS

Offshore Systems Engineering (B.Eng.)

During the 2012/13 winter semester 36 students started on this new engineering course (2013/14: 28 new students). The broad-ranging course is based on basic engineering and naval architecture teaching supplemented by comprehensive offshore-specific specialist knowledge. In addition to the general engineering applications, graduates can above all be deployed in design, development or planning and the operation of dynamic, extremely demanding systems in the offshore field. Course content includes:

- › Fundamentals of mathematics and natural sciences
- › Engineering fundamentals (static and solidity, materials engineering, design, machinery dynamics, electrical engineering)
- › Environmental conditions and geotechnical basics in the offshore field
- › Development and design of offshore foundations and systems
- › Manufacturing and installation technology for large-scale plants
- › Wind energy
- › Logistics and installation
- › Offshore ships
- › Technical project management, business management and law

Duration: 6 Semester

(also see interview on page 120)

Lübeck University of Applied Sciences



FACH
HOCHSCHULE
LÜBECK

University of Applied Sciences

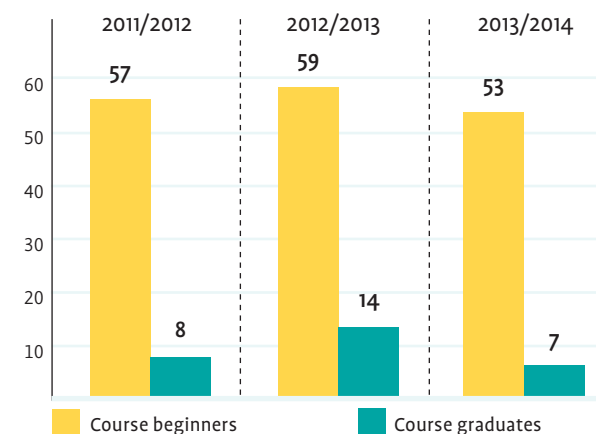
Course guidance team

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Chemical and environmental engineering (B.Sc.)

The main subjects of this broad-ranging interdisciplinary course lie in the fields of environmental protection engineering, chemistry, biotechnology and process engineering. Its curriculum is based on the continuous further development and interlocking of the courses in chemical engineering and environmental engineering. The sectors of environmental protection, chemistry, pharmacy, biomedical engineering and food will be open to graduates.

Duration: 7 semesters



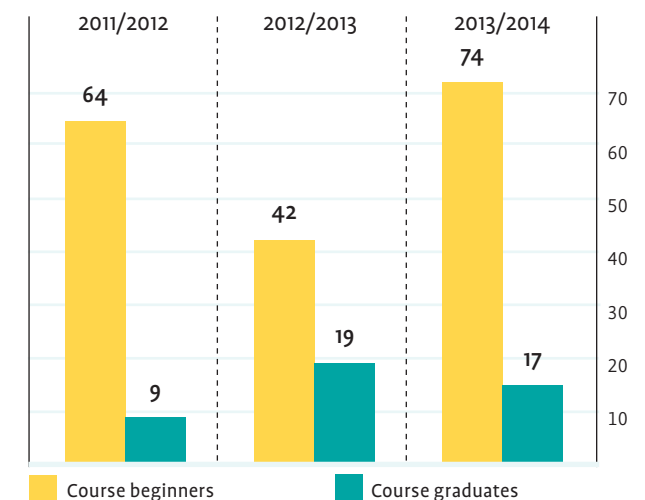
Energy systems and automation engineering (B.Sc.)

The traditional main subjects of energy engineering are supplemented by the requirements of automation engineering owing to the change in demand from the market. Therefore the merger of energy engineering and automation engineering in the Energy systems and automation engineering course represents a tailor-made course for the requirements of the energy and product market. Graduates are in demand at energy supply companies and in the new fully automated energy billing sector as well as at companies, which operate in the renewable energy sector. The course content in the main subject of energy engineering includes:

- › Technical mechanics
- › Drive technology
- › Positioning drives
- › High voltage technology and EMC
- › Energy supply
- › Renewable energy

After the 3rd semester students can move to the "the international electrical engineering course of studies". Here they will study for two semesters in Lübeck with American students in English and then complete a double Bachelor's degree at the partner university in Milwaukee (USA).

Duration: 7 semesters



Information for WS and the subsequent Summer Semester SS



Fully equipped laboratories ensure knowledge is imparted at the highest level in the universities in Lübeck.

Photo: Lübeck University



Lübeck UAS: Study at a Hanseatic city full of tradition, which bears the title of world cultural heritage site.

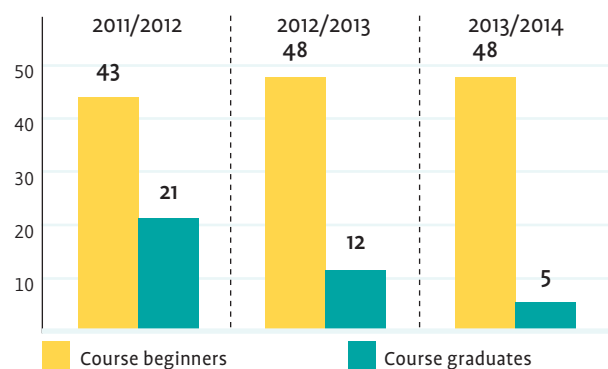
Photo: Lübeck UAS

Online course in industrial engineering (B.Eng.)

The majority of the course that has been offered since 2003 is provided online. Students learn with dedicated course modules and together with other students on an online learning platform. Face-to-face events account for approximately 20 per cent of the study time, including examinations, laboratory events and exercises, which mainly take place at the weekends. Through this model students can combine the course with work or other commitments. In addition to imparting economic and engineering skills in the field of mechanical engineering/manufacturing, the course also focusses on technical information media as well as social-communicative content. Students can choose the specialisation module of the energy industry.

Duration: 7 semesters full-time, correspondingly longer part-time

Info: www.oncampus.de

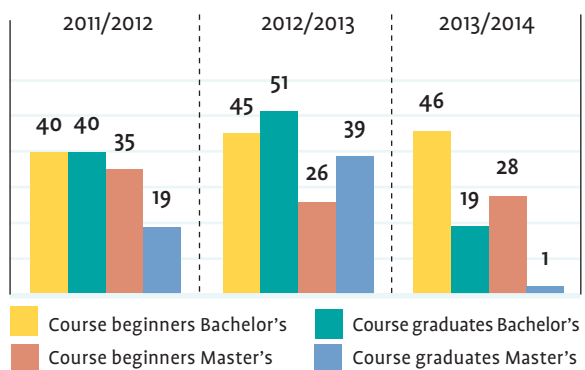


Architecture (B.A. and M.A.)

Skills and basic knowledge are taught in design, presentation and configuration, building design and technical building equipment, urban planning, history of architecture, as well as organisational and business support for building projects. Students are expected to acquire the ability to think on the basis of scientific and artistic fundamentals and work as well as learning the corresponding methods and specialist knowledge in the field of architecture from the course and prepare for a career in the field of engineering. Specialisations in the energy sector are possible in these elective subjects:

- › Climate-conscious construction
- › Energy performance certificates
- › Sustainable building

Duration: 6 semesters



Information for WS and the subsequent Summer Semester SS

Applied information technology (M.Sc.)

The course started with ten students in the 12/13 winter semester (WS 2013/14: 9 Course beginners, 6 Course graduates). The course content is in line with Bachelor's courses in energy systems and automation engineering, electronics and communication systems as well as the international electrical engineering course of studies. Graduates of these courses benefit from a broader, in-depth scientific

content without excessive specialisation. The aim of the course is to acquire knowledge and skills for the design, development and operation of information technology systems in companies, public administration or other establishments.

Duration: 3 semesters

West Coast University of Applied Sciences



Course guidance team

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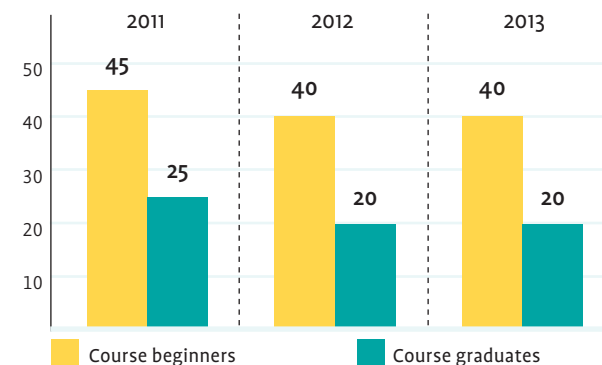
Electrical and Information Engineering (B.Sc.)

The course is geared to the requirements in the growing markets of microelectronic systems and industrial automation. The course therefore takes account of the continually increasing proportion of information technology within engineering.

After learning the fundamentals of natural sciences, electrical and information engineering, wind energy engineering is one of the elective subjects. The following are offered as advanced courses:

- › **Automation and applied information technology:** Use of new types of sensors and actuators, controlling and regulating plants using the latest computer hardware and software, programming and networking
- › **Microtechnologies and electronic systems:** from resistance to the microchip, from circuit board design to microwave circuits, from digital signal processing to Bluetooth and satellite transmission

Duration: 7 semesters



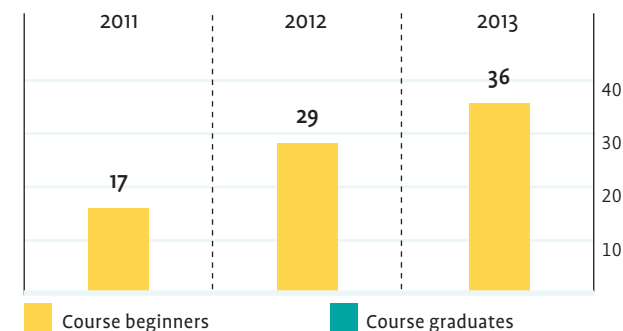
Green Building System Engineering (B.Sc.)

There is an enormous demand in the industry for engineers who are familiar with energy-efficient construction and environmentally conscious refurbishment of existing buildings. Students on this course will become experts, who can analyse and optimise a building in its entirety with regard to energy, material and information flows. The focus is on the optimisation of buildings with regard to energy efficiency and sustainability. Central subjects are:

- › technical building equipment (heating, ventilation, air conditioning, cooling, sanitary equipment)
- › renewable energy supply
- › building automation and security technology
- › heat protection

Graduates are in a position to manage projects, develop building designs with regard to energy and technologies and assume an advisory function at every stage of building.

Duration: 7 semesters




Information for SS and the subsequent WS

Green Energy (M.Sc.)

The new course is planned to start in the 2014/15 winter semester and offers a link between economic, technical and legal aspects on the subject of renewable energy. Students will learn interdisciplinary knowledge with the focus on management and project planning and certification in the field of renewable energy. The three cornerstones of the course and learning social skills are intended to en-

sure that graduates are in a position to develop concepts in their entirety, present and market them as well as managing project implementation and acceptance. They can work at energy supply companies, as energy advisers in associations and businesses, at authorities, research institutes or as experts.

Duration: 4 Semester



Centres of competence and large-scale energy research projects

European Center of Competence (ECPE)
Forschungs- und Entwicklungszentrum Fachhochschule Kiel GmbH (FuE)
ANGUS+ research network
KIEL EARTH INSTITUTE (KEI)
Centre of Excellence of Biomass in Schleswig-Holstein
Schleswig-Holstein Electromobility Centre of Excellence (KESH)
E-Mobility Coordination Schleswig-Holstein
Competence Center for Power Electronics Schleswig-Holstein (KLSH)
Smart Energy Centre of Excellence
CE WindEnergy Schleswig-Holstein
Wind Energy Technology Institute (WETI)
Wissenschaftszentrum für intelligente Energienutzung (WiE)
Center for Sustainable Energy Systems (ZNES)

Champions League power electronics

ECPE European Center for Power Electronics

Thomas Harder

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ECPE facilities in Schleswig-Holstein:

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Three institutes in Schleswig-Holstein have been designated as “Centres of Competence” by the European Center for Power Electronics (ECPE): in addition to the Fraunhofer Institute for Silicon Technology ISIT (Itzehoe) and the chair of power electronics and electrical drives at Kiel University, Kiel UAS was the first university of applied sciences to be accepted into the group of leading European research facilities in the field of power electronics. This equates to an academic knighthood for the Institute of Mechatronics’ excellent research work.

Experts are convinced: power electronics will play an increasingly important role in the energy transition away from fossil fuels and towards regenerative energy sources. “It is a key technology for massive future energy savings. We have enormous innovation potentials, for example in regional electricity grids and their planned expansion,” emphasises Professor Eisele. Modern power electronics ensures that wind turbines can feed their electricity into the grid, trams can drive and fridges can operate efficiently. “Miniaturisation of these systems will be an increasingly important competitive factor in electromobility, LED lighting or in the conversion of regenerative energy sources.” Around 40 per cent of total energy demand is already covered by electrical energy. “Merely by using energy-efficient converters – they represent the heart of power electro-

ronics systems – we can achieve energy savings of more than 30 per cent,” Professor Eisele is convinced. In cooperation with leading industry companies, teams at the Kiel Institute of Mechatronics are working on various innovative research and transfer projects dealing with energy efficiency, as well as with the durability of heavy-duty electronic components.

The Institute of Mechatronics brings its expertise into play in more than one way. First, in the field of silver sintering technology, which increases the service life of electronic assemblies: usually, the individual elements of electronic components are connected by adhesive or soldering. However, these components age very quickly as a result of heavy loading, for example in load cycle-intensive use in wind turbines. Under the leadership of Professor Eisele the Institute of Mechatronics has developed a new bonding process: with the aid of nano- and micro-scaled silver suspensions as the jointing material they have been successful in forming permanent and temperature-resistant connections. Bonds such as these only disconnect at the melting temperature of the silver, i.e. at around 962 de-

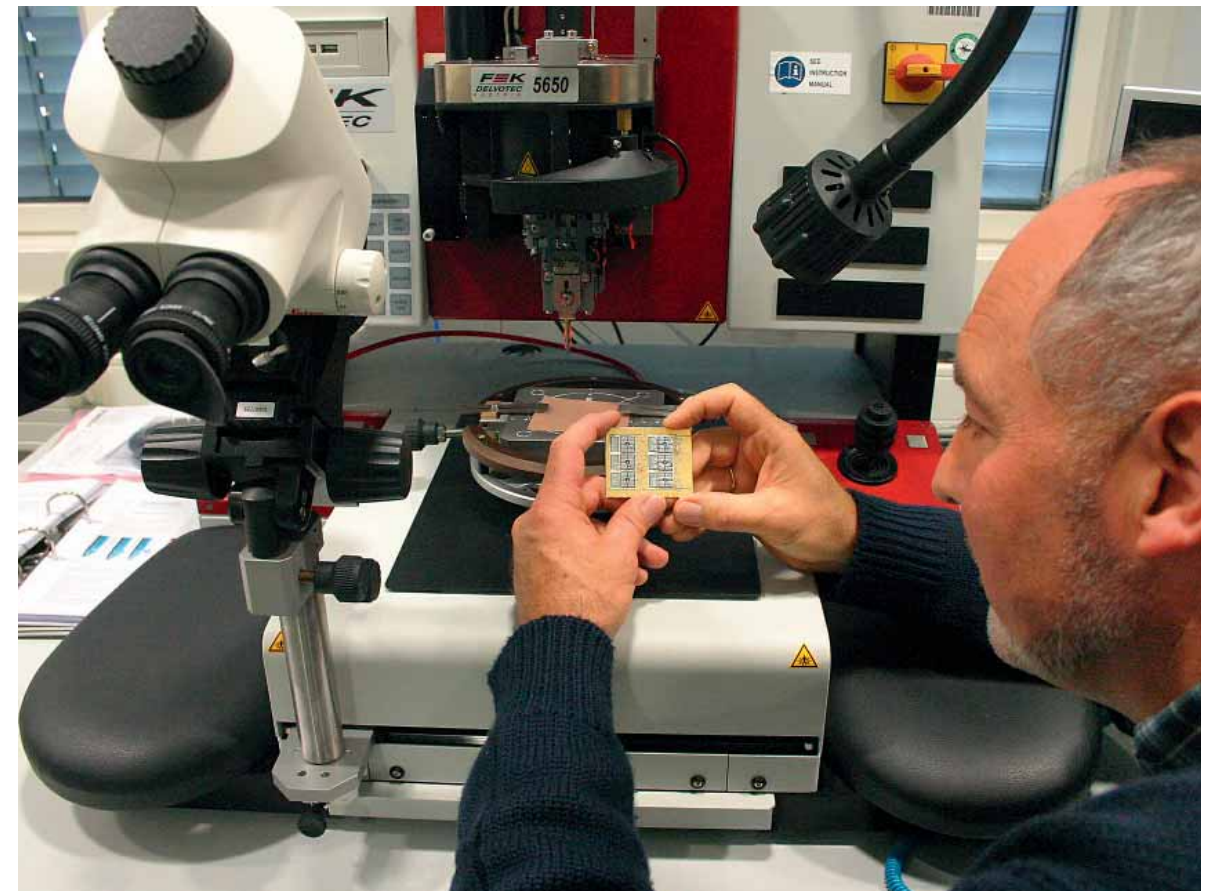
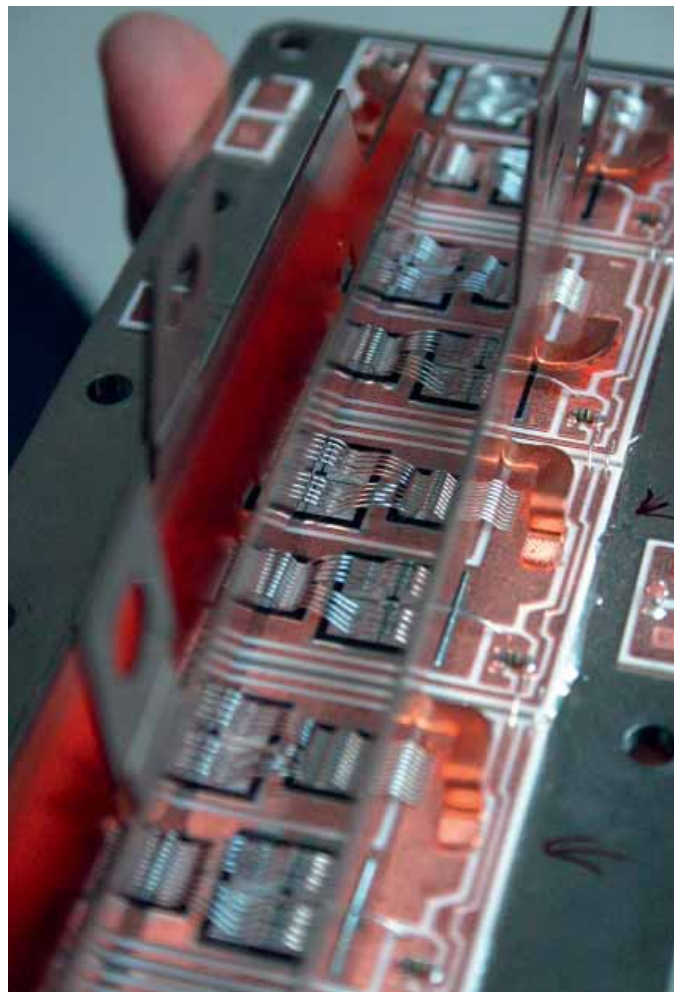
grees Celsius. “We presented this module as the world’s first diode module using silver sintering technology at the trade fair in Nuremberg,” reports Eisele.

Cooperation in the ProPower project (2012–2015) is one of the largest projects at the institute. This large-scale joint project, “Compact, high-power electronic modules for electromobility, drive and lighting technology”, is supported by the German Federal Ministry of Education and Research to the tune of €16 million. A total of 21 partners from industry and science are participating under the leadership of Siemens. “We are very proud of this, because this funding is the result of numerous, persistent team activities and developments, which began with an empty laboratory in 2006 and which now performs nationally recognised research work,” explains Eisele. Among other things, six sub-projects aim to develop simplified production methods for drive technologies used in electric cars and for use in both wind and solar energy, to miniaturise components and to improve the cooling of heavy-duty elements. Methods for liquid cooling of hot electronic components will allow extremely compact frequency conver-

ters to be developed for motor control. Companies such as Audi, Bosch, Osram, Infineon and Danfoss are among the immediate ProPower project partners in Kiel.

The institute will also be involved in another important, forward-looking project, Eisele announced: the new “Power electronics for renewable energy systems innovation cluster” is to develop innovative, high-performance converters using Fraunhofer-Gesellschaft and Schleswig-Holstein state funding. The aim is to further develop a key technology for wind state Schleswig-Holstein: wind turbines.

The students profit from all of our projects. “We have a total of 24 staff in the project teams – from students to engineers. Young students about to enter their professions profit from the possibility of writing theses on what are, in the majority of cases, innovative projects. And this makes them highly interesting on the jobs market,” says Professor Eisele with a view to his students’ excellent job prospects.



Making components more efficient and durable: This uncased power module for a wind turbine was built at the Institute of Mechatronics (left). Thanks to new silver sintering methods it was possible for Professor Ronald Eisele and his team to considerably improve the durability of heavy-duty electronic components.

Photos: Joachim Welding

Head-start through knowledge pool

Björn Lehmann-Matthaei

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They test ways of producing energy from renewable natural resources and develop the offshore technologies of the future on the FINO3 research platform in the North Sea. The collective knowledge pool of around 150 professors from Kiel UAS and other universities in the state are bundled in the Forschungs- und Entwicklungszentrum der Fachhochschule Kiel GmbH (R&D centre Kiel University of Applied Sciences GmbH) – for the benefit of innovative businesses in the North.

Since its founding in 1995 the R&D centre Kiel University of Applied Sciences GmbH has processed more than 1,000 private and public projects. Around 150, often well-known, businesses from Airbus and BMW Oracle Racing through Dräger and Jungheinrich to Repower and Thyssen Krupp Marine Systems, are among the project partners. “We bring scientific expertise and corporate research and development requirements together. The comprehensive technical facilities of Kiel UAS and other universities in Schleswig-Holstein are available to this end, in addition to the recognised expertise of the professors,” explains Björn Lehmann-Matthaei, CEO of the R&D centre. The facility accepts scientific challenges from all fields – from consultation to project completion. Companies can fall back on an enormous knowledge pool, providing practical results for a rapid ROI.

FINO³

North Sea research platform

The “Competence Centre Offshore Wind Energy Use – North Sea Development Platform for Technology and Nature Conservation (FINO3-NEPTUN)” which was sponsored by the Ministry of Economic Affairs of the Federal State of Schleswig-Holstein with federal state funding and funds from the European Regional Development Fund (ERDF), together with the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety was established at the end of 2005. After three and a half years of planning, design, construction and erection of the platform 80 kilometres west of the German island of Sylt, operations began in August 2009. In this project scientists develop and test procedures and products for offshore technology – practically adjacent to the planned offshore wind farms. The aim is to gain knowledge on wave behaviour, lightning strikes, meteorology, hydrology, bird migration, noise control and wind farms foundations in the open sea. The results help wind farm operators and wind turbine manufacturers in planning, building and future operations of offshore wind farms.

Research in the middle of the North Sea: The FINO3 platform provides information on the construction and operation of offshore wind farms.

Photos: R&D centre Kiel UAS GmbH



Fast racing boats: Flow tests in experimental set-ups form part of the research services in the Yacht Research Unit Kiel.

In 2012 the R&D centre at Kiel UAS was commissioned by the German Federal Ministry for the Environment to also operate the FINO1 research platform in the North Sea north of the island of Borkum. On the platform, which has been operated by Germanischer Lloyd since 2003, the scientists perform research with a variety of project partners on physical, hydrological, chemical and biological projects. They investigate environmental conditions and the effects of offshore wind turbines on the environment. The data acquired and results achieved provide crucial information for both the licensing agencies and the potential operators of offshore wind turbines.

In January 2014 CE WindEnergy SH started operations. The objective is for it to stabilise, reactivate and develop on the duties of the former CEwind e.G. cooperative. The new Center of Excellence is now based in the research and development centre at Kiel UAS and operates as a centralised contact point for academic wind power research in Schleswig-Holstein (see page 36 of the report).

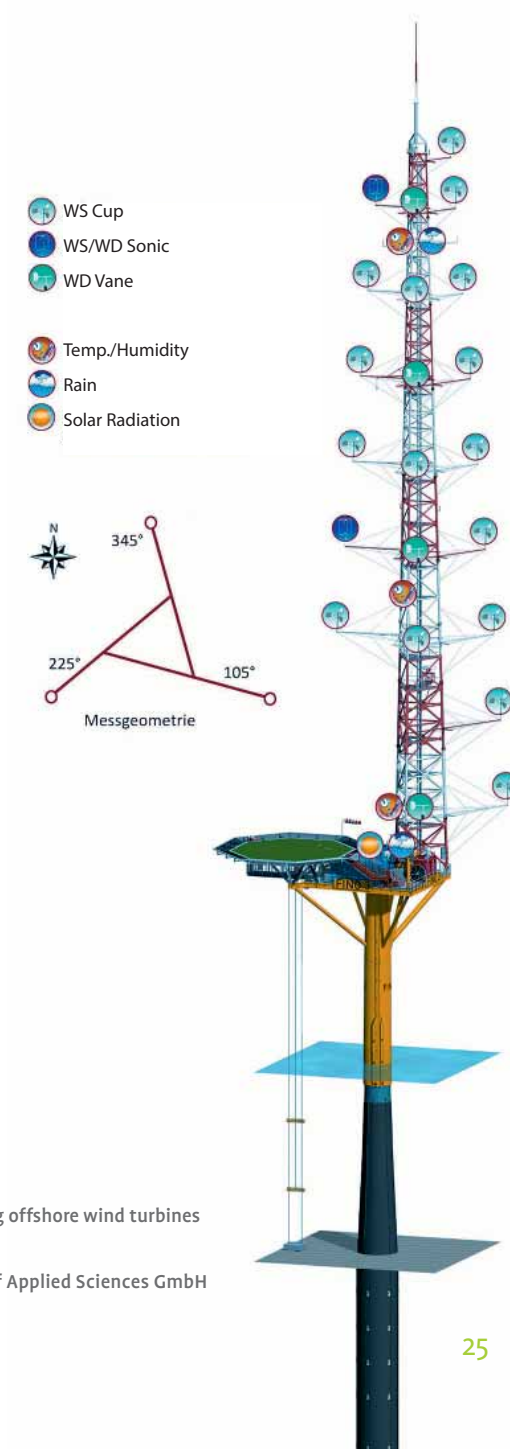
“It is primarily regional companies that profit from the expertise of our researchers,” explains Lehmann-Matthaei. Two-thirds of customers are from within Schleswig-Holstein, the remaining partners are distributed throughout the federal republic or outside its borders. The young scientists also profit: In the projects the UAS graduates get the chance to sniff practical air and recommend themselves to companies looking for qualified new staff, says the head of the R&D centre. “Since our foundation far more than 250 graduates have taken the leap into industry from the research centre and found a permanent job.”

Test platform FINO3 in the North Sea: Lightning research aims to contribute to making offshore wind turbines insensitive to lightning strikes.

Diagram: R&D centre Kiel University of Applied Sciences GmbH

The R&D centre brings its expertise into the following fields:

- › **Testing and measuring services:** Testing and measuring products, developments and failure cases with precise results.
- › **Transfer projects:** From expert opinions through project planning and development to acceptance and quality assurance as a partner in technical projects in a wide variety of fields
- › **Externally funded project services:** The R&D centre can help in the acquisition of external public funds, from project initiation through application to successful project execution
- › **CPD:** The R&D centre has managed the Kiel UAS CPD programme since 2009



The potential of underground energy storage systems

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The energy transition in Germany means, for northern Germany in particular, a highly fluctuating power supply from regenerative energy sources. Enhanced grid expansion and the use of energy storage systems are necessary to allow budgeting with surplus energy, for example from solar installations or wind farms. “Due to the potential large storage capacities and the proximity to energy producing companies, underground energy storage systems will have a large role to play,” explains Professor Sebastian Bauer from Kiel University. He heads the ANGUS+ project jointly with his Kiel colleague Professor Andreas Dahmke.

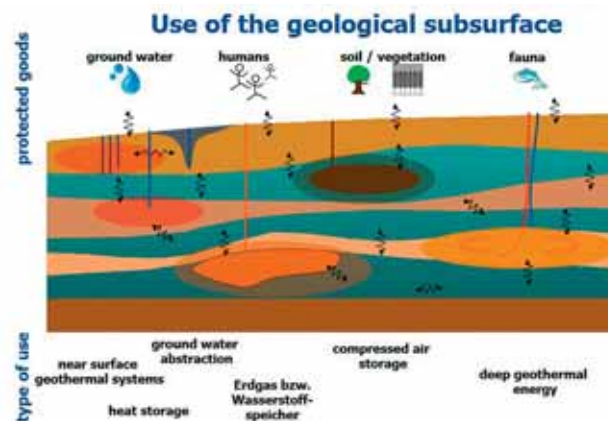
In order to explore the potential in Schleswig-Holstein's ground, it was planned to research the geoscientific basis for underground storage systems, says Bauer further: “We are concentrating our investigations on the storage of natural and artificial gas, hydrogen and compressed air in caverns and pore storage space, as well as storing heat in the shallow subsurface.” Moreover, the possible impacts of these options are to be linked to the existing surface infrastructure, and the defined conservation and priority zones. “The end result is a map of Schleswig-Holstein's subsurface, underlain by utilisation and storage potentials – the basis for a type of spatial planning never seen before,” supplements Professor Dahmke. The name ANGUS+ stands for “Auswirkungen der Nutzung des geologischen Untergrunds als thermischer, elektrischer oder stofflicher Speicher im Kontext der Energiewende” (Impacts of the

use of the geological underground for thermal, electrical or material storage in the context of the energy transition). With its high proportion of wind energy and the planned offshore wind farms, Schleswig-Holstein is faced with the task of storing the temporally fluctuating quantities of electricity, thus guaranteeing a reliable electricity supply.

Thanks to its geology, Schleswig-Holstein's subsurface provides favourable conditions for the storage of energy sources from renewable energies, because options are available for creating both pore and cavern storage systems. These stores can then also be large enough to compensate for seasonal fluctuations. Good knowledge of the underground structures in Schleswig-Holstein is achieved in particular where industry exploration for crude oil has taken place.

In an initial step scenarios are defined on the computer, which serve as the basis for calculation of certain types of underground use. The programs required for numerical simulation are compiled as an integral part of the project. With the aid of in-house experimental work, thermal, geophysical, geomechanical and geochemical sediment properties are studied and geochemical understanding of the indicated reactions in the rock is acquired. In conjunction with known literature data, this work allows model parametrisation and numerical execution of the scenarios. By specific analysis of the scenarios and supported by geographical information systems to record the relevant infrastructure, the impacts of the various subsurface uses are to be defined and a methodology for subsurface spatial planning developed.

The ANGUS+ research network, with around €7.5 million of funding and headed by Kiel University with partners at the Helmholtz Centre for Environmental Research in Leipzig, the Helmholtz Centre in Potsdam and at the Ruhr-Universität Bochum, is a flagship project in the Federal Government's “Energy storage research initiative”. The project duration is four years.



Utilisation of the subsurface.

Diagram: ANGUS+

Virtual and interdisciplinary

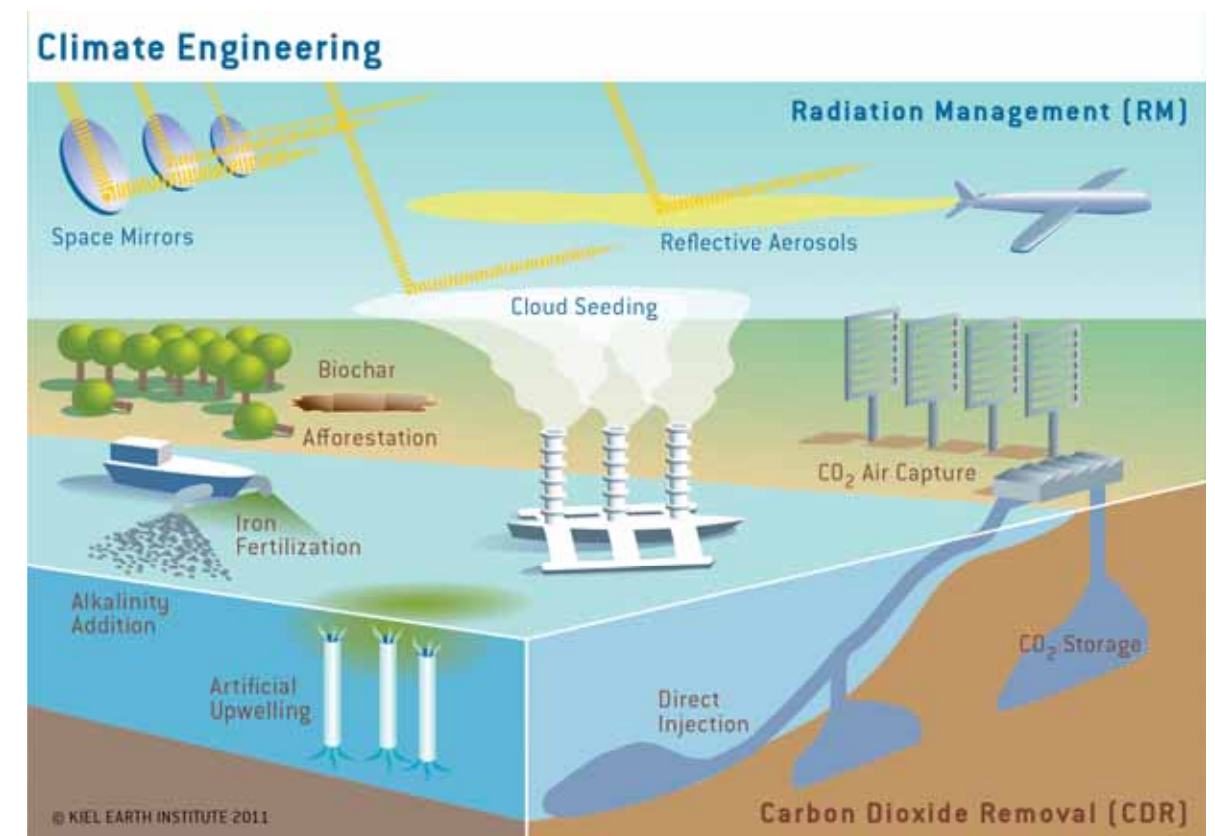


Prof. Gernot Klepper, Ph.D.

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The virtual Kiel Earth Institute is an initiative of the GEO-MAR Helmholtz Centre for Ocean Research in Kiel and the Kiel Institute for the World Economy. The KEI is a virtual institute where important topics relating to global change and its ecological, economic and social consequences are identified, researched and discussed. The cooperation between researchers from different disciplines, and political and commercial decision-makers is at the forefront, allowing practical approaches to solutions to be developed. Global markets, scarce resources, environmental change and their interactions are challenges which modern society must face up to. KEI's task is to demonstrate ways and develop integrated measures for meeting these challenges. These two research emphases involve the topics of energy and climate protection:

- › **Climate Engineering:** Successful climate policy means good carbon cycle management and will be characterised by efficient and effective, long-term regulations. In addition to aspects of avoiding greenhouse gases and adapting to global change, KEI also studies the options for and boundaries of technical measures (climate engineering).
- › **Land use conflicts caused by bioenergy:** Biomass is being used as an alternative energy source increasingly often, in order to lower greenhouse gas emissions and simultaneously reduce the dependence on fossil energy sources. However, the rapidly increasing agricultural cultivation of energy crops competes with the cultivation of foodstuffs. Researching these land use conflicts is extremely important for a comprehensive assessment of the use of biomass.



Climate Engineering: The options for and boundaries of engineering solutions such as artificial cloud formation are studied at KEI.

Diagram: KEI

Energy from renewable natural resources

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Discover the options of biomass: Not only fuels, gas and energy can be produced from biomass, the spectrum is much broader than this. In the Centre of Excellence of Biomass in Schleswig-Holstein scientists from several universities in the state develop new procedures and methodologies in cooperation with industry. The R&D centre Kiel University of Applied Sciences GmbH acts as project manager.

Biomass, which can be utilised economically and with low environmental impact, is more than just manure and sweet corn for biogas plants. Example microalgae: This enormous resource, barely utilised to date, contains valuable substances. For example, some microalgae types contain up to 70 per cent fat in the dry solid matter. But also other substances such as omega-3 fatty acids, a popular dietary supplement, can be extracted from algae. There is no doubt that algae are little all-rounders: because in addition to the energy use of algae (macro- and microalgae) they can also provide important raw materials for pharmaceuticals or cosmetics and simultaneously bond carbon dioxide harmful to the climate using photosynthesis. In the future, artificially propagated algae will probably be just as interesting as an alternative source for biodiesel as is the use of their residues for methane gas production. So it's hardly surprising that the "Kiel Algae Round Table" discusses such future-oriented topics. It is organised by the Centre of Excellence of Biomass in Schleswig-Holstein in cooperation with Prof. Dr. Rüdiger Schulz (Kiel University, Botanical Institute).

The centre of excellence was called into being in 2006 as a joint initiative of the universities of Kiel and Flensburg, and universities of applied sciences of Kiel, Lübeck and Flensburg and since then has continuously expanded its spectrum of expertise. The centre of excellence is currently founding technical groups on a variety of topics. The network handles topical subjects such as algae, waste and residual substances, energy storage systems and international cooperation. This is a good way to bundle the forces of industry and science in Schleswig-Holstein. "Using the technology and knowledge transfer in the field of biomass use we hope to make a contribution to supporting farmers, businesses and institutions in Schleswig-Holstein. The aim is to develop innovative products and procedures

and to establish them on the market and for the specific application," says Björn Lehmann-Matthaei, CEO of the R&D centre Kiel University of Applied Sciences GmbH.

Activities are wide-ranging: A series of applied research projects is supplemented by exchange of information between the experts and practitioners – for example in the event series' "Thematic network, Science-industry workshop" and Kiel algae round table. "With this we have laid down a good foundation for researching the considerable development potential for the entire value added chain in the field of biomass substance and energy utilisation for Schleswig-Holstein," says Dr. Wolfgang Bonn, project manager at the centre of excellence. It is supported by a university network in the following disciplines:

- › Agricultural sciences
- › Process engineering
- › Computer science and electrical engineering
- › Plant and process engineering
- › Biology and chemistry
- › Micro- and molecular biology
- › Bio- and enzyme technology
- › Energy engineering
- › Agricultural economy

The state of Schleswig-Holstein is funding the centre of excellence with around €300,000 from the Zukunftsprogramm Wirtschaft (Programme for the Future – Economy) until the end of 2014. Continued funding means continued nationally and internationally oriented work, it was said by the Ministry of Economic Affairs, Employment, Transport and Technology Schleswig-Holstein. It secures the advancement of the centre of excellence and the execution of new projects.

Partners of the project:

- › Kiel University
- › University of Flensburg
- › Kiel UAS
- › Flensburg UAS
- › Lübeck UAS

Electrically rapid innovations



Prof. Dr. Klaus Lebert

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A quiet revolution has taken over Germany's roads: An increasing number of people drive electric or hybrid drive cars. They are true pioneers, because in the long-term the low-emission and almost noiseless cars will guarantee mobility in industrial countries. Even though no cars are mass-produced (yet) in the far north: The Schleswig-Holstein Electromobility Centre of Excellence (KESH) at Kiel UAS has garnered a good reputation in research cooperation with industry partners.

The speed with which e-cars can move was demonstrated by Kiel UAS in an unusual project: supported by their professors, 25 enthusiastic students showed that they can give the electric-boom new impulses and designed a racing quad with electrical drive. What's more, a real motorbike world champion runner-up made the first test drive: Bert von Zitzewitz, trainer of the German Enduro team, put the power into the 2010 presentation in front of the lecture rooms and was enthusiastic about its capabilities. A possible record 240 Newton metres of torque catapulted the orange-coloured construction to 50 kph in three seconds. A petrol-driven quad was provided by Zitzewitz, but not much remained of the original: In the halls of the centre of excellence the students fitted materials worth €40,000. Now that the quad has completed the practical tests, the centre of excellence uses the unique specimen for teaching and research projects.

It is hoped to have one million electric vehicles on Germany's roads by 2020, as ambitiously specified by the Federal Government. "To achieve this it will be necessary to develop a whole series of innovations in terms of the vehicles, drives and components, as well as in integrating the vehicles in the electricity and traffic networks," explains Prof.

Klaus Lebert. Together with his colleagues Prof. Ronald Eisele, Prof. Christoph Weber and Prof. Ulf Schümann, the systems simulation and control engineering expert is part of a four man centre of excellence team primarily occupied with optimising electrotechnical components in vehicles.

"In research and transfer projects we concentrate on the problem of how to design individual components and their interactions more efficiently. It is first necessary to acquire detailed data on the operational behaviour of electric vehicles," reports Prof. Lebert. The researchers are therefore monitoring a small fleet of electric E.ON Hanse vans with data recording systems. The results will provide information on how and whether the vans already fulfil their transport tasks and what requirements it will be necessary to meet in the future. Electronic battery, motor and control data for the eco-carrier are transmitted to the monitoring station together with the GPS movement data and analysed by the scientists.



In-house design with world championship runner-up: Bert von Zitzewitz (left), German motorbike Enduro team trainer, tested an electro-quad, built by students at Kiel UAS under their own direction.

Photo: Welding

Advancing “moving technologies”

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Emission-free driving: At the Kiel UAS Electromobility Centre of Excellence, electric cars of the newest generation are in use as “rolling research laboratories”.

Photo: Joachim Welding

A likeable advertising medium for e-mobility scuttles across the UAS campus again and again: A white Peugeot iOn, one of the pioneers of electric cars, serves as a rolling laboratory. This project aims to clarify a number of questions: How much energy is required for heating and cooling in different driving situations? Which improvement potentials can be determined for the various technical components by analysing the data collected when driving the e-car? These and other questions will be answered by the mechatronics team, comprising students, engineers and professors, during the coming years. The project is funded by the European Union's Interreg IVa programme, among others, and managed by the R&D centre Kiel University of Applied Sciences GmbH.

“These data also help us, for example in the development of a battery system in cooperation with Lübeck's o.m.t.. The battery cells are monitored autonomously and information on the charge and battery status provided,” says Prof. Lebert. The list of industry partners is impressive. It includes global players such as Danfoss Silicon Power, Jenoptik and Volkswagen, as well as renowned regional businesses, including Flensburger Fahrzeugbau, Jungheinrich, Vishay and Weier Antriebe und Energietechnik. An important factor for the KESH team is that regional industry, in particular, can profit from the head-start in electronic component expertise and the centre of excellence thus

supports the competitiveness of these enterprises. “In addition, we always involve our students in our research in order to provide them with expert qualifications for the electromobility industry, an industry of the future,” Prof. Lebert emphasises. And with success: young engineers from Kiel UAS are highly sought after by the region's businesses.

In summary, KESH offers the following services to businesses:

- › Expertise and technological services in the broad field of electromobility
- › Investigation of the behaviour of battery systems
- › Development of battery management systems
- › Investigation of the behaviour of electric drive systems and on-board power supply systems in vehicles
- › Robust electronics and cooling fabrication laboratory with testing and verification options
- › Thermal systems simulation
- › Mechatronic system integration using model-in-the-loop, software-in-the-loop, rapid prototyping and hardware-in-the-loop methods
- › Research on reliable and durable connections for semiconductor elements using special production methods

In the field of electromobility, Schleswig-Holstein has more to offer than some may think – especially technologically. The expertise of universities/institutes and businesses lie in the fields of battery technology, power electronics, control engineering and electric motor construction, for example.

Although Schleswig-Holstein is not traditionally the heartland of the automotive industry, the juxtaposition of “wind energy and electromobility”, innovative mobility concepts as well as niche markets, for example in the field of maritime electromobility or in tourism, provide interesting perspectives.

In order to further develop the key issue of the future, electromobility, within the state, the “E-Mobility Coordination

Schleswig-Holstein” project was started in October 2012. “Our objective is increased participation of businesses and other facilities within Schleswig-Holstein in the value added chains associated with electromobility,” says state coordinator Jens Sandmeier. The duties of the coordinating agency located within the WTSH – Business Development and Technology Transfer Corporation of Schleswig-Holstein – include:

- › Increasing the visibility of innovative activities in Schleswig-Holstein within the state and nationally
- › Development of subject-based knowledge, idea, information and technology transfer
- › Support and monitoring of innovative activities and specific projects in the field of electromobility



Electrifying: students at Kiel UAS present an e-quad to the public, which they have designed and built as a result of team work.

Photo: Joachim Welding

Students build electric racing car

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Since 2005 the Kiel UAS Raceyard racing team has fought at the “Formula Student” for trophies every year with racing cars designed and built in-house. The student team brings the expert knowledge of mechanical engineering, computer science, electrical engineering, design, economics and media into play.

The 45-person team only just presented their electric racing car “T-Kiel A14E” to the public during a roll-out. The ninth car to be produced by the student workshop was created with the aid of UAS technicians and professors, but was also supported by regional businesses. And if they are occasionally found lacking, engineering graduate Hans Thüring, design development lecturer, is at hand as a problem solver. “I first let the students get on with it alone and only interfere when something goes wrong,” he ex-

plains with regard to the independence and passion of the students, some of whom are only 19 years old. “They must subordinate themselves in a large team to an overriding objective, building a technically competitive racing car. Older students help the newcomers.”

All of those intensively involved in Raceyard for many months, in addition to their normal studies, invest blood, sweat, sleepless nights and innumerable working hours in the project. Prospective employers like reading about this kind of commitment in applications. This is how young professionals demonstrate their practical experience and teamwork, as well as the will to deliver the best quality: Because only in this way can the Kiel students possibly manage to get on the winners’ podium at the race in Silverstone or at Hockenheimring.



Fast and quiet: The electric racing car built in 2014 by the Kiel student team Raceyard guarantees extreme acceleration values.

Photo: Team Raceyard

Power for greater efficiency



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Dealing with the energy supply of the future. In the entire chain, from electricity generation to its use in electrical devices at the consumer’s, there are gigantic savings potentials. The innovative use of power electronics plays a key role here. In this field, the Competence Center for Power Electronics Schleswig-Holstein (KLSH) represents a driving force in applied research. The KLSH is organised by the Fraunhofer Institute for Silicon Technology, ISIT, in Itzehoe. The project partners include, among others, the Kiel UAS Institute of Mechatronics.

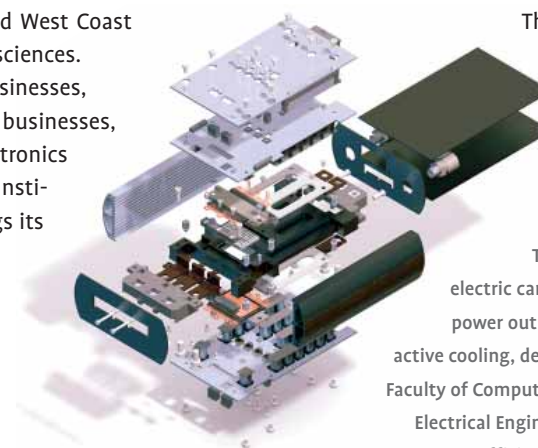
With a budget of €6 million from ERDF funds, KLSH started up in 2008 under the leadership of the Fraunhofer Institute for Silicon Technology (ISIT) in Itzehoe. The aim is to bundle the power electronics expertise in the state. Industry partners such as ESW (Jenoptik), Danfoss, Jungheinrich and Vishay cooperate with ISIT, Kiel University and the Kiel and West Coast universities of applied sciences. KLSH aims to provide businesses, especially medium-sized businesses, with access to power electronics innovations. The Kiel UAS Institute of Mechatronics brings its expertise into play in the following fields, among others:

- › Silver sintering technology for heavy-duty electrical components
- › Thermal simulation and cooling
- › Packaging (enveloping compact power electronics elements)

“Constantly increasing electricity costs force industry to innovate in order to use energy more efficiently and further develop new sources such as renewable energy,” explains Professor Christoph Weber, who heads the projects at the Faculty of Computer Science and Electrical Engineering together with his colleague Professor Ronald Eisele. It is necessary to consider the entire value added chain, from creating the primary energy through its con-

version to electric current, energy transport and into the consumers’ houses and flats. “In all cases power electronics components will substantially contribute to energy savings,” is Weber’s opinion.

Recent studies show that 40 billion kilowatt hours worth of energy could be saved per annum in Germany by the use of available energy-efficient products and technologies. This corresponds to the annual electricity used in the state of Hesse. “Electrical drive engineering offers the greatest savings potential through the use of demand-oriented motor controls in pumps, fans, compressors or centrifuges,” explains Weber. Hybrid drives or fully electric vehicle motors, and the efficient generation and conversion of energy in wind turbines and photovoltaic installations, are regarded as key topics in power electronics.



The heart of an electric car: The compact power output stage with active cooling, developed in the Faculty of Computer Science and Electrical Engineering, is very energy-efficient and durable, despite extreme loads.

The competence centre facilitates contact between the research facilities, universities and industry partners in Schleswig-Holstein, who are involved in the development, production, marketing, use or verification of power electronics components and systems. The entire value added chain, from semiconductor elements to power electronics systems, is

covered. KLSH provides a platform for power electronics topics with the following objectives:

- › Strengthening the innovation drive, competitiveness and expertise of the partners in the field of power electronics
- › Promoting cooperation between industry, universities and research facilities
- › Knowledge transfer between partners
- › Initiation of publicly funded projects
- › Bi- and multilateral projects between partners

- › Workshops and seminars
- › Founding of working groups to deal with special power electronics topics
- › Education, theses, doctoral degrees
- › Job creation

The “Power Cube”, jointly managed by professors Weber and Eisele, is one of the Kiel projects at the Institute of Mechatronics. “The project aims to develop and test a highly compact power output stage with high integration density and active cooling for three-phase drives for use in electric cars,” explains Weber. The unit must be capable of processing extremely high and rapidly alternating energy fluxes, it must be energy-efficient and be particularly reliable and durable.

An unusual project is the Toolbox for three-phase motors, because of its didactic use in training electrical engineering students. “Companies are demanding a university education in the field of engineering-aided development of control devices. We were able to apply this expertise, available in our faculty, in the externally funded project with Lucas-Nülle GmbH, a leading provider of teaching aids in Germany,” says Professor Weber. What is special about this is that the system can simulate newly developed components on the computer and can subsequently automatically compile a real programming code. This is then used to control the connected electric motor. The previous, extremely time-consuming, prototype development process is considerably shortened and simplified using this system. We are proud that the toolbox has now been developed to series maturity, meaning that Lucas-Nülle can now begin with global marketing to universities, said Weber.

In order for modern lithium ion batteries to be as durable as possible and only exposed to low wear, the individual battery cells must be constantly monitored. In a cooperative project with the Fraunhofer Institute in Itzehoe and the materials technology specialist o.m.t. GmbH (Lübeck), Professor Weber and his team have developed a battery management system that can provide valuable information on the charge and health status of the batteries. This is done by mathematical modelling and characterisation of the batteries and an estimating the status, by constantly measuring current, voltage and temperature. If the status becomes critical suitable correcting commands can be issued. “This can also counteract the danger of an explosion

Battery spa: With this battery management system from Kiel UAS the battery cells, for example in electric cars or aircraft, can be constantly monitored. This helps to prevent damage and thus increases the durability of the batteries.

Photo: Joachim Welding

or a fire in this battery type at extremely high temperatures,” explains the scientist. This is indispensable when using lithium ion batteries in aircraft, for example. In order to test this with as little danger as possible, the researchers adopt the most modern development methods. For example, a battery simulator controlled by a real-time computer was developed, which can create a correct physical model of the behaviour of a real battery. In this way the battery management control device can be quickly and methodically developed.

The research efforts, in which the faculty students are always integrated, follow one aim: to develop components that scrimp with energy or help to save electricity – and as long-lived as possible.

Project partners:

- › Fraunhofer Institute for Silicon Technology (ISIT)
- › Kiel University
- › Kiel UAS
- › West Coast UAS
- › Siliconix Itzehoe GmbH
- › Danfoss Silicon Power GmbH
- › Jungheinrich AG
- › Jenoptik
- › ESW GmbH
- › Vishay



Clever technologies



In view of the energy challenges we now face, the Kiel UAS Smart Energy Centre of Excellence currently being established bundles resources and expertise. Applied research projects in cooperation with commercial enterprises are planned. The expertise of the centre of excellence spans the topics of energy generation, transfer, distribution and consumer topics.

The word smart – also meaning clever, resourceful and enterprising – is used to describe modern and future electrical energy systems. In the context of future electrical energy supply systems, this means upgrading energy supply networks: from innumerable generators, through the transmission and distribution systems and their components, to the consumers, to upgrade from today's level of technology to intelligent systems and processes.

Keywords such as “smart meter, micro CHP, microgrids, smart grids, electromobility, energy storage systems, Internet of energy and social acceptance” are now almost routinely used and are all elements for describing a future energy supply network allowing a switch to more environ-

mentally friendly energy supply by means of intelligent, i.e. smart, control and monitoring, as well as operational management.

Topics in this context include:

- › Grid operation and stability
- › Comfort and efficiency
- › Energy generation facilities
- › Storage technologies and their integration
- › Communications between future energy systems
- › New business models
- › Social aspects of the energy transition

The Smart Energy Centre of Excellence will coordinate the activities in these fields and bring together the university and industry partners. The various institutes in the Faculty of Computer Science and Electrical Engineering, with their emphases in traditional energy engineering, renewable energy sources, and information and communications technologies, are heavily involved. They are supplemented by the expertise of additional Kiel UAS faculties.



With new energy for wind power in the state

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Carried by a sustained pioneering spirit in the wind power industry, Schleswig-Holstein's universities joined forces as early as 2005 to form an unusual research network: CE WindEnergy SH – formerly CEwind – brings together all the expertise in the state necessary to drive forwards new developments in wind energy engineering. In 2014 CE WindEnergy SH finds itself in a reorientation phase under the umbrella of the R&D centre Kiel University of Applied Sciences GmbH.

The new CE WindEnergy SH began operations in January 2014 with the support of the state government. The centre is funded by the Zukunftsprogramm Wirtschaft (Programme for the Future – Economy) and in 2014 and 2015 is to stabilise, reactivate and develop on the duties of the former CEwind e.G. cooperative. The new centre of excellence is now housed in the R&D centre Kiel University of Applied Science GmbH. The R&D centre thus operates as a central contact point for academic wind power research in Schles-



Members of the CE WindEnergy SH research network.

Diagram: R&D centre Kiel University of Applied Sciences GmbH

wig-Holstein. “The centre of excellence will contribute to upgrading the research infrastructure in Schleswig-Holstein and establishing a site of national importance. The interdisciplinary interaction between engineering, natural and economic sciences is extremely important here,” explains Janina Ipsen, project manager at CE WindEnergy SH.

The wheel turns. Driven by the power of the wind, which Schleswig-Holstein has an ample supply of thanks to its location between the North Sea and the Baltic. The economy took advantage of the tailwind: 200 businesses – among them the major turbine manufacturers Senvion and Vestas – employ 7,000 excellently trained specialists in Schleswig-Holstein. In order to further the technological advantage in the future, CE WindEnergy SH bundles wind energy expertise in Schleswig-Holstein and promotes technology transfer between science and industry. The Flensburg, Kiel, Lübeck and West Coast universities of applied sciences, as well as Kiel University, contribute their specialised wind energy professors to this exceptional centre of excellence.

Giants of the future: efficient wind turbines are gradually replacing small, outdated wind turbines in Schleswig-Holstein. The research cooperative CE WindEnergy SH is supporting the manufacturers in developing cutting-edge technologies.

Photo: Joachim Welding



The research on wind turbines in Schleswig-Holstein provides the energy transition in Germany with additional dynamics.

Photo: R&D centre Kiel University of Applied Sciences GmbH, Nürnberg

The overarching aim is the sustained transfer of expertise between science and industry. The centre of excellence has the following duties:

- › Initiation and management of research and development projects
- › Technical support for innovation projects
- › Practical and comprehensive scientific and interdisciplinary handling of wind energy use problems
- › Networking, close and national interaction between science and practice in the wind energy industry
- › Coordination and marketing of the wind engineering M.Sc. course at the Kiel and Flensburg universities of applied sciences
- › Compiling a strategy and an implementation concept for research in the state of Schleswig-Holstein

The focus here is always on technology transfer to industry. The individual R&D projects are oriented around the special requirements of the industry, institutional and installation operating partners. In cooperation with the economic development agencies and industry enterprises, the centre of excellence will provide impulses for innovations and thus contribute to mid- to long-term employment security and increases.

The technical emphases of the centre of excellence are:

- › **Electrical engineering and computer science:** grid integration, electrical components and systems, operational monitoring and servicing management, lightning protection and EMC, information technology and messaging systems

- › **Mechanics:** rotor blades, drive train, offshore platforms, tower concepts, foundations
- › **Energy industry:** energy management, economics and law
- › **Environment and climate:** maritime engineering and oceanography, noise emissions and shadow flickering, environmental management, meteorology, landscape aesthetics
- › **Academic training and CPD:** Master of Science in Wind Engineering (Flensburg UAS), Bachelor of Science in Offshore Systems Engineering (Kiel UAS), academic training and CPD

In order to further knowledge transfer the precursor establishment CEwind agreed to cooperate with the grid agency windcomm schleswig-holstein in 2012, which will now be developed further. The agency, in the guise of a cluster management, currently represents around 300 businesses from the onshore and offshore industries in the state.

“Wind energy training and CPD is in demand as never before in wind state Schleswig-Holstein. In the wind energy industry we see an increasing demand for well-trained specialists,” explains Janina Ipsen.

Members of CE WindEnergy SH:

- › Flensburg UAS
- › Kiel UAS
- › Kiel University
- › Lübeck UAS
- › Westcoast UAS

The energy that it all rotates around

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In WETI everything rotates around new wind energy technologies and expertise – in applied research projects and in student education. The Wind Energy Technology Institute, founded in 2010 at Flensburg UAS, builds on the close cooperation between university and industry. In addition, tomorrow's specialists are trained in four different courses.

WETI regards knowledge transfer as one of the most important tasks, in addition to teaching and research. The foundation institute is funded by Flensburg UAS, the Gesellschaft für Energie und Klimaschutz Schleswig-Holstein (EKSH) and wind energy industry companies. In addition to applied R&D presentations, the portfolio includes research and CPD projects, and publications and consulting services for businesses and associations, predominantly in the wind energy industry. Research papers written in the companies promote cooperation between the UAS and industry partners. Last but not least, WETI organises national and international cooperation between universities, businesses and organisations for the wind energy industry.

Since late 2013 WETI has been able to use a 163 meter high wind turbine in the Eggebek energy park for research projects. The installation, built by the cooperation partners Denker und Wulf, and Repower (today Senvion), cost €2.8 million. What's special about it is: The operating proceeds – up to €100,000 per annum – are used for Flensburg UAS research projects. Two additional research wind turbines in Wanderup will be added in 2014.

With its M.Sc. course in Wind Engineering and the B.Eng. courses Renewable Energy Engineering, Electrical Energy Systems Engineering and Energy and Environmental Management, Flensburg UAS provides a broad range of courses for training renewable energy engineers, in particular in the field of wind energy. "Not least in the context of the energy transition we need engineers in all fields in the future to plan, build and operate wind turbines," explains the institute head Professor Torsten Faber. "It is important that they learn to understand how the parts of a wind turbine operate that are not part of their specialist field. We provide this holistic, interdisciplinary knowledge in the Wind Engineering M.Sc. course." The demand for qualified personnel is large: The number of employees in the Ger-

man wind power industry has increased from 70,000 to more than 100,000 in five years (2011).

The success of these comparatively young courses stands up to scrutiny: in June 2013 a team of students from Flensburg UAS and Kiel UAS won an award in an international competition for the best small-scale wind turbine in Delft in the Netherlands. Despite the small diameter of 1.60 metres, the WindMaster 500 W showed its best form in the wind canal and achieved 480 Watts. No other small-scale wind turbine in the broad international field of participants was able to even approximately achieve this result.



The winning laugh: Students of the M.Sc. Wind Engineering in Flensburg won the international wind power competition in Delft in 2013.

Photo: Gatermann

New technologies also star in two current projects, funded by EKSH at €285,000. One deals with the development of an energy-efficient tubular steel tower for wind turbines. In this project Professor Faber cooperates with aerodyn (Rendsburg), the global market leader in the development of wind turbines. The focus is on material savings and thus the reduction of carbon dioxide emissions. In the second funded project, his colleague at WETI, Professor Clemens Jauch, investigates the dynamic behaviour of gearless wind turbines in terms of the provision of power in the grid.

Institute founders:

- › AGV Nord
- › Denker & Wulf AG
- › Flensburg UAS
- › GL Garrad Hassan
- › Gesellschaft für Energie und Klimaschutz Schleswig-Holstein GmbH
- › Investitionsbank Schleswig-Holstein
- › REpower (today Senvion)
- › Vestas
- › WKN AG

Technological change in the context of the energy transition



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The Lübeck UAS Wissenschaftszentrum für intelligente Energienutzung (WiE – Scientific centre for intelligent energy use) enjoys intensive dialogue and knowledge transfer with small and medium-sized energy supply companies, energy-intensive businesses, the trades and interested citizens. The work focuses on research and development, as well as qualification in the modern energy supply and the energy industry.

The research emphases at WiE are energy information technologies for decentralised, regional upgrading of energy infrastructure for intelligent energy conversion and use. In addition, the scientists research the effects and interactions of the legislative framework on technological change within the energy industry.

Today's energy grid is characterised by its good availability and constant good grid quality. Technologies and procedures have been developed over many years for this purpose. The energy industry has successfully established itself using this energy infrastructure in an environment moulded by a regulatory, political and economic framework.

Where in the past it was exclusively the role of centralised large power plants to guarantee the reliable distribution of electrical energy to the consumer, the task now is to also integrate fluctuating quantities of electricity, for example from wind or solar energy, in the grid.

The increasing proportion of volatile, renewable energy in the electricity supply and its decentralised feed-in to the energy supply networks, in particular in the low voltage ranges, initially appear to contradict the guarantee of good availability and constant good grid quality. "A new generation of electricity grids must control the behaviour of all users integrated in the electricity grid so intelligently that a cost, resource, and low-pollutant and sustainable energy industry is achieved, based on regenerative and low-risk energy forms," emphasises the head of the scientific centre, Prof. Cecil Bruce-Boye.

In order to meet this challenge, the WiE scientists, together with the Stadtwerke Norderstedt utility, investigate how the load profiles can be optimised by redistributing the domestic customer loads. Dynamic time-variable tariffs aim to encourage domestic customers to limit their electricity demand during certain times or in critical grid load situations and high-price phases, and relocate to low-load periods.

Other current projects deal with the topics of autarchy and virtual power plants. For example, in the **Sub-Autarchy** research project in a newly developed residential area in Norderstedt, approx. 30 houses are grouped in a collective to form a virtual balancing circuit. The aim is to achieve a suboptimal autarchy¹ from the public supply grid. Energy export and import, and temporary zero calibration from the public grid to the residential unit collective are organised by a virtual balancing circuit management system. In another project, how and under what conditions a **microgrid** is capable of supplying itself with electricity independent of the grid, i.e. to what degree autarchy can be achieved, is investigated.

As an information centre WiE provides clarification, mediation and knowledge transfer, over and above pure research activities. In the **Junior Campus** the scientists are busy actively forming and simply communicating the energy transition and climate protection. The combined heat and power plants of the primary and secondary schools in Lübeck are networked to form a virtual power plant. The aim is to give the pupils a feeling of the importance of a sustainable energy supply, and to develop technical and energy-related background knowledge. In the field of adult education WiE and its cooperation partner, Stadtwerke Norderstedt, and other partners in the energy industry and energy-intensive businesses, is currently working on accreditation of a new **M.Sc. course, Intelligent Energy**.

¹ Complete autarchy is not aimed for, for reasons of grid quality and availability.

Technology driven by the energy transition



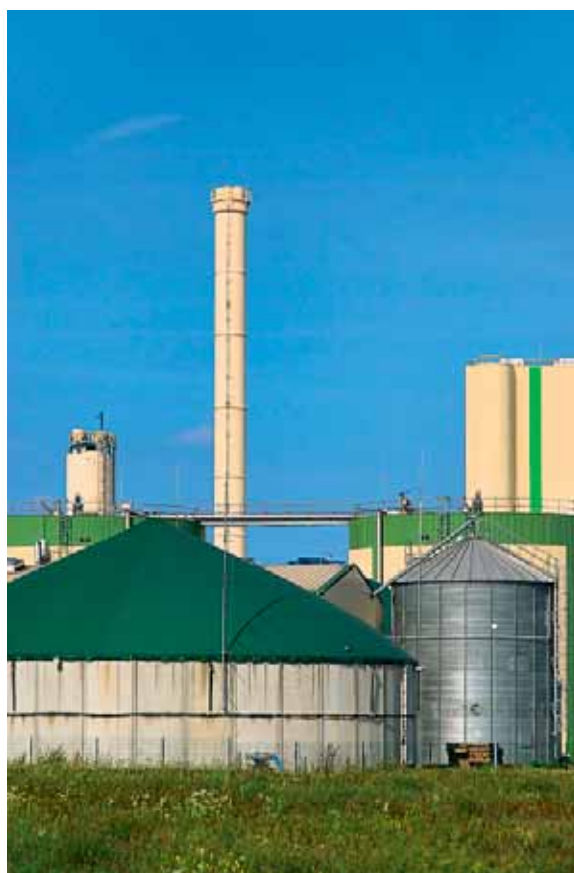
From biogas upgrading to solar thermal, from island technologies to the energy transition – the University of Flensburg and Flensburg UAS have been researching jointly in the field of sustainable energy systems since 2012. Expertise in all the principal fields of renewable energy is bundled in the newly founded Center for Sustainable Energy Systems (ZNES).

The professors, who jointly carry the centre, have formulated an objective: They aim to pioneer the technological change necessary to find answers to the pressing questions presented by human-caused climate change. “A highly developed and well-functioning partnership between the two Flensburg universities has already existed for several years in the field of sustainable energy systems,” explains UAS president Professor Herbert Zickfeld. The establishment of a joint centre for sustainable energy systems documents the thematic breadth of this field of expertise to the outside world and thereby improves the chances of both partners to acquire research projects and external funding.

The interdisciplinary expertise of both universities is to be expanded in research and teaching, and for graduates in particular. Overall, the network strengthens the interdisciplinary research approach adopted by the sector of energy and sustainability in Flensburg. The centre’s research and development work ranges from details of individual technologies to the development of target scenarios for one hundred per cent renewable energy supply systems and from strategies to climate-friendly local and regional development. The centre is closely intertwined with teaching and recruits the majority of its staff from courses at the two universities.

Thematically, work at ZNES is structured in accordance with the special research and development experience of the participating university lecturers and scientists:

Biomass: This research field deals with the development of technologies for converting energy crops, residual biological substances, and waste and wastewater to recyclable materials and fuels. The focus is on the development of highly efficient and adapted biogas technology, and its integration in process chains for facilitating nutrient cycles. Examples include the development of small, modular fermentation units, biogas upgrading using suitable fermentation unit design and process management, inno-



vative pretreatment processes and fermentation residue treatment, as well as integration into sustainable food production process chains (organic farming, greenhouses, aquaculture).

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Wind: The focus is primarily on the development of guidelines and technologies in the fields of structural engineering and wind turbine grid connections. Guidelines for hot-climate locations are currently being developed. In the field of structural engineering, tower structure research is at the forefront. In the field of grid connections, research primarily focuses on the grid connection conditions and the interactions between wind turbines and the grid. The research field is represented by the Wind Energy Technology Institute.

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Thermal energy systems: The research emphasis focuses on the role of individual systems and thermal energy technology concepts in current and future energy supply systems. Examples of such systems are solar thermal power plants, compressed air storage power plants, systems for combined heat and power or other advanced heating systems. The focus is on assessment, development and optimisation of such energy installations. Calculation and simulation are performed with the aid of both established commercial and in-house software solutions.

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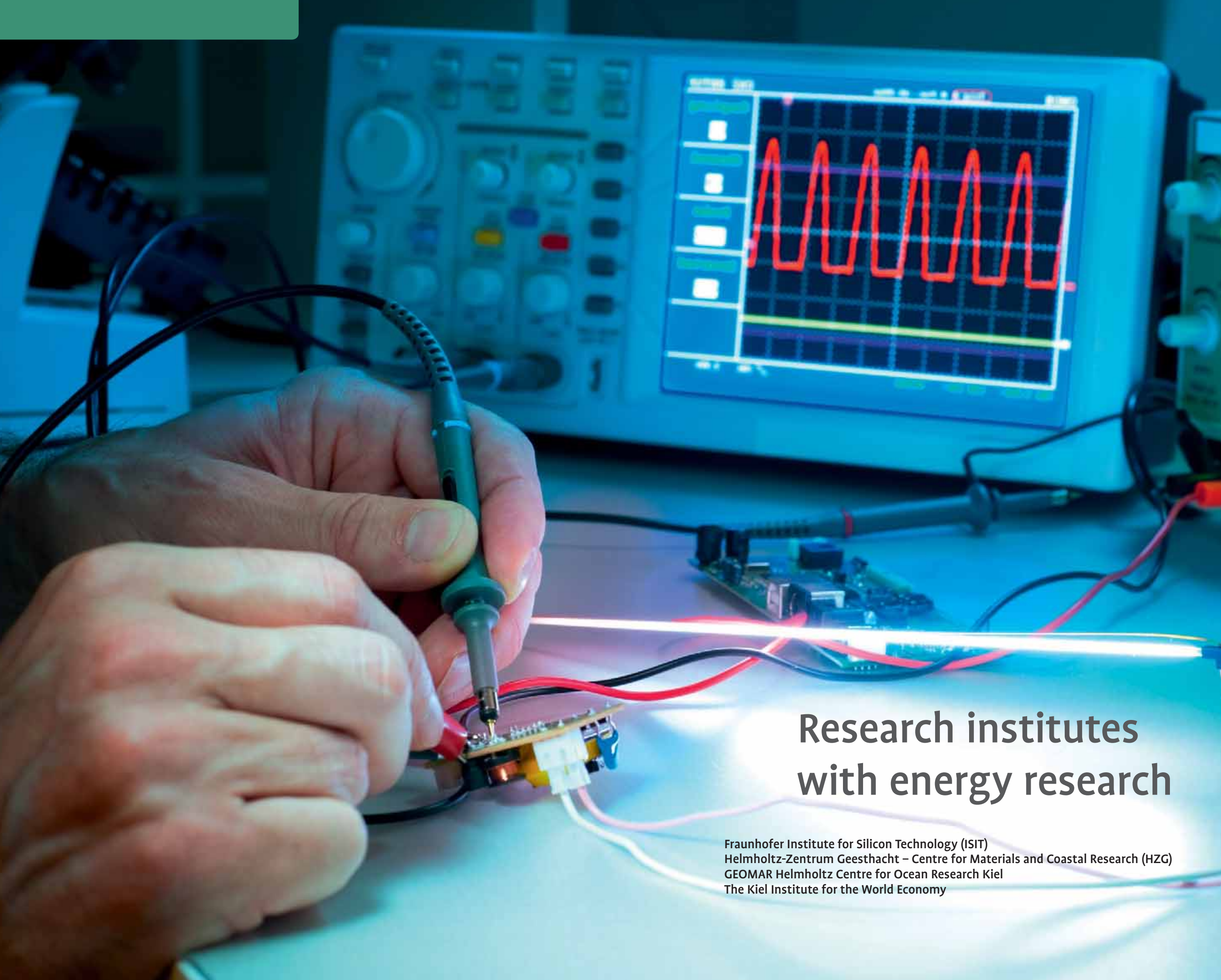
System integration and simulation: Here, questions related to the design of sustainable energy systems on the basis of renewable energy sources and high energy efficiency are addressed. Both the development of consistent target systems with one hundred per cent renewable energy supplies, and the analysis and design of changeover paths from today’s energy systems to the target systems are addressed – keywords energy transition. Questions centring around the interactions between different renewable energy sources and the integration of different energy storage technologies are dealt with.

Climate protection concepts: ZNES develops long-term climate protection concepts for communities, corporations and businesses. When developing local climate protection concepts, in particular, the team aims to include all key players in the process in order to achieve greater acceptance of the results and higher chances of implementation. In addition to individual technical-economic solutions, climate protection concepts for businesses comprise strategic corporate planning, based on a long-term company climate protection vision.

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Research institutes with energy research

Fraunhofer Institute for Silicon Technology (ISIT)
Helmholtz-Zentrum Geesthacht – Centre for Materials and Coastal Research (HZG)
GEOMAR Helmholtz Centre for Ocean Research Kiel
The Kiel Institute for the World Economy

Innovative power for accumulators and power electronics

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Fraunhofer Institute for Silicon Technology (ISIT) in Itzehoe is one of the most modern research facilities for microelectronics and microsystems technology in Europe. 150 scientists develop power electronic components and microsystems with fine movable structures in close collaboration with partners from the industry for

- › sensors (pressure, movement, biochemical analysis, etc.) and
- › actuators (valves, scanners, micromirrors and many others) including the casing technology required for this.

These miniaturised components are used in medicine, environmental and traffic engineering, communication technology, the automotive industry and mechanical engineering. In addition to the large clean room for research and the production of microchips in industrial scale covering 3,000 square metres, a 70 metre long, four-storey new building was put into operation in 2014. It is intended to help secure the leading position of ISIT worldwide in the field of technologies for power electronics and microsystems (MEMS). The Institute gained 1,000 square metres of clean room and 500 square metres of laboratory space as well as office space for 44 employees. The total investment amounted to Euro 36.6 million, to which the Federal State of Schleswig-Holstein is contributing Euro 27.45 million and the Fraunhofer-Gesellschaft Euro 9.15 million.

Power electronics has developed into a key technology of the 21st century. It guarantees energy efficiency – from generation right up to the consumer – and is therefore the decisive lever to save energy through needs-based energy consumption and in the use of renewable energy.

The topic area of **integrated power systems** is one of the most important research fields at ISIT. It was lithium accumulators that made the success and widespread use of mobile phones, PDAs and laptops possible in the first place. They are also used in the operation of electric vehicles and power tools. However, every one of these areas of use also brings with it new requirements of the accumulator. Lithium technology, as a comparatively new technology, still has substantial development potential to cope with the wide range of requirements of these areas of use through new materials and manufacturing techniques.



The Fraunhofer Institute for Silicon Technology in Itzehoe.

Photo: ISIT

The Integrated Power Systems department of ISIT has been working on the development of accumulators on the basis of lithium ion polymer technology for over ten years. By varying the materials within the accumulator, its output can be influenced over a wide area, which depends on its actual field of use. The fact that special attention is paid to production-related development has not least also been demonstrated with the successful transfer of ISIT laboratory processes into the manufacturing environment of a battery manufacturer.

In addition, since 2013 the **innovation cluster Power Electronics for Renewable Energy** has been located at ISIT. Itzehoe is therefore the location of an innovation cluster as part of the high-tech initiative of the Federal Government. With financial support from the Federal State and funding from the Fraunhofer-Gesellschaft, the Institute is expanding the existing network for power electronics in northern Germany with the cluster. This is because ISIT had already managed the **Competence Center for Power Electronics Schleswig-Holstein (KLSH)** previously (see report page 33). An important area of responsibility of the new innovation cluster will be future research projects on the subject of power electronics for wind turbines, which academics will initiate and implement together with industry.

Know-how for lightweight materials and climate protection



Zentrum für Material- und Küstenforschung

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 www.hzg.de

The Helmholtz-Zentrum Geesthacht (HZG) is involved in the fields of materials and coastal research and regenerative medicine with more than 860 employees at the sites in Geesthacht and Teltow near Berlin. The scientific work is divided between four institutes:

- › **Institute of Materials Research:** Development of lightweight materials based on magnesium and titanium aluminide alloys as well as novel joining technologies along with composite and hybrid structures. The objective is to make cars and aircraft lighter, thus helping to save energy and conserve resources.
- › **Institute of Coastal Research:** Research into the impact of global climate change at a regional level, particularly in northern Germany and the Baltic Sea region. Use of modern monitoring methods for coastal areas.
- › **Institute of Polymer Research:** Membranes and techniques for environmental and resource conserving applications in chemical process engineering as well as polymer nanocomposites for lightweight applications.
- › **Institute of Biomaterial Science:** Development of medical products and drug releasing systems from the synthesis of polymers via processing and sterilisation of materials as well as biological evaluation up to small series production for (pre-)clinical studies (Teltow site).

The research field of **functional material systems** covers a range of topics concerning the subject of energy: It ranges from automotive and aircraft construction to medical technology. Completely new system solutions – such as for energy-saving lightweight construction of car bodies, engines or turbines, for emission-free drives in transport technology and also for functionalised medical implants – become possible through innovative material developments at Helmholtz-Zentrum Geesthacht.

What does the future of energy supplies look like? How can we deal with the dangers posed by climate change? What materials support the protection of the environment? Researchers are working on concepts at Helmholtz-Zentrum Geesthacht to provide answers to these questions. In line with its slogan “Science creates benefits”, many of its research results can be implemented in practical applications.

Materials research: Scientists are undertaking research into materials for the cars and aircraft of tomorrow. This is because high performance materials and their applications can improve our world. For example vehicle construction: the lighter a car is, the less fuel it requires. A large number of departments focus on the subject of “lightweight engineering”. This leads to new technologies so that for example aircraft parts can be joined together more effectively, or new, light alloys, for example made of magnesium. The HZG runs the “Magnesium Innovations Center” (MagIC), the “Assessment, Computing and Engineering Centre” (ACE) and the “German Engineering Materials Science Center” (GEMS).

The Institute of Coastal Research owns the shallow water research vessel “Ludwig Prandtl”, which is chiefly used in the North Sea and Baltic Sea, estuary areas and the shallow coastal waters of the Baltic Sea. In addition, the HZG operates two service facilities for knowledge transfer in the field of climate research:

- › **Climate Service Center:** Information and services offered for the growing need for advice on climate issues. The CSC (located in Hamburg, run by Prof. Dr. Guy Brasseur) was created by the Federal Government as an important component of the “High-Tech Strategy for Climate Protection” (www.climate-service-center.de).
- › **The North German Climate Office:** Partner for climate issues in northern Germany working for municipalities, associations, political parties, scientific facilities and other institutions. Scientific-based information about possible climate changes in the various regions (www.norddeutsches-klimabuero.de).
- › **Coastal research:** Coastal research covers issues on the condition and change of coastal regions. Scientists have the task of understanding the changing climate and coasts and making this knowledge available to society. Researchers are involved in networks at a national and international level such as the CLiSAP Hamburg Cluster of Excellence and the Baltic Sea Experiment (BALTEX).

Investigating the secrets of the sea

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The GEOMAR Helmholtz Centre for Ocean Research Kiel with approximately 850 employees is one of the leading marine research institutes in Europe. The scientists investigate chemical, physical, biological and geological processes in the ocean and their interaction with the sea floor and the atmosphere. There are also large-scale projects in fundamental research such as the Cluster of Excellence The Future Ocean and the Collaborative Research Centre (SFB 754) "Climate-Biogeochemistry Interactions in the Tropical Ocean". In addition to fundamental research, GEOMAR is also involved in application-related topics. Amongst the latter, the following are of particular interest to companies:

- › Mineral and marine substances
- › Gas hydrates

GEOMAR has an efficient research infrastructure. It includes four in-house research vessels: the only manned German research submersible JAGO, the deep-sea robots KIEL 6000, PHOCA, HyBis and ABYSS as well as various long-term observatories. The Institute also offers excellent working conditions on land with one of Europe's leading facilities in isotope analysis, access to efficient large-scale computers and one of the largest marine science libraries in Germany. The focus of research concentrating on energy and climate protection includes:

Marine resources: The scope and opportunities to use the living and non-living resources of the world's oceans are still unknown to a large extent. The use of the ocean's biological, mineral and energy resources will however become increasingly important in view of the sharp rise in the world's population by the end of this century. The usable resources available in the world's oceans can be subdivided into:

- › **Living raw materials:** Important for nutrition, pharmaceutical applications (active agent research) and sources of renewable energy.
- › **Non-living raw materials:** Metal and energy raw materials or potential submarine CO₂ storage sites (important for climate protection issues).

Deep-sea robots and submersibles used for scientific purposes.

Future research fields will be found in these areas:

- › Exploration of new mineral and energy raw materials
- › Investigation of the genetic resources of the seas
- › Development of environmentally friendly and sustainable usage strategies

The use of resources such as manganese nodules, massive sulphides, gas hydrates and heavy minerals will have an impact both on the non-living environment as well as on the major functions of marine ecosystems. This is why it is extremely important to harmonise the use of raw materials and the protection of the underwater world.

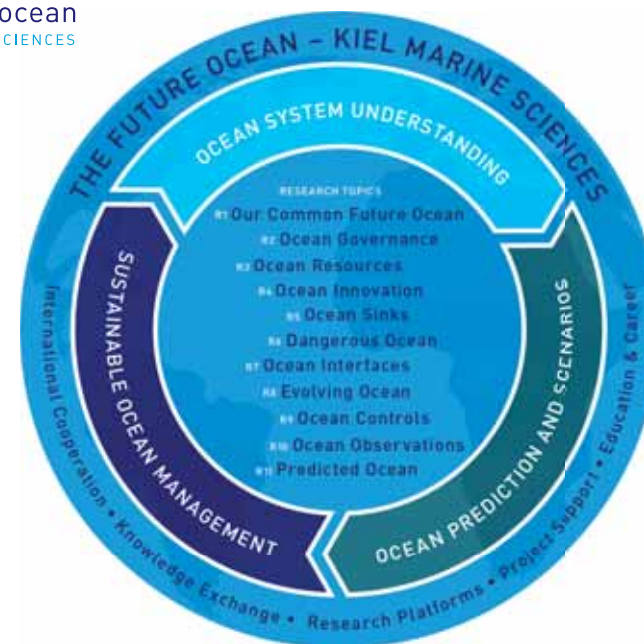
The role of the ocean in climate change

The oceans play a central role in global climate changes on our earth. An excellent example is the Gulf stream with its origin in the Caribbean and possible reactions through the melting of the Greenland ice sheet. The absorption and transport of gases and solid particles in the sea as well as their exchange with the atmosphere also have an effect on the climate as these materials are partially chemically active and can influence the radiation budget of the atmosphere. Central research topics are:

- › Understanding past, current and future changes in the ocean circulation
- › Changes in tropical and temperate widths
- › Past and present oceanographic and climatic conditions in the Arctic
- › Changes in the composition and function of marine communities
- › Future climate warming: Investigation and modelling
- › Past geochemical changes in the oceans



Cluster of Excellence "The Future Ocean"



The Kiel "The Future Ocean" Cluster of Excellence researches the changes in the oceans in the past, present and future with an approach that is unique in the world: Marine scientists, geoscientists and economists as well as physicians, mathematicians, computer scientists, lawyers and social scientists bundle their specialist knowledge in a total of eleven multi-disciplinary research groups. Their research results flow into sustainable usage concepts and options for action for worldwide management of the oceans. The fundamental understanding of the ocean is intended to lead to scientifically based forecasts and scenarios in order to contribute to a sustainable management of the oceans – in a dialogue with decision-makers. These are the working groups concerned with energy and climate protection:

- › **Ocean Resources:** Potential of organic and inorganic raw materials in the sea as well as new ways to manage them
- › **Ocean Sinks:** Estimate of the potential and limits of marine capture and storage techniques
- › **Ocean Interfaces:** Enrichment, change and transport of climate-relevant substances on and over the ocean surfaces
- › **Ocean regulatory systems:** The role of the ocean in past climate and environmental changes, statements on future global warming
- › **Forecasts:** Improvement of modern climate models in order to highlight the changes in regional ocean dynamics and biogeochemistry over the next 50 to 100 years

The areas of knowledge transfer, public relations and international activities, the ISOS graduate school and the

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postdoc network (IMAP) are also part of the Cluster of Excellence. The research network is funded by Kiel University (Christian-Albrechts-Universität zu Kiel, CAU), the GEOMAR Helmholtz Centre for Ocean Research Kiel, the Kiel Institute for the World Economy (IfW) and Muthesius Academy of Fine Arts and Design (MKHS).



The yellow research submersible "Jago" can dive to a depth of up to 400 metres.
Photos: GEOMAR

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Active in: Ocean circulation and climate dynamics
At the University since: 2003

Core competences in energy research

1. Natural climate fluctuations
2. Human influence on the climate
3. Development of climate models

Management responsibilities in transfer organisations and facilities relevant to energy research

- _ Member of the Managing Board of the Cluster of Excellence "The Future Ocean"
- _ Head of the Ocean Circulation and Climate Dynamics research division at GEOMAR
- _ Member of the Managing Board of the German Climate Consortium (Deutsches Klima-Konsortium, DKK)

Publications in professional journals covering energy issues

- _ Gulev, S.K., Latif, M., Keenlyside, N.S., K.P. Koltermann (2013): North Atlantic Ocean Control on Surface Heat Flux at Multidecadal Timescales. *Nature*, DOI: 10.1038/nature12268.
- _ Latif, M., Martin, T., Park, W. (2013): Southern Ocean Sector Centennial Climate Variability and Recent Decadal Trends. *J. Climate*, doi: 10.1175/JCLI-D-12-00281.1.

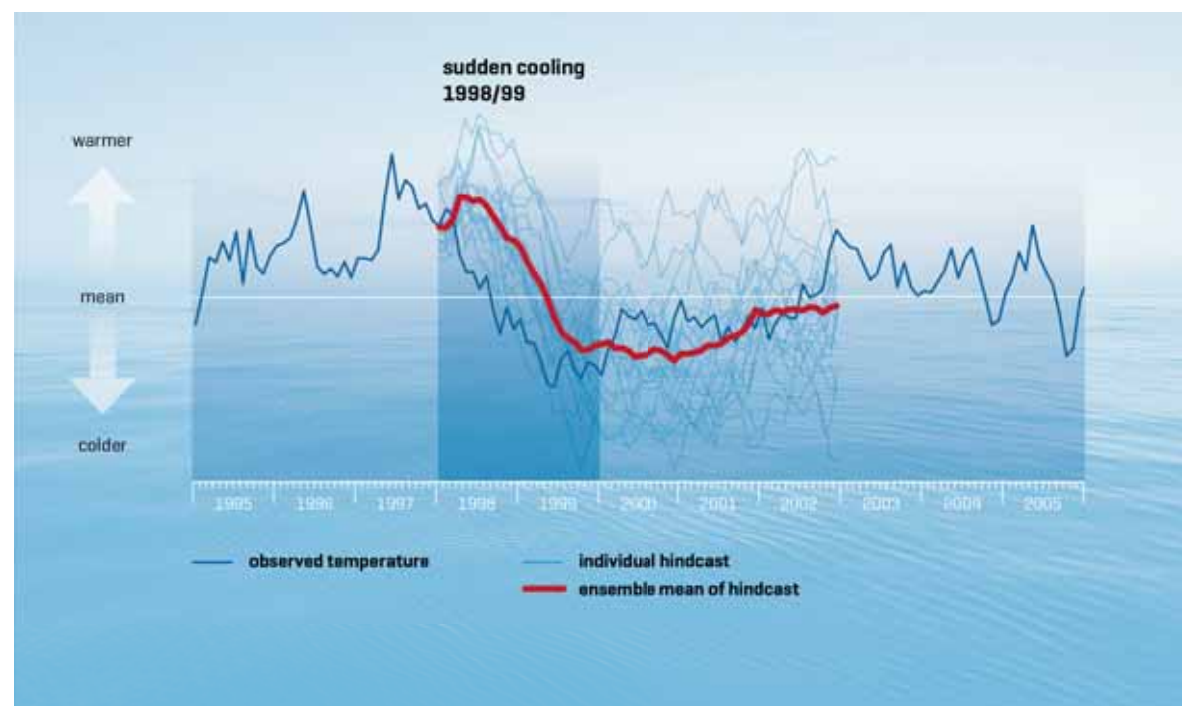
_ Semenov, V., Latif, M. (2012): The Early Twentieth Century Warming and Winter Arctic Sea Ice. *The Cryosphere*, 6, 1231-1237, doi:10.5194/tc-6-1231-2012.

_ Latif, M., Keenlyside, N. S. (2011): A Perspective on Decadal Climate Variability and Predictability. *Deep-Sea Research II*, 10.1016/j.dsr2.2010.10.066.

_ Hasselmann, K., Latif, M. and co-authors (2003): The challenge of long-term climate change. *Science*, 302, 1923-1925.

Popular scientific publications

- _ *Globale Erwärmung*, UTB, Stuttgart 2012, ISBN 9783825235864.
- _ *Klimawandel und Klimadynamik*. Ulmer, Stuttgart 2009, ISBN 978-3-8252-3178-1.
- _ *Warum der Eisbär einen Kühlschrank braucht: ... und andere Geheimnisse der Klima- und Wetterforschung*. Herder Verlag 2010, 176 S., ISBN 978-3-451-30163-6.



Reconstruction of abrupt climate shifts in the Pacific.



You address a broad section of the public with your books on climate change. What links are there to your academic work?

Prof. Latif: Climate research is an area of major social relevance. I can certainly provide first-hand accounts of the scientific results for example from our climate calculations in books for a broad readership.

On which R&D projects are you working currently?

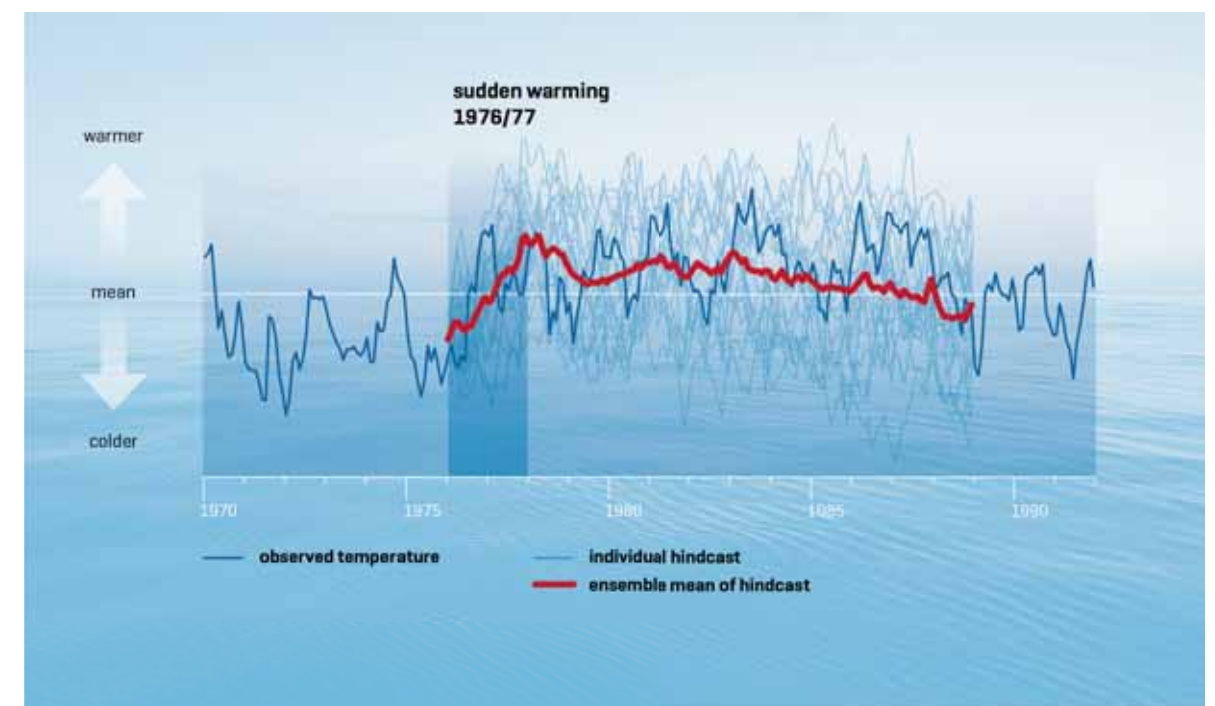
I am currently interested in two things above all: On the one hand I am trying to understand why the climate has fluctuated during the last few hundred thousand years – there were always cold and warm periods. The other major topic: short-term fluctuations. With climate change we are talking about slow changes over 100 to 200 years. But there are also short-term fluctuations that are superimposed over the long-term trend of global warming and can slow it down and accelerate it. I would like to find out whether

these natural fluctuations can actually be forecast. If we want to forecast the future, we must be able to calculate both developments reliably.

I am also researching the changes in the Atlantic Ocean – keywords Gulf stream. Here we are recording fluctuations in temperatures from decade to decade, which are probably connected to changes in the Gulf stream and have an impact for example on hurricane activity or the rain in the Sahel region.

Why is it important for you as a researcher to become involved in the public debate about climate protection?

In the final analysis we as scientists have a responsibility not to remain in our ivory towers but to bring scientific findings to an external audience. I believe that we should point out risks that arise from the way in which we humans live our lives.



Diagrams: GEOMAR

Economic problem-solver

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The Kiel Institute for the World Economy (IfW) that was established in 1914 at Kiel University is regarded as one of the most important centres in the world for research into the world's economy, providing economic-political advice and economic education. The Institute belongs to the Leibniz Association. It employs approximately 160 staff, of which over 80 are scientists.

Its main task is to research innovative solution approaches for pressing world economic problems. The IfW advises decision-makers in politics, business and society on the basis of this research work and informs the general public about important economic and political connections. It cooperates closely with the neighbouring German National Library of Economics, the world's largest specialist library for economic issues. The IfW postgraduate course of **Advanced Studies in International Economic Policy Research** is geared towards young economists who have completed a university degree as well as economists with several years of professional experience. The **Kiel Summer School on Economic Policy** with 25 places is aimed at young employees at political institutions as well as doctoral candidates of economics.

The research activities of the IfW concentrate on seven areas of research. These also include the research area of **"The Environment and Natural Resources"**, which investigates the individual and overall economic adjustment processes to global and country-specific scarcities in natural resources. Traditionally the focus lies in particular on climate change and climate policy, which is also reflected in the current emphasis on the subjects:

- › **International Climate Policy:** This focuses on analysing current political proposals at a European and international level. They are analysed with regard to their effects and the optimal structure. These include topics such as the European emissions trading scheme (ETS), measures that are associated with the Kyoto Protocol, as well as sustainable fishery management.
- › **Bioenergy and Land Use:** The economic valuation and analysis of bioenergy has been a major focus of the research area for many years. In this context, land use competition, for example with food production, is gaining in importance. In order to be able to improve ana-

lysis of land use conflicts and the role of bioenergy for climate protection, the research team is developing an integrated modelling system. The project "Land grabbing and sustainable development" deals with large-scale land acquisitions by foreign investors in Africa and their effects on local natural resource scarcity.

- › **Natural Resource Scarcity:** A new focus of the research area is on the causes and effects of scarcities in the supply of natural resources. The current topics include strategic resource exploitation (such as rare earth), management of fish stocks, determinants of energy efficiency in Germany and perspectives for marine mineral resources etc.
- › **Valuing the Ocean:** The oceans play a central role in climate change. The research area deals with this subject as part of the interdisciplinary Kiel Cluster of Excellence "The Future Ocean".



In front of the building of the Kiel Institute for the World Economy:
Employees of the research area of The Environment and Natural Resources.
Photo: IfW

Prof. Gernot Klepper, Ph.D.

Active in: Climate protection, energy markets and bioenergy
Appointment as honorary professor by the Federal State of Schleswig-Holstein: 1989

Core competences in energy research

1. Economic modelling
2. Promotion of bioenergy
3. Certification of biomass

Management responsibilities in transfer organisations and facilities relevant to energy research

- _ Chair of ISCC e.V. (International Sustainability and Carbon Certification)
- _ Deputy Chairman of the German Climate Consortium (Deutsches Klima-Konsortium, DKK e.V.)

Energy and climate protection R&D projects (since 2010)

Land use planning and sustainable biomass production for climate protection

Funded by: BMELV
Project duration: 2010 until 2012
Cooperating partners:
WWF

Creating and implementing the International Sustainability and Carbon Certification (ISCC) normal operations

Funded by: BMELV
Project duration: 2010 until 2012
Cooperating partners:
Meo-Carbon Solutions GmbH, Cologne

Creating a certification system for biofuels.

Paradigm Shifts Modelling and Innovative Approaches (PASHMINA)

Funded by: EU FP6
Project duration: 2010 until 2013
Cooperating partners:
Several European partners

Modelling of the international effects of promoting biofuels on land use and food supplies.

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Policy Options to Engage Emerging Asian Economies in a Post-Kyoto Regime

Funded by: EU FP6
Project duration: 2010 until 2012
Cooperating partners:
Several European and Asian partners

Modelling of the international effects of promoting biofuels on land use and food supplies.

Desert Power Industrial Initiative: Modelling sectoral and regional impacts of renewable electricity production in the MENA region

Funded by: Desertec Industrial Initiative (dii) GmbH
Project duration: 2010 until 2012

Publications in professional journals covering energy issues

- _The future of the European Emission Trading System and the Clean Development Mechanism in a post-Kyoto world. Energy economics, ISSN 0140-9883, ZDB-ID 795279x. – Amsterdam: Elsevier. – vol. 33.2011, 4, pp. 687–698.
- _Hübler, M., Klepper, G., Peterson, S.: Costs of climate change: the effects of rising temperatures on health and productivity in Germany. Ecological economics, vol. 68.2008, 1/2, pp. 381–393.
- _Klepper, G., Lange, M.: Verteilungskonflikte durch die Klimaschutzpolitik: verschärft die EU die Hungerproblematik? Zeitschrift für Wirtschaftspolitik, vol. 60.2011, 3, pp. 317–329.
- _Raupach, M., Gregg, M., Ciais, P., Le Quéré, C., Canadell, J., Klepper, G., Field, C. (2007): Global and regional drivers of accelerating CO emissions. Proc. Natl. Acad. Sci. 104 (24), 10288–10293.
- _Klepper, G., Peterson, S.: Marginal abatement cost curves in general equilibrium: The influence of world energy prices. Resource and energy economics, vol. 28.2006, 1, pp. 1–23.

Dr. Sonja Peterson



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Energy and climate protection R&D projects (since 2010)

EXPECT – An experimental study of climate policy negotiations: implications for policy design and impact assessment

Funded by: BMBF

Funding volume: €244,000

Project duration: 10/2011 to 10/2014

Cooperating partners:

Kiel University, Prof. Dr. Till Requate

The aim of this project is to combine methods of experimental economics with applied general equilibrium modelling in order to investigate how decision-makers behave in social dilemma situations with collective risks such as climate change. The purpose is to obtain findings, which are of significance for international climate negotiations.

Specifically with the assistance of a public goods game in which real test persons can invest a budget provided to them in climate protection, it is investigated under what conditions sufficient funds are provided. The focus is on the effect of asymmetries because the countries and regions involved in climate negotiations have different levels of wealth or are affected differently by climate change. The experiments have shown that these asymmetries do not reduce the probability of a solution, but can even increase it. In addition, it seems to be regarded as fair that rich countries have higher benefit costs than poorer countries. However, with regard to welfare costs, if one also takes account of the effects of the decline in the use of fossil energy and correspondingly fossil energy prices, then analyses with a general equilibrium model show that this would mean a very high transfer of energy importers to energy exporters.

Active in: Climate protection, energy markets and bioenergy
At the Institute since: 2001

Core competences in energy research

1. International and European climate and energy policy
2. Bioenergy and land use
3. Environmental policy instruments

CORE – Cooperative Regimes for Future Climate Policy

Funded by: BMBF

Funding volume: €440,000

Project duration: 2/2012 to 12/2015

Cooperating partners:

Fraunhofer ISI, Karlsruhe, Prof. Dr. Schleich

KIT, Karlsruhe, Prof. Dr. Ehrhart

Attempts to implement 2° target-compatible emission reductions via international cooperation have not been very successful so far. The CORE project analyses whether global cooperation is possible under the current form of international climate negotiations, i.e. if it is possible to design a climate regime where long-term climate targets may be met and all countries agree on the distribution of emission reductions. This analysis combines cooperative game theory with an applied equilibrium model, taking into account the uncertainty about key mitigation technologies to avoid CO₂. The theoretical model is supplemented by field experiments with stakeholders in the climate negotiations and a controlled laboratory experiment.

POEM – Policy Options to Engage Emerging Asian Economies in a Post-Kyoto Regime

Funded by: EU

Project duration: 10/2009 to 9/2012

Cooperating partners:

Chalmers University of Technology, Gothenburg, Sweden
Netherlands Environmental Assessment Agency (PBL), Bilthoven, The Netherlands

Indian Institute of Management, New Delhi, India

Tsinghua University, Beijing, China

Institute of Economic Growth, New Delhi, India

Beijing Institute of Technology, Beijing, China

The main aim of the project was to analyse the possibility of reaching both development and climate protection objectives in India and China. In the project policy options were developed and assessed including combinations of national and international measures together with institutional framework conditions for international cooperation in post-Kyoto regimes. For this an integrated model system of coupled models was developed and applied in order to analyse various policies and identify development pathways, which contribute to climate protection.

The IfW contributed to the analysis with the DART model and focused in its analysis especially on the distributional effects of international climate policy on different household types in India. The model simulations show that emission trading with a generous allocation of emission rights that profits the Indian economy as a whole, may have negative effects for poor households that spent a large share of their income on energy.

Renewable Resources and Land Use (NaRoLa) Integration of bioenergy into a sustainable energy strategy

Funded by: BMBF

Funding volume: €500,000

Project duration: 1/2007 to 3/2010

Cooperating partners:

Institute of Rural Studies at the Thünen Institute (vTI), Braunschweig

Institute for Food and Resource Economics at the University of Bonn

In the NaRoLa project the contribution of biomass to a sustainable energy supply was analysed and assessed under economic, ecological and social aspects. An integrated modelling system was developed for this, which is in a position to depict the land use competition between biomass and food production and also takes account of the overall economic and international feedback effects. The aim was to provide a proposal for the integration of renewable resources into a sustainable energy system and draw up policy recommendations with the assistance of this modelling system and supplementary analyses, e.g. regarding the environmental effects of expanded use of bioenergy. In specific terms the project concentrated on the following research issues – focussing on Germany:

- › What role can biomass or renewable resources play in energy generation?
- › What are the overall economic and international feedback effects of bioenergy use and the resulting consequences for the excellence of various strategies for biomass use and emission reduction?

- › What consequences does the promotion of bioenergy have on agricultural land use and production, factor input and income?
- › What regional allocation will develop when cultivating the various renewable resources as well as energy production plants taking account of location potential and transport costs?
- › How should the ecological effects be assessed?
- › What contribution is provided by the expansion of the bioenergy sector to the development of rural areas?
- › How can the various complex interactions at different scales and between the sectors be modelled?

Publications in professional journals covering energy issues

_Heitmann, N., Peterson, S. (forth): The Potential Contribution of the Shipping Sector to an Efficient Reduction of Global Carbon Dioxide Emissions. *Environmental Science & Policy* 42:56-66.

_Weitzel, M., Ghosh, J., Peterson, S., Pradhan, B. K. (forth.): Effects of international climate policy for India: Evidence from a national and global CGE model. *Environment and Development Economics*.

_Weitzel, M., Hübler, M., Peterson, S. (2012): Fair, optimal or detrimental? Environmental vs. strategic use of border carbon adjustment. *Energy Economics* 34:p198-S207.

_van Ruijven, B., Weitzel, M., den Elzen, M., Hof, A., van Vuuren, D., Peterson, S., Narita, D. (2012): Emission allowances and mitigation costs of China and India resulting from different effort-sharing approaches. *Energy Policy* 46:116-134.

_Khalilian, S., Peterson, S. (2011): Auf dem Weg zu einer effizienteren Regulierung im Energiebereich – Subventionsabbau und grundlegende Reform. *Zeitschrift für Umweltpolitik & Umweltrecht* 34(2): 183-212.

_Kretschmer, B., Narita, D. and Peterson, S. (2009): The economic effects of the EU biofuel target. *Energy Economics* 31:p285-S294.

_Klepper, G., Peterson, S. (2006): Emissions Trading, CDM, JI and More – The Climate Strategy of the EU. *The Energy Journal* 27(2), 1-26.

_Klepper, G., Peterson, S. (2006): Marginal Abatement Cost Curves in General Equilibrium: the Influence of World Energy Prices. *Resource and Energy Economics* 28(1):1-23.

_Rickels, W., Görlich, D., Peterson, S. (forth): Explaining European Emission Allowance Price Dynamics: Evidence from Phase II. *German Economic Review*.

Congress presentations on energy issues

_Klimapolitik und Energiemärkte – Was sind die aktuellen ökonomischen Herausforderungen? 7th Conference Gebäude energetisch optimieren 2014, 4 April 2014.

_Emissionshandel: “Theoretisch funktioniert er – praktisch hat er kaum Bedeutung”. DKK-Klima-Frühstück Berlin, 1 July 2013.



Energy research at universities

University of Flensburg

Prof. Dr. Olav Hohmeyer

Flensburg University of Applied Sciences

Prof. Dr. Joachim Berg
Prof. Dr. Friedrich Blödown
Prof. Dr. Jens Born
Prof. Dr. Torsten Faber
Prof. Dr. Gerd Hagedorn
Prof. Dr. Frank Hinrichsen
Prof. Dr. Clemens Jauch
Prof. Dr. Dirk Ludewig
Dr. Hermann van Radecke
Prof. Dr. Michael Thiemke
Prof. Dr. Ilja Tuschy
Prof. Dr. Holger Watter
Prof. Dr. Jochen Wendiggensen

Kiel University

Prof. Dr. Sebastian Bauer
Prof. Dr. Johannes Bröcker
Prof. Christoph Corves, Ph.D.
Prof. Dr.-Ing. Friedrich W. Fuchs
Prof. Dr. Eberhard Hartung
Prof. Dr. Wilhelm Hasselbring
Prof. Dr. Dr. Christian H. C. A. Henning
Prof. Dr. Rainer Horn
Prof. Dr. Christian Jung
Prof. Dr. Uwe Latacz-Lohmann
Prof. Dr. Marco Liserre
Prof. Dr. Thomas Meurer
Prof. Dr. Katrin Rehdanz
Prof. Dr. Till Requate
Prof. Dr. Carsten Schultz
Prof. Dr. Friedhelm Taube

Kiel University of Applied Sciences

Prof. Dr. Sabah Badri-Höher
Prof. Dipl.-Ing. Benedict Boesche
Prof. Dr. Gordon H. Eckardt
Prof. Dr. Ronald Eisele
Prof. Dr. habil Mohammed Es-Souni
Prof. Dr. Hans-Jürgen Hinrichs
Prof. Dr. Constantin Kinias
Prof. Dr. Klaus Lebert
Prof. Peter Quell
Prof. Dr. Yves Reckleben
Prof. Dr. Kay Rethmeier
Prof. Dr. Alois Schaffarczyk
Prof. Dr. Ulf Schümann
Prof. Dr. Christoph Weber
Prof. Dr. Harald Wehrend
Prof. Dr. Rainer Wulfes

Lübeck University

Prof. Dr. Stefan Fischer
Prof. Dr. Michael Herczeg
Prof. Dr. Martin Leucker

Lübeck University of Applied Sciences

Prof. Dr. Michael Bischoff
Prof. Dr. Cecil Bruce-Boye
Prof. Georg Conradi
Prof. Dr. Horst Hellbrück
Prof. Dr. Siegfried Kreußler
Prof. Dr. Mario Oertel

West Coast University of Applied Sciences

Prof. Dr. Rainer Dittmar
Prof. Dr. Gunther Gehlert
Prof. Dr. Reiner Johannes Schütt

Prof. Dr. Olav Hohmeyer



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Energy and climate protection R&D projects (since 2010)

K-2050-KG – Climate protection plan 2050 municipal buildings – requirements, economic efficiency, financing, framework conditions

Funded by: BMU

Funding volume: €105,000

Project duration: 2013 until 2015

Cooperating partners:

Cooperation with 10 different German municipalities

It is the task of the research project to identify bottlenecks in the financing of climate protection measures in the municipal building stock, develop new financing options, make them accessible and investigate their implementation. In the long term a range of instruments is to be implemented to enable the municipalities to be categorised according to their specific difficulties and options for the financing of municipal climate protection measures and the indication of suitable financing options in each case.

Calculation of scenarios for the trend in the hourly prices on the German electricity market for the years 2015 to 2040

Funded by: Stadtwerke Kiel

Funding volume: €30,000

Project duration: 2013

Cooperating partners:

ENERCON GmbH, Aurich
Flensburg UAS

It is the task of the research project as preparation for the construction of the new power plant of Stadtwerke Kiel to simulate the trend in hourly electricity market prices in Germany under the ancillary condition of the enormous expansion of electricity generation from renewable energy sources with the assistance of the technical/economic simulation model renpass and through this to make a further basis available to assess the economic efficiency of possible power plant plans.

Professorship: Energy and Resource Management

At the University since: 1998

Core competences in energy research

1. System integration questions for 100% renewable energy systems
2. Local plans for 100% climate protection
3. Economic aspects of climate protection and the move to alternative energy

VerNetzen: Social-ecological, technical and economic modelling of trajectories of the move to alternative energy

Funded by: BMU

Funding volume: €151,000 (University of Flensburg contribution)

Project duration: 2013 until 2016

Cooperating partners:

IZT, Berlin

Deutsche Umwelthilfe e.V., Berlin

The task of the research project is to identify current and future hotspots of the move to alternative energy, analyse influential political decisions, legal framework conditions and social-ecological key factors for the acceptance of the necessary building work and the investigation of targeted measures increasing acceptance to minimise the duration and costs of the transformation of the entire system.

Master plan 100% climate protection – CO₂-neutral Flensburg by 2050

Funded by: BMU

Funding volume: €130,000 (University of Flensburg contribution)

Project duration: 2012 until 2013

Cooperating partners:

City of Flensburg

The task of the research project is to develop the climate protection strategy further for the City of Flensburg and the participative development of a master plan to achieve 100 % climate neutrality in all sectors by 2050. The project is based on the results of the integrated climate protection plan for Flensburg led by the University of Flensburg and is extending this with the target of reducing energy consumption by at least 50 %. The strategic plan for the master plan will prepare the first implementation phase for the years 2013 to 2016, which is being funded as part of the same project by the BMU with additional financing of over Euro 500,000.

Large Scale Bio Energy Lab

Funded by: BMU

Funding volume: €210,000 (University of Flensburg contribution)

Project duration: 2011 until 2015

Cooperating partners:

Aalborg University, Esbjerg Campus
Flensburg UAS

The task of the research project is to analyse new options for the use of biomass as energy in the border region of Southern Denmark – Schleswig-Holstein. This is investigating both new types of plants and cultivation as well as new process technology for use as energy. The task of the University of Flensburg is to investigate as part of the research project both the regional economic effects as well as the acceptance of various usage strategies and to develop recommendations for action from this for the future structure of funding policy in the biomass sector.

Drawing up an integrated climate protection plan for the Evangelical Lutheran Church in Northern Germany

Funded by: BMU

Funding volume: €185,000

Project duration: 2011 until 2012

Cooperating partners:

Evangelical Lutheran Church in Northern Germany, Evangelical Lutheran Church of Mecklenburg and Pomeranian Evangelical Church

The task of the research project was the participative compilation of an integrated climate protection plan for the Evangelical Lutheran Church in Northern Germany for a 100% climate neutral church by 2050 over all the relevant sectors of church activities ranging from the energy consumption of all church properties, mobility on official business of all staff and procurement for the Evangelical Lutheran Church in Northern Germany. The plan was submitted to the synod of the Evangelical Lutheran Church in Northern Germany in 2012 and adopted as a binding framework for action by the synod.

Drawing up an integrated climate protection plan for Flensburg with the aim of CO₂-neutrality by 2050

Funded by: BMU

Funding volume: €210,000

Project duration: 2010 until 2011

Cooperating partners:

City of Flensburg and Klimapakt Flensburg e.V.

The task of the research project was the participative compilation of an integrated climate protection plan for the City of Flensburg for a 100% climate neutral city by 2050 over all sectors and relevant activities in the City of Flensburg ranging from industry, trade and commerce, private

households to transport. The future generation of electricity and district heating by Stadtwerke Flensburg are also part of the plan. The plan was submitted to the City of Flensburg in 2011 and adopted as a binding framework for action for the City and Klimapakt Flensburg e. V.



Report on greenhouse gas emissions in Flensburg. Status and development of Business as Usual

Funded by: Klimapakt Flensburg e.V.

Funding volume: €50,000

Project duration: 2009 until 2010

Cooperating partners:

City of Flensburg and Klimapakt Flensburg e.V.

The task of the research project was to survey the historical greenhouse gas emissions of all sectors for the City of Flensburg and the development of a business as usual scenario for the future development of greenhouse gas emissions as the basis for the compilation of an integrated climate protection plan at a later date.

FURGY (International Technology Region Renewable Resources and Energy Efficiency)

Funded by: EU/Interreg

Funding volume: €327,000

Project duration: 2009 until 2012

Cooperating partners:

Flensburg Chamber of Commerce and Industry (IHK)
Udviklingsrad Sønderjylland
University of Southern Denmark

The task of the research project was the investigation of the conditions for the development of an integrated competence region for research into, the development and use of renewable energy sources in Southern Denmark and Schleswig-Holstein.

Prof. Dr. Olav Hohmeyer

Publications in professional journals covering energy issues

_Hohmeyer, O., Bökenkamp, G., Wiese, F., Wingenbach, C.: An Open Source Energy Simulation Model as an Instrument for Public Participation in the Development of Strategies for a Sustainable Future. In: Energy and Environment. 2013, accepted for publication.

_Hohmeyer, O., Bohm, S.: Trends towards 100 % Renewable Energy Supply in Germany and Europe – A Paradigm Shift in Energy Policies. In: Energy and Environment 2013, accepted for publication.

_Hohmeyer, O.: Wasserstoff kontra Wasserkraft – Realisierung einer 100 % regenerativen Stromversorgung. In: HZwei. 04/2013, pp. 18–20.

_Hohmeyer, O. et al.: 100 % regenerativ – Wie lange vertragen sich konventionelle und erneuerbare Energien auf dem Weg zur komplett regenerativen Stromversorgung? In BWK, Vol. 62 (2010), No. 10, pp. 14–19.

_Hohmeyer, O., Hartmann, C.: Knappe CO₂ Speicherstätten für Biomasse-CCS. In: Energiewirtschaftliche Tagesfragen 60 (2010), pp. 144–148.

Congress presentations on energy issues

_Hohmeyer, O.: 100 % Renewable Electricity Supply for Germany Europe and North Africa by 2050. Lecture given at Renewable Energy World Europe. Vienna. 6.6.2013. Nominated for Best Paper Award at the conference.

_Hohmeyer, O.: Scenarios of Our Future Energy Supply and the Role of Energy Storage. Lecture given at Energy Storage 2013. Düsseldorf, 18.3.2013.

_Hohmeyer, O.: Bedarf des Netzausbaus aus der Sicht einer 100 % regenerativen Energieversorgung. Lecture given at the conference Neue Energie und alte Netze (New energy and old networks) of the Hans Böckler Foundation and the German Confederation of Trade Unions (DGB). Berlin, 1.2.2012.

_Hohmeyer, O.: Norway – Europe's Green Battery? – 100% Renewable Electricity Supply by 2050. Lecture given as part of Technoport Talks at the University of Trondheim. Trondheim. 10.10.2011.

_Hohmeyer, O.: 100 % Renewable Electricity – How Can the Norwegian and German Power Systems Interact? Lecture given at NEREC 2010. Oslo. 28.9.2010.

The most important Bachelor's/Master's theses on energy issues supervised by the professorship/working group

_Benjamin Köhler, Modellierung des Wärme- und Kältebedarfs von Wohngebäuden im Rahmen eines Simulationsmodells des Energiesystems der Bundesrepublik Deutschland, 2013, Master's thesis

_Justus Riedlinger, Direct Linkage of Norwegian Pumped-Storage Hydropower Stations to the Central Western European Grid, 2013, Master's thesis

_Samuel Glismann, The Future Role of Gas-Fired Power Plants in the Netherlands – A Market Simulation in the Context of a Renewable Energy Dominated Electricity

System, 2012, Master's thesis

_Sebastian Schraven, Techno-ökonomische Bewertung induktiver Lademöglichkeiten für Elektrofahrzeuge, 2010, Diplom thesis

_Johanna Hartmann, Power to Gas bei den Stadtwerken Flensburg – Standortbetrachtung und Wirtschaftlichkeitsanalyse am Minutenreservemarkt, Bachelor's thesis

The most important conferrals of doctorates on energy issues supervised by the professorship/working group

_Mora Alvarez and David Fernando, Large Scale Integration of Renewable Energy Sources for Power Generation in Colombia, 2013

_Sascha Schröder, Wind Energy in Offshore Grids. 2012. Cumulative dissertation at the DTU, Management Engineering, Risø Campus

_Tom Trittin, "No Smoking" – CO₂-arme Stromerzeugung in einem nachhaltigen deutschen Energiesystem – ein Vergleich der CO₂-Vermeidungskosten von erneuerbaren Energiequellen und Carbon Capture and Storage, 2012

_Ingrid Nestle, The Cost of Climate Change in the Agricultural Sector – A Comparison of two Calculation Approaches, 2012

_Nicolai Herrmann, Regional Energy 2050 – A Sustainability-Oriented Strategic Backcasting Methodology for Local Utilities, 2010

Energy-related business startups/participation/cooperation (since 2002)

Name of founder(s): Olav Hohmeyer and eight partners

Name of company: Sustainable Energy and Climate Systems – Hohmeyer und Partner GmbH (in the process of being established)

Company headquarters: Flensburg

Type of business activity: Scientific consultancy services

Form of your cooperation with the company: Cooperation in division of work. Consultancy services are provided by the company, research is undertaken by the University of Applied Sciences.

Prof. Dr. Joachim Berg

Professorship: Electrical power engineering

At the University of Applied Sciences since: 1996

Core competences in energy research

1. Highly efficient electrical drive engineering
2. Sustainable drive engineering production technologies
3. Road, rail and coastal waters electromobility
4. High-voltage test technology in drive technology, partial discharge check on electrical machinery

Management responsibilities in transfer organisations and facilities relevant to energy research

_Publicly appointed and sworn expert for the specialist field: Electrical machinery and drive technology

Energy and climate protection R&D projects (since 2010)

eMotion

Funded by: Interreg IVA

Funding volume: €190,000 (Flensburg UAS contribution)

Cooperating partners:

SDU/Denmark

Kiel University

Kiel UAS

Emerge

Funded by: Interreg IVA

Funding volume: €173,000 (Flensburg UAS contribution)

Project duration: 10/2012 to 6/2015

Cooperating partners:

SDU/Denmark

University of Flensburg



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The most important Bachelor's/Master's theses on energy issues supervised by the professorship/working group

_Mateus Ohlsen, Optimierung des Messprozesses zur Bestimmung magnetischer Größen und Qualifizierung von magnetischen Eigenschaften in Elektrolechen, 2010, Bachelor's thesis

_Christian Frahm, Einflussanalyse der Elektrostahlqualität auf Testprozeduren eines permanenterregten Synchronmotors für Niedervoltanwendung, 2010, Bachelor's thesis

_Christian Frahm, Entwicklung eines 2-Phasen permanenterregten Synchronmotors mit einseitig elliptischem Drehfeld, 2011, Master's thesis

_Mateus Ohlsen, Analyse des Einflusses von magnetischen Eigenschaften in Elektrolechen auf das Verhalten elektrischer Maschinen, 2011, Master's thesis

_Jonas Gläser, Erstellung einer Datenbanksoftware zur automatisierten Auswertung weichmagnetischer Stoffe, 2012, Master's thesis

_Jens Schröder, Analyse und Optimierung der Entwicklungsprojekte elektrischer Maschinen, 2013, Bachelor's thesis

The most important conferrals of doctorates on energy issues supervised by the professorship/working group

_Jonas Gläser, Optimierungsprozesse bei der Berechnung elektrischer Maschinen, SDU/Denmark

_Henning Brodersen, Entwicklung optimierter Reluktanzgeneratoren für KWK, SDU/Denmark

Patents and patent applications on energy issues (since 2002)

Designation of proprietary right:

DE202009001837.7 dated 16 April 2009

Mobile standard lightning impulse voltage generator

All holders: Flensburg UAS

All inventors: Joachim Berg

Energy-related business startups/participation/cooperation (since 2002)

Name of founder(s): SECOP GmbH

Name of company: MCCH GmbH

Company headquarters: Flensburg

Homepage: www.mcc-tec.com

Type of business activity: Electrical machine development and series production



Prof. Dr. Friedrich Blödw



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Biotechnology

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bloedow

Professorship: Measurement and control engineering
At the University of Applied Sciences since: 1989

Core competences in energy research

1. Small-scale wind turbines
2. Frequency converters
3. Sensor fusion

Energy and climate protection R&D projects (since 2010)

Frequency converters with silicon carbide semiconduc- tors for small-scale wind turbines

Funded by: ISH
Project duration: 2011

Frequency converters for small-scale wind turbines up to approximately 10 kW are currently built exclusively using silicon power semiconductors (PIN diodes, IGBTs). They generally have a fairly good efficiency of approximately 96%. However, the overall efficiency of a wind turbine should primarily be considered. This is the product of the efficiencies of the rotor, any gearbox, the generator and the frequency converter, and is the decisive factor in how much of the power in the wind can be fed into the electrical grid. The task of this project was to enhance the overall efficiency of a small-scale wind turbine. The electrical component of the energy conversion chain, consisting of generator and frequency converter, will be optimised in terms of lower overall losses.

Current further education courses or conferences on energy issues held on a regular basis

Use of digital signal controllers in
frequency converters
Place/time: Flensburg UAS by appointment
Organiser: Prof. Dr. F. Blödw
Target group: Developers
Homepage: www.at.fh-flensburg.de/bloedow

Patents and patent applications on energy issues (since 2002)

A sensor fusion filter for determining the roll, pitch and
yaw angles
All holders: Friedrich Blödw

Determination of start commutation in synchronous ser-
vo drives
All holders: Friedrich Blödw



Prof. Dr. Jens Born

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Professorship: Chemistry and chemical technology
At the University of Applied Sciences since: 1995

Core competences in energy research

1. Biogas technology
2. (electro-)chemical accumulator and products, waste as energy store
3. Bioenergy as a complementary energy source to wind and solar energy

Management responsibilities in transfer organisations and facilities relevant to energy research

– Speaker for Centre of Excellence of Biomass in Schleswig-Holstein

Energy and climate protection R&D projects (since 2010)

Development, characterisation and testing of a laboratory MAB reactor for complex, unsterile fermentation taking place in ecological equilibrium (MABR)

Funded by: ZPW

Funding volume: €180,000

Project duration: 4/2009 to 9/2010

Previous unsterile anaerobic fermentation, such as anaerobic digestion in the biogas process, is nowadays generally carried out in continuous stirred tank reactors, in which ideally the same conditions prevail at each location. On the other hand, a large number of species of microorganisms are involved in the biogas process, which each require their own special optimal living conditions, that are however very different (pH-value, temperature, composition of the medium). A new type of reactor was developed from waste water technology (Anaerobic Baffled Reactor, ABR) into a multifunctional reactor MABR. In the medium term the technology might be able to replace the prevailing biogas technology in the local countryside.

The ABR enables the complex process of anaerobic digestion to be distributed in terms of space-time to any number of compartments, from which spatially different process conditions arise due to the development of microbial activity alone over time. The hydraulic retention time is also drastically reduced. The process becomes robust towards changes overall. In the MAB reactor that was investigated these conditions can also be specifically steered through certain external actions for every compartment and the yield of products of interest can be maximised in terms of both quality and quantity. The fluid mechanical and technical process evaluation and variation of the external influences in the various compartments leads to considerably more detailed findings about the kinetic progress of anaerobic digestion. These investigations will be used to optimise the yield and the concentration of gaseous and



dissolved products (biomethane, organic acids etc.). A further major advantage of the reactor is its extensive substrate invariance, insofar as the substrates are free-flowing or become fluids in the first process stage.

Scientific support for the bioenergy region of Northern Friesland North

Funded by: Fachagentur Nachwachsende Rohstoffe e.V.

Funding volume: €25,000

Project duration: 10/2009 to 6/2012

Cooperating partners:

Aktivregion Nordfriesland Nord

Scientific support for the bioenergy region of Northern Friesland through consultancy and lectures, studies and investigations on the issue of biogas, biomethane filling stations, grass fermentation and much more.

Large Scale Bioenergy Lab

Funded by: ZPW

Funding volume: €700,000

Project duration: 3/2012 to 3/2015

Cooperating partners:

Aalborg University, Esbjerg

University of Flensburg

The aim of the project is to develop and test technically, economically and ecologically sustainable solutions for the use of biomass in particular in biogas plants and in

bio-refinery environments in the region. Increasing use of biomass for technical and in particular for energy purposes can be observed on both sides of the German-Danish border. The different approach on either side of the border is a good starting point for the development of new collective solutions to generate energy, new energy products and other high quality products.

The high density of approx. 300 bioenergy plants is not only a significant income factor, but also brings challenges for the solution of new technical, economic, ecological and social problems, which result from this high density and the ensuing new antagonistic and synergistic effects. The large number of bioenergy plants is also a major factor in creating complementarity to other fluctuating renewable energy sources and therefore to improved use of the grid on both sides of the border.

The project together with the FUTURE eneRGY network forms the basis for a transnational network of politically responsible and economically/socially active players on either side of the border in order to identify these new problems, test possible solutions and demonstrate their feasibility on a commercial scale. The network brings together players from universities, the bioenergy plant operators and manufacturers and associated industries from municipalities on both sides of the border. Together they want to discover the most appropriate approaches to solutions and prepare for testing on a commercial scale.

This project brings not only an economic improvement but it should also make the region a leader in the innovative production of bioenergy and in the production of high quality products, namely a Large Scale Bioenergy Lab.



The most important Bachelor's/Master's theses on energy issues supervised by the professorship/working group

– Lars Jürgensen, Optimierungspotenziale im Anaerobic Baffled Reactor, 2011, Master's thesis

– Till Fuder, Optimierung der Energieversorgung einer Molkerei durch die Nutzung eigener Biogaserzeugungspotenziale, 2012, University of Flensburg, Master's thesis

– Tomke Janßen, Bioenergiedörfer in Baden-Württemberg Evaluation von Struktur und Effizienz, 2012, Bachelor's thesis

– Sebastian Jebesen, Anaerobe Fermentation von Großküchenabfällen mittels Mehrkammerfermenter, 2012, Master's thesis

– Rene Casaretto, Evaluation von effizienzsteigernden Maßnahmen an Biogasanlagen, 2013, Bachelor's thesis

– Dirk Buchholz, Integriertes Energiekonzept für kleine Kommunen unter dem Einsatz von Wärme- und Stromspeichern am Beispiel Föhr, 2013, University of Flensburg, Master's thesis

The most important conferrals of doctorates on energy issues supervised by the professorship/working group

– Lars Jürgensen, Dynamic Methanation of Biogas CO₂, running since 2012, Aalborg University

Patents and patent applications on energy issues (since 2002)

DE102010010294 dated 09/08/2011

Procedure and device for anaerobic fermentation

All holders: Flensburg UAS

All inventors: Jens Born, Holger Schneider

Brief description: Procedure for the anaerobic fermentation of a free-flowing substrate with defined dry substance content, by using a reactor with an inflow and an outflow with a large number of dividing walls between the inflow and the outflow, which are arranged in such a way that they alternately extend into the lumen of the reactor from the ceiling and the floor of the reactor, forming compartments through which substrate flows upwards and downwards. This is characterised by the fact that the distance between the dividing walls depends on the dry substance content of the free-flowing substrate.

Energy-related business startups/participation/cooperation (since 2002)

Name of founder(s): Holger Schneider, Jens Born

Name of company: Conviotec GmbH

Company headquarters: Flensburg

Homepage: www.conviotec.com

Type of business activity: Biogas technology

Form of your cooperation with the company:

Commissioned projects

Prof. Dr. Torsten Faber



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Wind Energy Technology
Institute
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http://weti.fh-flensburg.de

Professorship: Wind energy technology
At the University of Applied Sciences since: 2010

Core competences in energy research

1. Wind energy, wave and tidal energy
2. Certification
3. Construction technology

Management responsibilities in transfer organisations and facilities relevant to energy research

- _ Head of the Wind Energy Technology Institute (WETI), Flensburg UAS
- _ CEO of the WindEnergieZirkel Hanse e. V. board of directors
- _ Member of Deutsches Institut für Bautechnik (DIBt) wind energy project group

Energy and climate protection R&D projects (since 2010)

GADOW – German and Danish Offshore Wind

WP 4: Academic CPD

Funded by: INTERREG4A

Funding volume: €130,000

Project duration: 1/2013 to 6/2015

Cooperating partners:

ww.gadow-offshore.net

The aim of the project is to deliver more transparency on the provision of offshore power in Denmark and Germany, from both the corporate side and by universities and research institutes. Completed, current and publicly funded research projects on the Danish and the German side of the border region shall be clearly visible and made available to the benefit of both sides.

Prototype development of an energy-efficient, tensioned tubular steel tower concept for wind turbines

Funded by: EKSH

Funding volume: €150,000

Project duration: 8/2013 to 7/2015

Cooperating partners:

Aerodyn Energiesysteme GmbH, Rendsburg

In terms of CO₂, wind energy is today the most effective way of producing energy and this advantage can be substantially improved by using larger wind turbines and hub heights.

A new tensioned tower concept for these wind turbines was developed in this research project. The focus is on material savings and thus CO₂ emission reduction. Other positive factors are easier erection, improved transportability and a substantial cost reduction.

Timber rotor blades for wind turbines: Development of a rotor blade for rotor diameters greater than 60 m in hollow timber construction

Funded by: EKSH

Funding volume: €150,000

Project duration: 4/2014 to 3/2016

Cooperating partners:

PhiBlades UG

Rotor blades are regarded as a central component in the research and development of wind energy technology. The aim of the research project is to demonstrate the suitability of timber as a modern wind turbine rotor blade production material for today's performance classes and to develop the prototype for a hollow timber blade using planking.

Study on the relocation of the yaw bearing from the top of the wind turbine tower to the base of the tower in conjunction with a profiled tubular steel tower

Funded by: Forschungsvereinigung Stahlanwendung e. V.

(FOSTA), co-funded by Thyssen Krupp Rothe Erde

Funding volume: €130,000.00

Project duration: Project outline proposal approved

Cooperating partners:

Thyssen Krupp Rothe Erde GmbH, Dortmund

Best available technology and research reveal two study hotspots:

1. Steel tower profiling and design initially from a structural, aerodynamic and economical perspective. Plus determining and quantifying the impacts of an aerodynamically optimised tower profile on the rotor assembly.
2. The conception of a yaw bearing capable of transmitting the imposed forces without neutralising the savings options available for tower construction by high additional costs.

Development of an energy-efficient and sustainable wind turbine tower concept with yaw bearing at the tower base (profiled wind turbine tower)

Funded by: EKSH

Funding volume: €1,400.00 monthly stipend

Project duration: 2014 until 2016

The dissertation project involves the development of an energy-efficient and sustainable wind turbine tower concept. The concept's primary distinguishing features are a profiled tower, e.g. elliptical in shape, and a yaw bearing at the base of the tower. This provides an opportunity to counter the negative trend towards increasing specific tower masses and of preventing the resulting additional costs and CO₂ emissions.

Programme on Energy Efficiency in Southern Africa (PEESA)

Funded by: EU – EDULINK-Programme

Project duration: 2013 until 2016

Cooperating partners:

University of Wismar (project management), Jena University of Applied Sciences, four universities in South Africa and Namibia: Cape Peninsula University of Technology in Cape Town, Tshwane University of Technology in Pretoria, Vaal University of Technology in Vanderbijlpark, Polytechnic of Namibia in Windhoek

The development of renewable energy Master's programmes is the focus of an international consortium. European quality standards provide the basis for designing engineering study programmes. The experience gained at German universities with the implementation of European Network for Accreditation of Engineering Education (ENAE) specifications is applied. At the same time, the project provides an opportunity to simplify student and lecturer exchanges by means of standardised Master's study programmes.

Development of a condition monitoring system (CMS) for assessing wind turbine towers in terms of early damage recognition and continued operation once service life has expired

Funded by: EKSH

Funding volume: €150,000

Project duration: Awaiting approval

Cooperating partners:

Bolz und Prass GbR (BuP), Hamburg

Wind turbines undergo dynamic loading with heavily fluctuating load conditions. This results in damage and material fatigue in all components of a wind turbine (WT) within the load path which increase with time. This in turn leads to a limited service life.

Once the analytically determined service life is reached, the WT must be dismantled. Whether the wind turbine can continue to be operated or must be dismantled, must now be examined in line with the Guideline for the Continued Operation of Wind Turbines, Germanischer Lloyd (GL guideline). There is currently no coherent concept for determining the fatigue status of a WT. This research project aims to compile a suitable condition monitoring concept for assessing the fatigue of the WT structure.

Publications in professional journals covering energy issues

_Faber T. et al. (2014): Understanding Wind Power Technology, Theory, Deployment and Optimisation; Capture 7: Tower and Foundation, John Wiley & Sons, (ISBN 978-1-118-64751-6).

_Rudolf, R.T., Roscheck, F., Aona, Y., Faber, T. (2013): Mass-Optimized Design of Wind Turbine Tower using Guy Cables and Struts, International Conference on Fracture and Damage Mechanics, Italy.

_Beye, T., Rudolf, R.T., Faber, T. (2013): Concept study for transferring the yaw bearing to the tower foot of a wind turbine, Bauingenieur.

_Faber, T. (2012): Richtlinie für Windenergieanlagen: Einwirkungen und Standsicherheitsnachweise für Turm und Gründung, Schriften des Deutschen Instituts für Bautechnik, Series B, No. 8.

Congress presentations on energy issues

_Produktinnovationen für Strukturen von Windenergieanlagen, 6th OBMC Offshore Conference, Rendsburg, 03.07.2014.

_Material efficient tower concept with yaw bearing at the tower base, Advances in Wind Turbine Towers 2014, 3. International Conference, Bremen, 26.08.2014.

_Presentation of the needs and currently available offers of academic training in the offshore wind energy industry and further steps, Offshore Wind International Business-2Business Event, Esbjerg, Denmark, 10.12.2013.

_Wirtschaftliche Effekte von Offshore-Windparks am Beispiel von alpha ventus, Kieler Branchenfokus, 22.11.2012.

The most important Bachelor's/Master's theses on energy issues supervised by the professorship/working group

_Ola-Tayo Winzenburg, Technical Note/Guidelines for Hot Climate and Desert Conditions, 2012

_Tjark Beye, Konzeptstudie: Verlegung des Azimutlagers an den Turmfuß einer Windenergieanlage, 2012

_Till Bauerochs, Energetische Analyse des Offshore-Testfelds alpha-ventus, 2013

_Rasmus Borrmann, Holzflügel für Windenergieanlagen: Vorstudie zur Entwicklung eines Rotorblatts in Hohlprofil-Holzbauweise

_Robert Thomas Rudolf, Taller Towers for Larger Turbines: a Market Study of tower technologies for Onshore Wind Energy, 2013



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Management responsibilities in transfer organisations and facilities relevant to energy research

_ Vice Chairman of VDI 4600 (cumulated energy demand), Verein Deutscher Ingenieure (The Association of German Engineers)

Publications in professional journals covering energy issues

_ Hagedorn, G.: Kumulierter Energieverbrauch und Erntefaktoren von Photovoltaik-Systemen. Energiewirtschaftliche Tagesfragen, Vol. 39 (1989) issue 11, pp. 712–71.
_ Hagedorn, G.; Ilmberger, F.: Kumulierter Energieverbrauch und Erntefaktoren von Windkraftanlagen. Energiewirtschaftliche Tagesfragen, Vol. 42 (1992) issue 1/2, pp. 42–51.
_ Hagedorn, G.: Druckabsenkung in Rohrleitungssystemen. Brennstoff-Wärme-Kraft, No.12, pp.701–710, VDI-Verlag GmbH, Düsseldorf, Dec. 1990.
_ Hagedorn, G., Wagner H. J.: Stoffstromanalyse der Herstellung von kristallinen Photovoltaikmodulen. VDI Re-

Professorship: Development and evaluation of energy engineering systems

At the University of Applied Sciences since: 1999

Core competences in energy research

1. Holistic evaluations (cumulated energy demand and life cycle assessments)
2. Energy management and rational energy application
3. Innovation management and product development

ports No. 1093, VDI Verlag GmbH, Düsseldorf, 1993.

_ Hagedorn, G., Schaefer H.: Hidden Energy and Correlated Environmental Characteristics of P. V. Power Generation. Renewable Energy, Vol. 2, No. 2, pp. 159–166, Pergamon Press Ltd., Oxford-New York-Seoul-Tokyo, 1992.

Congress presentations on energy issues

_ Hagedorn, G., Kollatz Ch.: Erfolgsfaktoren für Kraftwerke aus Deutschland in den Wachstumsmärkten-Bestandsaufnahme und Trends. Conference Dampfkraftwerke im Wettbewerb (Steam power plants in a competitive market), TU Darmstadt, 09./10.04.1997.
_ Hagedorn, G.; Paul I.: Innovative Steam Power Plant Technology – New Solutions for the Benefit of Customers Worldwide. Power-Gen Europe '97, Madrid, Spain, June 1997.
_ Hagedorn, G., Seiter Ch.: Advanced Concepts for Large Steam Power Plants – Economic and Technical Solutions for Maximum Customer Benefit in Asia and Worldwide. Power-Gen Asia '97, Singapore, September 1997.
_ Hagedorn, G., Sogal V.: 2x300 MW-Class Coal-fired Steam Power Plant for India – Introduction of a New Modular Plant Concept. Power-Gen Asia '98, New Delhi, September 1998.
_ Collor, A., Hagedorn, G., Müller, S.: Möglichkeiten und Grenzen der Fernwärmeauskopplung aus standardisierten GUD-Kraftwerken. Kraftwerkstechnisches Kolloquium, TU Dresden, Dresden, September 2002.

The most important Bachelor's/Master's theses on energy issues supervised by the professorship/working group

_ H. Petersen, Analyse der elektrischen Energieversorgung einer mittelständischen Schiffswerft als Basis zur Ermittlung von Energieeinsparpotenzialen, 2010
_ I. Alcaz, Entwicklung des Regelenergiemarktes und Auswirkungen für die Voith GmbH, 2012
_ J.D. Singer, Modell zur vereinfachten Simulation der thermischen Leistung im Solarfeld und Receiver eines solaren Turmkraftwerks, 2011
_ T.D. Kringiel, Analyse der Leistungsschwankungen eines autarken PV-Hybridsystems, 2012
_ H. Kuczewski, Analyse des elektrischen Energie- und Medienverbrauchs bei der Fertigung von Zylinderkopf und Zylinderkurbelgehäusen, 2013



Professorship: Electrical energy engineering
At the University of Applied Sciences since: 2014

Core competences in energy research

1. Inverters for photovoltaic installations and battery storage
2. Wind power converters
3. Power converters for drives

The most important Bachelor's/Master's theses on energy issues supervised by the professorship/working group

_ N. Ketelsen, Entwicklung eines elektrischen Energiespeichersystems für Solaranlagen zur Kompensation des Eigenstrombedarfs von Einfamilienhäusern, 2014
_ H. Matthiesen, Optimierung eines gesteuerten Gleichrichters für einen Frequenzumrichter, 2014
_ N.-Chr. Post, Marktanalyse – Monitoring-Systeme für Photovoltaik-Kleinanlagen, 2014

Publications in professional journals covering energy issues

_ Hinrichsen, F.: 1 MW of Power from the Sun – Solar station eases grid connection of large photovoltaic power plants, Power Systems Design Europe, Sept. 2009, AGS Media Group, Annapolis MD, USA, pp. 34–35.
_ Hinrichsen, F., Ahmeling, M.: String central inverter system – A novel system combines the benefits of both central inverters and string inverters., Power Systems Design Europe, Jan./Feb. 2013, AGS Media Group, Annapolis MD, USA, pp. 32–34.

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Congress presentations on energy issues

_ Hinrichsen, F., Tareilus, G., Canders, W.-R.: 1 MVA-ARCPi with High Voltage IGBT Modules – Design and Practical Experience, Proceedings of the 10th European Conference on Power Electronics and Applications (EPE, 03), 2–4 Sept. 2003, Toulouse, France.
_ Hinrichsen, F., Koch, I., Canders, W.-R.: Current Source IGBT-Inverter for Low Inductive Synchronous Machines, Proceedings of the 35th Annual IEEE Power Electronics Specialists Conference (PESC, 04), 20–25 June 2004, Aachen, Germany.
_ Koch, I., Hinrichsen, F., Canders, W.-R.: Application of SiC-JFETs in Current Source Inverter Topologies, Proceedings of the 11th European Conference on Power Electronics and Applications (EPE, 05), 11–14 Sept. 2005, Dresden, Germany.
_ Canders, W.-R., May, H., Hoffmann, J., Hoffmann, P., Hinrichsen, F., Koch, I., Röstermundt, D.: Flywheel Mass Energy Storage with HTS Bearing – Development Status, WCRE/Eurosolar, International Conference on Renewable Energy Storage (IRES I), 30–31 Oct. 2006, Gelsenkirchen, Germany.
_ Hinrichsen, F., Canders, W.-R.: The Resonant Commutated Twin Pole Inverter, Proceedings of the 39th Annual IEEE Power Electronics Specialists Conference (PESC, 08), June 15–19, 2008, Rhodes, Greece, pp. 1414–1420.



Prof. Dr. Clemens Jauch



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Management responsibilities in transfer organisations and facilities relevant to energy research

– Vice-head of the Wind Energy Technology Institute (WETI) at Flensburg UAS

Energy and climate protection R&D projects (since 2010)

Investigation of the dynamic behaviour of gearless WT's in terms of the provision of power in the grid in the minutes and seconds range

Funded by: EKSH

Funding volume: €150,000

Project duration: 2013 until 2015

Cooperating partners:

GL Garrad Hassan Deutschland GmbH, Kaiser-Wilhelm-Koog

One of the greatest obstacles in the development of renewables in Schleswig-Holstein is the transmission capacity of the electrical grid. Grid expansion is inevitable, but also costly and time-intensive. It is therefore necessary to optimise utilisation of the existing grid. Using feed-in management modules grid operator's limit the power of wind turbines (WTs) as soon as the affected section of the grid reaches critical capacity. Grid utilisation could be increased if the WT power was not limited across the board, but intelligently controlled and adapted to current grid loading. The gearless WT concept with full power converter is widespread. At the same time, published metrological investigations into the dynamics of this installation concept are practically non-existent.

In terms of the controllability of WT power for targeted grid utilisation, this project will therefore focus on a gearless WT concept with full power converter.

The project will investigate and model the dynamic properties of the WT. The validated simulation model will be used to simulatively design controls for active adaptation of the WT power output to comply with current grid utilisation.

Professorship: Wind energy technology

At the University of Applied Sciences since: 2012

Core competences in energy research

1. Control of wind turbines
2. Wind energy grid integration
3. Electrical engineering for wind turbines

Development of a contactless pitch angle sensor

Funded by: Endowed professorship funds and Flensburg UAS

Funding volume: €25,000

Project duration: 2013 until 2014

In this project a pitch angle sensor is developed which contactlessly measures a wind turbine's (WT) pitch angle. For research purposes, the pitch angle of a WT often needs to be measured independently of the WT controls. When developing this sensor one specification is that neither the WT control sensor system, nor the WT's electrical installation should be altered. In order to meet these demands the sensor is installed on the WT's nacelle and measures the pitch angle contactlessly when the rotor blade passes the sensor. The measurement method is based on distance measurement using laser. The measured distances in millimetres are converted to a pitch angle in degrees in a data processing unit.

Dynamic grid support by wind turbines

Funded by: EKSH

Funding volume: €140,000

Project duration: 2014 until 2016

Cooperating partners:

Denker und Wulf AG, Sehestedt

Today, wind turbines (WTs) are already an important factor in electricity generation in Schleswig-Holstein and will assume a dominant role in the future. WTs produce fluctuating power as a function of the available wind. In an AC voltage grid the produced power and the consumed power must be identical at all times. Differences between produced and consumed power lead to deviations in the grid frequency. Because of their fluctuating power, WTs cause an increased demand for backup power plants, which maintain an equilibrium between production and consumption. Backup power plants are usually fast response, conventional power plants. Conventional power plants, among them fast response power plants, are being ousted by the increasing use of WTs. WTs therefore increase the demand for backup power and simultaneously replace power plants that can provide this backup power. WTs should therefore contribute to controlling the grid frequency. This research project aims to investigate practical options for providing backup power using WTs and for increasing sys-

tem inertia in the grid. WTs are generating units consisting of large, rotating masses. A rotating mass stores kinetic energy. This energy increases with increasing rotation speed and is released if the speed of the mass decreases. In the context of this project a control strategy and a controller shall be simulatively developed, which will allow the provision of backup power by WTs. This requires detailed knowledge of the dynamics of the wind turbine and its interaction with the wind. In addition, an algorithm shall be compiled, which forecasts the primary energy supply in the wind in front of the WT in the minutes and seconds range. This, in turn, can be incorporated in the WT control strategy.

Determining the aerodynamic properties of WT's from averaged WT operating data

Funded by: Endowed professorship funds and Flensburg UAS

Funding volume: €10,000

Project duration: 2013

The aerodynamic properties of a wind turbine (WT) represent an essential component of a WT simulation model. Information of this nature is not normally published by the WT manufacturers. During WT operation the WT's SCADA system (Supervisory Control and Data Acquisition) stores a number of characteristic signals at low temporal resolution. The purpose of these stored signals is to monitor WT operations. In this project an algorithm was developed to allow the aerodynamic properties of the WT to be reconstructed from the stored and time-averaged signals.

Controllable flywheel in a wind turbine rotor used to support grid frequency control (preliminary study)

Funded by: EKSH

Funding volume: €23,500

Project duration: 2014 until 2015

In this project a flywheel energy storage system is developed, with which the mass inertia of the wind turbine's (WT) rotor can be varied. The primary aim of this project is to make the energy stored in the rotating mass of a WT available for the electrical power grid. This is usually done by controlling the speed of the WT rotor. However, this also has unavoidable negative consequences for the aerodynamic power that the rotor can draw from the wind. Using the method developed in this project the kinetic energy stored in the rotating drive train is not stored or released by varying the speed, but instead by varying the mass inertia.



Publications in professional journals covering energy issues

– Jauch, C.: Stability and control of wind farms in power systems Risø-PhD-24(EN), 202 p. (ph.d. thesis), 2006.

– Jauch, C.: Transient and Dynamic Control of a Variable Speed Wind Turbine With Synchronous Generator. WIND ENERGY, vol. 10, pp. 247–269, 2007.

– Jauch, C., Sørensen, P., Norheim, I., Rasmussen, C.: Simulation of the Impact of Wind Power on the Transient Fault Behavior of the Nordic Power System, ELECTRIC POWER SYSTEMS RESEARCH, issue 77, pp. 135–144, 2007.

– Jauch, C., Cronin, T., Sørensen, P., Bak-Jensen, B.: A Fuzzy Logic Pitch Angle Controller for Power System Stabilization, WIND ENERGY, vol. 10, issue 1, pp. 19–30, 2007.

– Jauch, C., Islam S.M., Sørensen, P., Bak-Jensen, B.: Design of a Wind Turbine Pitch Angle Controller for Power System Stabilisation, RENEWABLE ENERGY, vol. 32, issue 14, pp. 2334–2349, 2007.

Patents and patent applications on energy issues (since 2002)

Simulation model for a wind turbine, and generation and use

All holders: Suzlon Energy GmbH

All inventors: Clemens Jauch

Brief description: Modelling method employing fuzzy inference systems, for compiling a precise WT simulation model, the source text of which allows no conclusions to be drawn on the design of the WT.

Simulation model for a wind turbine, and creation and use

All holders: Suzlon Energy GmbH

All inventors: Clemens Jauch

Brief description: Modelling method employing system identification and fuzzy logic, for compiling a precise WT simulation model, the source text of which allows no conclusions to be drawn on the design of the WT.

Prof. Dr. Dirk Ludewig



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Professorship: Marketing and entrepreneurship
At the University of Applied Sciences since: 2008

Core competences in energy research

1. Green entrepreneurship
2. Green economy

Management responsibilities in transfer organisations and facilities relevant to energy research

- _ Member of Dr. Werner Jackstädt-Zentrum für Unternehmertum und Mittelstand Flensburg
- _ Member of the Green Economy working group of the ADT – Bundesverband Deutscher Innovations-, Technologie- und Gründerzentren e.V.

The most important Bachelor's/Master's theses on energy issues supervised by the professorship/working group

- _ Maria Babry, Outlines of an International Marketing Strategy for Solar Landfill Covers. An Analysis for Solar Integrated Technologies GmbH, 2010, Bachelor's thesis
- _ Maria Babry, The Photovoltaics Market of Thailand: Strategic Market Analysis and Proposal for the Market Entry of juwi Solar GmbH, 2011, Master's thesis
- _ Bastian Lassen, Green Marketing – Marketing Ansatz im Bereich Green Business – Modellentwicklung und Betrachtung aktueller Beispiele, 2013, Master's thesis
- _ Michael Erdmann, Aufbau einer neuen Geschäftseinheit am Beispiel des Wärmecontractings in der Paribus Northenergy GmbH – Geschäftsmodellentwicklung und Herangehensweise, 2014, Master's thesis

Current further education courses or conferences on energy issues held on a regular basis

International Green Entrepreneurship Forum (IGEF)

Type of event: Annual network forum for science, the economy, politics and the public sector

Organisers: Dr. Werner Jackstädt-Zentrum für Unternehmertum und Mittelstand Flensburg and INTERREG Project "SPICE"

First forum in March 2014: Event slogan "Business Opportunities in the Green Economy – Combining Efforts of Science, Economy and the Public"

Sponsor of the first forum: Gesellschaft für Energie und Klimaschutz Schleswig-Holstein GmbH (EKSH)

Energy-related business startups/participation/cooperation (since 2002)

Name of founder(s): Benedikt Glück
Name of company: suncleX PV & Solarreinigung GbR
Company headquarters: Ohlstedt
Homepage: www.sunclex.com
Type of business activity: Solar and PV cleaning and derivation of amelioration measures

Name of founder(s): Jonas Lesch, Ulf Müller, Simon Hilpert
Name of company: Werde Energie GbR
Company headquarters: Handewitt
Homepage: www.werde-energie.de
Type of business activity: Small wind turbine/renewable energy projects

Name of founder(s): Jens Born, Holger Schneider
Name of company: Conviotec GmbH
Company headquarters: Flensburg
Homepage: www.conviotec.com
Type of business activity: Biogas plants

International Green Entrepreneurship Forum

Over 200 experts of the "Green Economy" came to Flensburg in March 2014 for the first IGEF network forum. This event for science, the economy and politics was held under the slogan "Business Opportunities in the Green Economy – Combining Efforts of Science, Economy and the Public".

"The IGEF wants to inform and network the forces of science and research, the economy, politics and the public. We want to prepare the ground with actual green economy projects and through this continue to move the region of Schleswig-Holstein, Hamburg and Southern Denmark forward in this sector", said the organiser Prof. Dr. Dirk Ludewig from Flensburg UAS. Representatives of companies, establishment projects and economic regions participated at the high quality event, together with students and academics. Five experts were involved in the podium discussion, including the Minister of Energy, Agriculture, the Environment and Rural Areas of Schleswig-Holstein Dr. Robert Habeck and the Chairman of the Danish industrial corporation Danfoss A/S Jørgen Mads Clausen.

IGEF

Dr. Hermann van Radecke

Active in: Physics and wind energy
At the University of Applied Sciences since: 1991

Core competences in energy research

1. Wind potential: Calculation, measurement, turbulence
2. Emissions: Noise, shade
3. Emissions from offshore wind farms: Underwater noise

Management responsibilities in transfer organisations and facilities relevant to energy research

- _ Member of the Underwater Noise Working Group Hamburg University of Technology (TUHH)

Energy and climate protection R&D projects (since 2010)

Measurement of the operational noise of offshore WTs to determine the noise emission through the noise transfer function between the tower and water in installations in the offshore test site

Funded by: BMU
Funding volume: €416,000
Project duration: 1/2008 to 12/2011

The marine mammals in the North Sea and Baltic Sea, seals and common porpoises, will in the future be subject to higher noise levels in the areas around the wind farms through the operation of offshore wind energy farms.

As part of this project the underwater noise emissions of 5 MW wind turbines from various manufacturers was determined in the alpha ventus wind farm (North Sea). Following the installation of three stationary underwater noise measurement facilities (5 hydrophones) in the wind farm and vibration measuring equipment at two underwater supporting structures (13 accelerometers at 2 foundations) it was possible to undertake noise measurements remotely in all weather conditions on 165 days and these could clearly be allocated to the sources.

The database built up over the duration of the project permits the statement that the wind turbines are quiet in relation to the loud North Sea and their noise emissions even at full load is of the same magnitude as the natural noise emission and that produced by ships. On average over everything the total level in the wind farm under water is the equivalent continuous noise level Leq 118 dB re 1 µPa. Converted to airborne noise (minus 62 dB) this is as loud as in the canteen at lunchtime. Harm to seals and common porpoises is not expected. The comparison with the canteen is also appropriate to the extent that algae grow on the foundations as artificial reefs, which attract fish and subsequently seals and common porpoises. The problem is that the water sound is very far-ranging and

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an accumulation of the operational noise of the offshore wind turbines occurs. It became clear that the underwater noise measurements carried out on offshore wind turbines would have to be continued similarly to subsequent measurements of the sound emissions of onshore wind farms in order to identify noise levels, which no longer correspond to the latest technology and in particular tonal parts in the noise emission spectrum, like the ones that occurred during this investigation and if applicable to arrange for them to be avoided through the Federal Maritime and Hydrographic Agency.

CEwind II, sub-project 3: Measurement of the natural and induced turbulence in the wake of wind turbines to provide statements on structural safety

Funded by: ZPW
Funding volume: €112,000
Project duration: 1/2009 to 12/2012
Cooperating partners: CEwind

In one onshore wind farm in the north of Schleswig-Holstein with 7 wind turbines, rated power of 2 MW each and a hub height of 65 m, 3 wind measuring masts in a line and 2 wind turbines in between were used to measure and record the wind speeds with high temporal resolution of one-second intervals at hub height for a period of over 9 months in 2012 and 2013. The measuring procedures were certified by 2 companies in accordance with the IEC standard so that reliable values were produced in a traceable manner. Wind speeds and turbulences were measured at 2 or 3 rotor diameter intervals from the wind turbines so that amongst other things the natural ambient turbulences in undisturbed inflow could be measured in front of a turbine as well as the additional turbulences generated by the turbines themselves. The initial result shows that the turbulence, averaged over all wind speeds greater than 4 m/s and broken down into direction per degree, rises from approx. 11% in the undisturbed inflow, which is the natural ambient turbulence at the site, to approx. 22% in the wake in close proximity to a turbine. These measurements are used to test calculation models for turbulences induced by turbines at a later date. With the validation of turbulence calculation models in the wake of wind turbines, in the future wind farms will be able to have additional density



Dr. Hermann van Radecke

without endangering structural safety, which is limited by the turbulence amongst other things.

The project is successful because during the investigation period the measurement data of wind in the wind farm was collected certified in accordance with the IEC standard at 3 locations in front of and in the wake of wind turbines to the nearest second over 9 months.

Publications in professional journals covering energy issues

_CEwind, Hrsg. (2014): *Understanding Wind Power Technology, Theory, Development and Optimisation*. Wiley Ltd., Chichester. Chapter 3 author team van Radecke, H., Mengelkamp, T., Kunte, A.: Wind resources, site assessment, ecology.

_van Radecke, H., Benesch, M.: *Schlussbericht zu Messung der Betriebsgeräusche von Offshore-WEA zur Bestimmung des Schalleintrags durch die Schallübertragungsfunktion zwischen Turm und Wasser an Anlagen im Testfeld Offshore*. RAVE Project reference number 0327687, Flensburg UAS, June 2012, <http://opac.tib.uni-hannover.de/DB=1/LNG=DU/>

_Benesch, M., van Radecke, H. (2012): *RAVE Underwater Operational Noise Measurements in the Offshore Wind Park alpha ventus – Project Description and Final Results*. DEWEK 2012, 11th German Wind Energy Conference, Bremen, November 2012.

_van Radecke, H. (2007): *Juni 2007 sonnenreichster Monat seit Beginn der Aufzeichnungen vor 25 Jahren*. Erneuerbare Energien, Edition 8, August 2007, pp. 54–57.

_van Radecke, H. (2004): *Turbulence Correction of Power Curves*. DEWEK 2004, 7th German Wind Energy Conference, Wilhelmshaven, October 2004.

Congress presentations on energy issues

_van Radecke, H., Benesch, M. (2012): *Operational underwater noise at alpha ventus*. Project: RAVE – Operational noise. RAVE International Conference 2012, Bremerhaven, 8–12 May, 2012, http://rave2012.iwes.fraunhofer.de/img/pdfs/Session4/4.5_vanRadecke.pdf.

_van Radecke, H. (2005): *Windenergie, Technische Entwicklungen, Multi-Megawatt-Klasse*. 9. Energietechnisches Forum, Kiel, 15–16 Nov. 2005.

_van Radecke, H., Christiansen, A. F., ed. (2004): *Die Novelle des EEG – Auswirkung auf Markt, Technik, Ökonomie*. Conference documentation, WIE Weiterbildung im Energiebereich, <http://www.wie-energie.de/3-archiv017.html>, March 2004.

_van Radecke, H., Christiansen, A. F., ed. (2003): *Repowering von Windenergieanlagen – Neue Herausforderung der Windenergienutzung an Land*. Conference documentation, WIE Weiterbildung im Energiebereich, Flensburg, March 2003.

_van Radecke, H., Christiansen, A. F., ed. (2002): *Windenergie aus dem Meer, Planungsstand Off-Shore-Anlagen*.

Conference documentation, WIE Weiterbildung im Energiebereich, Flensburg, Feb. 2002.

Current further education courses or conferences on energy issues held on a regular basis

Course Wind Energy

Date: Annually, in a university in Europe, a university in America

Organiser: Flensburg UAS and partner university

Target group: Bachelor's or Master's students as an elective or compulsory subject in renewable energy

Contact: hermann.vanradecke@fh-flensburg.de

Introduction to wind farm planning tools WindPRO and Windfarmer on the computer

Date: Annually, Flensburg UAS

Organiser: Flensburg UAS and partners

Target group: Wind energy engineers

Contact: hermann.vanradecke@fh-flensburg.de

The most important Bachelor's/Master's theses on energy issues supervised by the professorship/working group

_J. Beimoskie, *Sicherheit von Maschinen – Sicherheitsbezogene Teile von Steuerungen bei Windenergieanlagen nach DIN EN ISO 13849*, Completion 2014, Master's thesis

_M. Graber, *Extended Site Suitability Assessment in Accordance to IEC 61400*, 2013, Master's thesis

_L. Phuong, *Internal Grid Design of a Wind Farm, Technical and Economic Analysis with WindPRO, Regulations, Policies in Germany and Vietnam*, 2012, Master's thesis

_R. Dähne, *Market Analysis and Development of a Measurement System for an Off-Grid Energy System for an Off-Grid Energy Container to Supply Rural Areas with Electricity*, 2011, Master's thesis

_A. Kaschwich, *Neu- und Weiterentwicklung der Auswertesoftware zur Beurteilung der Geräusche und tonalen Anteile von WEA gemäß IEC 61400-11*, 2011, Master's thesis

_K. Luplow, *Fundamententscheidung für einen Offshore-Windpark unter Berücksichtigung technischer und wirtschaftlicher Aspekte*, 2010, Bachelor's thesis

The most important conferrals of doctorates on energy issues supervised by the professorship/working group

_Preparation of joint conferral of doctorates in the renewable energy sector at the University of Flensburg and Flensburg UAS

Prof. Dr. Michael Thiemke

Professorship: Combustion engines, energy engineering facilities

At the University of Applied Sciences since: 2012

Core competences in energy research

1. Engine engineering
2. Marine propulsion systems

Energy and climate protection R&D projects (since 2010)

Reduction in fuel consumption and CO₂ emissions in marine diesel engines

Funded by: AiF

Funding volume: €149,000

Project duration: 11/2010 to 01/2013

Cooperating partners:

FMC Fiedler Motoren GmbH, Aken

This project aims to identify the conditions required to achieve low fuel consumption (CO₂) and simultaneously low NOx emissions on a diesel engine specially designed to perform such investigations.

Current further education courses or conferences on energy issues held on a regular basis

36. Informationstagung zur Schiffsbetriebstechnik (35th briefing conference on marine propulsion engineering)

Date: 23.05.2014

Organiser: Institute for Nautical and Maritime Technologies (INMT) at Flensburg UAS

Target group: Shipping lines, shipyards, maritime suppliers

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The most important Bachelor's/Master's theses on energy issues supervised by the professorship/working group

_I. Stürzebecher, *Untersuchung zur elektrogeneratorischen Nutzung einer historischen Wassermühle*, 2014

_T. Naumann, *Konzeptstudie LNG*, 2014

_H. Jürgens, *Möglichkeiten zur Abwärmenutzung des Gunt-Gasturbinenversuchsstandes ET 792*, 2014

_M. Radloff, *Remotorisierung mit Gas-Generatorsätzen*, 2013

_J. Machau, *Energie- und Ressourceneinsparung auf einem Containerschiff*, 2013

_M. Gößwein, *Emissionsminderung durch Miller-Verfahren*, 2012



Savings potential through technical progress: Fuel consumption and pollutant emissions of marine engines can be drastically reduced.

Photo: Flensburg UAS

Prof. Dr. Ilja Tuschy



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Management responsibilities in transfer organisations and facilities relevant to energy research

- _ Founding member of the Center for Sustainable Energy Systems at the FUAS and University of Flensburg (ZNES), and head of research cluster of thermal energy systems
- _ ASME Journal of Solar Energy Engineering expert reviewer
- _ Jury member at EKSH EnergieOlympiade

Energy and climate protection R&D projects (since 2010)

Schleswig-Holstein compressed air energy storage power plant

Funded by: EKSH

Project duration: 2014 until 2016

Cooperating partners:

GEO mbH Langenhorn

In cooperation with a project planner, a transfer project sponsored by EKSH investigates the technical feasibility of a compressed air energy storage power plant in Schleswig-Holstein, its economical attractiveness to investors and operators, and its practical implementation with regard to the site.

Evaluation of an innovative steam turbine train concept

Project duration: 2011 until 2012

Cooperating partners:

MAN Diesel & Turbo SE Oberhausen

A special train concept, said to have advantages over conventional concepts in the partial load range, was investiga-

Professorship: Energy engineering in mechanical engineering
At the University of Applied Sciences since: 2006

Core competences in energy research

1. Techno-economical assessment of power generation concepts and installations
2. Energy storage in the power and heat industry, in particular compressed air energy storage power plants and thermal energy storage systems in power generation engineering
3. Solar thermal power plants and combined use of conventional and renewable energy

ted for a steam turbine supplier. The aim was to evaluate the market situation for this concept. Accordingly, both technical and economical criteria were evaluated.

Energy-related evaluation of solar thermal steam power plants

Project duration: 2010 until 2011

Cooperating partners:

MAN Diesel & Turbo SE Oberhausen

Differing solar thermal steam power plant concepts were compared in terms of energy for a steam turbine supplier. The aim of the comparison was to provide the component suppliers with information on the most probable technology path and the anticipated markets, to allow them to coordinate their development strategy.

Primary energy evaluation of the provision of district heating

Project duration: 2010

Cooperating partners:

Stadtwerke Flensburg GmbH

A balance of the facilities for district heating provision was drawn up for a local utility in order to evaluate the district heating supplied in the accounting period.

Engineering evaluation of an innovative power generation concept

Project duration: 2010

Cooperating partners:

Evonik AG Essen

An innovative power generation concept was evaluated technically and in terms of its efficiency potential for a power plant designer.

Comparison of technologies - steam turbine for solar thermal power plants

Project duration: 2009 until 2010

Cooperating partners:

MAN Turbo AG Oberhausen

Various concepts for use in solar thermal power plants were compared for a steam turbine supplier. The technical comparison was based on analyses of the annual technical yield at a number of example sites.

Publications in professional journals covering energy issues

_Morovic, T., Tuschy, I. (1997): Environmental effects of energy use in the Baltic region. In: A sustainable Baltic Region, Bd. 2: Energy, Uppsala: Ditt Tryckeri 1997, ISBN 91-7005-125-9.

_Tuschy, I., Franke, U. (2002): Thermische Hybridkraftwerke. In: BWK 54, No. 7/8, S. 56–58, Springer VDI-Verlag, Düsseldorf.

_Tuschy, I. Althaus, R., Gerdes, R., Keller-Sornig, P. (2004): Entwicklung der Gasturbinen in der Luftspeicher-Technologie. In: VGB PowerTech 84, No. 4, pp. 84–87, VGB, Essen.

_Vogelsang, A., Tuschy, I. (2011): Auswirkungen verschiedener technischer Parameter auf Einsatzmöglichkeiten und Ertrag solarthermischer Parabolrinnenkraftwerke. In: Beckmann, M., Hurtado, A.: Kraftwerkstechnik. Volume 3, pp. 411–421, TK-Verlag, Neuruppin.

_Tuschy, I., Render, M., Vogelsang, A. (2012): Planung, Einsatz und Entwicklung thermischer Kraftwerke unter neuen energiewirtschaftlichen Rahmenbedingungen. In: Beckmann, M., Hurtado, A.: Kraftwerkstechnik. Volume 4, pp. 159–168, TK-Verlag, Neuruppin.

Congress presentations on energy issues

_Tuschy, I., Dittmann, A., Franke, U. (1999): Hoch- und Nieder-Temperatur-Wärme-Kopplung: Kombination unterschiedlicher Energiequellen zur Krafterzeugung. Fortschrittliche Energiewandlung und -anwendung: Tagung/VDI-Gesellschaft Energietechnik. Munich (VDI Reports 1457).

_Tuschy, I., Althaus, R., Gerdes, R., Keller-Sornig, P. (2002): CAES with High Efficiency and Power Output. Energiespeicher: Tagung/VDI-Gesellschaft Energietechnik. Veitshöchheim (VDI Reports 1734).

_Tuschy, I. Althaus, R., Gerdes, R., Keller-Sornig, P. (2002): The Future of Compressed Air Energy Storage: High Efficiency and Power Output with Reliable Turbine Technology, ECOS 2002 15th International Conference on Efficiency, Costs, Optimization, Simulation and Environmental Impact of Energy Systems, Berlin.

_Tuschy, I. (2008): Druckluftspeicherkraftwerke als Option zur Netzintegration erneuerbarer Energiequellen: Ein Vergleich der Konzepte. 40. Kraftwerkstechnisches Kolloquium. Dresden.

_Vogelsang, A., Tuschy, I., Hohmeyer, O. (2011): Multi-Objective Optimization of Parabolic Trough Receiver Power Plants Under Variable Electricity Pricing Schemes by Different Technical Design Criteria, Proceedings SolarPACES2011.

The most important Bachelor's/Master's theses on energy issues supervised by the professorship/working group

- _V. Jülch, Wirtschaftliche Grenzkosten von Luftturbinen für Druckluftspeicherkraftwerke, 2010
- _S. Heinig, Thermodynamic and economic evaluation of the Shams 1 solar thermal power plant based on a comparison with conventional parabolic trough plant configurations, 2011
- _S. Helbig, Methoden und Kriterien zur Berechnung regionsspezifischer CO₂-Emissionsfaktoren der Sekundärenergieträger Strom und Fernwärme, 2012
- _J. Thomsen, Erstellung eines Modells zur Fernwärmeproggnose für die Stadtwerke Flensburg GmbH, 2012
- _L. Leienbach, Eine vergleichende Analyse der Potenziale von Power to Heat und Power to Gas in Deutschland – Status-Quo und langfristiger Ausblick, 2013

The most important conferrals of doctorates on energy issues supervised by the professorship/working group

- _A. Vogelsang, Mehrzieloptimierung von solarthermischen Parabolrinnenkraftwerken unter Berücksichtigung variabler Vergütungsschemata mit Hilfe technischer Auslegungsparameter, 2014, University of Flensburg
- Currently involved in four further doctoral projects on topics dealing with the technical energy industry.

Patents and patent applications on energy issues (since 2002)

US 6725665

All holders: ALSTOM Technology

All inventors: Peter Keller-Sornig, Ilja Tuschy

Brief description: Method of operation of gas turbine having multiple burners.

US 20030033812

All holders: Patent application

All inventors: Ralf Gerdes, Bozidar Seketa, Peter Keller-Sornig, Ilja Tuschy

Brief description: Method for cooling turbine blades/vanes.

US 7073335

All holders: ALSTOM Technology

All inventors: Ralf Gerdes, Peter Keller-Sornig, Ilja Tuschy

Brief description: Gas storage power station.

US 6725663

All holders: ALSTOM Technology

All inventors: Velimir Bakran, Peter Keller-Sornig, Ilja Tuschy

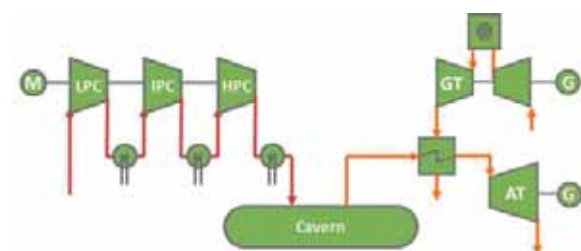
Brief description: Power plant and associated starting method.

US 6715296

All holders: ALSTOM Technology

All inventors: Velimir Bakran, Hermann Engesser, Peter Keller-Sornig, Ilja Tuschy

Brief description: Method for starting a power plant.





Faculty of Mechanical Engineering, Process Engineering and Maritime Technologies

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Professorship: Power engines and driven machines
At the University of Applied Sciences since: 2010

Core competences in energy research

1. Renewable energy systems
2. Fluids engineering
3. Marine engineering

Energy and climate protection R&D projects (since 2010)

e4ships – fuel cells in marine applications www.e4ships.de

Funded by: NOW, BMVBS

Funding volume: €30,919

Project duration: 2010 until 2016

Cooperating partners:

Hamburg University of Applied Sciences

The aim is to demonstrate the functionality of fuel cells in the on-board power supply of ships under routine conditions. Fuel cells can considerably contribute to emissions savings compared to traditional ships' aggregates. In e4ships, both high-temperature fuel cells using molten carbonate technology and low-temperature fuel cells using PEM technology are used.

Extension of ship engine simulation

Funded by: DFG

Funding volume: €173,000

Project duration: 2011 until 2013

The research activities are related to energy-efficient and resource-saving ship operations.

Purchasing replacement boiler and turbine units

Funded by: DFG

Funding volume: €328,000

Project duration: 2011 until 2013

Steam and turbine technology represent important core elements of energy, process and marine engineering with a broad application range. The aim is to identify optimisation and efficiency potentials through project work and application-oriented research activity (Wissen wirkt - Knowledge works).

ISO Ship Performance Monitoring project

Project duration: 2013 until 2014

Cooperating partners: www.nsmtdin.de

The International Standards Organisation (ISO) has initiated a working group on increasing energy efficiency in

maritime operations. Potential for efficiency increases in particular among the technical ship management personnel. The aim is to investigate and evaluate different standards, to allow practical recommendations for options for action to be defined and to compile a user guide.

Simulation of components for ocean and wave energy power plants

Using simulations, the dynamic history of power plant components is investigated, evaluated and optimised in terms of their load profile and yield forecasts under dynamic conditions.

Publications in professional journals covering energy issues

_Watter, H.: Regenerative Energiesysteme: Systemtechnik und Beispiele nachhaltiger Energiesysteme aus der Praxis, www.springer.com, 978-3-658-01484-1.

_Watter, H.: Schiffseffizienz – Praxisbeispiele für anwendungsorientiertes Wissenschaftsmanagement, SCHIFFS-INGENIEUR JOURNAL March 2014 (No. 351), pages 4–8.

_Jendrossek, J.-U., Watter, H.: Neue Performances-Standards für die Energieeffizienz des Schiffsvortriebes im praktischen Seebetrieb, INGENIEURSPIEGEL 2/2014, pages 69–17.

_Watter, H. (Ed.) et al.: Tagungsband OFFSHORE – ABER SICHER, Flensburg UAS, 2014, www.fh-flensburg.de/mz/2014_Offshore-aber_sicher-Tagungsband.pdf

The most important Bachelor's/Master's theses on energy issues supervised by the professorship/working group

_Tomke Wilde, Analyse und Bewertung von Projektierungsvorgaben für LNG-Rohrleitungssysteme eine Dual-Fuel-Schiffsantriebes, 2013

_Knuth Spahn, Lorenzen, Restrepo: Untersuchungen an STIRLING-Motoren, 2013

_Lars Nacke, Systemanalyse eines hydraulischen Energiespeichers für Windkraftanlagen, 2013

_Thies Sohrt, Einsatz experimenteller Modellbildung zur Trimmoptimierung zur Kraftstoffverbrauchsminimierung, 2013

_Andreas Christian Petersen, Modellierung, Bewertung und Aufteilung von Emissionskennwerten für verschiedene Transportschiffe, 2013

Professorship: Automation technology
At the University of Applied Sciences since: 1994

Core competences in energy research

1. Automation
2. Simulation

Energy and climate protection R&D projects (since 2010)

Mobile renewable charging station for electric bicycles

Funded by: EKSH

Funding volume: €26,000

Project duration: 4/2012 to 7/2013

The aim of the project is to design and build a mobile charging station for four electric bikes. The required electrical energy is intended to be provided exclusively through renewable energy. The charging station will be installed on the campus of Flensburg UAS in order to determine figures that can be used to design this type of system. As part of this the measured values will be found in field trials of the system to be developed. The system knowledge for a meaningful combination of decentralised renewable energy generation and its intelligent adaptation to certain consumers offers great potential with regard to the development of more complex systems.

Congress presentations on energy issues

_Wendiggensen, J.: Entwicklung einer autarken Ladestation für E-Bikes, published in: AALE 2013 Tagungsband, 10. Fachkonferenz Stralsund, ISBN 978-3-8356-3364-3.

The most important Bachelor's/Master's theses on energy issues supervised by the professorship/working group

_S. Köhn, Prognose der witterungsabhängigen Strombelastbarkeit von Freileitungen, 2011

_M. Jansen, Bewertung von Mechanismen zur Bepreisung von Ausgleichsenergie hinsichtlich der Systemintegration von Windenergie, 2011

_C. Wingenbach, Präqualifikation von Windenergieanlagen für die Erbringung negativer Minutenreserveleistung, 2011

_B. Gemsjäger, Netzeinspeisung, Vermarktung oder Eigenverbrauch – Deckungsbeitragsoptimierte Betrachtung eines dezentralen Energiesystems, 2010

Faculty of Energy and Biotechnology

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Electric charging station: Here electric bikes can be powered by renewable energy. Photo: Flensburg UAS

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Institute of Geosciences

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Management responsibilities in transfer organisations and facilities relevant to energy research

– ANGUS+ project: Scientific coordination of the joint BMBF project

Energy and climate protection R&D projects (since 2010)

ANGUS+: Impacts of the use of the geological subsurface for thermal, electrical or material storage – dimensioning, risk analysis and prognosis of induced effects

Funded by: BMBF

Funding volume: €1,670,000

Project duration: 7/2012 to 6/2016

Cooperating partners:

Institute of Geosciences, Kiel University, GFZ Potsdam, UFZ Leipzig, RUB Bochum

In the context of the ANGUS+ alliance the objective is to draft concepts for subsurface spatial planning with the aim of using deep subsurface space as a storage facility for synthetic natural gas, hydrogen and compressed air in caverns and pore storage space, as well as the shallow subsurface as heat storage. In an initial step, type scenarios are defined and parameterised, which then serve as the basis for storage option scenario analyses. In order to perform the envisaged scenario simulations, exhaustive development work on the numerical simulation system is necessary for process simulation. The aim is to realistically model the hydraulic, thermal, mechanical and geochemical processes involved. Based on the model system developed and the defined scenarios, the direct and indirect effects of energy and mass storage in the subsurface will then be investigated and quantified for these type localities. The impacts of individual and mutually-influencing storage options are determined and linked to the infrastructure on the surface, and the defined conservation and priority zones, based on the scenarios modelled. The insights gained will be made accessible to the public in a guide describing the use of the subsurface for energy and mass storage.

Professorship: Geohydromodelling

At the University since: 2007

Core competences in energy research

1. Storing renewable energy in the geological subsurface in the form of synthetic methane, hydrogen or compressed air
2. Geothermal energy and heat storage in the subsurface
3. Underground CO₂ sequestration and nuclear waste disposal

CO₂-MoPa – Modelling and parameterisation of CO₂ storage in deep saline formations for dimension and risk analyses

Funded by: BMBF

Funding volume: €640,000

Project duration: 1/2008 to 12/2011

Cooperating partners:

Institute of Geosciences, Kiel University; Helmholtz Centre for Environmental Research, Leipzig; Institute for Modelling Hydraulic and Environmental Systems, University of Stuttgart; State Agency for Agriculture, Environment and Rural Areas of Schleswig-Holstein

For the acceptance of new technologies, such as the storage of CO₂ in deep geological formations (CCS), a well-founded risk assessment and risk analysis is essential. The monitoring strategies necessary for this can be investigated using synthetic numerical modelling studies, because in these cases the parameterisation and the processes involved – in contrast to in nature – are precisely known. A modelling instrument, which reproduces the processes involved, was developed to numerically simulate CO₂ storage. The applicability of the modelling instrument was tested and impact forecasts compiled using a virtual location. The effects recorded were quantified on the basis of these numerical simulations and monitoring strategies investigated.

CLEAN – CO₂ Large-Scale Enhanced Gas Recovery In The Altmark Natural Gas Field

Funded by: BMBF

Funding volume: €125,000

Project duration: 7/2008 to 6/2011

Cooperating partners: GFZ Potsdam

In the CLEAN research and development project, the aim was to investigate the possibility of extracting, by means of carbon dioxide (CO₂), natural gas deposits not extractable using conventional methods in a subfield of the Altmark gas field. At the same time fundamental insights, adoptable globally for geological storage of CO₂ in almost exhausted gas reservoirs, were gained. The CLEAN project makes an important contribution to a scientific and impartial

assessment of underground CO₂ storage in the context of modern climate protection, because this technology can contribute critically to reducing future greenhouse gas emissions on a global scale.

Publications in professional journals covering energy issues

– Bauer, S., Class, H., Ebert, M., Feeser, V., Götze, H., Holzheid, A., Kolditz, O., Rosenbaum, S., Rabbel, W., Schäfer, D., Dahmke, A. (2012): Modeling, parameterization and evaluation of monitoring methods for CO₂ storage in deep saline formations: The CO₂-MoPa project. Environ. Earth Sci., DOI: 10.1007/s12665-012-1707-y.

– Mitiku, A.B., Li, D., Bauer, S., Beyer, C. (2013): Geochemical Modelling of CO₂ Interaction with Water & Rock Formation and Assessment of its Impact Referring to Northern Germany Sedimentary Basin. In press. Applied Geochemistry, DOI: 10.1016/j.apgeochem.2013.06.008.

– Li, D., Bauer, S., Benisch, K., Graupner, B., Beyer, C. (2013): OpenGeoSys-ChemApp a coupled simulator for reactive transport in multiphase systems – Code development and application at a representative CO₂ storage formation in Northern Germany. Acta Geotechnica, DOI: 10.1007/s11440-013-0234-7.

– Bauer, S., Beyer, C., Dethlefsen, F., Dietrich, P., Duttmann, R., Ebert, M., Feeser, V., Görke, U., Köber, R., Kolditz, O., Rabbel, W., Schanz, T., Schäfer, D., Würdemann, H., Dahmke, A. (2013): Impacts of the use of the geological subsurface for energy storage: an investigation concept. Env. Earth Sci. 70(8):3935–3943. DOI: 10.1007/s12665-013-2883-0.

– Beyer, C., Li, D., Lucia, M., Kühn, M., Bauer, S. (2012): Modelling CO₂-induced Fluid-Rock interaction in the Altensalzswedel Gas Reservoir, Part II – Coupled Reactive Transport Simulations. Env. Earth Sci., DOI: 10.1007/s12665-012-1684-1.

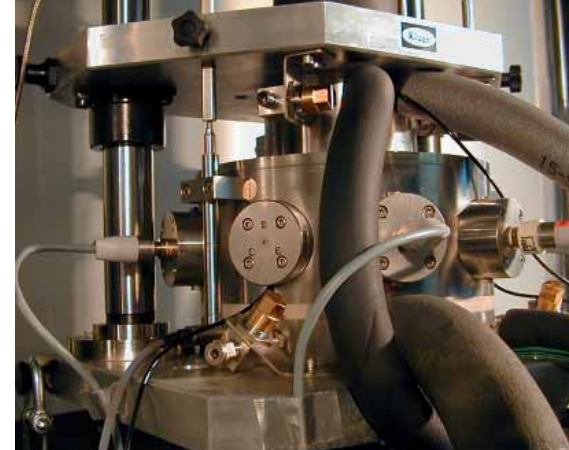
Congress presentations on energy issues

– Bauer, S., Li, D., Benisch, K., Graupner, B., Mitiku, A., Beyer, C. (2012): Development, Verification and Application of a coupled Multiphase Flow and Reactive Transport Simulator for Simulation of CO₂ storage in Saline Aquifers. Computational Methods in Water Resources 2012, 18.–21.06.2012, Urbana-Champaign.

– Boockmeyer, A., Bauer, S., (2014): Investigation of near borehole processes during high temperature heat storage in geological media using high resolution numerical simulations. Computational Methods in Water Resources 2014, 10.-13.06.2014, Stuttgart.

– Benisch, K., Köhn, D., al Hagrey, S., Rabbel, W., Bauer, S. (2013): Comparative study of CO₂ mass quantification using process modelling and geophysical techniques. Technologies for Sustainable Use of the Deep Sub-surface Conference, 30.09.-03.10.2013, Pau.

– Benisch, K., Graupner, B., Bauer, S. (2013): The Coupled



High-pressure test cell for performing one-dimensional deformation tests with temperature differentials. Photo: Volker Feeser

OpenGeoSys-eclipse Simulator for Simulation of CO₂ Storage – code Comparison for Fluid Flow and Geomechanical Processes. Energy Procedia 37, 3663–3671, 2013.

– Popp, S., Beyer, C., Bauer, S. (2014): Influence of periodic heat storage on transport and reaction processes in shallow aquifers. Computational Methods in Water Resources 2014, 10.-13.06.2014, Stuttgart

The most important Bachelor's/Master's theses on energy issues supervised by the professorship/working group

– K. Benisch, Numerische Prozesssimulation von CO₂-Sequestrierung in tiefe salinare Formationen, 2010, Diplom thesis

– A. Boockmeyer, Numerische Prozesssimulation von thermischer Konvektion in tiefen Formationen, 2012, Diplom thesis

– T. Pfeiffer, Einfluss von kleinskaligen geologischen Strukturen auf die Phasenausbreitung von CO₂ in tiefen salinaren Formationen, 2012, Master's thesis

– S. Popp, Ausbreitung von CO₂ in einem oberflächennahen Aquifer – Numerische Simulation von Mehrphasenströmungsprozessen am Standort Wittstock, 2012, Master's thesis

– J. Götz, Geochemische Folgereaktionen von Wasserstoffspeicherung in untertägigen Porenspeichern, 2013, Master's thesis

The most important conferrals of doctorates on energy issues supervised by the professorship/working group

– K. Benisch, Simulation of long term induced effects of pressure propagation and mechanical deformation and verification of geophysical monitoring methods for CO₂ sequestration in saline formations, current

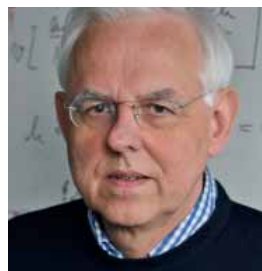
– A. Boockmeyer, Wärmespeicherung im Untergrund: Hochauflösende Modelle, Up-Scaling und Prognose der Auswirkungen, current

– W. Pfeiffer, Simulation von Wasserstoffspeicherung in untertägigen Porenspeichern: Hydraulische und geochemische Effekte, current

– A. B. Mitiku, Prognosis of hydraulic and geochemical long-term effects of CO₂ sequestration in saline formations, 2013

– S. Popp, Wärmespeicherung und thermische Beeinflussung des Schadstoffabbaus im Untergrund urbaner Räume, current

Prof. Dr. Johannes Bröcker



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Institute for Regional Research

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Professorship: International and Regional Economics
At the University since: 2000

Core competences in energy research

1. Modelling of spatial effects
2. Modelling of regional growth and development

Management responsibilities in transfer organisations and facilities relevant to energy research

- Member of editorial board of Letters in Spatial and Resource Sciences
- Member of the Environment Prize Committee of Studien- und Fördergesellschaft der Schleswig-Holsteinischen Wirtschaft e.V.

Energy and climate protection R&D projects (since 2010)**Added value and employment effects as a consequence of the expansion of renewable energy in Schleswig-Holstein**

Funded by: EKSH
Funding volume: €40,000
Project duration: 9/2013 to 5/2014

The subject of the project is to estimate employment and income effects, which arise during the course of the energy transition from the increased production of renewable energy in Schleswig-Holstein. The energy types covered are onshore wind energy, photovoltaics and energy generation from biogas as well as the network expansion associated with this. A distinction is made between effects in the construction and usage phase as well as between direct and indirect effects. The focus of the project is on the construction phase and in quantifying the direct employment and income effects. In addition, multiplier effects and fiscal effects are estimated. The most important indirect effects, such as for example displacing conventional types of energy, technological externalities and the change in the electricity price are described in qualitative terms. Finally the employment and income effects are estimated, which would arise from the Federal State Government's target of supplying 300 to 400 per cent self-supply with electricity from renewable energy by 2020.

Congress presentations on energy issues

- Riekhof, M.-C., Bröcker, J. (2014): Does the Adverse Announcement Effect of Climate Policy Matter? – A Dynamic General Equilibrium Analysis. Monte Verità Conference on Sustainable Resource Use and Economic Dynamics, Ascona, Switzerland.

The most important Bachelor's/Master's theses on energy issues supervised by the professorship/working group

- Jan Hendrik Preißler-Jebe, Beschäftigungs- und Einkommenseffekte als Folge des Ausbaus von Windenergie in Schleswig-Holstein, 2014

The most important conferrals of doctorates on energy issues supervised by the professorship/working group

- Marie-Catherine Riekhof, Essays in Resource and Development Economics, 2014



Photo Bröcker: Nees

Prof. Christoph Corves, Ph.D.

Professorship: Geography and media
At the University since: 2002

Core competences in energy research

1. Education and media for sustainable development
2. Social entrepreneurship
3. Environmental and sustainable communication

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www.sustainability.uni-kiel.de

**Management responsibilities in transfer organisations and facilities relevant to energy research**

- Coordination of Kiel School of Sustainability at Kiel University
- Management of the YooWeeDoo project (Inspirum gUG and Kiel University)

Energy and climate protection R&D projects (since 2010)**YooWeeDoo**

Funded by: EKSH, BMBF, MBWSH, Stifterverband, Kiel University, FFHSH
Funding volume: €300,000
Project duration: Since 2010

The project makes it possible for students to learn how to plan their own change projects to solve social tasks and



yooweedoo.

implement these themselves as part of their course. It provides students with strategies of social entrepreneurship and shows them how they can solve social challenges by using entrepreneurial approaches. In collaboration with EKSH focus points in the fields of energy, climate and environmental protection will be developed for students at universities in Schleswig-Holstein from 2014 until 2016.

The project consists of the following components:

Changemaker MOOC (October to January)

Changemaker MOOC is a video-based online course on which students learn about sustainable development, social innovation and social entrepreneurship. They are taught the fundamental aspects of methods for project planning, public relations, social media marketing and fund-raising. They draw up plans for their own change projects in teams of three to five people.
www.iversity.org/courses/changemaker-mooc-social-entrepreneurship

YooWeeDoo ideas competition (February to March)

Students can compete for start-up capital in the YooWeeDoo ideas competition to implement their projects using the plans for change projects drawn up in the Changemaker MOOC.
www.yooweedoo.org/ideenwettbewerb

Implement change projects (April to September)

Teams that win start-up capital in the ideas competition will implement their projects from April until September. Whilst doing so they will be supported by YooWeeDoo and their universities. In parallel with the implementation of their change projects the students will attend workshops on project and team management, cost planning and controlling, fund-raising, social reporting standards, non-profit marketing and communication.

Scope

The project has been built up since 2010 at the School of Sustainability at Kiel University. As of the winter semester 2013 participation in the MOOC is open to all those who are interested. Students at universities in Germany, Austria and Switzerland can take part in the YooWeeDoo ideas competition in 2014. There are special prizes for students at universities in Schleswig-Holstein.

Next Step Kiel. Electricity savings at universities through changing behaviour at the workplace. A pilot trial at the Institute of Geography of Kiel University

Funded by: MSH and the Governing Board of Kiel University
Funding volume: approx. €25,000
Project duration: 2011 until 2012



www.next-step-kiel.de

The aim of the "aving electricity campaign" project was to try out as an example at the Institute of Geography for Kiel University whether electricity can be saved by combining information, incentives to change behaviour and small-scale technical measures. All the measures were designed in such a way that they can be

Prof. Christoph Corves, Ph.D.

transferred to other departments at Kiel University.

The following partners are working together on the project:

- › GeoMedia working group (Institute of Geography) with students on the “Environmental communication and environmental management” at universities module.
- › Central administration at Kiel University, Department 5 “Technical construction and facility management” and Department 6 “Facility management – infrastructure
- › Gebäudemanagement Schleswig-Holstein (GMSH)

It was possible to stop the long-term trend of rising electricity consumption and to reduce electricity consumption by approximately 5%.

www.next-step-kiel.de

Learning city/Learning region

Funded by: Deutsche Bundesstiftung Umwelt (DBU), Ministry of the Interior of Land Schleswig-Holstein, City of Kiel, City of Lübeck, Bingo-Lotto-Stiftung-SH

Funding volume: €66,000

Project duration: since 2012



The research project “the learning city/region” deals with the question of how local sustainability processes can be supported and promoted by using participative Internet technologies. As part of the project the portals www.die-lernende-stadt.de and www.die-lernende-region.de are being built up. They can be used by cities to organise integrated and participative city and regional development processes. Ideas and knowledge regarding all aspects of sustainability (e.g. mobility, building & living, energy, nutrition & consumption, education) can be developed and implemented cooperatively on the portal. www.die-lernende-stadt.de
www.die-lernende-region.de

Citizens actively involved in the energy transition in SH

Funded by: Bingo-Lotto-Stiftung SH

Project duration: 2013 until 2014 (Phase I)

Cooperating partners:

Heinrich-Böll-Stiftung Schleswig-Holstein, Kiel

The project has the aim of raising awareness and increasing the commitment of citizens in Schleswig-Holstein in the energy transition by initially promoting the targeted education and information provided to citizens through appropriate formats in education, participation, process development and networking. This will be built on by creating a joint knowledge base as the foundation for joint action. Lastly actual voluntary action by citizens on site will be initiated and supported together with establishing a continuous exchange of information on a supra-local and supra-regional basis.

Overall the intention is to make a substantial contribution to promoting a sustainable, value added energy transition that protects the climate in the local and regional areas of activity of the Federal State. In addition, the project has the aim of creating interaction with business players as well as in politics and administration to use the great opportunities of the energy transition and climate protection for local development.

The following partners are working together on the project:

- › Heinrich-Böll-Stiftung SH
- › Gustav-Heinemann-Bildungsstätte
- › Hermann-Ehlers-Stiftung SH
- › Kirche für Klima, the climate campaign by the Evangelical Lutheran Church in Northern Germany
- › Bildungszentrum für Natur, Umwelt und ländliche Räume des Landes Schleswig-Holstein
- › Landesverband der Volkshochschulen Schleswig-Holstein e.V.
- › Working group for Geography and Media at Kiel University

The most important Bachelor's/Master's theses on energy issues supervised by the professorship/working group

- _ Niklas Hubert, Smarte Mobilität? Nutzungsverhalten und Effekte von Smartphone-Anwendungen für Fahrradverleihsysteme am Beispiel StadtRAD Hamburg, 2013, Diplom thesis
- _ Sebastian Starzynski, Verhalten ändern, Strom einsparen, 2012, Diplom thesis

The most important conferrals of doctorates on energy issues supervised by the professorship/working group

- _ Robin Koerth, Online-Partizipation und -Kooperation im Kontext nachhaltiger Stadtentwicklung

Prof. Dr.-Ing. Friedrich W. Fuchs

Professorship: Power electronics and electrical drives

At the University: From 1996 until 2013, remains active in research management and teaching

Core competences in energy research

1. Power electronics and electrical drives
2. Electrical energy conversion and grid integration of renewables
3. Drives in electromobility

Management responsibilities in transfer organisations and facilities relevant to energy research

- _ Chairman of the power electronics standardisation commission and international spokesman, German Commission for Electrical, Electronic & Information Technologies/VDE
- _ Member of EPE and PCIM conferences steering committee
- _ Associate Editor IEEE Transactions on Power Electronics

Energy and climate protection R&D projects (seit 2011)

Electrical drive train – highly efficient and robust electric drives with battery backup for working vehicles and automobiles

Funded by: EU, State of Schleswig-Holstein

Funding volume: €258,000

Project duration: 1/2012 bis 1/2015

Cooperating partners: Various

Globally increasing mobility and oil scarcity have pushed electromobility to the centre of society's, politics' and science's attention. The aim of this Interreg 4a – eMOTION project work package is to investigate and optimise the electrical drive train of an electric vehicle or a working vehicle. Possible drive train configurations were extensively analysed during the first project year. The driving power is approximately 40 kW. The battery voltage level should be between 200 V and 400 V.

Development and optimisation of an inductive charging system for hybrid and electric vehicles

Funded by: EKSH, industry

Funding volume: €172,000

Project duration: 6/2013 to 6/2015

Cooperating partners: Various

Today, electric vehicles are primarily charged using a cable connection between the vehicle and a mains connection point. Using inductive charging, in contrast, the power is contactlessly transferred via a magnetic field from a primary coil, embedded in the ground, to a secondary coil located in the vehicle. Inductive charging systems are based

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on the transformer principle, but suffer considerably less from coupling compared to conventional transformers due to the air gap between the ground and the vehicle.

Design, construction, commissioning and use of a low-voltage/medium-frequency measuring current generator for grid analysis

Funded by: BMU, industry

Funding volume: €328,000

Project duration: 2/2012 to 2/2015

Cooperating partners: Various

Electrical grids are increasingly fed from decentralised, regenerative energy generators. Grid control must be adapted to this situation. In order to do this the grid properties must be known. However, these are dependent on the connected consumers and their behaviour. This project aims to determine the behaviour of the low-voltage grid, and in particular its impedance, in order to improve feed-in from regenerative sources.

Investigation of autonomously controlled converters with the aim of improving behaviour for transient and stationary grid faults in microgrids

Funded by: Kiel University, industry

Funding volume: approx. €185,000

Project duration: 6/2010 to 5/2013

The aim of the project is to expose the positive and negative interactions between converters in a microgrid and to demonstrate exploitable synergies. The investigations are carried out on weak and isolated grid structures. The knowledge gained will be used to improve grid quality and stability under stationary and transient grid conditions. Conventional control approaches are compared to modern control methods for this purpose. In terms of the asymmetries in the supply voltage in particular, improvements in terms of stability, dynamics and grid quality are anticipated using the latter methods

Prof. Dr.-Ing. Friedrich W. Fuchs

Investigation of interactions between decentralised generating systems in electrical grids with a high number of converters

Funded by: Windenergiepark Westküste GmbH and E.ON Hanse AG

Funding volume: €90,000

Project duration: 5/2012 to 1/2015

This project investigates the behaviour of several decentralised generators in a grid. The analyses will first analyse the effects in quasi-stationary operations such as voltage boost and harmonics. The behaviour of the network, for example given a voltage drop, will then be investigated, whereby transient response, and system robustness and stability are important variables. Based on the results, strategies are developed and tested, in order to ensure high supply quality.

Analysis and optimisation of small-scale wind turbines

Funded by: EKSH, industry

Funding volume: €166,000

Project duration: 2/2012 to 2/2015

Cooperating partners: Various

Wind energy plays a large role in generating electrical energy. However, not only large wind turbines are important, but also small-scale wind turbines for producing energy as island systems in regions with weak infrastructure, in agricultural holdings, commercial zones or in private households, in order to guarantee sustainable energy generation. In this project the power electronics for such a system are optimised and implemented in the laboratory.

Optimisation of a converter assembly for wind turbines

Funded by: ISIT, State of Schleswig-Holstein, industry

Funding volume: €280,000

Project duration: 7/2013 to 11/2015

Cooperating partners: Various

The aim of this research project is to optimise a converter assembly for use in wind turbines (WTs). In addition to the extra space in the WT, efficiency improvements and enhanced reliability for simultaneous simplification of servicing are the priorities. These factors result in a converter system designed for use in WTs up to 1 MW.

Condition monitoring for frequency converters and controllers on generators in wind turbines

Funded by: ESF/Innovationsfond in CEwind

Funding volume: €100,000

Project duration: 9/2009 to 8/2012

This project deals with strategies for enhancing the availability of the electrical converter systems in wind turbines, especially with regard to offshore installations. One strategy investigated in this project encompasses the use of fault-tolerant converter topologies. This means that in the case of a fault in a power electronics component, such as a power semiconductor, the system remains capable of maintaining operations. This can be facilitated using redundant converter extensions, for example, which become active in case of a fault, or with the aid of new converter topologies. There are large differences in terms of fault tolerance options, depending on topology.

Grid integration of wind turbines with energy storage systems

Funded by: Industry

Funding volume: approx. €185,000

Project duration: 11/2010 to 11/2013

This project investigates the demand for energy storage systems (ESS) on WTs. Which of these grid-stabilising measures can be provided by WTs with ESS in an economically viable manner is also investigated.

Grid-adaptive control of the operating behaviour and active filter functionality of grid-connected PWM converters in wind turbines

Funded by: ESF/Innovationsfond in CEwind, industry

Funding volume: €362,000

Project duration: 09/2009 to 9/2012

Cooperating partners: Various

The electrical grid to which regenerative generators, such as wind turbines, are connected, comprises generators and consumers of the power-carrying fundamental frequency of 50 Hz. In addition, consumers may also draw from the grid by means of reactive power, asymmetries and low-frequency current harmonics, leading to a decrease in voltage quality. Using an adaptation of the frequency- and time-dependent grid impedance, grid-connected PWM converters can, in the ideal case, eliminate the asymmetrical fundamental frequency voltages and the low-frequency harmonic voltages in a range covering several multiples of the grid frequency (grid-adaptive active filter functionality).

Development of a battery backup system with power management in electric vehicles using 24/48 V, 5 to 20 kVA

Funded by: ISIT, State of Schleswig-Holstein

Funding volume: €170,000

Project duration: 2/2010 to 3/2013

Cooperating partners: Various

In this part of the project a battery backup system shall be developed for drive motors powered by a battery via converters. It consists of a DC/DC converter and double layer capacitors (DLC), in which the energy of braking can be stored. In addition, a higher-level power management system shall be developed, which defines the DC/DC converter setpoint value in order to return the stored energy to the system at a suitable point in time.

Publications in professional journals covering energy issues

_Wessels, C., Gebhardt, F. and Fuchs, F. W. (2011): Fault Ride-Through of a DFIG Wind Turbine Using a Dynamic Voltage Restorer During Symmetrical and Asymmetrical Grid Faults, IEEE Transactions on Power Electronics.

_Mohr, M., Franke, W. T., Wittig, B. and Fuchs, F. W. (2010): Converter Systems for Fuel Cells in the Medium Power Range – A Comparative Study, IEEE Transactions on Industrial Electronics.

_Dannehl, J., Wessels, C. and Fuchs, F. W. (2009): Limitations of Voltage-Oriented PI Current Control of Grid-Connected PWM Rectifiers With LCL Filters, IEEE Trans. on Industrial Electronics.

_Rothenhagen, K. and Fuchs, F. W. (2009): Doubly Fed Induction Generator Model-Based Sensor Fault Detection and Control Loop Reconfiguration, IEEE Transactions on Industrial Electronics.

_Bierhoff, M. H. and Fuchs, F. W. (2008): DC-Link Harmonics of Three-Phase Voltage-Source Converters Influenced by the Pulsewidth-Modulation Strategy – An Analysis, IEEE Transactions on Industrial Electronics.

Congress presentations on energy issues

_Fuchs, F. W., Gebhardt, F., Hoffmann, N., Knop, A., Lohde, R., Reese, J., Wessels, C. (2012): Research laboratory for grid integration of distributed renewable energy resources – design and realization, Energy Conversion Congress and Exposition, Raleigh (USA).

_Hoffmann, N., Fuchs, F. W. and Asiminoaei, L. (2011): On-line grid-adaptive control and active-filter functionality of PWM-converters to mitigate voltage-unbalances and voltage-harmonics – a control concept based on grid-impedance measurement, Energy Conversion Congress and Exposition, Phoenix (USA).

_Rothenhagen, K. and Fuchs, F. W. (2005): Performance of diagnosis methods for IGBT open circuit faults in three phase voltage source inverters for AC variable speed drives, European Power Electronics and Applications, Dresden.

The most important Bachelor's/Master's theses on energy issues supervised by the professorship/working group

_M. Andresen, PI-basierte Zustandsraumregelung eines Netzpulsstromrichters mit netzseitigem LCL-Filter bei reduzierter Anzahl von Messsensoren und variierenden Netzimpedanzen, 2013, Master's thesis

_M. Hempel, Verbesserung des Regelverhaltens von Netzpulsstromrichtern mit Aktiv-Filter-Funktionalität durch Störgrößenbeobachter und Adaption der Netzimpedanz, 2011, Diplom thesis

_B. Benkendorff, Entwurf, Aufbau und Inbetriebnahme von IGBT Treiberschaltungen, 2012, Diplom thesis

_S. Brüske, Untersuchung von Verfahren zur Fehlerdiagnose für einen fehlertoleranten dreistufigen NPC-basierten Umrichter für den Einsatz in Windenergieanlagen, 2011, Diplom thesis

_F. Gebhardt, Entwurf, Aufbau und Inbetriebnahme eines FACTS Umrichters für Windenergieanlagen, 2009

The most important conferrals of doctorates on energy issues supervised by the professorship/working group

_J. Dannehl, Regelung von Netzpulsstromrichtern mit LCL-Filter für Antriebe mit kleiner Kapazität im Zwischenkreis, 2012

_W. T. Franke, Vergleich von Siliziumkarbid-Leistungshalbleitern und ihre Anwendung in einem wirkungsgradoptimierten Photovoltaik-Wechselrichter, 2013

_K. Rothenhagen, Fehlertolerante Regelung der doppeltgespeisten Asynchronmaschine bei Sensorfehlern, 2011

_C. Wessels, Durchfahren von Netzfehlern bei Windenergieanlagen mit FACTS, 2012

_M. Bierhoff, Ein Vergleich von Netzpulsstromrichtern mit eingepprägter Spannung und eingepprägtem Strom im Zwischenkreis, 2008

Current further education courses or

conferences on energy issues held on a regular basis

Course on electrical machines, electronic power converters and controls 2011 and 2012

Organiser: Chair of power electronics, Kiel University

Target group: Industry employees being newly introduced to the field

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Prof. Dr. Eberhard Hartung



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Professorship: Agricultural engineering
At the University since: 2005

Core competences in energy research

1. Harvesting, storing and preserving biomass
2. Determination of energy/gas yields, fermentation kinetics
3. Contactless identification of constituents

Management responsibilities in transfer organisations and facilities relevant to energy research

- _ Speaker of the research and development group at Centre of Excellence of Biomass in Schleswig-Holstein
- _ Chairman of the “Knickholz” technical group at Centre of Excellence of Biomass in Schleswig-Holstein
- _ Member of governing board of Kuratorium für Technik und Bauwesen in der Landwirtschaft – KTBL

Energy and climate protection R&D projects (since 2010)

Development and investigation of a power-heat pump storage heating system

Funded by: Zentrales Innovationsprogramm Mittelstand (ZIM)

Funding volume: €133,000

Project duration: 1/2010 to 10/2011

Cooperating partners:

PSW-Energiesysteme GmbH

Koralewski Industrie-Elektronik oHG, Hambühren

TU Braunschweig

An innovative and highly efficient heat pump system, operated directly by a small, integrated combustion engine by means of gas and, alternatively, fuel oil, was developed. By exploiting the various waste heat fluxes and utilising environmental heat, the system allows improved energy exploitation compared to traditional heating systems.

Publications in professional journals covering energy issues

- _ Svoboda, N. et al. (2013): Crop production for biogas and water protection – A trade-off?, Agriculture, Ecosystems and Environment 177.
- _ Sieling, K. et al. (2013): Biogas cropping systems: Short term response of yield performance and N use efficiency to biogas residue application, European Journal of Agronomy 47.
- _ Jacobi, H.F. et al. (2012): NIRS-aided monitoring and prediction of biogas yields from maize silage at a full-scale biogas plant applying lumped kinetics, Bioresource Technology 103(1).
- _ Jacobi, H. F., Moschner, C. R., Hartung, E. (2011): Use of

near infrared spectroscopy in online-monitoring of feeding substrate quality in anaerobic digestion, Bioresource Technology 102(7).

- _ Jacobi, H. F., Moschner, C. R., Hartung, E. (2009): Use of near infrared spectroscopy in monitoring of volatile fatty acids in anaerobic digestion, Water Science & Technology 60(2).

The most important Bachelor's/Master's theses on energy issues supervised by the professorship/working group

- _ Hannes Lenz, Vergleich der Verfahrensketten Hackschnitzelinie und Rutenlinie zur Ernte von Kurzumtriebsgehölzen, 2011, Master's thesis
- _ Christian Glinkemann, Auswirkungen der Gärsubstrataufbereitung durch Ultraschallintegration auf den Biogasprozess, 2012, Bachelor's thesis
- _ Katarina Döpke, Die ökologischen Aspekte von Kurzumtriebsplantagen – eine Literaturübersicht, 2012, Bachelor's thesis
- _ Annika Hold, Konservierung von Winterrüben und Bestimmung des Biogasbildungspotentials, 2012, Master's thesis
- _ Sebastian Sporleder, Technische und Ökonomische Bewertung ausgewählter Verfahren zur Biogasaufbereitung, 2013, Master's thesis

The most important conferrals of doctorates on energy issues supervised by the professorship/working group

- _ Fabian Jacobi, Near-Infrared Spectroscopy for Process and Substrate Supervision of a Full-Scale Biogas Plant, 2011
- _ Susanne Ohl, Ermittlung der Biogas- und Methanausbeute ausgewählter Nawaro, 2011
- _ Current: Nutzung von Zuckerrüben als Energiepflanze
- _ Current: Nachhaltige Verwertung innovativer Gärprodukte zur langfristigen Verbesserung des Bodenlebens und der Bodenfunktionen im Landbau
- _ Current: Minimierung der Verluste in der Lagerung von Hackgut aus KUP und AFS

Prof. Dr. Wilhelm Hasselbring

Professorship: Software Engineering
At the University since: 2008

Core competences in energy research

1. Control technology
2. Monitoring
3. Operational management

Management responsibilities in transfer organisations and facilities relevant to energy research

- _ Spokesperson of Kompetenzverbund Software System Engineering (KoSSE)
- _ Scientific head, ESN Software Lab (Energiesysteme Nord GmbH)

Energy and climate protection R&D projects (since 2010)

ESN Software Lab

Funded by: ESN EnergieSystemeNord GmbH

Funding volume: €135,000

Project duration: 11/2012 to 11/2014

In the ESN Software Lab association project a general product line architecture is being drawn up for web-based cockpits in collaboration between the professorship for Software Engineering at Kiel University and ESN Energie-SystemeNord GmbH. The actual cockpits based on this architecture can then for example be used as control technology for network operations management, for energy registers as well as for decision support systems in the water and housing industry.

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Publications in professional journals covering energy issues

- _ Gul, I. A., Hasselbring, W. (2010): Towards Power Consumption Reduction by User Behavior Monitoring at Application level [Paper] In: Proceedings of the 23rd International conference on Architecture of Computing Systems (ARCS 2010).
- _ Hasselbring et al., WISENT: e-Science for Energy Meteorology [Paper] In: Proceedings of 2nd IEEE International Conference on e-Science and Grid Computing (e-Science '06).
- _ van Hoorn, A., Rohr, M., Gul, I. A., Hasselbring, W. (2009): An Adaptation Framework Enabling Resource-efficient Operation of Software Systems [Paper] In: 2nd Warm Up Workshop (WUP 2009) for ACM/IEEE ICSE 2010, 1-3 April 2009, Cape Town, South Africa.
- _ Ploski, J., Petroligis, T., Heinemann, D., Scheidsteger, T., Hasselbring, W. (2007): Grid-based modelling in Wissensnetz Energiemeteorologie [Paper] In: Tagungsband der Deutsch-Österreichisch-Schweizerischen Meteorologentagung (DACH 2007).



For a new generation of electronic signal boxes on the railways: In the KoSSE-MENGES association project the Department of Computer Science is working together with Funkwerk IT and b+m Informatik. Photos: Funkwerk IT



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Professorship: Agricultural policy
At the University since: 2000

Core competences in energy research

1. Political economy of bioenergy and agricultural policy
2. Interdependency of bioenergy and agricultural production
3. Bioenergy and regional development as well as bioenergy and quality of life

Energy and climate protection R&D projects (since 2010)

SP 12: Economic effects and assessment of biogas production in Schleswig-Holstein

Funded by: WTSH

Funding volume: €316,604

Project duration: 9/2009 to 9/2012

Cooperating partners:

Europrojects-LBV GmbH, Kiel

Treurat und Partner Unternehmensberatungsges. mbH, Kiel

U2B-Consulting GmbH, Kiel

Aim of this project is a quantitative analysis of the complex economical impact of an intensified expansion of the biogas production in Schleswig-Holstein taking into account the environmental restrictions. Special emphasis is put on the investigation of the impact on an operational, sectoral and regional level and their implication for local environmental goods for various physical subregions of Schleswig-Holstein taking into account the different economical and political conditions. Primary data acquisition of the biogas plants in Schleswig-Holstein via interviews over the telephone and enquiries to the offices in charge, secondary statistics, amongst others from the Agricultural Bookkeeping Organisation and from the Statistical Bureau of Schleswig-Holstein.

Factual implementation, regional distribution and economic effects of the intervention regulation under nature conservation law for wind turbines in Schleswig-Holstein

Funded by: EKSH

Funding volume: €18,400

Project duration: 10/2013 to 7/2014

Cooperating partners:

Prof. Dr. Uwe Latacz-Lohmann, Department of Farm Management and Production Economics, Kiel University

The construction of wind turbines is an intervention in nature and the landscape. In the Federal Republic of Germany the current Nature Conservation Act envisages that

unavoidable adverse effects on nature and the landscape are to be compensated by the person causing the latter. In a nutshell compensation is provided in the form that the area of compensation determined on the basis of the severity of the intervention is revalued through corresponding nature conservation measures.

Although the regulations of the intervention under nature conservation law through wind turbines are clearly documented, their specific implementation is not directly apparent in Schleswig-Holstein. In particular the specific administrative procedure to determine the level of the compensation payments as well as the specific use of the compensation payments is unknown. Precisely with re-



gard to the last aspect, the geographical distribution of income and expenditure for the compensation payments is interesting. On the one hand this arises from the fact that use of the compensation payments always also includes demand for farmland. The question therefore arises to what extent the regional use of the compensation payments for wind turbines has an effect on local land prices.

Publications in professional journals covering energy issues

_Albrecht, E. and Henning, C. (2013): *Biogasproduktion und Nachhaltige Landnutzung: Ein Widerspruch? – Eine Modellgestützte Analyse am Beispiel von Schleswig-Holstein*, published in the Austrian Society of Agricultural Economics (ÖGA) Yearbook.

Congress presentations on energy issues

_Albrecht, E. and Henning, C. (2012): *Biogasproduktion in Schleswig-Holstein und ihre Auswirkungen auf lokale und globale Umweltgüter*, Paper presented at the 62nd Public Faculty Conference of the Faculty of Agricultural and Nutritional Sciences of Kiel University, Germany.

_Henning, C., Zarnekow, N., Petri, S., Albrecht, E. and Hedtrich, J. (2013): *Public Evaluation and Political Acceptance of Sustainable Land Use Policies: An Econometric Application to Biogas Subsidization in Germany*, Paper presented at the 2013 AAEE/CAES Joint Annual Meeting in Washington, D. C., USA.

_Henning, C. (2014): *Gesellschaftliche Bewertung und Akzeptanz nachhaltiger Landnutzungspolitiken*, Paper presented at the 64th Public University Conference of the Faculty of Agricultural and Nutritional Sciences of Kiel University, Germany.

_Albrecht, E. and Henning, C. (2013): *Biogasproduktion in Schleswig-Holstein und ihre Auswirkungen auf lokale und globale Umweltgüter*, Paper presented at the 52nd Annual Conference of the German Society of Economic and Social Sciences in Agriculture (GEWISOLA).

The most important Bachelor's/Master's theses on energy issues supervised by the professorship/working group

_Michael Edeler, *Lobbying als Einflussfaktor politischer Beliefs: Eine Anwendung eines Politiknetzwerkansatzes auf die EU-Agrarpolitik*, 2012, Master's thesis

_Ernst Christian Albrecht, *Biogasproduktion und ihre Wirkung auf lokale und globale Umweltgüter: Eine modellgestützte Analyse für Schleswig-Holstein*, 2011, Master's thesis

_Martin Glimm, *Modellierung des Einflusses von Biogasanlagen auf die ökonomische Performance und Stoffflüsse in landwirtschaftlichen Betrieben in Schleswig-Holstein: Eine LP-gestützte Analyse*, 2010, Master's thesis

_Maria Höhne, *Bioethanolproduktion in Brasilien: Ein Konflikt zwischen lokalen und globalen Umweltinteressen?*, 2011, Bachelor's thesis

_Simon Stajohann, *Analyse der zeitlichen und räumlichen Ausbreitung von Biogasanlagen in Schleswig-Holstein*, 2011, Bachelor's thesis

The most important conferrals of doctorates on energy issues supervised by the professorship/working group

_Ernst Christian Albrecht, *Public evaluation and political feasibility of sustainable land use policies. Essays in political and economic modelling*, in preparation, Kiel University

Prof. Dr. Rainer Horn



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Professorship: Soil science
At the University since: 1988

Core competences in energy research

1. Maintaining soil functions and regeneration strategies
2. Optimisation of sustainable cable installation
3. Minimisation of environmental degradation and ecosystem processes

Energy and climate protection R&D projects (since 2010)

Suitability of various substrates and substrate mixtures for use in fermentation and effects of application on physical soil parameters considering the aspect of maintaining the sustainability of soil functions

Funded by: Fachagentur Nachwachsende Rohstoffe e. V. (FNR)

Funding volume: €500,000

Project duration: 12/2012 to 11/2015

Cooperating partners:

Institute of Agricultural Engineering, Kiel University

The aim of the project is to quantify various substrates (fresh and silaged) and substrate mixtures in terms of the energy utilisation of sustainable raw materials by anaerobic fermentation, and the effects of the fermentation products (FP) produced on microbiological and soil science properties, both in the laboratory and in field tests. Among other things, the facilities of a biogas process laboratory are used for scientific investigations with a variety of test set-ups at laboratory and pilot plant scales. To begin with, the input substrates (fresh/silaged) for fermentation are investigated in terms of their contents and microbiological quality, and fermented using the batch/continuous flow method. The resulting FP are subsequently characterised in terms of microbiological and substrate-specific rheological parameters, and are also applied to defined soils with differing textures and structures. The aim is to identify the effects on shear strength, as well as on permeability with regard to air and water, and on microbiological utilisation. For the first time, the planned investigations will provide systematic, detailed information from the beginning of the silaging process, through the fermentation stages, up to the reactions in soils. This will allow reliable recommendations on FP utilisation, interactions and sustainable soil functions to be derived.

Geotechnical and soil science monitoring for land-based cable installation for the DolWin alpha – Dörpen West 320 kV cable

Since 2008 soil science/geological mapping of the soils has been carried out, monitored by the institute, on behalf of Eon Netz Offshore/Transpower Offshore/

TenneT Offshore, prior to the construction project beginning, to provide information for the call for tenders. To date, a total of 150 km of underground cable route have been mapped prior to the project, and appropriate recommendations for the call for tender and also for the prior assessment of site conditions derived. The construction project was monitored during cable installation and the consequences of the construction project in terms of the quickest possible reinstatement of the site- and use-specific soil functions quantified by means of laboratory and field analytics. To date, around 1,000 probes/boreholes have been sunk in the context of soil mapping.



Preparing ditches for underground cable installation.



Installation of underground cables stored on geotextiles due to excessively soft ground.

Photos: Dr. S. Gebhardt

Services

- _Scientific monitoring of construction projects in the context of underground cable installation
- _Preparatory soil analyses along the route and deriving project boundary conditions and machine use

Publications in professional journals covering energy issues

_Gebhardt, S., Fleige, H., Horn, R. (2012): Bodenschutz auf Linienbaustellen. Bauernblatt, 06.

_Gebhardt, S., Zink, A., Horn, R. (2012): Bodenschutz auf Linienbaustellen am Beispiel der Erdverkabelung für den landseitigen Netzanschluss. Bodenschutz, 01/12.

_P. Hartmann, Gebhardt, S., Janßen, I., Fleige, H., Horn, R. (2009): Auswirkungen des Klimawandels auf die Gestaltung von geschichteten mineralischen Abdeckungssystemen von Deponien. Abschluss und Rekultivierung von Deponien und Altlasten: Egloffstein und Burghardt (Hrsg): 17, 207–217, ISBN: 978-3-939662-06-8, ICP Eigenverlag Bauen und Umwelt.

_Gebhardt, S., Fleige, H., Horn, R. (2009): Effect of compaction on pore functions of soils in a Saalean moraine landscape in North Germany, JPNSS 172,688-695.

_Zink, A., Gebhardt, S., Fleige, H., Horn, R. (2013): Verification of harmful soil compaction on cable construction sites. Advances in Geoecology, Soil Degradation 148–163. Advances in Geoecology, 42, Catena Verlag ISBN: 978-3-923381-59-3.

Congress presentations on energy issues

_Gebhardt, S., Fleige, H., Zink, A., Horn, R. (2011): Bodenkundliche Begleitung des Baus von Erdkabelanbindungen für Offshore Windparks in Ostfriesland. DBG Reports, www.dbges.de

_Horn, R. (2012): Bodenschutz auf Linienbaustellen – Auswirkungen auf die Ertragsfähigkeit landwirtschaftlicher Flächen. Erfahrungen aus der Erdkabelverlegung für den Netzanschluss von Offshore-Windparks. Presentation UA Erdkabel BMWi, Berlin.

_Gebhardt, S., Fleige, H., Horn, R. (2011): Bodenkartierung und nachfolgende bodenkundliche Baubegleitung für die 300-kV BorWin Alpha – Diele onshore-Kabeltrasse (Süd). Final report TenneT 60 S.

_Horn, R., Gebhardt, S., Fleige, H. (2013): Gedanken zur Energiewende aus der Sicht der Bodenkunde: Anforderungen im Zusammenhang mit der Stromtrassenwahl und Kabelverlegung. AEF publication series.

_Horn, R., Gebhardt, S., Fleige, H. (2011): Gutachten: Wissenschaftliche Baubegleitung zur Untersuchung und Herbeiführung von Betretungen sowie zur Einschätzung von Bodenmaßnahmen bei der Erdkabelverlegung.

Energy-related business startups/participation/cooperation (since 2002)

Name of founder(s): S. Gebhardt, A. Zink

Name of company: GZP

Company headquarters: Kiel

Homepage: www.gzp-kiel.de

Type of business activity: Construction monitoring, soil reports and deriving improvement measures.

Form of your cooperation with the company: Scientific and metrological analysis of current problems.



Prof. Dr. Christian Jung



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Professorship: Plant breeding
At the University since: 1993

Core competences in energy research

1. Genetics
2. Plant breeding
3. Energy beet

Publications in professional journals covering energy issues

—Frerichmann, S., Kirchhoff, M. Müller, A., Scheidig, A., Jung, C., Kopisch Obuch, F. (2013): EcoTILLING in *Beta vulgaris* reveals polymorphisms in the FLC-like gene BvFL1 that are associated with annuality and winter hardiness, BMC Plant Biology 13:52, doi:10.1186/1471-2229-13-52.
—Kirchhoff, M., Svirshchevskaya, A., Hoffmann, C., Schechert, A., Jung, C. and Kopisch-Obuch, F.J. (2012): High degree of genetic variation of winter hardiness in a panel of *Beta vulgaris* L. Crop Sci. 52:179–188.
—Kirchhoff, M., Kopisch-Obuch, F.J. and Jung, C. (2011): Genetische Variation zur Verbesserung der Winterhärte in Zuckerrüben. Zuckerindustrie 136:51–54.

Congress presentations on energy issues

—Kopisch-Obuch, F., Kirchhoff, M., Uhlmann, F., Pfeiffer, N., Ogutu, J., Orsini, E., Schechert, A., Jung, C. (2014): QTL for Winter Hardiness in Sugar Beet (*Beta vulgaris* ssp. *vulgaris* L.). International Plant and Animal Genome XXII, San Diego, 11-15 January 2014. Oral Presentation.
—Pfeiffer, N. et al. (2013): Genetic and phenotypic characterization of bolting failure in Sugar Beet (*Beta vulgaris*). “Sugar beet Workshop” Plant and Animal Genome Conference XXI, San Diego, CA, USA, 12-16 January, Oral Presentation.
—Kirchhoff, Martin et al. (2012): Genetic variation for improvement of winter-hardiness in sugar beet. “Breeding crops for sustainable agricultural production” Symposium of GPZ e.V., Gießen 28.2.–1.3.2012. Oral Presentation.

The most important Master's theses/conferrals of doctorates on energy issues supervised by the professorship/working group

—F. Uhlmann, QTL-Analyse von Winterhärte in Zuckerrübe (*Beta vulgaris* ssp. *vulgaris*), 2014, Master's thesis
—M. Kirchhoff, Genotypic and phenotypic characterization of winter hardiness in Beta species, 2013, Dissertation
—Nina Pfeiffer, Genetic mapping of bolting failure and bolting delay in *Beta vulgaris*

Energy and climate protection R&D projects (since 2010)

Centre of Excellence of Biomass in Schleswig-Holstein SP22: Breeding measures to increase the yield potential of beta beet for biomass generation

Funded by: EU, ZPW

Funding volume: €481,000

Project duration: 4/2009 to 9/2012

Cooperating partners: Strube Research, Söllingen

Non-flowering and sufficiently frost-resistant winter beet prototypes were to be created, which can be used for breeding winter beet species. The investigations show that the observed winter hardiness within the sugar beet gene pool is sufficient for cultivating winter beet under mild, maritime winter conditions. Beet bolting was to be prevented using a molecular hybrid switch system. To this end transgenic sugar beet were produced, containing various inactive forms of flower formation repressors, which can be activated after hybridisation with FLP recombinase plants. Hybridisation of the transgenic sugar beet was performed and the resulting seeds will be available soon.

Bioenergie 2021: Sugar beet as energy crop – Optimisation of the winter beet biological system

Funded by: BMBF

Funding volume: €371,000

Project duration: 4/2009 to 9/2014

Cooperating partners: Strube Research, Söllingen
Institute of Sugar Beet Research (IfZ), Göttingen

SP1: The aim is to investigate sugar beet transformants and mutants, as well as natural *Beta vulgaris* nativities, for bolting tendencies, to map genetic factors controlling bolting tendencies and to generate sugar beet with bolting resistance.

SP2: The aims are to determine the genetic variation in winter hardiness in sugar beet and related species, to create populations by targeted hybridisation, to split them according to winter hardiness and frost-tolerance and to genetically map the winter hardiness and frost-tolerance characteristics.

Prof. Dr. Uwe Latacz-Lohmann

Professorship: Farm Management and Production Economics
At the University since: 2002

Core competences in energy research

1. Effects of energy policy measures in agricultural businesses
2. Environmental economic assessment of energy policy measures
3. CO₂ efficiency and greenhouse gas avoidance costs in agricultural businesses

Management responsibilities in transfer organisations and facilities relevant to energy research

—Member of the Academic Council for Agricultural Policy at the Federal Ministry of Food and Agriculture
—Visiting professor for Agricultural and Resources Economy at the University of Western Australia

Energy and climate protection R&D projects (since 2010)

Analysis of the energy and greenhouse gas efficiency of agricultural businesses in Germany

Funded by: Deutsche Bundesstiftung Umwelt (DBU)

Project duration: 2013 until 2016

The core of this doctoral project is an empirical analysis of the energy and greenhouse gas efficiency of agricultural production in Germany with the assistance of the instrument of efficiency analysis. The data basis for this is a comprehensive dataset of annual financial statements from agricultural businesses in Germany. The following specific targets are being pursued with the research project:

1. It is to be investigated the energy and greenhouse gas efficiency of agricultural businesses in Germany and the determinants of energy-efficient agricultural production



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are to be evaluated. What features differentiate energy and climate gas efficient businesses from less efficient businesses? For example what role is played by the production system (ecological versus conventional, pasture grazing versus indoor stabling)?

2. It is to be analysed the change in the efficiency of the businesses over time in the dataset with reference to energy, greenhouse gases and costs. It can for example be determined through this what types of businesses and production systems have developed particularly positively with regard to their costs, energy and greenhouse gas efficiency and in what sectors of agriculture a need to catch up has manifested itself over time.
3. It is to be investigated what production-related changes (e.g. in factor input or the production programme) are needed to achieve energy or greenhouse gas efficient production and how high the costs or the benefits of the move to a minimal energy or greenhouse gas production are.
4. It is to be compared the competing elements and congruences of energy and greenhouse gas targets with business efficiency targets are to be identified and quantified on the basis of the results. In addition, recommendations for political action are to be derived and the implications for an energy and greenhouse gas efficient structure of agricultural production are to be presented.

Compensation for the external effects of preferences in the energy transition of population groups affected by the establishment of wind farms and electrical power lines

Funded by: EKSH

Project duration: 2014 until 2017

The aim of the doctoral project is an economic assessment of current practices providing compensation for intervention in nature and the landscape following the construction of wind farms and high voltage power lines. This assessment refers to two specific issues:

To what extent does the current and future expected occurrence of compensation payments for the construction of wind farms and ultra-high voltage power lines reflect the willingness to accept (WTA) of the population concerned? The WTA is the payment, which provides those affected

Prof. Uwe Latacz-Lohmann

ted with the same benefit for tolerating the intervention in the landscape as an unaffected landscape without any compensation payments. The WTA therefore provides the compensation level required to balance out benefit-neutral intervention. However, as the compensation does not flow directly to those affected, but provides only an indirect benefit in the form of nature conservation projects, the question must arise about the optimal use of the compensation money collected:

To what extent do the current and future conceivable alternative uses of the compensation money reflect the allocation of the funds collected to maximise their benefit? This question can be answered by using a willingness to pay analysis for alternative uses of funding. The specific aim is therefore to investigate the preferences of population groups affected by the intervention with regard to the use of the above-mentioned compensation payments.

Publications in professional journals covering energy issues

_Schulz, N., Breustedt, G., U. Latacz-Lohmann (2014): *Assessing farmers' willingness to accept "greening": insights from a discrete choice experiment in Germany*. Journal of Agricultural Economics 65 (1), 26–48.

_Alqaisi, O., Hemme, T., Latacz-Lohmann, U., Susenbeth, A. (2014): *Evaluation of food industry by-products as feed in semi-arid dairy farming systems: the case of Jordan*. Sustainability Science. DOI 10.1007/s11625-013-0240-6

_Latacz-Lohmann, U., Hennig, S., Dehning, R. (2014): *Bio-gas als Prestreiber am Boden- und Pachtmarkt? Eine empirische Analyse*. In: Die Zukunft der Bioenergie. Schriftenreihe der Rentenbank, Volume 30, 45-75. ISSN: 1868-5854.

_Hagemann, M., Ndambi, A., Hemme, T., Latacz-Lohmann, U. (2012): *Contribution of milk production to global greenhouse gas emissions: an estimation based on typical farms*. Environmental Science and Pollution Research 19 (2), 390–402.

Congress presentations on energy issues

_Latacz-Lohmann, U.: *Biogas als Treiber am Boden- und Pachtmarkt?* Lecture at the Scientific Conference of the Edmund Rehwinkel Foundation on the subject of "The future of bioenergy" on 6 and 7 May 2014 in Berlin.

_Latacz-Lohmann, U., Breustedt, G., Schulz, N. (2014): *Assessing farmers' willingness to accept "greening": insights from a discrete choice experiment in Germany*. Contributed paper at the 88th Annual Conference of the Agricultural Economics Society (AES); Paris, 9–11 April 2014

_Latacz-Lohmann, U.: *Einbeziehung der Landwirtschaft in die Klimaschutzpolitik: Möglichkeiten und Grenzen*. Lecture at the 64th Faculty Conference of the Faculty of Agricultural and Nutritional Sciences of Kiel University on 6 February 2014 in Kiel.

_Latacz-Lohmann, U.: *Emissionshandel in der Landwirtschaft*. Lecture at the annual conference 2013 of the Verband der Landwirtschaftskammern e. V. and the Bundesarbeitskreis Düngung (BAD) on 23 April 2013 in Würzburg.

The most important Bachelor's/Master's theses on energy issues supervised by the professorship/working group

_Malte Grohall, CO₂-Vermeidungskosten im Ackerbau, 2014, Bachelor's thesis

_Dorothee L. Schröder: *Einbeziehung der Landwirtschaft in die Klimaschutzpolitik: Eine Bestandsaufnahme internationaler Politikansätze*, 2012, Bachelor's thesis

_Norbert Fandrey, *Determinanten kosteneffizienter und klimagaseffizienter Milchproduktion – eine empirische Analyse*, 2014, Master's thesis

_Lars Köchel, *Einfluss der Biogaserzeugung auf die Landpachtpreise in Schleswig-Holstein*, 2014, Master's thesis

_Jan-Steffen Robohm, *CO₂- versus kosteneffiziente Rationen für die Milchviehfütterung*, 2014, Master's thesis

The most important conferrals of doctorates on energy issues supervised by the professorship/working group

_Patrick Wettemann, *Analyse der Energie- und Treibhausgaseffizienz landwirtschaftlicher Betriebe in Deutschland*, ongoing DBU project

_Ruben Dehning, *Kompensation externer Effekte der Energiewende-Präferenzen betroffener Bevölkerungsgruppen beim Ausgleich von Windparks und Stromtrassen*, ongoing EKSH project

_Solveigh Hennig, *Determinanten der Pacht- und Kaufpreise landwirtschaftlicher Flächen – räumlich-ökonomische Analysen*, ongoing doctorate project

_Martin Hagemann, *Empirische Analysen der Milcherzeugung im Hinblick auf Umweltwirkungen und Wettbewerbsfähigkeit*, 2011, Dissertation



Prof. Dr. Marco Liserre

Professorship: Power electronics

At the University since: 2013

Core competences in energy research

1. Power electronics and electrical drives
2. Electrical energy conversion and grid integration of renewables
3. Drives in electromobility

Management responsibilities in transfer organisations and facilities relevant to energy research

- _IEEE Fellow, 2013
- _Member of editorial board of various IEEE publications
- _Founder (2007) and editor-in-chief of the IEEE Industrial Electronics Magazine (2007–2009)
- _Founder (2008) and chairman of the technical committee for renewable energy systems (2008–2010)

Energy and climate protection R&D projects (since 2010)

The Highly Efficient And Reliable smart Transformer (HEART), a new Heart for the Electric Distribution System

Funded by: ERC Consolidator Grant (European Union)

Funding volume: €2,000,000

Project duration: 5/2014 to 4/2019

Cooperating partners:

CORPE (Center Of Reliable Power Electronics), Aalborg University

This project proposes a new smart transformer based on a modular architecture consisting of power electronics converters. The system will be capable of controlling the flow of energy and information between sources and loads with the objective of decoupling from the integrated grid. Current smart transformer designs cannot compete with traditional transformers in terms of costs, efficiency and reliability. This means that one of the emphases comprises increasing the competitiveness of the system in terms of these points.

The overarching aim of this research is to create a new, durable core for the electrical distribution network.

Publications in professional journals covering energy issues

_Remus, T., Liserre, M., Rodriguez, P. (2011): *Grid Converters for Photovoltaic and Wind Power Systems*, Wiley-IEEE, ISBN 8-0-470-05751-3.

_Liserre, M., Sauter, T., Hung, J. Y. (2010): *Integrating Renewable Energy Sources into the Smart Power Grid Through Industrial Electronics*, IEEE Industrial Electronics Magazine.

_Peña-Alzola, R., Liserre, M., Blaabjerg, F., Sebastián, R., Dannehl, J., Fuchs, F. W.: *Systematic Design of the Lead-lag*

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Network Method for Active Damping in LCL-Filter Based Three Phase Converters, IEEE Transactions on Industrial Informatics.

_Ma, K., Liserre, M., Blaabjerg, F.: *Operating and Loading Conditions of a Three-Level Neutral-Point-Clamped Wind Power Converter Under Various Grid Faults*, IEEE Transactions on Industry Applications.

_Blaabjerg, F., Teodorescu, R., Liserre, M., Timbus, A.V. (2006): *Overview of Control and Grid Synchronization for Distributed Power Generation Systems*, Industrial Electronics, IEEE Transactions on, vol.53, no.5, pp.1398, 1409.



Prof. Dr. Marco Liserre

Congress presentations on energy issues

_Andresen, M., Liserre, M., Buticchi, G.: Review of Active Thermal and Lifetime Control Techniques for Power Electronic Modules, The 16th European Conference On Power Electronics And Applications (EPE), Lappeenranta, Finland, August 2014.

_De Carne, G., Liserre, M., Christakou, K., Paolone, M.: Integrated Voltage Control and Line Congestion Management in Active Distribution Networks by Means of Smart Transformers, International Symposium on Industrial Electronics (ISIE), Istanbul, Turkey, June 2014.

_Brüske, S., De Carne, G., Liserre, M.: Multi-Frequency Power Transfer in a Smart Transformer Based Distribution Grid, 40th Annual Conference of IEEE Industrial Electronics Society (IECON), Dallas, USA, October 2014.

_Jedtberg, H., Pigazo, A., Liserre, M.: Robustness Evaluation of Transformerless PV Inverter Topologies, 15th IEEE Workshop on Control and Modeling for Power Electronics (COMPEL), Santander, Spain, June 2014.

_Buticchi, G., Barater, D., Concari, C., Soldati, A., Liserre, M., Franceschini, G.: Frequency-Based Control of a Microgrid with Multiple Renewable Energy Sources, IEEE Energy Conversion Congress & Expo (ECCE), Pittsburgh, USA, September 2014.

The most important Bachelor's/Master's theses on energy issues supervised by the professorship/working group

_Johannes Falck, Aktive thermische Regelung von Leistungshalbleitermodulen zur Erhöhung der Lebensdauer, Nov. 2014

The most important conferrals of doctorates on energy issues supervised by the professorship/working group

_Markus Andresen, Active Thermal Control for Power Electronic Modules, 2016

_Giovanni De Carne, Analysis of Smart Transformer Features for Electric Distribution, 2016

_Sebastian Brüske, Multi-frequency and Wireless Power Conditioning, 2017

_Holger Jedtberg, Robust Design and Reliability of Power Electronic Systems, 2017

_Levy Costa, Architectural Design of the Smart Transformer, 2017

Energy-related business startups/participation/cooperation (since 2002)

Name of founder: Nils Hoffmann

Name of company: Ingenieurbüro Hoffmann GmbH

Company headquarters: Halle/Peißen

Homepage: www.ibrhoffmann.de/beratung

Type of business activity: Consultation, draft development and training for industry incorporating system concepts and feasibility studies, as well as support in problematic cases

Form of your cooperation with the company:

Project monitoring, knowledge transfer

Prizes for services to science and knowledge transfer

IEEE award Dr. Bimal Bose Energy Systems (2014).

“Intelligent transformer ready-for-market by 2020”

Prof. Liserre, in the large HEART research project in Kiel, you aim to reinvent the distribution transformer, which has been used to electrify our towns and cities for 125 years. What must this component be capable of in future?

Prof. Liserre: The project aims to upgrade the electricity grid to meet current and future requirements. With the aid of communications and control technologies we aim to integrate an intelligent component into the distribution system. The power electronics components allow us to control the energy flow in the grid.

How can you develop your innovation until it is ready-for-series? And how long will it take?

There are already applications in railways and harbours where the intelligent transformer concept is used. We also anticipate that this technology will generate a turnover of 5 billion euros by 2020. The special properties for controlling the grid and its power fluxes will justify its use at higher procurement costs. The prerequisite is optimising the

efficiency and lifetime of the system in order to achieve maximum reliability. We will test this key concept within the next five years in order to demonstrate the competitiveness of the intelligent transformer compared to the traditional transformer. We expect market maturity in 2020.

How will the new transformer change electrification of towns and households?

The intelligent transformer allows maximum grid integration for renewables and therefore contributes to the energy transition. In addition, the electrical distribution grid can be optimally utilised, thus reducing overhead line construction. The flexibility of the intelligent transformer means that parts of the grid can be implemented in DC voltage, energy storage systems and charging stations for electric cars integrated, and gas and district heating systems coupled to the grid.

Prof. Dr. Thomas Meurer

Professorship: Automatic Control

At the University since: 2012

Core competences in energy research

1. Mathematical modelling
2. Optimisation and model-predictive control
3. Energy-efficient building automation
4. Networked dynamic systems

Management responsibilities in transfer organisations and facilities relevant to energy research

_Head of the Technical Committee “Distributed Parameter System” of the International Federation of Automatic Control (IFAC)

Publications in professional journals covering energy issues

_Wild, D., Meurer, T., Kugi, A. (2009): Modelling and experimental model validation for a pusher-type reheating furnace. Mathematical and Computer Modelling of Dynamical Systems (MCMDS), 15(3), 209–232.

_Wild, D., Meurer, T., Kugi, A., Eberwein, K., Bödefeld, B. (2009): Nichtlinearer Zustandsschätzer für einen Stoßofen. Stahl und Eisen, 129(1), 45–50.

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The most important Bachelor's/Master's theses on energy issues supervised by the professorship/working group

_Modellierung und Regelung eines Großgasmotors basierend auf einer Brennraumdruckerfassung, 2011, Vienna University of Technology

_Regelungsorientierte Modellierung der Klimatisierung eines Raumes, announced, 2014, Kiel University

The most important conferrals of doctorates on energy issues supervised by the professorship/working group

_Modellierung und Zustandsschätzung für Stoßöfen der Stahlindustrie

_Modellierung und energieoptimale Regelung von Gebäuden

_Modellierung und Regelung verfahrenstechnischer Prozesse





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Professorship: Environmental and Resource Economics
At the University since: 2007

Core competences in energy research

1. Climate and Energy policy
2. Determinants of energy demand

Management responsibilities in transfer organisations and facilities relevant to energy research

- _ Associate editor Energy Economics
- _ Member of the Steering Committee: EU ACCESS project

Energy and climate protection R&D projects (since 2010)

ACCESS – Quantification of climate change impacts on economic sectors in the Arctic



Funded by: EC-DG Transport (FP7-Ocean-2010/CP-IP)

Funding volume: €283,000

Project duration: 3/2011 to 2/2015

The Arctic Ocean is changing owing to advancing climate change. Rising temperatures are leading to a decrease in the ice cover in particular. This has implications not only for the ecosystem itself, but can also change human activities. The ACCESS project is investigating the socio-economic effects of improved access to the Arctic Ocean and considers the risks associated with this. Our research group is looking at the implications of increased oil and gas production in the Arctic Ocean. Together with partners from other disciplines we are investigating the costs, environmental risks, world market implications and the sustainability of offshore energy production.
(www.access-eu.org).

ACCEPT – What determines people's willingness to accept new climate change mitigation options?

Funded by: BMBF

Funding volume: €592,000

Project duration: 3/2012 to 2/2015

The international negotiations on controlling emissions have so far had only limited success. Governments are

therefore considering new instruments for climate protection, including CO₂ capture and storage (CCS) and climate engineering. Before these instruments can be tested or used, the costs and risks associated with them as well as their benefits must be investigated. The aim of the ACCEPT project is to undertake a detailed analysis of public acceptance of new technology to weaken climate change in Germany. Major determinants of the acceptance of innovative technology associated with risk are the available information on possible risks, feelings and risk awareness of citizens, as well as their trust in the institutions and players implementing the technology.

Publications in professional journals covering energy issues

_ Petrick, S., Rehdanz, K. and Wagner, W. J. (2011): Energy Use Patterns in German Industry: Evidence from Plant-level Data, *Journal of Economics and Statistics*, 231(3) 379–414.

_ Rehdanz, K. and Schröder, C. (2011): Residential Energy Expenditures in Germany: Intertemporal Evolution and Determinants, *Environmental Economics*, 2(3) 104–117.

_ Meier, H., Rehdanz, K. (2010): Determinants of Residential Space Heating Expenditures in Great Britain, *Energy Economics*, 32 949–959.

_ Rehdanz, K., Stöwhase, S. (2008): Cost Liability and Residential Space Heating Expenditures of Welfare Recipients in Germany, *Fiscal Studies*, 29 329–345.

_ Rehdanz, K. (2007): Determinants of Residential Space Heating Expenditures in Germany, *Energy Economics*, 29 167–182.

The most important Bachelor's/Master's theses on energy issues supervised by the professorship/working group

_ Measuring Sustainable Development: The Example of Energy Extraction in the Arctic

_ Konzeption und Messung von Energiesicherheit: Ein kritischer Überblick

_ Instrumente zur Förderung von Windenergie: Eine ökonomische Analyse

_ Methoden der Bewertung von Gesundheitsschäden am Beispiel eines nuklearen Super-GAU

_ Regulierung von CO₂-Emissionen durch den Schiffsverkehr: Eine ökonomische Analyse



Prof. Dr. Till Requate



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Professorship: Innovation economics, competition policy,
and new institutional economics

At the University since: 2002

Core competences in energy research

1. Modelling of energy markets and energy policy
2. Experimental economic research regarding behaviour on energy and emission trading markets
3. Emission trading

Energy and climate protection R&D projects (since 2010)

EXPECT: An experimental study of climate policy negotiations for policy design and impact assessment

Funded by: BMBF

Funding volume: approx. €450,000

Cooperating partners:

Kiel Institute for the World Economy (IfW)



The aim of this project is to combine methods of the experimental economy and computable general equilibrium modelling (CGE) to investigate how decision-makers behave in social dilemma situations with collective risks such as climate change. The purpose is to obtain findings, which are of significance for international climate negotiations.

Efficient market design for the support of renewable energy

Research project on energy (not financed by third-party funds).

Publications in professional journals covering energy issues

_Requate, T. (2014): Feed-in Tariffs versus Green Certificates in the Promotion of Renewable Energy, forthcoming, in Environmental Economics and Policy Studies.

_Döpke, L., Requate, T. (2014): The Economics of Exploiting Gas Hydrates, Energy Economics 42, 355–364.

_Reichenbach, J., Requate, T.: Potential Anti-Competitive Effects of Emission Permit Markets – A survey on Theoretical Findings and Evidence, Review of Economics 64 (3) 271–292.

_Camacho, E., Requate, T., Waichman, I. (2012): Invest-

ment Incentives under Emission Trading: An Experimental Study, Environmental and Resource Economics 53: 229–249.

_Reichenbach, J., Requate, T. (2012): Subsidies for Renewable Energies in the Presence of Learning Effects and Market Power, Resource and Energy Economics 34, 236–254.

Congress presentations on energy issues

_Subsidies for Renewable Energies in the Presence of Learning Effects and Market Power, EAERE 2011, 9 Jun 2011 to 02 Jul 2011, Tor Vergata, Rome, Italy.

_Investment Incentives under Emission Trading: An Experimental Study, EAERE 2011, 27 Jun 2012 to 30 Jun 2012, Prague, Czech Republic.

_The Economics of Exploiting Gas Hydrates, 28 Jun 2010 to 02 Jul 2010 Montreal, Canada, 4th World Congress of Environmental and Resource Economics.

The most important Bachelor's/Master's theses on energy issues supervised by the professorship/working group

_Jan Studt, An experimental investigation on a truth telling mechanism for emission control, 2014, Master's thesis

_David Hugo, Carbon leakage and border adjustment, 2014, Master's thesis

_Midja Mulser, Anreize und Fehlanreize beim Ausbau des Elektrizitätsnetzes im Zuge der Energiewende, 2011, Bachelor's thesis

_Dennis Wessendarp, Upstream vs. Downstream Regulierung: Alternativen zum traditionellen Emissionshandel aus wettbewerbspolitischer Sicht, 2011, Bachelor's thesis

_Annika Frommhold, Instrumente zur Förderung erneuerbarer Energien: Ein kritische Analyse, 2011, Bachelor's thesis

The most important conferrals of doctorates on energy issues supervised by the professorship/working group

_Lena Katarina Döpke, Optimale Ausbeutung endlicher Methanhydrat-Vorkommen und ihre Rückwirkungen auf das Klima, 2013

_Johanna Reichenbach, Analysis of Carbon Mitigation Policies: Feed-in tariffs, energy and carbon price interactions, and competitive distortions on carbon markets, 2011

_Wilfried Rickels, Optimal global carbon management with ocean sequestration, 2011

Prof. Dr. Carsten Schultz

Professorship: Technology management

At the University since: 2012

Core competences in energy research

1. Development of service innovations
2. Development of skills
3. Innovation processes

Energy and climate protection R&D projects (since 2010)

Innovative service – service skill for energy suppliers

Funded by: EKSH

Funding volume: Doctoral scholarship

Project duration: 7/2014 to 7/2017

In order to support companies in the energy industry with lower R&D capacities in developing services that are relevant for the future, the Institute for Innovation Research has initiated a three-year research project. This has the aim of giving support to energy suppliers in building up skills in service innovations independently. As part of this project, skills and requirements analyses will be conducted with participating companies, service development methods and innovative service concepts will be drafted together with select energy providers in pilot projects. These pilot projects will be supported by the Research Institute.

The research project is tailored for small and medium-sized energy companies, which frequently lack the funds and staff capacities for larger R&D projects. The project therefore ensures that small companies can also build up skills so that they can in future further develop their own ideas on innovative services independently and implement them on the market.

The three-year research project began in July 2014 and is supported by a doctoral scholarship from the Gesellschaft für Energie und Klimaschutz Schleswig-Holstein. Energy companies interested in innovation are welcome to contact Prof. Schultz and register to join the project.

Publications in professional journals covering energy issues

_Lütjen, H., Tietze, F., Nuske, T. (2014): Innovationskooperationen von Stadtwerken – Eine empirische Untersuchung von Treibern und Barrieren, BoD, Norderstedt.

_Lütjen, H., Tietze, F. (2014): Vom Energielieferanten zum Dienstleistungsinnovator. emw (Zeitschrift für Energie Markt Wettbewerb), Issue 04/2014.

_Tietze, F., Schiederig, T., Herstatt, C. (2013): Firms' transition to green product service system innovators: cases from the mobility sector. International Journal of Technology Management 63(1/2): 51–69.

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_Schiederig, T., Tietze, F., Herstatt, C. (2012): Green innovation in technology and innovation management – an exploratory literature review. R&D Management 42(2): 180–192.

_Lütjen, H., Tietze, F., Nuske, T. (2014): Kooperativ in die Zukunft. Zeitung für kommunale Wirtschaft (May): 9.

The most important Bachelor's/Master's theses on energy issues supervised by the professorship/working group

_Lütjen, H., Entwicklungskooperationen von Stadtwerken – Eine empirische Untersuchung von Treibern und Barrieren. Institute for Innovation Research, Kiel University, 2013, Master's thesis



Prof. Dr. Friedhelm Taube



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Management responsibilities in transfer organisations and facilities relevant to energy research

- _ Member of the Scientific Advisory Board on Agricultural Policy at the German Federal Ministry of Food, Agriculture and Consumer Protection (BMEL)
- _ Member of the German Research Foundation's (DFG) FG 207 (Plant Cultivation) review board
- _ Chairman of Deutsches Maiskomitee (DMK)
- _ Member of the AG Klimaschutz at Kuratorium für Technik und Bauwesen in der Landwirtschaft (KTBL)
- _ Member of the scholarship committee at Deutsche Bundesstiftung Umwelt (DBU)

Energy and climate protection R&D projects (since 2010)

Optimisation of cultivation methods for maize cultivation protecting water bodies (Green Maize for Blue Water)

Funded by: MELUR
Funding volume: €259,000
Project duration: 2013 until 2015
Cooperating partners:
Landwirtschaftskammer Schleswig-Holstein
Kiel UAS

Silo maize as fodder or a raw material for biogas production has expanded enormously in Schleswig-Holstein as a result of its good performance. This must be evaluated critically from an ecological perspective where maize production occurs on light-soiled sites threatened by leaching, often as a monoculture. In addition, it must be assumed that, in practice, maize tends to be oversupplied with nitrogen. The aim of this project is to analyse the potential of catch crops in combination with early-maturing maize types for reducing nitrate discharges in various Schleswig-Holstein landscapes. The project comprises development of a tool which allows a forecast of yield, N uptake and N flows in maize-catch crop systems and thus represents a component for optimising maize cultivation in Schleswig-Holstein.

Professorship: Grass and Forage Science/Organic Agriculture
At the University since: 1995

Core competences in energy research

1. Optimisation of biomass production systems
2. Evaluation of the environmental effects of biomass production
3. Modelling of biomass production and nutrient flows

BIOGAS-EXPERT, model-aided substance flow management in the soil-plant-fermenter system

Sub-project: Pilot operation Northern Friesland – Future proof biogas production in a preferential biogas generation region in Schleswig

Funded by: ZPW
Funding volume: €446,592
Project duration: 2011 until 2013
Cooperating partners:
Landwirtschaftskammer Schleswig-Holstein, Rendsburg;
Norddeutsche Pflanzenzucht
Hans-Georg Lembke KG, Hohenlieth
Schmack Biogas AG, Hamburg
Agronomy and Crop Science Group
Kiel University

The viability of biogas plants is primarily determined by the methane/hectare yield. In marginal yield locations, such as the marsh regions of Schleswig-Holstein, maize may lose its superiority compared to other crop types such as cereals and fodder grasses. In addition to productivity, the stipulations of the fertiliser regulations and cross-compliance regulations must be taken into consideration. In this context, nitrate leaching losses and ammonia volatilisation, as well as the potentially negative effects of maize monocultures on the humus balance, must be regarded as problematic. This pilot project analyses and evaluates substrate production and substance flow management for marshes with the aid of models.

Sub-project: Model coupling and regionalisation

Funded by: ZPW
Funding volume: €149,840
Cooperating partners:
Agronomy and Crop Science Group, Kiel University

An internet-based, regionalised information service was to be developed with the aid of the model system, providing users with information on optimising crop rotation and the use of fermentation residues considering local site conditions. The emphasis of the work was placed on coupling the individual modules to form an overall system model. The aim was to then analyse and quantify the following target variables: Yields of energy crop rotations

(dry solid matter, N extraction, potential gas yield), N losses (leaching, N₂O, NH₃ emissions), methane emissions, N utilisation efficiency and humus balance.

Sub-project: Life-cycle assessment of biogas production systems under Schleswig-Holstein's cultivation conditions

Funded by: ZPW
Funding volume: €83,256
Project duration: 2011 until 2013
Cooperating partners:
E.ON Hanse Wärme GmbH
Agronomy and Crop Science Group, Kiel University

The majority of Schleswig-Holstein's biogas plants are located in the Geest region, where the light soils mean a greater risk of nitrate being displaced into the groundwater. In addition, the trend is towards larger plants, meaning long transport routes for the fermentation substrates and fermentation residues, thereby negatively influencing the energy balance and thus climate protection. The aim of the project was to perform a comprehensive evaluation of the system of biogas production in Schleswig-Holstein by means of a life-cycle assessment in the context of a life-cycle analysis (LCA), based on the data raised in the Biogas-Expert project.

Sub-project: Optimisation of the yield and nutrient utilisation efficiency in systems for the production of biomass for biogas plants under Schleswig-Holstein's climatic conditions

Funded by: ZPW and innovation fund
Funding volume: €259,152
Project duration: 2008 until 2011
Cooperating partners:
Agronomy and Crop Science Group, Kiel University

The aim of the sub-project was to investigate various energy crop cultivation systems in terms of their performance and fermentation residue utilisation options. Field tests were established at two test sites (Hohenschulen, eastern hill country, and Karkendamm, Geest). Maize monocultures, energy crop rotations and grasslands were then subjected to differing fertiliser regimes and investigated. Dynamic simulation modules used to calculate dry mass production and N efficiency of the tested crop types were then adapted to the special energy crop production conditions and developed further based on the data collected.

Sub-project: Impacts of fermentation residue application on the N leaching potential of different crop rotations

Funded by: ZPW and innovation fund
Funding volume: €203,382
Project duration: 2008 until 2011

With the coming into force of the Renewable Energy Sources Act (EEG) and in particular since its amendment in 2004 there was an increased tendency to install biogas plants. During the course of this development an expansion of energy crop cultivation, in particular maize, for use in co-fermentation with liquid manure or in mono-fermentation was observed. As far as evaluating the environmental impact of energy crop cultivation in terms of emissions of trace climate gases and ammonia, as well as N input to the hydrosphere is concerned, there was an urgent need for research at the time the project was applied for. This is extremely relevant, in particular in view of the EU nitrate and NEC directives. The aim of the sub-project was to systematically analyse and evaluate the N leaching potential of selected, practice-relevant energy crop production systems.

Crops and Animals TOGETHER – CANTOGETHER

Funded by: EU 7th Framework Programme
Funding volume: €90,479
Project duration: 2012 until 2017
Cooperating partners:
25 cooperating partners from a variety of European countries

German agriculture is characterised by a high degree of specialisation. This increasingly leads to excessive N and P problems in animal husbandry operations and to increasing resistance in pests due to very rapid crop rotation. In the EU project CANTOGETHER the potentials of a mixed farming system in terms of N efficiency, and energy and ecological efficiency, are quantitatively recorded at a variety of sites in Europe. In the context of this project various operating models are simulated using variable crop rotation at the Experimental Farm Lindhof (Kiel University). The performance, nutrient outputs and greenhouse gas emissions are recorded and the eco-efficiency of these operating models determined using modelling approaches. Our hypothesis is that mixed farms display greater eco-efficiency than specialised operations.

Climate gas emissions in conventional and organic farming

Funded by: Fielmann AG
Funding volume: €51,395 (donation)
Project duration: 2012 until 2015
Cooperating partners:
Institute of Applied Ecology, Kiel University

Numerous studies demonstrate that organic farming produces less greenhouse gas emissions per unit of area (ha). With land for the production of agricultural raw materials becoming increasingly scarce globally, eco-efficiency (emissions per product unit) is becoming increasingly relevant as the scale against which sustainable land use is evaluated. Against this backdrop the eco-efficiency of or-

Prof. Dr. Friedhelm Taube

ganic and conventional farming is comparatively studied in two pilot operations in Schleswig-Holstein's eastern hill country. The hypothesis is that the product-related greenhouse gas emissions reduce the superiority of organic farming in terms of the land area reference variable (ha).



CO₂ gas exchange measurements in grassland.



Eddy covariance tower for recording CO₂ gas exchange between the soil and the atmosphere in the Eider-Treene-Sorge lowlands.

GRASS AGE CARBON

Funded by: NSFC (National Science Foundation, China)

Funding volume: €49,200

Project duration: 2010 until 2013

Cooperating partners:

Chinese Agricultural University (CAU), Beijing, China
Prof. Shan Lin

The contribution of permanent grassland to carbon sequestration in the soil is critically determined by the age of the grassland sward. In a field experiment on the Experimental Farm Lindhof, the contribution of carbon input is determined using root mass formation in the soil by means of the in growth core method on grassland stock between 1 and 20 years old. The data are used to quantify the positive climate effects of permanent grassland and are evaluated in cooperation with Chinese colleagues.

Enhancing resource efficiency in milk production

Funded by: EU Interreg

Funding volume: €459,551

Project duration: 2009 until 2013

Cooperating partners:

Jyndevad Forsøgsstation, Denmark
Ove Edlefsen

Fodder production critically influences greenhouse gas emissions in milk production. In a cooperation project with Danish colleagues the product carbon footprint (PCF) of a variety of milk production systems in Schleswig-Holstein and Denmark is quantified. A central sub-project in this study identifies the effects of grassland ploughing and subsequent farming use (maize) on the associated greenhouse gas emissions and nutrient outputs through the seepage water path. Using modelling approaches the effect of grassland ploughing on the milk PCF can be determined as a function of maize or permanent grassland as a fodder base.



Greenhouse gas measurements in the field, January 2013.

Photos: Arne Poyda

Publications in professional journals covering energy issues

_Herrmann, A., Claus, S., Loges, R., Kluß, C., Taube, F. (2014): Can arable forage production be intensified sustainably? A case study from northern Germany. *Crop and Pasture Science* 65, 538-549

_Claus, S., Taube, F., Svoboda, N., Kage, H., Herrmann, A. (2013): Life cycle assessment of biogas production under the environmental conditions of northern Germany: Greenhouse gas balance. *The Journal of Agricultural Science*. DOI:10.1017/S0021859613000683.

_Herrmann, A. (2013): Biogas production from maize: Current state, challenges, and prospects. 2. Agronomic and environmental aspects. *Bioenergy Research* 6, 372-387.

_Sieling, K., Herrmann, A., Wienforth, B., Taube, F., Ohl, S., Hartung, E., Kage, H. (2013): Biogas cropping systems: Short term response of yield performance and N use efficiency to biogas residue application. *European Journal of Agronomy* 47, 44-54.

_Rath, J., Heuwinkel, H., Herrmann, A. (2013): Specific biogas yield of maize can be predicted by the interaction of four biochemical constituents. *Bioenergy Research*. doi 10.1007/s12155-013-9318-3.

_Svoboda, N., Taube, F., Wienforth, B., Kluß, C., Kage, H., Herrmann, A. (2013): Nitrogen leaching losses after biogas residue application to maize. *Soil & Tillage Research* 130, 69-80.

Congress presentations on energy issues

_Claus, S., Taube, F., Sieling, K., Techow, A., Quackernack, R., Pacholski, A., Kage, H., Herrmann, A. (2013): Energy balance of grass based biogas production systems on a coastal marsh soil. *Grassland Science in Europe* 18, in press.

_Sieling, K., Herrman, A., Wienforth, B., Ohl, S., Taube, F., Kage, H. (2012): Nitrogen dynamics in maize based cropping systems for biogas production. 17th International Nitrogen Workshop, 26-29 June 2012, Wexford, Ireland, 168-169.

_Techow, A., Dittert, K., Senbayram, M., Quackernack, R., Pacholski, A., Kage, H., Taube, F., Herrmann, A. (2012): Nitrous oxide emission from biogas production systems on a coastal marsh soil. 17th International Nitrogen Workshop, 26-29 June 2012, Wexford, Ireland, 182-183.

The most important Bachelor's/Master's theses on energy issues supervised by the professorship/working group

_J. Tode, Einfluss der Landnutzung auf Gehalt und Menge organisch gebundenen Kohlenstoffs in Böden unterschiedlicher Naturräume Schleswig-Holsteins, 2011, Master's thesis

_F. Viebach, Ertrag, N- und C-Bilanz von langjähriger Maismonokultur bei variierter N-Versorgung, 2012, Masterarbeit

_M. Jezek, Wurzelwachstum und N-Aufnahmepotenzial von Winterzwischenfrüchten nach Silomais, 2012, Master's thesis

_L. Jahn, Beeinflussung der Biogas- und Methanerträge verschiedener Nawaro durch Kofermentation, 2012, Bachelor's thesis

_H. Stöfen, Alternativen zur Maismonokultur in Schleswig-Holstein, 2012, Bachelor's thesis

The most important conferrals of doctorates on energy issues supervised by the professorship/working group

_N. Svoboda, Auswirkungen der Gärrestapplikation auf das Stickstoff-Auswaschungspotential von Anbausystemen zur Substratproduktion, 2011

_A. Techow, Leistung und ökologische Effekte von Anbausystemen zur Biogaserzeugung, 2013, current

_S. Claus, Ökobilanzierung von Biogasproduktionssystemen unter den Anbaubedingungen Schleswig-Holsteins, 2013, current

_H. Schuch, Optimierung von Anbauverfahren für einen Gewässer schonenden Maisanbau, current

_M.S. Schmeer, Der Einfluss von Bodenverdichtungen sowie Grünlanderneuerung auf Stickstoffemissionen und Ertragsleistungen von Futterbausystemen, 2012

Photo: T. Jürgens



Prof. Dr. Sabah Badri-Höher



Faculty of Computer Science
and Electrical Engineering

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Professorship: Digital signal processing, digital transmission
technology

At the University of Applied Sciences since: 2009

Core competences in energy research

1. Safety of offshore wind turbines
2. Monitoring of wind turbines

Energy and climate protection R&D projects (since 2010)

EECole – Development and testing of permanent, online- supported scour pool monitoring systems for various wind energy offshore structures

Funded by: EKSH

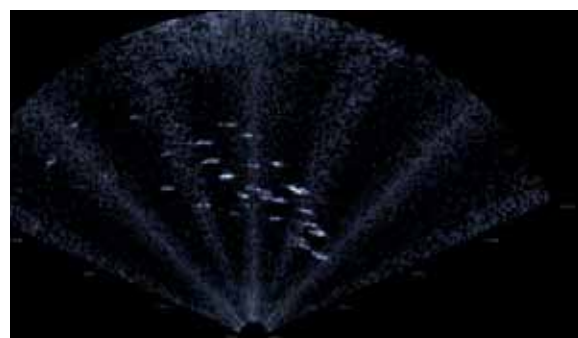
Funding volume: €141,000

Project duration: 2 years

Cooperating partners:

R&D centre Kiel University of Applied Sciences GmbH

The safety of offshore wind turbines is substantially influenced by the formation of scour pools on the seabed (formation of scour pools corresponds to the development of protrusions and holes around the offshore structures). The project is pursuing the aim of developing a range of scour pool monitoring systems – depending on the foundation structure. The project also includes offshore testing of a system. The two research platforms FINO1 and FINO3 provide unique opportunities for this project.



Sonar image



Structure with sonar, cameras and other sensors. Photos: Kiel UAS

Underwater Fish Observatory (UFO)

Funded by: BLE

Funding volume: €1,150,000

As part of a joint project, Prof. Dr. Sabah Badri-Höher and Prof. Dr. Hauke Schramm from the Faculty of Computer Science and Electrical Engineering at Kiel UAS are involved in the development of an Underwater Fish Observatory (UFO). Platforms equipped with low-light cameras and sonar are to recognise and identify shoals of fish automatically to see which species of fish are present – without disturbing the fish and therefore falsify the measuring result. Marine biologists may be able to draw conclusions about the size of fish stocks and their migration and spawning habits as well as the distribution of the fish by using the UFO. However, the observatory can also support the search for suitable locations to establish wind farms.

The most important Bachelor's/Master's theses on energy issues supervised by the professorship/working group

- E. Wenzlaff, Entwicklung und Erprobung eines Kolküberwachungssystems, 2013



Prof. Dipl.-Ing. Benedict Boesche

Professorship: Naval engineering

At the University of Applied Sciences since: 2010

Core competences in energy research

1. Sustainable maritime transport
2. Maritime engineering/offshore platforms
3. Naval engineering

Management responsibilities in transfer organisations and facilities relevant to energy research

- Fraunhofer IGD Go-3D conference programme committee in Rostock
- Member of Flensburg UAS' Institute for Nautical and Maritime Technologies (INMT) scientific advisory board

Energy and climate protection R&D projects (since 2010)

Empirical lifetime analysis of offshore structures using the FINO3 research platform as an example and develop- ment of methods for producing a reliable lifetime fore- cast

Funded by: State of Schleswig Holstein

Funding volume: €266,579

Project duration: 1/2012 to 4/2015

Cooperating partners:

R&D centre Kiel University of Applied Sciences GmbH

The dimensioning and construction of offshore structures are primarily based on the permanent and operating loads. The peculiarities of maritime construction are closely linked to the environmental conditions given by wind, water level, swell, currents, snow volumes, icing, sea ice, air and water temperatures, and marine growth on shallow structural elements. The forces on the structure resulting from these environmental conditions must be taken into consideration for the hydrodynamic analysis.

The overall aim of this project is improved analysis of the true anticipated lifetime of fixed offshore structures. This will be achieved using the FINO3 platform as an example, based on a long-term evaluation. In the case of the FINO3 research platform, the calculated lifetime is currently ten years. It can be assumed that the anticipated true lifetime is actually longer than the calculated lifetime on which the structure is based. However, it is difficult to produce sufficiently quantified and reliable data. A generally applicable measurement and calculation methodology will be developed by empirical collection of a range of data directly on the offshore structure, e.g. by means of acceleration sensors.

In order to consider dynamic loads more efficiently and to base an evaluation of lifetime on reliable information, the

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FINO3 offshore research platform has now been equipped with acceleration sensors on three levels.

Publications in professional journals covering energy issues

- Jeromin, A., Boesche, B., Jacobsen, H., Patz, R. (2014): Schwingungsmessung auf der Offshore-Forschungsplattform FINO3, 5. VDI-Fachtagung Schwingungen an Windenergieanlagen 2014, Bremen, Germany, 11/12 Feb. 2014, In: VDI Reports 2220, Published by: VDI Wissensforum GmbH.
- Friedewald, Lööding, von Lukas, Mesing, Boesche et al. (2012): Einsatz und Entwicklung innovativer VR-Technologien im Schiffbau, Ergebnisse des Verbundvorhabens Power-VR, 2012, TuTech Verlag, ISBN 978-3-941492-52-3.
- Boesche, B. (2010): Improvement of Interoperability between Yards and Equipment Suppliers, 9th Conf. Computer and IT Applications in the Maritime Industries (COMPIT), Gubbio, pp.285–289.
- Boesche, B. (2010): Komponenteninitiative für den Schiffbau, Schiff & Hafen.

The most important Bachelor's/Master's theses on energy issues supervised by the professorship/working group

- Sören Braren, Prüfung der Integration eines Systems zur Nutzung der Abwärme von Verbrennungsmotoren mittels Latent-Wärmespeicher-Technologie in einer LNG betriebenen Küstenfähre, 2014, Kiel UAS, Naval Architecture and Maritime Engineering and company: Becker Marine Systems GmbH & Co. KG
- Jeroen Anderson, Entwicklung eines LNG Antriebskonzeptes für eine Megayacht, 2013, Kiel UAS, Naval Architecture and Maritime Engineering and company: Peters Schiffbau GmbH Wewelsfleth
- Jens Wagner, Abgasreinigung von Schiffen, 2012, INTEC
- Philip Hammerschmidt, Simulation von Schiffsbetriebssystemen – Vergleichs-Untersuchung diverser Antriebsmöglichkeiten, 2011, Wärtsilä
- Thomas Nitzsche, Umbau von Schiffen bezüglich der Vorschrift "MARPOL ANNEX VI" zur Verminderung des Schadstoffausstoßes bei Abgasen, 2011, Blohm + Voss Repair GmbH

Prof. Dr. Gordon H. Eckardt



Faculty of Business Management

Tel +49 (0)431-210-3507
gordon.eckardt@fh-kiel.de

Professorship: General business studies, marketing
At the University of Applied Sciences since: 2005

Core competences in energy research

1. Entrepreneurship – Prospects and business models along the value added chain in the offshore wind energy sector

Energy and climate protection R&D projects (since 2010)

Public relations offensive for the three research platforms FINO1, FINO2 and FINO3

Funded by: Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

Funding volume: €191,330

Project duration: 1/2011 to 10/2013

In January 2002 the Federal Government adopted the resolution to establish three research platforms in the North and Baltic Sea (FINO) so that the Federal Government's strategy of using wind energy at sea can be implemented. The research platforms FINO1, FINO2 and FINO3 started operations between 2003 and 2009 very close to planned large-scale offshore wind farms.

The aim of the project is to develop a joint more extensive communications policy for all three research platforms so that they can be marketed at national but also at international level and can therefore safeguard their operation during the next few years.

GADOW – German and Danish Offshore Wind

Funded by: EU INTERREG IV A

Funding volume: €520,000

Project duration: 1/2012 to 3/2015

Cooperating partners:

www.gadow-offshore.net

Despite a wide range of network activities in the field of wind energy both in Germany and in Denmark, no cross-border Danish-German network exists that is specifically geared to satisfy the requirements of the offshore wind energy sector. Another deficiency is the lack of cross-border transparency regarding on-going research projects on the subject of offshore wind energy and the latter's results.

It is precisely for the southern part of Denmark and the northern part of Schleswig-Holstein (Interreg IV A region) that offshore wind energy is however a sector for the future, which promises a high level of growth and therefore potential jobs. Building on a comprehensive analysis, a platform is to be created for mutual exchanges of information and in this way push forward future investment and the establishment of companies.

Publications in professional journals covering energy issues

_Eckardt, G. H., Vanini, U.: Offshore-Windenergie – Marktpotenziale und Erfolgspotenziale: Eine Studie für Unternehmen in der Region Kiel, in Zusammenarbeit mit der KiWi, Kieler Wirtschaftsförderungs- und Strukturentwicklung GmbH. In: Eckardt, G. H. (Ed.): Schriftenreihe des Norddeutschen Instituts für Familienunternehmen – Institut an der Fachhochschule Kiel, Göttingen 2011.



Prof. Dr. Ronald Eisele

Professorship: Sensor development and component packaging

At the University of Applied Sciences since: 2006

Core competences in energy research

1. Power electronics assemblies (diodes, MOSFET, IGBT and SiC elements)
2. Thermal assembly management

Management responsibilities in transfer organisations and facilities relevant to energy research

- _ Member of the core team in the ProPower research alliance
- _ ECPE (European Center for Power Electronics) Competence Centre

Energy and climate protection R&D projects (since 2010)

CPV systems with highly efficient and installation-friendly modules (CPV Magnus)

Funded by: BMWI

Funding volume: €360,000

Project duration: 7/2012 to 6/2015

Cooperating partners:

Soitec Solar GmbH, Freiburg

Fresnel Optics GmbH, Apolda

Fraunhofer ISE, Freiburg

Kirchner Solar Group GmbH, Alheim-Heinebach

Concentrated photovoltaics (CPV) makes use of semiconductor material savings by employing an optical concentrator, and the highest system efficiencies by employing multi-junction solar cells, in order to facilitate economic electricity generation in the Earth's sunbelt.

The aim of the alliance is to develop a considerably cost-reduced CPV system with two-stage optics, in which the vertical value chain can be covered by German industry.

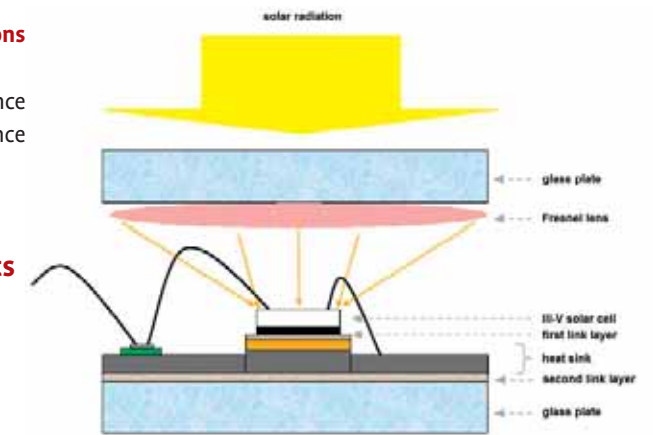
The project comprises four specific topics:

- › Developing a new CPV system with two-stage optics based on Köhler's principle
- › Increasing efficiency and yield
- › Developing new techniques for solar cell installation
- › Developing suitable quality assurance processes

Sintering technology offers great potential for improving the solar cell's thermal connection, as well as its robustness in terms of temperature cycles. In fundamental studies at Kiel UAS, we examine to what degree sintering technology can be applied to assembly of what are known as III-V multijunction solar cells.

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Basic Construction of a CPV module.

Diagram: Lukasz Zielinski

SiC-HeV

Funding volume: €200,000

Cooperating partners:

TransiC AB / Farischild Semiconductor

Martin Domeij, Sweden

Load- and temperature-change resistant, vibration and corrosion resistant, extensive cooling and assembly options, high assembly rate and efficiency; these are only a few properties, in addition to electrical properties, expected of a high-quality traction module. In order to comply with the rigorous boundary conditions demanded by the automotive industry, this power module was planned and produced using the most modern production technologies available. However, an innovative power module such as this is of no use if the switching semiconductors were not also the product of the best available research. This traction module was therefore equipped with the innovative silicon carbide transistors and diodes. In this module twelve of them form a half-bridge capable of meeting demands such as carrying a maximum voltage of 1200 V or a maximum current of 180 A.

However, the silicon semi-conductors are nothing but naked chips if they are not protected from the environment by robust casing. These silicon carbide semiconductors are fixed to a DCB by means of silver sintering, which transfers the waste heat of the semiconductors produced during operation to the heat sink below. The upper contact is implemented by means of 120 aluminium bonding wires

Prof. Dr. Ronald Eisele

with a thickness of 300 µm. However, this module is only what it is as a result of the soldered lead frame and the moulded casing surrounding it. This high-quality traction module is rounded off by the 4 internal NTCs, making it possible to record the temperatures of the respective individual half-bridge elements.

Innovation cluster: Power electronics for regenerative energy supplies

Funded by: WTSH, ESF/ERDF

Funding volume: €200,000

Project duration: 1/2013 to 11/2015

Cooperating partners:

Fraunhofer ISIT, Itzehoe

Danfoss Silicon Power, Flensburg

VishaySiliconix, Itzehoe

Senvion, Osterrönfeld

Reese + Thies, Itzehoe

Kiel University

West Coast UAS, Husum

This project is aimed at developing a new system concept for the power electronics components of a wind turbine. In modern wind turbines the entire electrical energy from the generator is converted for grid feed-in by these components. The aim of the project here is to develop a 1,200 V system with up to 600 A.

The sub-objective of Kiel UAS is to improve the reliability of the power modules in order to comply with the rigorous operating period requirements, for example for offshore wind turbines. This can be achieved using new technolo-

gies, such as low-pressure silver sintering technology (chip underside) and chip contacting using copper wires (chip upper side; known as copper wire bonding wires). Using these technologies the durability of the modules is substantially increased compared to brazed and aluminium wire contacted power modules.

ProPower joint project

Funded by: BMBF

Funding volume: €420,000

Project duration: 1/2012 to 12/2014

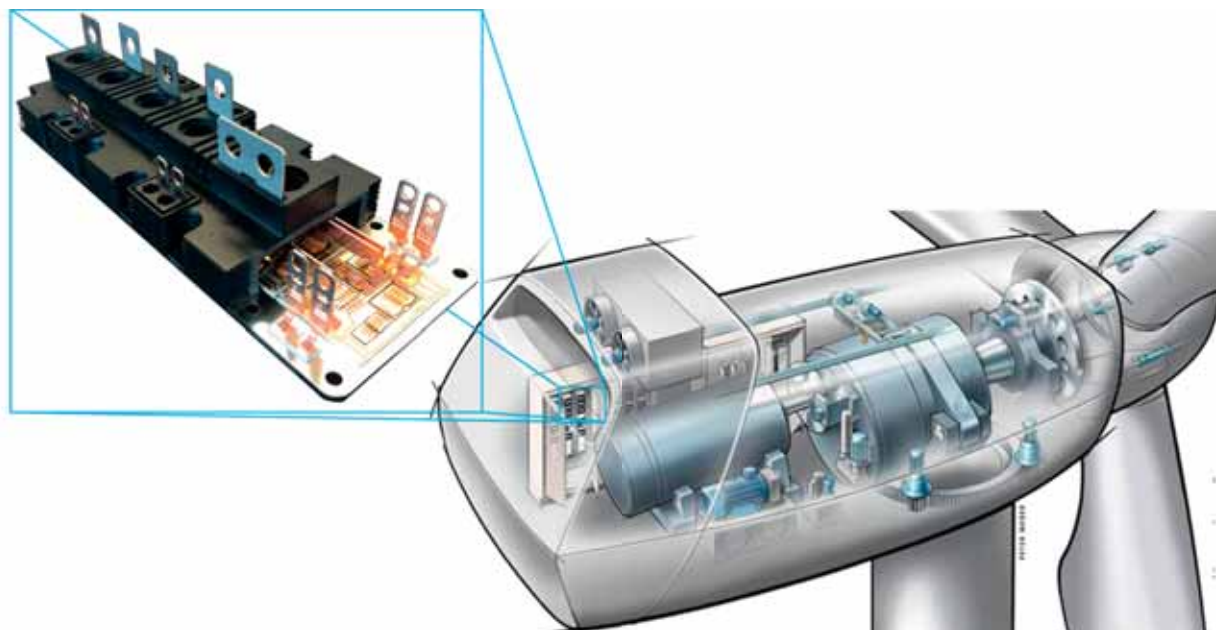
Cooperating partners:

21 industry and science partners

www.projekt-propower.de

Research for the next generation of electric drives and LED illumination

Modern power electronics ensure that wind turbines can feed their electricity into the grid, trams can drive and fridges can operate efficiently. As a power control centre, they play a vital role in almost every area of our daily lives. Miniaturisation of these systems is an increasingly important competitive factor, not only in the electromobility field, but also in LED illumination or for renewables. Today, the desired miniaturisation for the same, or even enhanced, performance is technically limited by the heat loss of the power electronics, which must be discharged by way of complex heat sinks, water cooling or fans. The challenge here, on one side, is to prevent heat loss, i.e. to design the systems for more energy efficiency, and on the other side the power electronics themselves need to be more robust in order to survive the high temperatures in miniaturised assemblies without damage.



Power module using silver sintering technology with copper wire bonding wires.

Source: Danfoss.com



Improved power electronics for drives and LEDs

In the ProPower project the challenges discussed above will be systematically addressed at all levels of the value chain. The converters between the battery and the motor, indispensable for drive engineering in modern electric vehicles, do not yet meet the requirements of customers and manufacturers in terms of the required installation space and achievable reliability. The aim of the project is to provide the basis for an energy-efficient, miniaturised and reliable new generation of power electronics, for example for use in electromobility, by dispensing with inefficient active cooling as far as possible.

In the field of LED illumination the necessary electronics are also not yet completely integrated in the illuminants, meaning that such LED lights still need to be operated with additional ballast devices and are correspondingly more expensive. The degree of integration, that is how much functionality can be fitted into a given volume, is the crucial lever for innovative electronics in drive and illumination systems. Additional emphasis in the ProPower research project is therefore placed on suitable production technologies, with which highly efficient LED electronic modules can be mass produced.

Publications in professional journals covering energy issues

_Olesen, K., Osterwald, F., Tønnes, M., Drabek, R., Eisele, R. (2010): *Kalte Dusche – Leistungsmodul für die Windkraft effizient kühlen*, Elektronik Journal, Hüthig.

_Altemark, S., Becker, M., Eisele, R., Fritzsche, S., Krebs, T., Blank, T., Schneider, M., Bruns, M. (2013): *Silber-Sintertechnologie im Verbundprojekt "ProPower" – Neue Materialien, Prozesse & Prüfverfahren*, PLUS – Fachzeitschrift für Produktion von Leiterplatten und Systemen, Leuze Verlag.

_Bredtmann, R., Olesen, K., Rudzki, J., Eisele, R., Becker, M. (2013): *Neue Aufbau- und Verbindungstechnik für das Hybrid-Fahrvergnügen*, Zeitschrift "Elektronik – automotive Sonderausgabe Elektromobilität", pp. 44–47.

Congress presentations on energy issues

_Olesen, K., Osterwald, F., Tønnes, M., Drabek, R., Eisele, R.: *Designing for reliability, liquid cooled power stack for*

the wind industry, European Wind Energy Conference and Exhibition (EWEC 2010) Germany, 20–23 April 2010, Warsaw, Poland.

_Rudzki, J., Osterwald, F., Becker, M., Eisele, R.: *Novel Cu-bond contacts on sintered metal buffer for power module with extended capabilities*, International Conference for Power Electronics, Intelligent Motion and Power Quality PCIM, Nuremberg 7–9 May 2012.

_Eisele, R., Bast, M.: *Innovative SiC-Traction Module Manufactured in Sinter- and Transfer-Mould-Technology*, International SiC Power Electronic and Application Workshop – ISiCpeaw – Kista, Stockholm, Sweden, 29–30 May, 2012.

_Becker, M., Eisele, R., Kock, M., Mannmeusel, G., Osterwald, F., Rudzki, J.: *Cu-WireBonding on a Sintered Bond Buffer*, ECPE Packaging Workshop – Baden Daettwil, 7–8 Nov. 2013.

_Eisele, R.: *Moderne Aufbau- und Verbindungstechnik für die Leistungselektronik von E-Fahrzeugen*, Rehm-Technologietage 2013, Blaubeuren, 20.9.2013.

The most important Bachelor's/Master's theses on energy issues supervised by the professorship/working group

_Magnus Sprehe, *Entwicklung, Bau und Erprobung einer mobilfunkgestützten Ladekontrolleinheit für Elektrofahrzeuge*, 2012, Bachelor's thesis

_Aylin Bicakci, *Entwicklung und Charakterisierung eines leistungselektronischen Substrates mit organischem Isolator durch Kombination von Laminier- und Sinterprozessen*, 2013, Master's thesis

_Schäfer, Freerk, *Selektives Drucksintern von elektrischen Kontakten auf Substraten von Leistungshalbleiter-Modulen*, 2013, Bachelor's thesis

The most important conferrals of doctorates on energy issues supervised by the professorship/working group

_Martin Becker, *Silbersintern und Kupferdrahtbonden für hochzuverlässige Halbleiterkontaktierungen in leistungselektronischen Modulen*

External partners: Danfoss & TU Chemnitz

Prof. Dr. habil. Mohammed Es-Souni



Department of Mechanical Engineering

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www.imst.fh-kiel.de

Professorship: Materials and surface treatment technologies
At the University of Applied Sciences since: 1993

Core competences in energy research

1. Electrochemical energy storage systems
2. Photocatalytic structures
3. Selective solar absorber coatings for solar collectors

Energy and climate protection R&D projects (since 2010)

Development of sustainable, cost-effective supercapacitors for energy storage (SuperCap)

Funded by: EU – Interreg IV A

Funding volume: €300,000

Project duration: 01/2013 to 06/2015

Cooperating partners:

Syddansk Universitet, Odense

The increasing proportion of renewables in Germany and Denmark's power supply also means increasing fluctuations in electricity generation. The long-term storage of energy still presents scientists today with a problem, because only rarely do wind turbines or photovoltaic installations generate electrical energy at the exact time it is also required. The project will make a contribution to the development and utilisation of electrochemical supercapacitors as an effective, flexible and reliable system for energy storage in the boundary region. The demand for such developments is all the more acute, because a large proportion of renewables, in particular wind power, is already produced in the boundary region.

Publications in professional journals covering energy issues

_Es-Souni, M., Schopf, D., Solterbeck, C., Dietze, M. (2014): Novel Approach to the Processing of Meso-Macroporous Thin Films of Graphite and in-situ Graphite-Noble Metal Nanocomposites, RSC Adv., 4, 17748–17752.

_Dar, F., Moonosawmy, K., Es-Souni, M. (2013): Morphology and property control of NiO nanostructures for supercapacitor applications, Nanoscale Research Letters, 8, 363.

_Dar, F. I., Habouti, S., Minch, R., Dietze, M. and, Es-Souni, M.: Morphology control of 1D noble metal nano/heterostructures towards multi- functionalit, J. Mater. Chem., 2012, 22 (17), 8671-8679.

_Es-Souni, M. et al. (2010): Brookite Formation in TiO₂ – Ag Nanocomposites and Visible-light-Induced Templated Growth of Ag Nanostructures in TiO₂, Adv. Funct. Mater., 20, 377–385.

_Minch, R., Es-Souni, M. (2011): On substrate, self-standing hollow-wall Pt and PtRu-nanotubes and their electrocatalytic behavior, Chem. Commun., 47, 6284–6286.

_Habouti, S., Es-Souni, M. et al. (2011): On-substrate, self-standing Au-nanorod arrays showing morphology controlled properties, nanotoday, 6 (1), 12–19.

Luo, L., Dietze, M., Solterbeck, Cl.-H., Luo, H., Es-Souni, M.: Orientation and phase transition dependence of the electrocaloric effect, in 0.71PbMg{1/3}Nb_{2/3}O₃-0.29PbTiO₃ single crystal, Appl. Phys. Lett., 2012, 101 (6), 062907, Doi: 10.1063/1.4745185.

Congress presentations on energy issues

_Es-Souni, M., Schopf, D.: Macro-mesoporous Nanocarbon Thin Films. Processing and Application to Energy Storage, CIMTEC 2014, Forum on New Materials, 15–19 June 2014, Montecatini (Italy).

_Es-Souni, M.: Template Synthesis of Nanomaterials for Energy and Sensing Applications, eingeladen, NANOAPP Conference, 22–26 September 2013, Portorose, Slovenia.

_Es-Souni, M.: Structure, Properties and some Applications of PMN-PT-Base Single Crystals, Plenar Vortrag 12th International Conference on Condensed Matter and Statistical Physics (ICCMSP). 30.10.–01.11.2013, Errachidia/Morocco.

_Es-Souni, M.: Nanostructured vanadium oxide films made by solution phase deposition: morphology, structure and optical property control, invited, CIMTEC 2012, Montecatini Terme, 10–14 June 2012.

The most important Bachelor's/Master's theses on energy issues supervised by the professorship/working group

_Benjamin Ullmann, Herstellung und Charakterisierung von Wärmedämmschichten auf ZrO₂-Basis, Master's thesis

_Dimitri Schopf, Poröse Graphitschichten und Graphit-Nanokomposite für die Energiespeicherung, Master's thesis

Current further education courses or conferences on energy issues held on a regular basis
www.workshop-smartmaterials.com

Prizes for services to science and knowledge transfer
ISH-Transferpreis 2012

Prof. Dr. Hans-Jürgen Hinrichs

Professorship: Electrical power engineering
At the University of Applied Sciences since: 1993

Core competences in energy research

1. Grid integration
2. System perturbations
3. Combined heat and power generation

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Energy and climate protection R&D projects (since 2010)

Voltage quality optimisation strategies in low-voltage grids

Sub-project: Development of a mobile test facility for measurements in low-voltage grids and compilation of the measuring and analysing software

Funded by: BMU

Project duration: 1/2012 to 12/2014

In this project a mobile test facility for low-voltage grids is developed, built and commissioned. Measurement of the grid impedance is not the focus here. Instead, the grid impedance of the harmonic voltage bias and the resulting harmonic currents in a grid node are analysed in order to acquire metrological baseline data for optimised supply of harmonic currents and to simultaneously compile proposals for improved evaluation of current harmonic emissions. Based on metrological data acquisition, the joint project aims to develop optimisation strategies for supplying harmonic currents with defined phase angles and test them in real grids.

CEwind Phase II

SP 5: Current harmonics source analyser

Funded by: EU

Funding volume: €260,000

Project duration: 1/2009 to 12/2011

Kooperationspartner:

Kiel University

Grid operators, Schleswig-Holstein

Wind power manufacturers, Rendsburg

Certifiers, Itzehoe

Measurement of the grid impedance response plays a very important role in determining current harmonics sources. In order to determine correct impedance data for harmonic frequencies with a heavy harmonic bias, the impedance response measurement was extended to include a special differential measurement method. If impedance measu-

rements are combined with current and voltage measurements in the supply lines to the nodes, it is possible to unequivocally identify the current harmonics sources. This project developed the measurement and analysis methods for identifying current harmonics sources and tested them in real low-voltage grids.





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Professorship: Ergonomics, occupational safety,
corporate management

At the University of Applied Sciences since: 1994

Core competences in energy research

1. Intelligent hierarchical control (IHC), renewables
2. Energy-efficient building/heating technology
3. Heat storage concepts

Energy and climate protection R&D projects (since 2010)

GeoCITTI

Sub-project: Pilot development and testing of a software-aided procedure for hierarchical energy supply incorporating geothermal energy systems as warm water and cooling stores

Funded by: ZPW

Funding volume: €1,500,000 (overall project)

Project duration: 12/2008 to 12/2012

Cooperating partners:

Kiel University, Prof. Dr. A. Dahmke (Applied Geology)

Sensatec GmbH, Kiel

Gicon GmbH, Dresden

CITTI Handelsgesellschaft mbH & Co. KG, Kiel

AX5 Architekten bda, Kiel

Geothermal potentials for energy optimisation of the commercial real estate stock and new-builds were tested on the CITTI Park in Kiel, Germany. The focus of the sub-project was to determine geothermal potentials for heating and cooling the buildings and identify suitable locations for application within the building complex, to optimise building services in this stock, to specify the invitation to tender criteria based on a simulated optimisation of the heating and cooling processes, to monitor the building process and results, and to evaluate the overall energy efficiency results. The aim of the project as a whole was to demonstrate the energy efficiency route for this type and size of building stock and to optimise it.

Conversion and commissioning of shrimp and Baltic Sea trawlers in the North and Baltic Seas with a view to energy efficiency

Funded by: Zukunftsprogramm Fischerei

Funding volume: €729,000

Project duration: 1/2011 to 11/2013

Cooperating partners:

Landesfischereiverband S.-H. e. V., Rendsburg

Fishermen now spend up to 25% of their turnover on fuel. In recent years fuel prices, and thus operating costs, have increased continuously. The project has the following objectives, in particular:

- › Reduction in operating costs as a result of energy efficiency of the ships and their equipment.
- › Enhancing the competitiveness of the trawler fleet.



Energy-efficient shrimp trawler.

In this project innovative products were developed, constructed and evaluated on a number of pilot ships. Here, it was possible to enhance the best available technology in several energy efficiency fields. It was possible to reduce the fossil energy consumption of prawn cookers by more than half compared to previous best available technology. Additional project innovations include an energy-efficient cooling room, contributing to enhanced occupational safety, and the use of wind and photovoltaic energy installations on board the ships.

SUGAR

Sub-project B3: Exploitation of submarine gas hydrate deposits and transport of natural gas – conception, project planning and evaluation of interfaces for at-sea and on-land handling of gas hydrate pellets

Funded by: BMWi

Funding volume: €180,000 (sub-project)

Project duration: 7/2008 to 06/2011

Cooperating partners of the sub-project:

GEOMAR Helmholtz Centre for Ocean Research Kiel

Leibniz Institute for Baltic Sea Research, Warnemünde

Linde AG, Pullach

Germanischer Lloyd AG, Hamburg

Meyer Werft GmbH, Papenburg

The SUGAR project developed and optimised new methods, which are indispensable for environmentally compatible production of natural gas hydrates and the transport of methane gas from the hydrate deposit to the ultimate consumer. The sub-project focussed on drawing up a concept for the engineering implementation of the platform, storage and pelletisation of the methane hydrates. The platform model was successfully tested in the Hamburg testing facility.

Vision Zero Galvanisation Emissions

Funded by: EU

Funding volume: €185,000

Project duration: 5/2009 to 9/2011

Cooperating partners:

Diamond Tools Präzisionswerkzeuge Michael Kleiner e.K., Kiebitzreihe

In the plating industry diamond tools are coated with a galvanic compound in order to use them for precision machining and material removal. The energy intensive process was analysed, the energy efficiency increased and, simultaneously, the quality of the plating, in particular on base materials difficult to plate, enhanced in the course of this project. A pilot galvanisation facility was erected at Kiel UAS for this project. Decentralised heating, in conjunction with continuous treatment, were researched. Optimisation potential was identified and appropriate measures implemented.

Energy optimisation in the commercial sector of industrial and electrical engineering

Funded by: EU

Funding volume: €143,000

Project duration: 6/2009 to 6/2011

Cooperating partners:

Gebr. Friedrich Industrie- und Elektrotechnik GmbH, Kiel

The aim of the project was to minimise the use of fossil fuels for heating the converted and refurbished building (former trading house administration building and goods shed). The operational and economical application was designed, developed, presented and examined with the aid of this pilot and demonstration project. The measures implemented were able to considerably reduce fossil fuel use.

Energy-efficient innovations in greenhouses (EIG)

Funded by: EU

Funding volume: €200,000

Project duration: 7/2009 to 1/2011

Cooperating partners:

Lebenshilfewerk Neumünster GmbH, Neumünster

Dyckerhoff AG, Wiesbaden

SCHEER Heizsysteme & Produktionstechnik, Wöhrden

BASF, Ludwigshafen



Energy-efficient greenhouse for Lebenshilfewerk Neumünster GmbH.
Photos: ergoTOP

Nursery new-build with main and ancillary buildings and greenhouse for increasing the energy efficiency of the buildings belonging to Lebenshilfewerk Neumünster. The use and coupling of various renewables in building services (energy mix) were implemented for a zero energy house vision, using solar collectors for utilising solar thermal and generating electrical energy.

EMK – Energy-efficient maritime air-conditioning

Funded by: EU

Funding volume: €199,000

Project duration: 11/2012 to 10/2014

Cooperating partners:

SCHEER Heizsysteme & Produktionstechnik GmbH, Wöhrden

SCHEER, a heating system manufacturer, has developed a particularly low-exhaust and energy-efficient heating system for all types of small ship and boat and introduced it to the market. The aim now is to develop it further to allow the interior of a ship to be cooled via cold recovery from seawater. The company's small heating systems, predominantly in use on board working ships such as excursion steamers, trawlers or lifeboats, are far below the guidelines for contaminant emissions laid down in environmental legislation. The project aims to also achieve this result for the air-conditioning and cooling facilities. The environmentally friendly, energy-efficient heating technology, in conjunction with an air-conditioning unit, is thus the R&D objective of this project.

CONDEMBER – Sustainable Concepts for the Decentralized Production and Storage of Renewable Energy at Naxos and the Small Cyclades in Consideration of the Demand of Agriculture, Waste Management and Tourism

Funded by: BBMBF (application stage)

Funding volume: €199,000

Project duration: 11/2013 to 9/2015

Cooperating partners:

Environmental Projects – Scientific & Technical Consultant

Prof. Dr. Constantin Kinias

Dr. Vassilios Thenas Naxos, Greece
Aristotle University of Thessaloniki
ergoTOP – I.A.U. Institut für Arbeitswissenschaft und Unternehmensoptimierung GmbH
Kiel University

The primary objective of the German-Greek CONDEME-TER joint project is to develop a comprehensive concept for supplying the island of Naxos and the Small Cyclades with renewables. The aim is to provide possible investors and technology enterprises, as well as the Greek population and the administration, with planning security and to sketch out potential impacts on agriculture and tourism.

IGLU – Development of an intelligent geothermal long-term heat store with environmentally neutral behaviour in the low temperature range for seasonal building supply and as control variable for energy feed-in management

Funded by: BMU (pending)

Funding volume: in application stage

Project duration: 7/2013 to 6/2016

Cooperating partners:

SCHEER Heizsysteme & Produktionstechnik GmbH, Wöhrden
UFZ, Leipzig
Kiel University
Helmholtz Centre for Environmental Research

The aims of the IGLU project are to develop and test an environmentally neutral, robust, economic and quantitatively relevant heat storage system component for rapid implementation. It will serve as both long-term, seasonal heat storage and as a buffer against excess electricity in the context of energy feed-in management, for building stock and new-builds, in urban areas, in particular.

SeaLift Phase I – Development and testing of a concept for transferring persons and material between supply ship and offshore wind turbines with high weather- and swell-related availability

Funded by: BMU

Project duration: 3/2013 to 2/2014

Cooperating partners:

FuE-Zentrum Fachhochschule Kiel GmbH
NTT Neuhaus Trans Tech GmbH
ergoTOP – I.A.U. Institut für Arbeitswissenschaft und Unternehmensoptimierung GmbH

Safe transfer of persons and material between supply ship and offshore wind turbines during high swell and correspondingly large relative movement has not yet been satisfactorily solved despite the availability of numerous concepts. The availability of the offshore WTs is therefore not sufficiently guaranteed due to the lack of servicing/repair

options, particularly in difficult weather conditions. This has a negative effect on the viability of the offshore wind farms. The SeaLift project aims to solve existing problems when transferring persons and material between supply ship and offshore WTs for the first time using a line/pod concept.

OWES – Occupational safety organisation during the construction and operation of offshore wind turbines using the FINO3 research platform as an example of best practice – FINO3 Safety Offshore Wind Energy Security

Funded by: ZPW

Funding volume: €227,000

Project duration: 12/2011 to 11/2013

Cooperating partners:

R&D centre Kiel University of Applied Sciences GmbH
ergoTOP – I.A.U. GmbH, Kiel

The aim of the project is to draft a systematic procedure for integrating occupational safety management as a service for the builder, operator and other engineering services companies on and for offshore wind energy converters. The project involves all product life phases, from project planning to servicing and repairs, including conversion and recycling. The results achieved in this project are calibrated against empirical data collected on the FINO3 research platform (construction and operation) as an example of best practice.

The most important Bachelor's/Master's theses on energy issues supervised by the professorship/working group

– *Thomas Zielinski*, Schleppgeschirr für Fischereifahrzeuge unter dem besonderen Aspekt der Reduzierung des Schleppwiderstandes und der Meeresbodenbelastung, 2011, Bachelor's thesis

– *Christian Häfeli*, Entwurf eines FPSO Schiffes für die Förderung von Gashydrat, 2011, Bachelor's thesis

– *Peer Marian Buchholz*, Messtechnische Bewertung von Energieeffizienz-Maßnahmen für die Garnelenkutter- und Ostseekutterflotte, 2011, Master's thesis

– *Nadine Kunze*, Integration von Heizsystemen in die schiffbaulichen Prozesse, 2012, Master's thesis

– *Daniel Splett*, Entwicklung eines Modells zur Reduzierung der EinsMan-Abschaltungen durch Generierung von dezentralen Abnahmen mittels WindWärme, 2013, Bachelor's thesis

Patents and patent applications on energy issues (since 2002)

Energy-optimised and flexible transfer system for transportable liquid and solid maritime goods

All holders: Kiel UAS

All inventors: Constantin Kinias, Jozsef Nedreu

Brief description: The property right application involves a method for the continuous transfer of transportable goods from a swimming processing platform to a floating transport unit.

Gear for bottom trawl nets

All holders: Kiel UAS

All inventors: Constantin Kinias

Brief description: Device for catching marine creatures consisting of a tyred, wing-shaped trawl beam and at least two outer circular disc-shaped retaining plates with connection points for trawl nets, trawl lines and ground chains.

Cooker for cooking marine creatures (utility model)

All holders: Constantin Kinias

All inventors: Constantin Kinias, Nicole Schroeter

Brief description: Procedure for energy-efficient heating of a liquid medium in an open vessel by means of a burner and a boiler, integrated in the heating vessel and connected to defined lamellar exhaust gas channels in the vessel wall in such a way that the largest possible proportion of exhaust heat can be transferred to the medium via the internal combustion chamber surface and simultaneously via the lamellar surface of the exhaust gas channels.

Cool room for marine creatures on board a fishing boat

All holders: Kiel UAS

All inventors: Constantin Kinias

Brief description: Cool room for marine creatures with an inlet accessible from the outside for accepting the cooked, still warm and moist creatures, and a vessel with an outlet leading into the cool room.

Protective wall for underwater noise sources

All holders: Kiel UAS, Kiel University

All inventors: Constantin Kinias, Andreas Dahmke, Janina Ipsen

Brief description: Noise control when installing wind turbine foundations. The task of the invention is to provide effective noise control for noise emitting measures in the offshore field or in lakes, rivers, etc.

Method for hierarchical energy supply for a hot water cylinder

All holders: Kiel UAS, Scheer Heizsysteme & Produktionstechnik GmbH

All inventors: Constantin Kinias, Gerd Stange, Klaus Lüking

Brief description: Method for controlling the energy input from a number of heat sources of various energy types in a hot water cylinder.

Electrical grid load management method

All holders: Andreas Dahmke, Constantin Kinias, Jan G. Tönnies

All inventors: Andreas Dahmke, Constantin Kinias, Jan G. Tönnies

Brief description: Method for managing the load in an electrical grid where, if there is an excessive supply of electrical energy, a signal is sent to the electricity customers allowing individual electricity customer consumers to be enabled for switching on, or to be excluded from enabling, and/or to be switched on or off automatically.

Energy-related business startups/participation/cooperation (since 2002)

Name of founder: Constantin Kinias

Name of company: SCHEER Heizsysteme & Produktionstechnik GmbH

Company headquarters: Wöhrden

Homepage: www.scheer-heizsysteme.de

Type of business activity: Development of energy-efficient and environmentally friendly heating technology

Form of your cooperation with the company:

Knowledge transfer with universities in Schleswig-Holstein. Development of energy-efficient heating systems, integration of regenerative energy forms for real estate, and mobile and maritime applications.

Prof. Dr. Klaus Lebert



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Management responsibilities in transfer organisations and facilities relevant to energy research

Founding member of the Schleswig-Holstein Electromobility Centre of Excellence

Energy and climate protection R&D projects (since 2010)

ERToS – Emission-Related Testing of Ship Engines

Funded by: EKSH

Funding volume: €119,600

Project duration: 6/2014 to 5/2016

Cooperating partners:

AVL Zöllner Marine GmbH, Kiel

Desulphurisation and waste gas treatment are topics that will critically govern the development of large modern engines for the maritime industry during the coming years. These developments must be accompanied by appropriate test bench environments. AVL Zöllner Marine GmbH in Kiel is a manufacturer of high-performance hydraulic brakes in the 100 to 140,000 kW test range. Facilities that are not optimally designed lead to cost-intensive excess resource consumption and increased emissions during testing operations. For this reason the first project objective is to develop a methodological validation of commissioning with automated evaluation of testing operations.

Emissions predominantly occur at what are known as transient transitions between different engine working points. These changes occur, for example, when manoeuvring in harbour. The aim is to investigate the potential of the existing high-performance hydraulic brakes for specifying transient transitions on test benches. For this reason the second project objective is to develop new, model-based concepts for controlling and evaluating transient transitions for high-performance hydraulic brakes.

Professorship: Modelling, control and optimisation of mechatronic systems

At the University of Applied Sciences since: 2008

Core competences in energy research

1. Model-based control, observation and optimisation methods
2. Simulation models for real-time applications
3. Hardware-in-the-loop test benches for testing embedded systems

eMotion – Cross-border mobility

Funded by: EU, Interreg

Funding volume: €247,000

Project duration: 10/2011 to 9/2014

Cooperating partners:

Udviklingsrad Sonderjylland

Flensburg UAS, Kiel UAS

Kiel University

SDU Sonderborg

SDU Odense

Even given the continuous development of the individual components of electric vehicles, the demand for energy-efficient use of existing resources remains. Against this backdrop and within the context of the E-MoBilanz sub-project, a simulation model for a real electric vehicle (Peugeot iOn) is developed, which balances the vehicle's electrical energy consumption, in particular, taking all consumers and generators into consideration. With the aid of the model an intelligent, secondary consumer controller will be developed on the computer, which will allow the driver to reach destinations at the outer limit of the vehicle's range with optimal use of comfort functions such as the air-conditioning unit or heating.

Battery management system for teaching and training purposes

Funded by: Industry

Project duration: 10/2011 to 6/2012

Cooperating partners:

Automotive industry, Baden-Württemberg

A working group formed together with Prof. Christoph Weber at the Schleswig-Holstein Electromobility Centre of Excellence at Kiel UAS works on the development and testing of battery management systems. The focus is on testing systems in the form of hardware-in-the-loop test benches, with which the test specimen can be tested with the aid of real-time capable simulation models. In this project a system was developed that can be used for teaching and training purposes.

Publications in professional journals covering energy issues

Lebert, K., Weber, C., Jürß, F. (2011): Nutzungsanalyse elektrischer Kleintransporter, Emobile plus solar, No. 82.

Congress presentations on energy issues

Lebert, K.: Elektromobilität – Trends und aktuelle Forschungsthemen, Stadt-Land-Umwelt S-H 2011.

Lebert, K.: Funktionsentwicklung für Batteriemanagementsysteme in Lehre und Training, Competence Exchange Symposium ETAS, 2012.

The most important Bachelor's/Master's theses on energy issues supervised by the professorship/working group

Ansgar Zimnak, Temperaturmodell für ein Energiemanagementsystem eines Elektrofahrzeugs, 2013 (current), Master's thesis

Hauke Peters, Entwicklung und Identifikation eines linear-parametervarianten Modells einer Windenergieanlage, 2012, Master's thesis

Patrick Schmidt, Entwicklung eines offenen Batteriemanagementsystems für Test- und Trainingszwecke, 2012, Master's thesis

Christian Loof, Aufbau und Inbetriebnahme eines Hardware-in-the-Loop Prüfstandes für ein Steuergerät eines Elektroquads, 2012, Bachelor's thesis

Henning Westphalen, Modellabgleich eines Echtzeitsimulationsmodells mit aufgezeichneten Realdaten, 2011, Bachelor's thesis



Filling up with electricity: Because they have their own electric vehicles, Kiel UAS is e-mobile, in line with their advertising slogan



Rolling research subjects in the Faculty of Computer Science and Electrical Engineering.

Photos: Joachim Welding

Prof. Peter Quell



Faculty of Mechanical Engineering

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www.fh-kiel.de

Professorship: Offshore technology
At the University of Applied Sciences since: 2012

Core competences in energy research

1. On and offshore wind turbines
2. Mechanical drive trains
3. Development of large installations
4. Technical project management

Prof. Quell, you are the head of the new offshore technologies course. Why is the offshore field so important to engineering education?

Prof. Quell: The global offshore field is growing rapidly, in particular with regard to power generation. In Germany, the emphasis is predominantly on the generation of wind power. Due to the high and constant wind speeds available here, offshore applications, in conjunction with renewables, provide very high availability together with considerable potential.

In order to implement the ambitious expansion targets and further develop the technologies and processes, considerable engineering resources are required. A complete new branch of industry has appeared in the offshore field, which is also subject to very rapid personnel growth.

In order to meet the demand for engineers, and at the same time cater for the very special requirements of the offshore field, we offer a targeted engineering education in our offshore technologies Bachelor's course. It is based on a very robust, elementary mechanical engineering education, but puts the offshore application at the focal point.

What are your impressions of the Bachelor's course started in 2012/13?

Developing a new course generally offers a lot of design options. Many new ideas and methods arising from teaching at Kiel UAS in recent years are directly incorporated into this course.

At the same time, this is also a very targeted course. The students have made a conscious decision to study in the offshore field and approached their studies with great dedication. At the same time, they are active in developing the course further and are often creatively involved. Both students and teaching staff have a certain sense of pioneering, which allows rapid implementation of new ideas and effective solutions.

In parallel, we actively incorporate the offshore industry and institutions in our teaching. Numerous offshore players are active as lecturers in lecturing, colloquia or conferences. Students are introduced to the demands of the offshore field in numerous excursions. However, the close contact also allows us to further develop teaching and research in this innovative branch.

What relevance does the conference on Helgoland have, that you are organising for 2014?

The conference forms part of our COOL programme. COOL stands for "Campus for Ocean and Offshore Learning" and will be hosted for the third time this year. In November we will travel to Helgoland with more than 100 students interested in the offshore field. Helgoland is the only German offshore island and makes offshore engineering tangible – especially in November.

At the 2-day conference around 15 national and international offshore industry companies will report on their experience and current trends in the development, erection and operation of offshore wind turbines. This gives the students an unfiltered and comprehensive impression of current offshore activities. At the same, direct contact between the students and the offshore companies is facilitated.

Today, Helgoland already serves as a servicing and reaction port in the erection of offshore wind farms. A large number of service staff and their offshore ships are stationed on the island. During bad weather some of the service staff attend our conference and in return allow us to visit their special offshore service ships, known as crew transfer vessels.

On which research problems do you want to concentrate as a professor at Kiel UAS?

The emphasis will be on offshore foundation structures with a focus on material properties, production and installation technologies. In this context, a new welding laboratory is planned, for example, which will accommodate the special offshore engineering requirements. The close cooperation with the mechanical and maritime engineering courses at Kiel UAS, and the existing laboratories, offers support in particular in the operational strength field.

(see course description on page 16)

Prof. Dr. Yves Reckleben

Professorship: Agricultural engineering
At the University of Applied Sciences since: 2005

Core competences in energy research

1. Silage clamp covering using renewable natural resources
2. Efficient production of renewable natural resources
3. Quality-optimised production of vegetable resources

Management responsibilities in transfer organisations and facilities relevant to energy research

- Head of the department of agricultural and energy engineering at Schleswig-Holstein Chamber of Agriculture
- Chair of the working group for commercial fertiliser application technologies with the nutrient management round table

Energy and climate protection R&D projects (since 2010)

Development and testing of a device for uniform and widespread application of starch foam based on renewable natural resources on silage clamps

Funded by: EKSH

Funding volume: €150,000

Project duration: 7/2014 to 6/2016

Cooperating partners:

Amandus Kahl/Reinbek

The year-round use of biomass, as fodder or as a substrate for energy utilisation, assumes that properties and qualities are retained after harvesting. However, careful covering up represents a weak link in the mechanisation chain. Applying sheeting is a time-consuming manual task requiring a number of employees and leads to compromises in quality and care. When removing silo fodder or fermentation substrate, handling and disposal of the sheeting present additional tasks. Clever and sustainable alternatives are required.

In Schleswig-Holstein, fodder (grass, maize and whole plant silage) to the value of 370 million euros is preserved in silage clamps. Nowhere near all of these silage clamps are correctly compacted and, in particular, correctly covered, leading to substantial losses. Losses at the edges and on the surface of silage clamps may contribute up to 10 to 50% of mass and energy (Thaysen, 2013). For downstream silage utilisation this represents an equally large additional biomass production area.

The aim of this project is to continue developing an idea first developed in a pilot project at the laboratory scale and to adapt it to practice conditions. The idea is to cover silage clamps with starch foam from renewable natural resources immediately after emplacement and to thus reduce losses

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and the necessary workload to a minimum.

This idea should now be tested on commonly used, practical silage clamps, and an application and distribution technique developed that functions without errors and does not impair the quality of the ensiled crop. The newly developed cover using foam (extrudate) from a starchy material can contribute to simplifying the cover and thus to low-loss harvest preservation. Fewer losses in preservation and storage mean greater efficiency in crop cultivation and a lower area requirement for their production. The productivity of farmland can thus be sustainably increased. The demand for this new silage clamp cover method in agricultural practice in Schleswig-Holstein is very high and the use of starch to cover silage clamps represents an additional option for achieving added value from domestic agriculture.

The results of the project can be easily transferred to other regions and contribute to resource saving, have a positive effect on land use and thereby make a sustainable contribution to climate protection.

Intelligent road use concept – biomass transport: Measuring loads on roads and service roads from agricultural traffic based on a variety of biomass utilisation paths

Funded by: LLUR/AktivRegion Nordfriesland

Funding volume: €50,000

Project duration: 2014

Cooperating partners:

Amt Mittleres Nordfriesland

The annual agricultural transport volume in Germany is more than 400 million t. The transported goods are widely varied, from seeds through mineral fertiliser to harvested crops. The average transport distance is around 3.9 km. More than 60% of the transported goods are commercial fertilisers and harvested products. The variety, but also the transport time window, demand special vehicles for use on the field and the road, and new logistics models, which must be adapted to the respective local conditions.

A feasibility study aims to investigate the transport loads resulting from maize cultivation. One of the objectives is to precisely measure the loads imposed on roads in order to better plan future maintenance measures and to document road damage. On the other hand, the knowledge gain

Prof. Dr. Yves Reckleben



ned from the study will be used to derive traffic management concepts. By using one-way roads, creating passing places, etc., concessions can be made to residents affected by harvesting. In addition, it is also possible to reduce the length of routes travelled by vehicles with the help of traffic management concepts. This can simultaneously save on CO₂ emissions.

Silage clamp covering using non-modified, starchy material from renewable natural resources

Funded by: Schleswig-Holstein Ministry of Economic Affairs, Science and Transport

Funding volume: €150,000

Project duration: 7/2009 to 9/2012

Cooperating partners:

Department of Polymer Engineering Paderborn

The year-round use of biomass assumes that properties/qualities are also retained after harvesting. A number of preservation methods, such as cooling, drying and silaging are used in practice. Silaging has always been successfully used to preserve the harvested crop for high-quality, year-round forage use or as a fermentation substrate, without additional energy input. Put simply: the faster silaging is carried out, the lower are the losses and the better the properties for subsequent use. Speed is not only required during harvesting, clamp filling and compaction, but also and particularly when sealing the clamp air-tight, in order to reduce the area subject to wind action and to achieve rapid pH lowering by the fermentation of lactic acid. The aim of the project is to develop a biodegradable silage clamp cover, consisting of renewable natural resources (starch compounds and fruit waxes) and which can be applied quickly using the appropriate machine technology, and finally which can be used with the silaged crop.

Publications in professional journals covering energy issues

_Reckleben, Y.: Gülletransport – mit Traktor oder LKW, Bauernblatt Schleswig-Holstein, 15 March 2014, pp. 35–38.

_Reckleben, Y.: Emissionsarme Gülleausbringung auf Grünland, Bauernblatt Schleswig-Holstein, 14.07.2012, pp. 24–25.

_Reckleben, Y., Trefflich, S., Thomsen, H. (2013): Auswirkung der Abgasnormen auf den Kraftstoffverbrauch von Traktoren im praktischen Einsatz, Landtechnik 68(5), pp. 322–326

_Reckleben, Y.: Silagebereitung bei Gras und Mais – verschiedene Systeme im Vergleich, Bauernblatt Schleswig-Holstein, 29 June 2013, pp. 28–29.

Congress presentations on energy issues

_60 t Frischmasse Mais vom Hektar – wie geht das. KWS Agrarforen 23.09.2013, Dammstedt.

_15 t Trockenmasse bei Mais – technische Lösungsansätze. Grundfüttertag der LKSH 25.2.2014, Tarp.

_Potenziale der Biomassenutzung. KWS Agrarforum, 17.01.2014, Rövershagen.

_Mais als Pflanze für eine energetische und stoffliche Nutzung. Rotary Club Rendsburg, 22.01.2014, Conventgarten Rendsburg.

The most important Bachelor's/Master's theses on energy issues supervised by the professorship/working group

_Niels Schäfer, Steigerung der Effizienz bei Straßentransporten am Beispiel unterschiedlicher Reifentypen, 2012, in cooperation with Grasdorf Wennekamp GmbH

_Wiebke Feddersen, Hochschnitt beim Mais – technische und ökonomische Auswirkungen, 2013

_Martin Schiewer, Mobiles Wärmespeicherkonzept im Bereich der erneuerbaren Energien: Technische Lösungen und Logistikoptimierung, 2012

_Morten Ohlsen, Maßnahmen zur Schallreduktion bei Biogasanlagen, 2012

_Johann-Martin Dallmeier-Tießen, Erprobung zur Aufbereitung der Rüben für die Biogasnutzung, 2011

_Johann-Martin Dallmeier-Thießen, Erprobung zur Aufbereitung der Rüben für die Biogasnutzung, 2011

_Katrin Ringe, Gülleseparation: der überbetriebliche Einsatz einer mobilen Separationsanlage im Biogas- und Milchviehbereich sowie die Nutzungsmöglichkeiten auf dem Grünland, 2011

Current further education courses or conferences on energy issues held on a regular basis

Werkstatt Wissenschaft Wirtschaft

Organiser: Centre of Excellence of Biomass in Schleswig-Holstein, Kiel UAS and business development associations

Place/Date: 21.10.2013, Rendsburg

Target group: Farmers, industry and research

Homepage: www.biomassenutzung-sh.de/werkstatt_wissenschaft_wirtschaft_2013.html

Prof. Dr. Kay Rethmeier

Professorship: High voltage engineering, lightning current and EMC

At the University of Applied Sciences since: 2012

Core competences in energy research

1. Reliability of energy supply operating resources
2. Diagnostic measurements
3. High-voltage test techniques

Management responsibilities in transfer organisations and facilities relevant to energy research

_Vice-head of cable testing project group in the Forum network technology / network operation (FNN) in the German Association for Electrical, Electronic & Information Technologies (VDE)

Publications in professional journals covering energy issues

_Kraetge, Rethmeier et al. (2012): Störsignalunterdrückung bei Teilentladungsmessungen, article ew, Volume 111, Issue 4, February 2012.

Congress presentations on energy issues

_Schmale, Rethmeier et al.: Teilentladungsmessung zur Zustandserfassung an Endverschlüssen eines 220-kV Erdkabels. VDE conference Diagnostik elektrischer Betriebsmittel, Fulda 2012.

_Rethmeier et al.: Erfahrungen mit Online-Teilentladungsmessungen an Trockentransformatoren und Mittelspannungs-Schaltanlagen. VDE conference “Diagnostik elektrischer Betriebsmittel”, Fulda 2012.

_Kraetge, Rethmeier et al.: Praktische Erfahrungen mit der akustischen Teilentladungsartung an flüssigkeitsisolierten Leistungs- und Verteiltransformatoren. VDE conference “Diagnostik elektrischer Betriebsmittel”, Fulda 2012.

_Rethmeier et al.: Vergleichende Untersuchungen nicht-konventioneller Auskoppelverfahren zur Teilentladungsmessung an Mittelspannungs-Schaltanlagen. VDE conference “Diagnostik elektrischer Betriebsmittel”, Fulda 2012.

_Rethmeier et al.: Untersuchungen zum praktischen Einfluss der TE-Wiederholrate auf die Scheinbare Ladung bei Teilentladungsmessungen nach IEC 60270. VDE conference “Diagnostik elektrischer Betriebsmittel”, Fulda 2012.

The most important Bachelor's/Master's theses on energy issues supervised by the professorship/working group

_Henning Wagner, Untersuchung der Blitzstromtragfähigkeit von Lagern in Windenergieanlagen, 2013, Germanischer Lloyd

_Michael Gärtner, Prüfungen für Kabel und Kabelanschlussstechnik in der Mittelspannung bei Verwendung eines Aluminiumschichtenmantels, 2013, E.ON Hanse

_Finn Dawurske, Inbetriebnahmekonzept eines Offshore-Windparks am Beispiel der Amrumbank West, 2013, E.ON

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climate & renewables

_Dennis Wulf, Vergleich von Diagnoseverfahren zur Zustandsbewertung eines Mittelspannungs-Kabelnetzes, 2013, Kiel UAS/Versorgungsbetriebe Kronshagen

_Oleg Michaelis, Qualifizierungsprüfungen an Schraubverbindern für rundeindrätige Aluminiumleiter für Energiekabel mit einem Querschnitt von 1600 mm², 2013, Nexans

Artificial lightning: The laboratory for high-voltage at Kiel UAS is unique in northern Germany.

Photo: Joachim Welding



Prof. Dr. Alois Schaffarczyk



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Professorship: Mathematics and Engineering Mechanics
At the University of Applied Sciences since: 1992

Core competences in energy research

1. Wind Turbine Aerodynamics
2. Flow simulations (CFD)

Management responsibilities in transfer organisations and facilities relevant to energy research

_ Program Manager of the international M.Sc. Wind Engineering course, Kiel

Energy and climate protection R&D projects (since 2010)

Aerodynamic glove for measuring the aerodynamic boundary layer on rotating wind turbine blades

Funded by: ZPW

Funding volume: €636,000

Project duration: 1/2009 to 12/2012

Cooperating partners:

ENERCON GmbH, Aurich
Flensburg UAS

The aim of this project was to design, build and test a measuring system (glove) on a blade of the Flensburg UAS WEA E30 research turbine to measure the aerodynamic boundary layer. The measurement results achieved in the April to September 2011 measurement campaign reveal that part of the blade is subject to low-friction flow (laminar) and that the transition to more frictional (turbulent) flow can probably not be explained by the Tollmien-Schlichting mechanism. The results achieved here open up new options for further improving the aerodynamic design of wind turbine blades.



Measurement and analysis of high-frequency (>1 kHz) turbulence components in offshore wind applications for optimising aerodynamic blade profiles

Funded by: ZPW

Funding volume: €291,000

Project duration: 7/2009 to 6/2012

Cooperating partners:

R&D centre Kiel University of Applied Sciences GmbH
Germanischer Lloyd, Hamburg

Onshore and offshore measurements of atmospheric turbulence, which are globally unique in their type and scope, were carried out. The turbulent pressure fluctuation data allow a deep insight into high-frequency turbulence in the atmospheric boundary layer. A new measuring device, known as the laser cantilever anemometer (LCA), was successfully developed for field applications from a laboratory device. It was possible to solve important engineering problems. It is also possible to use this device in the difficult offshore environment. Turbulent velocity and pressure fluctuations at high frequencies were measured simultaneously in the atmosphere for the first time.

Achieving yield improvements by rotor blade modifications on existing wind turbines

Funded by: Deutsche Bundesstiftung Umwelt (DBU)

Funding volume: €50,000

Project duration: 2/2009 to 6/2013

Cooperating partners:

Deutsche Windguard GmbH, Varel

The aerodynamic qualities of turbine rotor blades in production for more than ten years are investigated and proposals for improvements made.

Publications in professional journals covering energy issues

- _ Hillmer, B., Borstelmann, Th., Dannenberg, L. and Schaffarczyk, A. P. (2007): Aerodynamic and Structural Design of MultiMW Wind-Turbine Blades beyond 5 MW, Journal of Physics 75.
_ Timmer, W. A. and Schaffarczyk, A. P. (2004): The effect of roughness on the performance of a 30 % thick wind turbine airfoil at high Reynolds numbers, WIND ENERGY 7(4).
_ Schaffarczyk, A. P., Gontier, H., Kleinhans, D. and Fried-



rich, R. (2010) in: Peinke, J., Oberlack, M., Talamelli, A. (Eds.), A new Non-Gaussian Turbulence Generator for Estimating Design-Loads of Wind-Turbines, Progress in Turbulence III, SPPHY, vol. 131, pp. 107–110, Springer, Heidelberg.

_ Aerodynamics and Blade Design, Chapter 4 of: Understanding WIND POWER TECHNOLOGY, Ed. A.P. Schaffarczyk, J. Wiley and Sons, Chichester, UK, 2014, ISBN-13: 978-1-118-64751-6.

_ Introduction to Wind Turbine Aerodynamics, Springer, 2014, ISBN-13: 978-3642364082.

Congress presentations on energy issues

_ Schaffarczyk, A. P. and Schwab, D.: Kiel's Aerodynamic Glove Experiment, IEA Wind Annex 29 (MexNext II) Meeting, NREL, Golden, CO, USA, 5/6 Nov. 2012.

_ Schwab, D., Ingwersen, S., Schaffarczyk, A. P. and Breuer, M.: Pressure and hot film measurements on a wind turbine blade operating in the atmosphere 3rd conference on the Science of making torque from wind, Oldenburg, Germany, 2012.

_ Jeromin, A., Bentamy, A. and Schaffarczyk, A. P.: Actuator Disk Modelling of the Mexico Rotor with openFOAM, First Symposium on penFOAM in Wind Energy, Oldenburg i.O., Germany (2013).

_ Timmer, W. A. and Schaffarczyk, A. P.: The effect of roughness on the performance of a 30 % thick wind turbine airfoil at high Reynolds numbers, Proc. EWEA special topic conference: The Science of making torque from wind, Delft, The Netherlands (2004).

_ Schaffarczyk, A. P. and Conway, J.: Application of a Non-

linear Actuator Disk Theory on Wind Turbines, Proc. 14th IEA Expert-Meeting on Aerodynamics of Wind Turbines, NREL, Golden, Colorado, USA (2000).

The most important Bachelor's/Master's theses on energy issues supervised by the professorship/working group

_ Ma Yu, Development and verification of multi-body formulations for the simulation of wind turbine rotor blades and other components, 2012, Fraunhofer IWES, Bremerhaven

_ A. Nicolaisen, Planning and implementation of a field test for the verification of ice detection systems for rotor blades of wind turbines, 2011, REpower Systems SE

_ Viviane Aquino da Silva, Development of a methodology for the calculation of wind indices for Brazil, 2012, Fraunhofer IWES, Kassel

_ C. Mohr, A nonlinear finite element simulation investigating the effect of wave loads to the bearing behavior of monopiles, 2011

_ J. Ramm, Process Qualification for Structure materials in rotor blade manufacturing, 2012, Senvion SE

The most important conferrals of doctorates on energy issues supervised by the professorship/working group

_ Daniela Schwab, Ein aerodynamischer Handschuh zur Vermessung der aerodynamischen Grenzschicht an rotierenden Windturbinenblättern, 2014, Kiel UAS and Helmut Schmidt University Hamburg, Prof. Dr. Breuer

Prof. Dr. Ulf Schümann



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Professorship: Electrical power engineering
At the University of Applied Sciences since: 2008

Core competences in energy research

1. Power electronics
2. Control of electrical machines
3. Electromobility/wind turbines

Energy and climate protection R&D projects (since 2010)

Wind turbine cluster

Funded by: ZPW, industry enterprises

Project duration: 3 years

Cooperating partners:

Wind energy company, Schleswig-Holstein

In the context of the development of a new wind turbine by a company with headquarters in Schleswig-Holstein, the electrical model of the wind turbine is being built at the University of Applied Sciences and the turbine's control strategy investigated. The mechanical part of the WT is represented by a simulation model. This simulation model controls a test bench motor. The motor drives the

associated wind turbine's model generator. A 120 kW class, self-programmable frequency inverter is installed to control the generator. A variety of different generator control strategies are investigated with the aid of this frequency inverter.

Congress presentations on energy issues

_Schümann, U., Goll, O., Eng, M., Frank, S.: Simulation of a Wind Turbine on a Test Bench using SIMPACK and Matlab/Simulink, SIMPACK Conference Wind and Drivetrain, 2012 Hamburg.

_Schümann, U.: Elektro- und Hybridfahrzeuge – Technische Herausforderungen bei der Umsetzung, 6th Symposium Versorgungswirtschaft SH, 2009.

_Schümann, U. Elektro- und Hybridfahrzeuge wie funktionieren die eigentlich?, Mobilitätstag Kiel, 2009.



New technologies: Test bench for the electrical model of a wind turbine.

Photo: Ulf Schümann

Prof. Dr. Christoph Weber

Professorship: Electronic circuit design and electric drives
At the University of Applied Sciences since: 2008

Core competences in energy research

1. Development of battery management systems for lithium ion cells
2. Characterisation of lithium ion cells
3. Converter design for energy-efficient drive systems

Management responsibilities in transfer organisations and facilities relevant to energy research

- _Member of the Competence Center for Power Electronics Schleswig-Holstein
- _Member of the Schleswig-Holstein Electromobility Centre of Excellence

Energy and climate protection R&D projects (since 2010)

Development of a rapid prototyping platform for three-phase drives in fork lift trucks with in-house designed power electronics hardware and an autocode toolbox for Matlab/Simulink

Funding volume: €25,000

Project duration: 4/2014 to 10/2014

Cooperating partners:

Kiel UAS, R&D centre Kiel University of Applied Sciences GmbH and Jungheinrich AG

Drawing up control engineering tests for energy-related topics, among others

Funding volume: €60,000

Project duration: 7/2014 to 6/2015

Cooperating partners:

Kiel UAS, R&D centre Kiel University of Applied Sciences GmbH and Lucas Nülle GmbH

Development of battery management systems for stationary applications

Funding volume: €55,000

Project duration: 9/2013 to 9/2014

Cooperating partners:

Kiel UAS, R&D centre Kiel University of Applied Sciences GmbH and IAV GmbH

Development of new algorithms for lithium ion cells with extremely flat cell voltage characteristics

Funding volume: €65,000

Project duration: 12/2013 to 8/2015

Cooperating partners:

Fraunhofer ISIT, Kiel UAS, R&D centre Kiel University of Applied Sciences GmbH

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Electric buses for local municipal transport

Funding volume: €35,000

Project duration: 4/2013 to 9/2014

Cooperating partners: E.ON Hanse AG, Euracom, Kiel UAS, R&D centre Kiel University of Applied Sciences GmbH

Publications in professional journals covering energy issues

_Lebert, K., Jürß, F., Weber C. (2011): Nutzungsanalyse Elektrischer Kleintransporter, Zeitschrift für Elektrofahrzeuge und solare Mobilität "EMobile plus solar".

Congress presentations on energy issues

_Rathmann, H., Benecke, W., Kähler, D., Weber, C.: State-of-Charge Bestimmung anhand von Impedanzmessungen für Lithium-Ionen-Zellen, 7th Developer Forum in Aschaffenburg, April 2014.

_Rathmann, H., Benecke, W., Kähler, D., Weber, C.: Sophisticated Estimation of Hardly Measurable Conditions of Lithium-Ion Batteries, IECON 2013, Vienna, November 2013.

_Janzen, K., Weber, C.: Mechatronisches Aufbaukonzept für Megawatt-Powerstacks, Workshop Innovation Cluster Power Electronics Schleswig-Holstein, Fraunhofer ISIT in Itzehoe, November 2013.

The most important Bachelor's/Master's theses on energy issues supervised by the professorship/working group

_Fabian Franke, Entwicklung eines Batteriemangement-systems für ein Elektrofahrzeug, 2014, project work

_Benjamin Weigel, Entwicklung eines BMS-Slave-Gateways für eine Batteriemangement, 2013, Bachelor's thesis

_Florian Weber, Entwicklung eines Matlab/Simulink Prototyping-Systems für Motoranwendungen, zur Programmierung prozessorgestützter Umrichterhardware mittels Embedded-Coder und anschließender Realisierung einer feldorientierten 4-Quadrantenregelung einer Aynchronmaschine, 2013, Master's thesis

_Torben Lamp, Entwicklung eines Online-Impedanzspektroskopieverfahrens für ein Batteriemangementssystem, project work

The most important conferrals of doctorates on energy issues supervised by the professorship/working group

_Entwicklung von neuen Algorithmen zur Zustandsprognose von Batteriesystemen auf Basis von Lithium-Ionen-Zellen, since Sept. 2011

Prof. Dr. Harald Wehrend



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Professorship: Electrical grids and smart grids
At the University of Applied Sciences since: 2012

Core competences in energy research

1. Network analyses, simulation of transient processes (ATP-EMTP)
2. Protection technology, grid automation, IEDs compliant with IEC 61850
3. Modelling and simulation of grids and decentralised energy generation installations using Digsilent/Powerfactory

Management responsibilities in transfer organisations and facilities relevant to energy research

_Deputy chairman of the European EMTP-ATP Users Group e. V. (EEUG)

The most important Bachelor's/Master's theses on energy issues supervised by the professorship/working group

- _Barsukov, Beschreibung eines GHKW zur Optimierung der Betriebsstrategie, 2014
- _Brüns, Nachbildung von Solaranlagen mit DigSILENT Power Factory zum Zwecke der Lehre, 2014
- _Naumann, Erweiterte Prüfung von Schutzgeräten auf Basis von SCL-Dateien im Rahmen der IEC 61850, 2014
- _Scheffler, Untersuchung des zeitlichen Verhaltens von GOOSE-Nachrichten von IEC61850-konformen IED's, 2014
- _Weber, Untersuchungen zum Blindleistungsverhalten von Windenergieanlagen im Stillstand, 2014

Publications in professional journals covering energy issues

_Wehrend, H.: Aspectos de protecao para desacoplamento entre geradores e as redes, EM Eletricidade Moderna No. 467, Brazil 2013.

Congress presentations on energy issues

- _Wehrend, H.: Der QU-Schutz, Hintergrund, Implementierung und Prüfung, OMICRON Anwendertagung Darmstadt, 2011.
- _Wehrend, H.: Islanding protection – national and international aspects, IPTS Brand, 2011.
- _Wehrend, H.: First steps to make ATP-EMTP run on Android-devices, EEUG Conference Zwickau, 2012.

Current further education courses or conferences on energy issues held on a regular basis

European EMTP-ATP Users Group (EEUG) conference

Organiser: EEUG

Target group: Engineers, technicians, energy engineering students

Homepage: www.eeug.org



Laboratory for energy management: Setup for investigation in parallel operation of generators with the grid and different loads.

Prof. Dr. Rainer Wulfes

Professorship: Grassland management, field forage crops and ecological farming

At the University of Applied Sciences since: 2014

Core competences in energy research

1. Cultivation and utilisation of energy crops for biogas production

Energy and climate protection R&D projects (since 2010)**Biomass energy – Challenge for the producers and growing regions**

Funded by: MWAVT

Funding volume: €260,000

Project duration: 2/2009 to 1/2011

Cooperating partners:

Norddeutsche Pflanzenzucht, Hohenlieth, KWS Saat AG, Einbeck, Rationalisierungs-Kuratorium für Landwirtschaft (RKL), Osterrönnfeld, Schleswig-Holstein Chamber of Agriculture, Rendsburg, DEULA, Osterrönnfeld, agricultural contractors and agricultural enterprises in Schleswig-Holstein

The aim of the project was to expand the baseline data on the performance and yield security of energy crop rotation under the conditions prevalent in Schleswig-Holstein, in order to provide agricultural enterprises a basis for calculations for the use of energy crops in biogas plants. By way of the cooperation between Landtechnikzentrum in Osterrönnfeld/Rendsburg with leading agricultural enterprises and agricultural contractors, as well as regional plant breeders, important contributions to the knowledge base and the transfer of results into practice shall be achieved.

EVA joint project: Development and comparison of optimised cultivation systems for the agricultural production of energy crops under a variety of site conditions in Germany

Funded by: BMELV

Funding volume: €46,000

Project duration: 8/2011 to 1/2013

Cooperating partners:

Thüringer Landesanstalt für Landwirtschaft (TLL) as coordinator, 23 additional institutions in 11 states

The aim of the EVA joint project in phase II was to holistically study the cultivation of energy crops. In addition to experimental crop production, a comprehensive set of problems was addressed by additional, in-depth, economical and ecological research. Using additional experiments involving aspects of energy crop cultivation and substrate processing, it was possible to derive relevant practical knowledge and recommendations for sustainable, site-

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specific cultivation systems.

EVA joint project: Development and comparison of optimised cultivation systems for the agricultural production of energy crops under a variety of site conditions in Germany

Funded by: BMELV

Funding volume: €241,000

Project duration: 4/2013 to 11/2015

Cooperating partners:

Thüringer Landesanstalt für Landwirtschaft (TLL) as coordinator, 23 additional institutions in 11 states

In project phase III of the EVA joint project, the knowledge gained from the first two project phases will be studied in more detail. The emphasis is more heavily placed on ecological and social problems.

The aims are:

- › To develop efficient and sustainable, site-specific cultivation systems for energy crops for biogas production.
- › To compile information to be used in consultations for decision-making in individual operations and for regional consultation.
- › To compile and provide decision aids for social objectives (increasing biodiversity, climate protection, resource protection, sustainable farming).

Congress presentations on energy issues

_Wulfes, R., Ott, H. und Hünerjäger, R. (2011): Leistungsfähigkeit von Energiepflanzenanbausystemen mit Mais und Sorghum in Schleswig-Holstein, 54th Annual Conference of Ges. für Pflanzenbauwiss., Kiel, Mitt. Ges. Pflanzenbauwiss., 23, 276.



Prof. Dr. Stefan Fischer



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Professorship: Computer Science
At the University since: 2004

Core competences in energy research

1. Computer networks
2. Distributed systems
3. Software architecture

Management responsibilities in transfer organisations and facilities relevant to energy research

– Head of the Smart City Research Center Lübeck

Develop Lübeck into a smart city

Interview on the new Smart CIRCLE research centre

Lübeck University and Lübeck University of Applied Sciences, the Hanseatic City of Lübeck and the Technikzentrum Lübeck are working together in the Smart City Research Center Lübeck (Smart CIRCLE) that was established recently. What is this all about?

Prof. Fischer: The term “smart city” is currently on everyone’s lips. The main feature is the intelligent use above all of information and communication technologies in an urban environment with the aim of improving people’s lives whilst at the same time using sustainable resources. Improve can mean almost anything in this context: more security, greater convenience, a longer life, better entertainment, fewer administrative formalities, more efficient transport and so on. A more sustainable use of resources initially means a more efficient and cost-effective use of energy up to the point where cities are completely self-sufficient with regard to energy. In this environment Smart CIRCLE has two main aims: On the one hand, members will research and develop new smart city technologies together, and on the other hand also implement them in practice – here in Lübeck. We are determined to drive the development of Lübeck into a smart city and play a major role in doing so.

What topics are the focus of research and development?

We will primarily deal with topics that are relevant to Lübeck: Culture and tourism, construction of residential accommodation and urban development, the health care sector, transport and logistics. In particular in the field of construction of residential accommodation and urban development as well as transport and logistics we will focus intensively on energy issues – above all solutions from the SmartHome sector and everything associated with electric cars and their incorporation into route planning for all means of transport will play an important role. However, in addition to the more technical aspects, we also want

to raise social science issues and aim to involve the local inhabitants on a large-scale.

Should commercial enterprises also be involved in the research – keywords transfer of knowledge?

In fact, a large number of companies are already involved via membership of the Technikzentrum Lübeck. However, we would like to increase this substantially. If we really want to turn Lübeck into a smart city, then this will work only as part of a public-private partnership – and we want to convince as many companies as possible of this.



Prof. Dr. Michael Herczeg

Professorship: Practical computer science – multimedia and interactive systems

At the University since: 1997

Core competences in energy research

1. Safety technology: Interaction between people, technology and organisation in safety-critical systems
2. Information ergonomics: Interactive visualisation of data and network structures
3. Automation: Intelligent interaction and automation in stationary and mobile systems

Department of Computer Science/Engineering

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You are an expert in multimedia and interactive systems and work as an adviser and expert for the nuclear supervisory authority of the Federal State of Schleswig-Holstein. Initially this sounds rather unusual. How do these aspects go together?

Prof. Herczeg: I deal with human-machine systems. This means understanding the interaction, in other words the interplay between humans and machines and to structure this in relation to the problem. This interaction or also communication between humans and machines is constantly being achieved through some form of multimedia, in other words visual, auditive or also haptic forms of interaction. This applies to every type of human-machine system, whether it is a smartphone, an office system, an intelligent house, a vehicle cockpit or the control room of a power plant. In particular it also deals with embedding such human-machine systems in organisational contexts. Nuclear power plants are a type of safety-critical human-machine system in a highly complex operating context. I have been dealing with such safety-critical human-machine systems such as nuclear power plants, aircraft, ships, network management or also medical technology systems for many years.

As far as nuclear power plants are concerned, one usually first thinks of technical safety. What safety criteria are you investigating in your report?

Technical operation and reliability were indeed the first step in nuclear technology over forty years ago. Later aspects such as human error were also investigated, in particular when there were more and more deviations and accidents in the operation of nuclear power plants, whose causes were also attributed to human errors. There was talk of human factors. The near-disaster at Three Mile Island in 1979 and also the disaster at Chernobyl in 1986 were examples of this. In the meantime it has been recognised that there are considerable risks from organisational, business and political errors. Fukushima in 2011 is a sad example of this. With regard to the problems of people and organisation in operations, in other words the operator’s behaviour in nuclear power plants, since 2002 I have been investigating a series of reportable events in the Brunsbüttel

and Krümmel nuclear power plants on the instructions of the nuclear supervisory authority of the Federal State of Schleswig-Holstein.

Above all the nuclear power plants in Brunsbüttel and Krümmel have been criticised following a series of accidents during the last few years. What conclusions have you reached as the expert when analysing the causes?

The Brunsbüttel and Krümmel nuclear power plants and their operating organisations have produced a series of serious reportable events, which cannot be reduced to mere technical problems. It has been shown that there are also noticeable weak points in the behaviour and specialist knowledge of individual people, above all in the reliability of the operating organisations. The events were an example that attention must be paid not only to technology but also to the successful interaction between people, technology and organisation, we also call it MTO. Various measures were taken in these power plants on the basis of these events and the associated findings amongst other things as part of so-called safety management to improve the operational organisation and the work processes such as also internal company management and external company communication. Even the best technology is of no use if it is being operated and communicated inadequately.

How does the policy of the energy transition of the Federal Government influence your work today in response to the reactor disaster at Fukushima?

At the end of 2013 the brochure “Wendepunkt Fukushima” (Fukushima, a turning point) was published by the Ministry of Energy, Agriculture, the Environment and Rural Areas Schleswig-Holstein. I was invited to make a contribution to the assessment of the safety and future of nuclear power plants with regard to the human factor in this recent brochure. After analysing the well-known disasters that have been investigated and various reports of my own in this field, the conclusion could only state that nuclear power plants are not responsible, as one has to expect that serious events can occur in any nuclear power plant through complex cause-effect chains, in particular in the end even nuclear meltdowns, in other words an MCA. The comple-

Prof. Dr. Michael Herczeg



Brokdorf nuclear power plant: The white dome can be seen from a great distance (above). Technicians must work in the control room (below) without any errors.

Photos: Joachim Welding

xity can obviously not be dealt with by either technical, human or organisational means. This is clear; the events speak for themselves. To this extent we can no longer wait for an effective energy transition. We no longer have any time for political or economic hesitancy or optimisations, as long as even only a single power plant is still operating. Moreover serious nuclear accidents and disasters can also still occur through deficiencies in the knowledge and reliability of staff and organisations in nuclear power plants that have been switched off and are shut down. One doesn't even want to think about the unsolved problem of local interim storage and the unsolved problem worldwide of final storage and the protection of and against radioactive waste organised by technology and humans for the next hundred thousand years.

In what subjects is the Institute for Multimedia and Interactive Systems at Lübeck University also undertaking research?

We are researching the further development and improvement of the relationship between humans and technology. Computer systems will also help to provide a much more efficient use of resources. This applies just as much to energy as to all the other resources that we use. At the Institute we are carrying out research and developing human, application and human-technology interfaces in the right context, which do not bring technology but people, their responsibilities, their social and organisational structures and their natural and cultural worlds into the foreground. The energy transition will not be possible without a new relationship at the interfaces between people, technology and the environment. It is our focus to understand and structure these interfaces as a whole.

Prof. Dr. Martin Leucker

Professorship: Practical computer science
At the University since: 2010

Core competences in energy research

1. Electromobility: Navigation for electric vehicles, routing algorithms, range forecasts
2. Optimisation of controls for improving energy efficiency
3. Data acquisition, preparation and analysis of measured data

Management responsibilities in transfer organisations and facilities relevant to energy research

- _ Director of the Institute for Software Engineering and Programming Languages
- _ Speaker of the Competence Center Software Systems Engineering (KoSSE)
- _ Founding member of the Smart City Research Center Lübeck (Smart CiRCLe)

Energy and climate protection R&D projects (since 2010)

ZeLiM – Centralised Lithium Storage Monitoring

Funded by: EKSH

Project duration: 4/2013 to 3/2015

Cooperating partners:

ECC Repenning GmbH, Geesthacht

In the context of this project a system for centralised monitoring and control of decentralised energy storage systems, which can work with a large number of energy stores simultaneously, is researched and developed.

eE-Tour Allgäu

Funded by: BMWi

Project duration: 10/2009 to 9/2011

In the context of this project concepts for introducing electromobility in the Allgäu tourism region were developed.

RollerRent

Project duration: since 10/2012

Cooperating partners:

Move About GmbH, Bremen

In the context of this project concepts for car-sharing of electric scooters are developed.

GreenNav

Project duration: since 10/2012

Cooperating partners: TU München, Dr. Martin Sachenbacher

The aim of this project is a navigation system for energy-

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optimal routing, which takes into consideration the particular needs of electric vehicles.

Publications in professional journals covering energy issues

_Sachenbacher, M. et al. (2011): Efficient Energy-Optimal Routing for Electric Vehicles. In: Proceedings of the 25th AAAI Conference on Artificial Intelligence, Special Track on Computational Sustainability and AI (AAAI 2011), pp. 1402–1407. AAAI Press.

_Artmeier, A. et al. (2010): The Shortest Path Problem Revisited: Optimal Routing for Electric Vehicles. In: Advances in Artificial Intelligence (KI 2010), vol. 6359 of Lecture Notes in Computer Science, pp. 309–316. Springer.

Congress presentations on energy issues

_Fischer, S., Leucker, M.: Runtime Verification and Reflection for Wireless Sensor Networks (SESENA 2013).

_Sachenbacher, M. et al.: Towards 2nd-Life Application of Lithium-Ion Batteries for Stationary Energy Storage in Photovoltaic Systems. In: Proceedings of the International Conference on Solar Energy for MENA Region (INCOSOL 2012), pp. 29-1 – 29-5. 2012.

The most important conferrals of doctorates on energy issues supervised by the professorship/working group

_Carsharing und Multimodalität als kombinatorische Optimierungsprobleme im Kontext der Elektromobilität, current

_Zentralisiertes Lithium-Speicher-Monitoring, Lübeck University, ECC Repenning GmbH, Geesthacht, current

Energy-related business startups/participation/cooperation (since 2002)

Name of founder(s): Michael Geppert, Winfried Mundl, Daniel Quinger, Harald Seemann

Name of company: LION Smart GmbH

Company headquarters: Garching

Homepage: www.lionsmart.de

Type of business activity: Development of battery management systems (BMS), development of battery storage systems.

Form of your cooperation with the company:

Software development consultation

Prof. Dr. Michael Bischoff



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Management responsibilities in transfer organisations and facilities relevant to energy research

- _ Head of the Air Pollution Control and Environmental Process Engineering laboratories at Lübeck UAS
- _ Manager and coordinator of the Sino-German CATE-B biomass network
- _ Leader of Technical Group International Cooperation in the Centre of Excellence of Biomass in Schleswig-Holstein

Energy and climate protection R&D projects (since 2010)

Characterisation of absorbents for biomethane enrichment / testing and further development of membrane procedures for biomethane production

Cooperating partners:

Haase, Neumünster
Helmholtz-Zentrum, Geesthacht
Sterling SIHI GmbH, Itzehoe

In Germany biogas as a source of renewable energy is chiefly converted into electricity and heat in cogeneration plants. The overall efficiency depends to a large extent on consistent and sustainable heat usage concepts - that are often lacking. An accumulation of the methane content until it reaches an appropriate quality enables it to be fed into the natural gas network or to fuel vehicles. This increases the usability of the biogas in terms of energy in the available infrastructure and for conventional usage concepts.

Undertaking fermentation tests and developing technical processes for biogas production

Cooperating partners:

GPU (Gesellschaft für kommunale Umwelttechnik mbH), Fulda

Organic waste as a fermentation substrate for biogas plants accounts for an increasingly important proportion of the production of biogas as a substitute for non-renewable energy sources. Waste from food and drinks production, flotsam and jetsam, agricultural waste, green waste, residues from the production of food supplements, the pharmaceutical or cosmetics industry are examples of

Professorship: Environmental process engineering
At the University of Applied Sciences since: 1994

Core competences in energy research

1. Environmental process engineering
2. Air pollution control
3. Energy efficiency in business and manufacturing
4. Biogas production and processing

this. Fermentation tests with the corresponding substrates or substrate mixtures in the laboratory or on a semi-technical scale are vital to plan biogas plants as well as to optimise operations. Such fermentation tests are carried out in the laboratory for environmental process engineering and if necessary process engineering proposals are developed for the plant design, pre-treatment stages or operational conditions. In addition, process stages can be interpreted based on test results and operational conditions can be simulated with the available computer programs and models (MatLab, SIMBA, ADM1).

Development of laboratory equipment for fermentation tests to produce biogas

Laboratory equipment, apparatus and forms of analysis to support and implement fermentation tests are optimised or developed if necessary with various partners within and outside the University of Applied Sciences. The aim is to supply biogas laboratory facilities with improved and safer handling and help to enable current problems with biogas production and biomethane production to already be processed previously on a laboratory scale with a high level of accuracy of the conclusions regarding technical implementation. (In-house developments, cooperation within the University).

Biomass processing from animal farms for the development of weak infrastructural regions in China

Funded by: Robert Bosch Stiftung

Funding volume: approx. €75,000

Project duration: 2010 until 2013

Project information: www.cate-b.com

The project concerns the exchange of scientific information between Chinese and German universities and economic partners in order to boost regions in China with an underdeveloped infrastructure through energy from biomass. The conditions for the production and use of biogas are being investigated in particular. The resulting CATE-B (China Applied Technologies for Environment – Biogas) network and the exchanges between the network partners are geared towards continuous further development and sustainability. On the German side the network works with GIZ (Gesellschaft für Internationale Zusammenarbeit), the DBFZ (German Biomass Research Centre), the Fachverband

Biogas (German Biogas Association) as well as the Centre of Excellence of Biomass in Schleswig-Holstein and concentrates on promoting economic cooperation and the transfer of technology between partners on the German and Chinese side (in collaboration with the WTSH).

Energy efficiency analyses for industrial plants

Energy saving measures make a major contribution to climate protection and reduce the more extensive use of fossil fuels to cover energy requirements. In particular small and medium-sized industries, such as printing plants, harbour great potential for energy saving measures, which can often be implemented with short payback periods. The laboratory for environmental process engineering carries out energy efficiency analyses and investigates, develops and optimises innovative technical measures, which provide economic use of the available savings potential. (Reference: broschek rollenoffset)

Publications in professional journals covering energy issues

_Wiese, J., Bischoff, M.: Instrumentation, Control and Automation on Biogas plants, submitted 01.2013 (for Biogas Engineering and Application, Volume 3' China Agricultural University Press, GIZ/CAU).

_Bischoff, M., Wiese, J., Raninger, B.: Views on the Communication needs in Biogas Sector between Germany and China, submitted 01.2013 (for Biogas Engineering and Application, Volume 3' China Agricultural University Press, GIZ/CAU).

The most important Bachelor's/Master's theses on energy issues supervised by the professorship/working group

- _ Tian Xinbo, Development of a mathematical model for the design of an absorption column for biogas purification and experimental research on solubility data, 2011
- _ Liu Yang, Basic Research on Biogas Upgrading based on the solubility experiments for Biogas components in different absorbents, 2012
- _ Miao Weiqiao, The suitability of salt water plants for biogas processing, 2012
- _ Jonas Vandeperre, Experimentelle und simulative Untersuchung über Latentwärme-Speicherung für Kraft-Wärme-Kopplung als Beitrag zur Erfüllung der Anforderungen zukünftiger Energiestrukturen, 2012
- _ Ole Küster, Rechnerische Simulation der Biomethan-gewinnung mittels physikalischer Absorption und experimentelle Ermittlung von Löslichkeitsgleichgewichten, 2012



Biogas plants in the countryside: Waste from food production could be used as a fermentation substrate.

Prof. Dr. Cecil Bruce-Boye



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Management responsibilities in transfer organisations and facilities relevant to energy research

_Head of Wissenschaftszentrum Norderstedt für intelligente Energienutzung (WiE – Scientific centre for intelligent energy use), Lübeck UAS

Energy and climate protection R&D projects (since 2010)

ZukunftsWerkStadt, “Internet der Energien”

Funded by: BMBF

Scope of funding: 2 research assistants

Project duration: 8 months, from February 2013

Cooperating partners:

Stadtwerke Norderstedt

Helmut Schmidt University Hamburg

FHL Forschungs-GmbH

Fluctuating power generation presents our power supply system with the following problems: deviations from forecasts, lulls, power gradients and excess power. The measures required to sustainably redesign the electricity supply include network expansion, flexible generation, consumer control and storage. For short-term periods of a few years the preferred solutions include flexible generation and load adaptation. Demand-side management is already successfully implemented in the industry. The knowledge gained must now be applied to private households and commerce.

Wissenschaftszentrum für intelligente Energienutzung (WiE)

Funded by: Industry

Scope of funding: 3 research assistants

Project duration: 3 years

Cooperating partners:

Stadtwerke Norderstedt, Stadtwerke Lübeck, FHL Forschungs-GmbH, Research Center for Energy Economics FfE

Wissenschaftszentrum für intelligente Energienutzung (WiE) is a scientific facility for research, education and dialogue in the fields of modern energy supply and the energy industry. WiE is engaged in an intense dialogue and knowledge transfer with small and medium energy supply

Professorship: Automation engineering, control systems engineering, power electronics

At the University of Applied Sciences since: 1991

Core competences in energy research

1. Industrial information technology
2. Distributed systems in power engineering
3. Energy2Energy communications

companies, energy-intensive companies, the trades and the population. WiE is involved with energy IT for regional development of the energy infrastructure for intelligent energy supply. Additional topics include the effects and interactions of the legislative framework (for example the German Renewable Energy Sources Act (EEG) or Energy Industry Act (EnWG)) on technological change within the energy industry. Intelligent energy meter concepts for timely power consumption control, the use of dynamic tariffs and automated load profile control represent some of the research topics. In addition, WiE is involved with virtual power plant concepts in terms of supply security when converting from centralised to decentralised energy supply. Further information on the Wissenschaftszentrum für intelligente Energienutzung can be found on page 39 of this brochure.

Expert team:

Director: Prof. Dr.-Ing. Cecil Bruce-Boye

Vice director: Prof. Dr.-Ing. Rüdiger Lohmann,

Prof. Dr.-Ing. Holger Hinrichs

Employees: Dipl.-Ing. (UAS) David Berner M.Eng.

Dipl.-Ing. (UAS) Jonas Vandeperre

Dipl.-Ing. (UAS) Kai Engelken

Mareike Redder M.Sc.

Malte Myrau M.Sc.

Kompetenzzentrum intelligente Energie (KiE) (pending)

Funded by: State funding, EU funding planned

Project duration: 3 years, beginning 2014

Cooperating partners:

Lübeck University, Research Center for Energy Economics FfE, in cooperation with universities and institutions in Schleswig-Holstein and Hamburg.

Emphases:

Basic research and standardisation for processes and innovative technologies for the energy industry.

In-service continued scientific development

M.Sc. in Energy IT



Cooperation between Kompetenz- and Wissenschaftszentrum für intelligente Energie.

Optimisation of plan forecast for energy procurement by means of measured customer load profiles

Funded by: EKSH

Funding volume: approx. €140,000

Project duration: 7/2014 to 7/2016

Cooperating partners:

Stadtwerke Norderstedt

The deviations between the plans compiled for procuring electrical energy and the true subsequent load profile will be minimised based on the real load household and commercial customer profiles acquired by means of intelligent measuring systems (smart meter with communications module). This increases the forecast's probability of occurring. The demand for subsequent cost-intensive corrections falls.

The increase in the occurrence probability of the energy supply companies' plan forecasts tends to lead to a reduction in the necessity for availability of fossil-fuel power plant capacity, which is in the interest of implementing the energy transition.

Generation scheduling and control of combined heat and power plants in a district heating network

Funded by: in planning

Project duration: until 2015

Cooperating partners:

Stadtwerke Lübeck (SWL) and other industry partners

As a result of energy system conversion to more decentralised structures, the future integration of combined heat and power plants (CHP) will play an increasingly important role, because the electricity generated in these systems can very easily be used to compensate for fluctuating, renewable energy electricity generators. The heat generated can either be used directly in-situ for the heating/domestic hot water supply or be fed into an existing heat network. The aim of the project is to design a higher-level

control system for the existing and planned combined heat and power plants in the studied area and to automate its integration and operation.

Publications in professional journals covering energy issues

_Bruce-Boye, C., Kazakov, D., Hou, W., Zhou, Y.: **Middleware-based Kalman filter design for a driver aid system**, in: Novel Algorithms and Techniques In Telecommunications, Automation and Industrial Electronics, Institute of Electrical & Electronics Engineers (IEEE), Springer Verlag 2008. pp. 43–48.

_Bruce-Boye, C., Kazakov, Dmitry A., Colmorgen, H., zum Beck, R., Hassan, J. Z., Wojtkowiak, H.: **Middleware-based distributed heterogeneous simulation**, in: Novel Algorithms and Techniques in Telecommunications and Networking, Springer 2010, pp. 333–337.

_Bruce-Boye, C., Menden, G., Hohl, A., zum Beck, R., Kazakov, D., Zapata, N. Z.: **Middleware based Distributed Heterogeneous Simulation for the Steel Industry**, Emerging Technologies & Factory Automation (ETFA), 16th IEEE conference, 5–9 Sept. 2011, Toulouse, ISBN: 978-1-4577-0017-0.

_Menden, G., Bruce-Boye, C.: **Intelligent energy and media management in the ThyssenKrupp CSA steel mill complex**, Stahl und Eisen 132 (No. 3 2012), pp. 33–38.

Congress presentations on energy issues

_Bruce-Boye, C. (2013): **Smart Metering mit Massendatenmanagement und kurzzyklischer Datenerfassung**, Energy Talks, Ossiach.

The most important Bachelor's/Master's theses on energy issues supervised by the professorship/working group

_Fabian John, **Regelung dezentraler Energieerzeuger zur Minimierung des Regelleistungsbedarfs in Niederspannungsnetzen**, 2011

_Jan Krieglstein, **Netzstabilisierung durch Photovoltaikanlagen und die Möglichkeiten für Virtuelle Kraftwerke am Regelleistungsmarkt**, 2012

_Georg Huguenin, **Entwicklung des Stromnetzes mit Einbindung von dezentralen und regenerativen Energieerzeugern**, 2012

_Vicky Lund, **AmbientEnergyAwareness System – Darstellung des Energieverbrauchs im Haushalt auf Basis von Smart-Metern und mobilen Endgeräten als Motivation zum Energiesparen**, 2012

_Christian Höft, **Realisierung von M-Bus- und SML-basierenden virtuellen Zählern**, 2013

_Mareike Redder, **Entwicklung eines virtuellen Smart Meter Management Systems zur Evaluierung von middleware-basierten Software- und Kommunikationslösungen**, 2013



Department of Civil Engineering

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conradi@fh-luebeck.de
www.regionalhaus-sh.deProfessorship: Building construction / design
At the University of Applied Sciences since: 1995**Core competences in energy research**

1. Storing energy in a building
2. Electrical storage / Hydrogen storage
3. Energy content of water supply and waste water systems, small wind turbines

**Energy and climate protection R&D projects
(since 2010)****KLIMZUG-NORD Strategic adjustment approaches to
climate change in the metropolitan area of Hamburg
SP 2.4 Innovations with regard to building to adjust to
climate change**

Project duration: 4/2009 to 3/2014

Funding volume: €280,000

Third-party funding: €57,500

Project information: www.klimzug-nord.de**WP 3: Developing a thatched roof design
adapted to climate change**

There are a large number of buildings with thatched roofs in northern Germany. As thatch or reeds are natural building materials, the effects of climate change cause direct and indirect changes that have an impact on the life of thatched roofs. In this sub-project Lübeck UAS and the Institut für Bauen mit nachwachsenden Rohstoffen (Institute for construction with renewable raw materials) are investigating what changes will arise from the consequences of climate change on thatched roofs and what constructive adjustments are required to maintain these roofs. As part of the sub-project a few investigations are being carried out on existing thatched roofs in order to analyse and assess the current condition of thatched roofs in the metropolitan area. The most important influencing parameters for every building will be recorded in the investigations and subsequently the condition will be assessed.



Test roofs on the campus of the University of Applied Sciences.

Photos: Klimzug

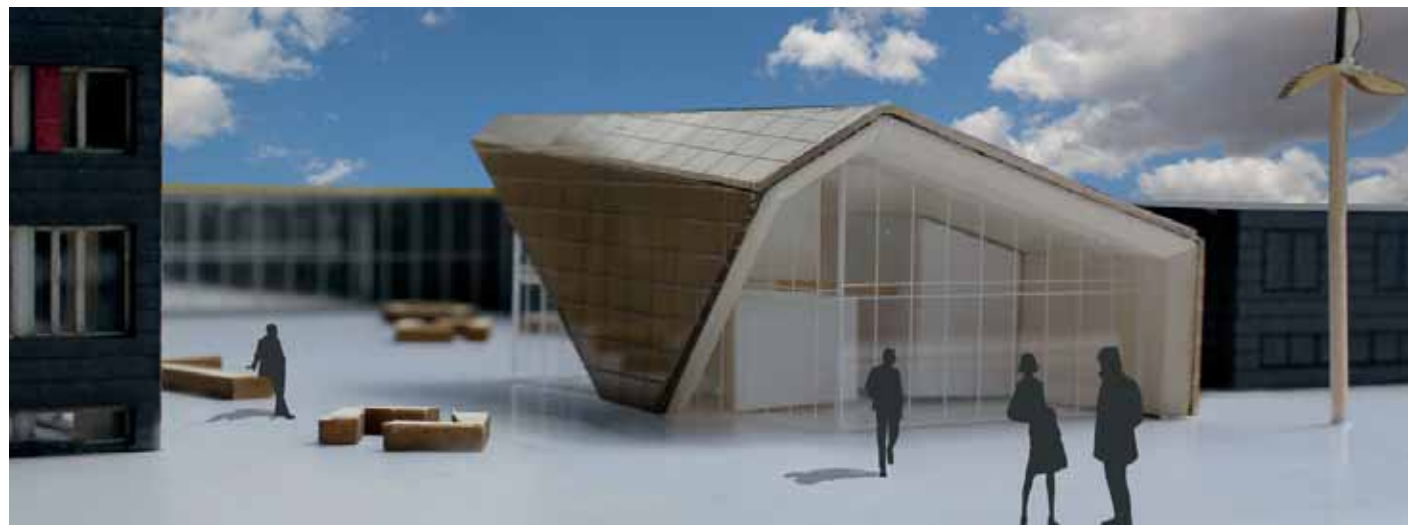


Regional house made of 100% renewable raw materials on the campus of the University of Applied Sciences.

During the investigations the parameters of roof size, rafter pitch, extension of the attic floor, age and thickness of the thatch covering, temperature and moisture in the roof as well as external conditions such as neighbouring buildings, the arrangement of the building, weather and main wind direction will be recorded amongst other things. In addition to the investigations on existing thatched roofs, two test roofs were erected at the Lübeck UAS for further measurements. These roofs are intended to help analyse the long-term meteorological effects on thatch roof coverings in particular. Various sensors will be installed on the roofs for this purpose, which will make it possible to assess the condition of the covering under real conditions at any time.

**WP 4: Passive air conditioning in administrative
buildings**

The aim is to develop adjustment approaches for the practical implementation of passive air conditioning when planning future administrative buildings in northern Germany. These will be summarised in a manual for building planners. The current situation is to be investigated and assessed through simultaneous collection of data and information in typical Hamburg administrative buildings with the assistance of test series, silent observations and anonymous user surveys on site. In addition, simulations will take place with current and expected future climate data from a regional climate model to assess the summer heat protection for a standard room that has been designed and the offices in the reference buildings.

BUILD NOW!
„Neue Wege in Lehrform & Forschung“**Learning and researching in the building
for research into self-sufficiency**

Model of modern architecture: This is how the new building for research into self-sufficiency is to be built on the campus of the Lübeck UAS.

Photo: Build now!

Completely new forms of research and teaching are being embarked on by the Department of Civil Engineering at the Lübeck UAS. The first energy self-sufficient building in Lübeck on the campus – as part of the Build Now! project – is currently at the application stage. The intention is that in the future teaching staff and students are to try out new, practical forms of learning and at the same time be able to research innovative building technologies and procedures.

“We want to return to the culture of the stonemason’s workshop and the old master-builders with BUILD NOW!. The new direction follows the principle of learning by doing.” The students themselves are to plan, design and build. The first phase concerns the planning of the self-sufficient building that manages without any external energy thanks to the use of new technologies. The design which the professors and students now actually want to build together with colleagues from the field of environmental engineering was the result of a competition for students with a subsequent workshop. The Architectural Advisory Board of the Hanseatic City of Lübeck also argued in favour of the student design.

“We want to build a learning and cultural centre that supplies most of its daily energy requirements through sun, wind and rain”, states Professor Conradi. Energy and water self-sufficiency were amongst the most important criteria for the designs of the climate-neutral building. The project team will use renewable energy exclusively in the building. The electrical energy generated is however not to be fed into the electricity network as is the case with other building projects. Instead it will be stored in such a way that it can be used within the building if required. The energy surplus of about 15,000 kilowatt hours per annum is to be

stored in two types of storage facility, a battery and a hydrogen metal hydride storage facility. “This offers us the option of combining the advantages of both types of technology with each other”, said Conradi.

Research project costs as of 2015 in the first decade: €1,835,000

Current data from the project

Various details were developed by students in the 6th Semester of the Architecture Bachelor degree in the subject Building construction V during the 12/13 winter semester in order to satisfy the requirements of the design. Facade connections, roof connections and foundation versions show the possible options.

As a continuation of the latter a Bachelor’s thesis is being written in collaboration with the company Sehlmann, which deals with the requirements of the planned post and beam facade. However, the design details are not only being planned but are also being developed and built in a 1:1 mock-up model.

In another Bachelor’s thesis on the subject of energy / technical building services equipment research will be undertaken into building automation with its technical components for media supply with regard to configuration, versions, networking, efficiency as well as the effects on operation and design.

Further information at www.build-now.de**The Build now! team**

- › Prof. Dipl.-Ing. Renate Abelmann
- › Prof. Dipl.-Ing. Georg Conradi
- › Prof. Dipl.-Ing. Stephan Wehrig
- › Prof. Arch. Heiner Lippe
- › Dipl.-Ing. Steffen Slama
- › Stefan Gruthoff, M.A.

Prof. Dr. Horst Hellbrück



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Professorship: Communication systems/distributed systems
At the University of Applied Sciences since: 2008

Core competences in energy research

1. Environmental monitoring of buildings
2. Energy-efficient networked systems
3. Autonomous systems

Management responsibilities in transfer organisations and facilities relevant to energy research

_Head of Communications Systems Applications (CoSA)
Center of Excellence

Energy and climate protection R&D projects (since 2010)

Positioning by radio propagation time measurements

Funded by: BMWi, ZIM
Funding volume: €175,000
Project duration: 1/2014 to 6/2017
Cooperating partners:
Solcon Systemtechnik GmbH

In this research and development project a new procedure for indoor positioning of objects or persons is being developed. The aim is to achieve an energy-efficient positioning procedure by measuring radio propagation with variable standard hardware. Power consumption is intended to be reduced by 60% compared with existing solutions.

BOSS – Bionic Observation and Survey-System

Funded by: BMWi
Funding volume: €1,478,000
Project duration: 7/2013 to 7/2016
Cooperating partners:
EvoLogics GmbH, Berlin
Sea & Sun Technology GmbH, Trappenkamp

By implementing innovative concepts from marine bionics, the intention is to create a high performance, intelligent Bionic Observation and Survey System (BOSS) combined with the latest technology in marine engineering, offering new unique features allows robust and efficient complex inspection and monitoring tasks in particular in unknown regions of the ocean. One aim is to use the BOSS system for the autonomous monitoring and inspection of environment-relevant engineering units such as underwater factories, sea cables and pipes. Another possible scenario for use is the exploration of unknown ocean regions.

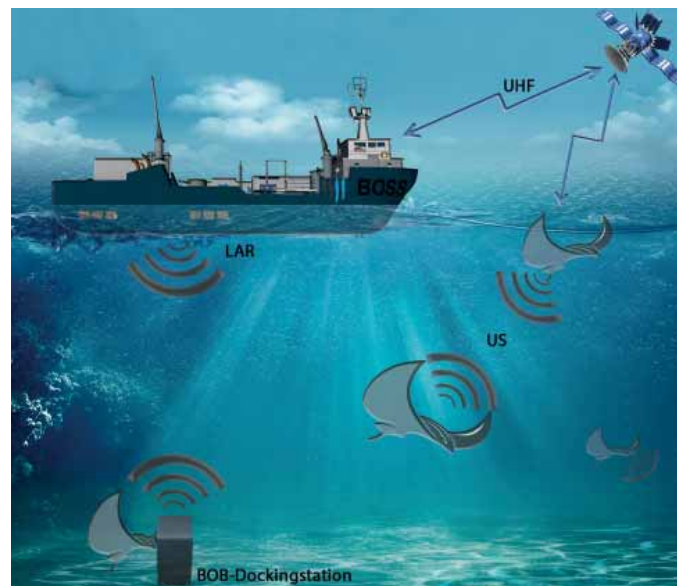


Diagram: BOSS

Soft – Self-organising RF Transmission

Funded by: BMBF
Funding volume: €256,000
Project duration: 6/2009 to 10/2012

The aim of the new technologies developed in the project is to measure and minimise environmental load by radio beams as well as identifying and recording strong sources of radiation.

The project designs and investigates a self-organising cognitive radio as a transceiver, which is aware of its surroundings and adjusts itself appropriately (SDR) with knowledge about priorities and requirements taking account of regulatory constraints and energy efficiency.

Real-World-G-Lab

Funded by: BMBF
Funding volume: €172,000
Project duration: 9/2009 to 8/2012

In this project it was investigated how wireless sensor networks, mesh networks or collection of such networks and associated technologies from the “Internet of Things” sector can fit into future Internet architectures and can interact via the latter or with the latter. A wide variety of long-term measurement tasks can be carried out autonomously and with the sensor networks that have been developed. These can be used in environmental engineering to record harmful substances and incidents. When monitoring buildings energy balances can be measured and recorded online in detail in order to take counter action quickly in case of dysfunction.

Publications in professional journals covering energy issues

_Fekete, S. P., Hendriks, B., Tessars, C., Wegener, A., Hellbrück, H., Fischer, S., Ebers, S. (2011): **Methods for Improving the Flow of Traffic**, Birkhäuser Verlag.
_Hellbrück, H., Wegener, A., Fischer, S. (2008): **AutoCast: A General-Purpose Data Dissemination Protocol and its Application in Vehicular Networks**, In *Ad Hoc & Sensor Wireless Networks journal (AHSWN)*, volume 6.

Congress presentations on energy issues

_Wegener, A., Hellbrück, H., Fischer, S., Hendriks, B., Schmidt, C., Fekete, S. P.: **Designing a Decentralized Traffic Information System – AutoNomos**, In *Proceedings of the 16th ITG/GI – Fachtagung Kommunikation in Verteilten Systemen (KiVS)*, 2009.
_Hellbrück, H., Pagel, M., Kröller, A., Bimschas, D., Pfisterer, Dennis, Fischer, S.: **Using and Operating Wireless Sensor Network Testbeds with WISEBED**, In *Proceedings of the 10th IEEE IFIP Annual Mediterranean Ad Hoc Networking Workshop*, 2011.
_Lipphardt, M., Hellbrück, H., Pfisterer, D., Ransom, S., Fischer, S.: **Practical Experiences on Mobile Inter-Body-Area Networking**, In *BodyNets '07: Proceedings of the Second International Conference on Body Area Networks*, 2007.

The most important Bachelor's/Master's theses on energy issues supervised by the professorship/working group

_Christian Friedrich, Auswahl, Inbetriebnahme und Evaluation einer energieeffizienten Plattform für Sendeempfänger mit programmierbarer FPGA-basierter Signalverarbeitung, 2012
_Dominic Cruse, Entwicklung einer Energie- und Datenübertragung über induktive Kopplung, 2012
_Entwicklung eines energieeffizienten Ortungssystem, 2012

The most important conferrals of doctorates on energy issues supervised by the professorship/working group

_Tim Esemann, Selbst-organisierende Funkübertragung, 2014, Institute of Telematics (ITM) – Lübeck University

Patents and patent applications on energy issues (since 2002)

Designation of proprietary right: Spring clip for fixing semiconductor modules to a heat sink

All inventors: Horst Hellbrück, Ralf Jörke, Konstantin Kanelis, Manfred Loddenkötter, Thilo Stolze

Brief description: In order to fix a semiconductor module to a heat sink, the semiconductor module and the heat sink are clamped together by one or more clips made of spring material, ie spring clips. A mutually matched form of the spring clips optimizes the connection between the heat sink and the semiconductor modules. A respective connection of clip body and heat sink or semiconductor module is advantageously effective in such a way that the spring clip can be inserted into a respective spring clip receptacle.

Designation of proprietary right: Method and apparatus for determining a driving strategy

Patent number: 8666629

All inventors: Sándor Fekete, Christopher Tessars, Christiane Schmidt, Axel Wegener, Stefan Fischer, Horst Hellbrück

Brief description: A method for determining a driving strategy for a driver of a motor vehicle includes receiving local information about a plurality of other motor vehicles using a receiving device, wherein the plurality of other motor vehicles are ahead of the motor vehicle and are relevant to the traffic situation. The method further includes recording the local information using the receiving device and deriving driving information from the local information so as to provide a driving strategy in the form of at least one action recommendation for the driver, the at least one action recommendation including a recommended speed based on an average speed of the plurality of other motor vehicles and on a desired speed of the motor vehicle.

Prof. Dr. Siegfried Kreußler



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Professorship: Experimental physics and solar engineering
At the University of Applied Sciences since: 1984

Core competences in energy research

1. Insolation measurements, databases
2. Solar thermal and photovoltaic installation simulations
3. Solar refrigeration (project completed)

Energy and climate protection R&D projects (since 2010)

Astronomical tracking solar modules

Funded by: Solar-Trak

Funding volume: €7,000

Cooperating partners:

Solar-Trak, Lübeck

The value of the extra yield of PV modules which track the astronomically calculated position of the sun shall be determined. This extra yield depends on local weather conditions.

The direct radiation and the global radiation are measured on the roof of a solar house and from this the insolation on the tracking surface area is calculated. The insolation on the tracking surface area is also measured. If the measurements and the calculations for the tracking surface area coincide, the radiation calculation algorithm is confirmed. It is then applied to the radiation data of the last ten years and the 10-year average insolation on the tracking surface area can be determined for northern Germany.

Publications in professional journals covering energy issues

_Kreußler, S.: Experiments on Solar Refrigeration, Proc. ISES-Europe "Eurosun 2000".

_Kreußler, S.: Wie gut Simulationsprogramme rechnen, Sonnenenergie, No. 4, 2000, p. 18.

_Kreußler, S.: Passive Wärmegewinne, Sonnenenergie und Wärmetechnik, No. 5, 1999, p. 30.

_Kreußler, S.: H2-Technologie, Sonnenenergie No. 1, 1996.

Congress presentations on energy issues

_Kreußler, S.: Experiments on Solar Adsorption Refrigeration, Eurosun 2000, Copenhagen.

The most important Bachelor's/Master's theses on energy issues supervised by the professorship/working group

_Yuelin Wang, Simulation of PV-Power Plant, 2011

_Jing Liu, Energy Balance of a Solar Heated House, 2011

_Min Yang, Measurement of a Solar Collector, 2011

Solar Energy Laboratory, Lübeck UAS

Patents and patent applications on energy issues (since 2002)

Designation of proprietary right: DE 199 62 644 A1

All holders: HKF Heizungsbau, 23992 Krassow

All inventors: Herbert Müller, Siegfried Kreußler,

Anouar Mrimi

Brief description: Autarkic solar supply system for stand-alone operation

Energy-related business startups/participation/cooperation (since 2002)

Name of founder(s): Stefan Höller, Uwe Küter

Name of company: H-Tec

Company headquarters: Lübeck

Homepage: www.h-tec.com

Type of business activity: Production of energy storage systems using hydrogen

Form of your cooperation with the company: Cooperation in thesis projects



Prof. Dr. Mario Oertel

Professorship: Hydraulic engineering
At the University of Applied Sciences since: 2012

Core competences in energy research

1. Pumped storage power plants
2. Run-of-river power plants
3. Storage power plants

Energy and climate protection R&D projects (since 2010)

Hydraulic laboratory

The hydraulic laboratory for teaching, research and contract work is being rebuilt and taken back into operation under the leadership of Prof. Oertel. This means that since October 2013 wide-ranging technical laboratory projects can be undertaken for water boards, engineering offices and businesses in order to find responses to the complex issues regarding hydraulic engineering and flood protection.

A hydraulic laboratory is suitable for projects in the field of flood protection in many respects. On the one hand, with the assistance of detailed models it is possible to analyse actual flood protection measures, such as mobile walls, sandbag systems or embankments or also depict structural flows. On the other hand, overview models help to model basic flow processes when there is flooding. Here the hydraulic laboratory offers large-scale, two-dimensional flow simulations. The latter help to detect and evaluate flow paths, water depths and flow speeds when there is flooding.

Publications in professional journals covering energy issues

_Oertel, M. (2013): In-Situ Measurements on Cross-Bar Block Ramps, Proc. International Workshop on Hydraulic Design of Low-Head Structures, Aachen, Germany, 111–119.

_Oertel, M., Mönkemöller, J., Schlenkhoff, A. (2012): Artificial stationary breaking surf waves in a physical and numerical model. Journal of Hydraulic Research, 50(3), 338–343.

_Oertel, M. (2012): Cross-bar block ramps: Flow Regimes



Numerical 2D flow simulation of a body of flowing water when there is flooding (water depths).

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- Flow Resistance - Energy Dissipation - Stability, Habilitationsschrift, University of Wuppertal.

_Oertel, M., Schlenkhoff, A. (2012): Cross-Bar Block Ramps: Flow Regimes, Energy Dissipation, Friction Factors, Drag Forces, Journal of Hydraulic Engineering, 138(5), 440–448.

_Oertel, M., Bung, D. (2012): Initial stage of two-dimensional dam-break waves: Laboratory vs. VOF, Journal of Hydraulic Research, 50(1), 89–97.

Congress presentations on energy issues

_Peterseim, S., Schlenkhoff, A., Oertel, M. (2013): Hydrodynamische Simulation von Sturzflutereignissen im urbanen Raum, 36th Dresden Conference on Hydraulic Engineering, Institute of Hydraulic Engineering and Technical Hydromechanics, TU Dresden.

_Oertel, M. (2012): Influencing parameters for friction factors and energy dissipation on cross-bar block ramps, 2nd European IAHR Congress, Munich, Germany.

_Oertel, M., Schlenkhoff, A. (2012): Scour development in basins of cross-bar block ramps, 2nd European IAHR Congress, Munich, Germany.

_Oertel, M., Bung, D., Schlenkhoff, A. (2012): Blocksteinrampen in Riegelbauweise – Neue Bemessungsansätze, 35th Dresden Conference on Hydraulic Engineering, Institute of Hydraulic Engineering and Technical Hydromechanics, Book 47, TU Dresden, 317–326.

_Oertel, M., Bung, D.B. (2012): Characteristics of cross-bar block ramp flows, 4th IAHR International Symposium on Hydraulic Structures, Porto.

The most important Bachelor's/Master's theses on energy issues supervised by the professorship/working group

_Aufbau und Standsicherheit von Sandsackdämmen und vergleichbaren mobilen Hochwasserschutzanlagen

_Optionen und Randbedingungen für die Steuerung des Polders Köln-Porz-Langel/Niederkassel-Lülsdorf aus Sicht des Kölner Hochwasserschutzes

_Technische und wirtschaftliche Machbarkeit der nachträglichen Integration einer Wasserkraftanlage in die Heilenbecke Talsperre

_Influence of climate change on beach nourishment and the seawall design at the Gold Coast, Australia

_Zweidimensionale Dammbruchwellen in physikalischen und numerischen Modellversuchen

Prof. Dr. Rainer Dittmar



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Professorship: Automation technology
At the University of Applied Sciences since: 1996

Core competences in energy research

1. Advanced process control in processing industries
2. Use of model-based control processes for energy-saving system operation
3. Early fault recognition and model-based measurement (development of soft sensors)

Energy and climate protection R&D projects (since 2010)

Early fault recognition in process engineering facilities

Funded by: Innovationsstiftung Schleswig-Holstein

Funding volume: €96,000

Project duration: 2/2012 to 4/2013

Cooperating partners:

Sasol Germany GmbH, Brunsbüttel

Application-oriented development and prototype testing of methods for recognising abnormal process situations in process engineering facilities. Use for early recognition and diagnosis of fault situations with the aim of reducing costs, saving energy, guaranteeing production quality, reducing the risk of damage, and supporting operators in complex production facilities. Evaluation of methods in terms of performance, preparation for use effort and maintenance, as well as support staff and end user qualification requirements. Result utilisation by downstream transfer to permanent operations and transmission to comparable processes on-site and in enterprises. Continuation of work with other industrial partners.

Publications in professional journals covering energy issues

_Dittmar, R. et al.: Robust optimization-based PID controller tuning. A new tool and its industrial application. Control Engineering Practice 20(2012)4, 355–370.

_Dittmar, R.: Control Performance Monitoring. In: Früh, K. H., Maier, U., Schaudel, D. (Ed.): Handbuch der Prozessautomatisierung. Oldenbourg Industrieverlag München 2008, pp. 142–157.

_Dittmar, R., Pfeiffer, B.-M.: Industrielle Anwendung von modellbasierten prädiktiven Regelungen. Automatisierungstechnik 54(2006)12, 590–601.

_Martin, G.D., Dittmar, R.: Einfache Methoden zur Vorabschätzung des ökonomischen Nutzens von Advanced-Control-Funktionen. Automatisierungstechnische Praxis atp 47 (2005) 12, 32–39.

Congress presentations on energy issues

_Dittmar, R.: PCA based blockage detection in an industrial solid state particle stripper AICHE Spring Meeting, New Orleans, April 2014.

_Darkow, T., Dittmar, R., Timm, H.: Real-time application of multivariate statistical methods for early-event detection in an industrial slurry stripper. IFAC World Congress Cape Town 2014.

_Dittmar, R., Kasper, J., Romahn, T.: Smoother refinery plant operation by averaging level control. Honeywell EMEA User's Group Meeting, Nice 2013.

_Dittmar, R.: Einstellung von PID-Reglern in einer Mehrgrößenumgebung-Software und Anwendungsbeispiel. 6th International Symposium on Automatic Control, AUT-SYM 2011 Wismar.

The most important Bachelor's/Master's theses on energy issues supervised by the professorship/working group

_D. Jarrens, Entwicklung eines MPC-Mehrgrößenreglers für einen Tonerdeslurry-Sprühtrockner, 2010, Diplom thesis

_J.H. Jürgensen, Untersuchung von Regelungskonzepten für Fahrzeug-Brennstoffzellensysteme, 2011, Master's thesis

_T. Ludwig, Optimierung der Temperaturregelung in der thermischen Abluftreinigung einer Anilinanlage, 2012, Bachelor's thesis

_D. Tiedemann, Prozessführung von Kristallisationsprozessen, 2011, Master's thesis

_J.-O. Schrader, Modellierung, Simulation und Optimierung eines Brennstoffzellensystems unter Beachtung thermodynamischer und elektrischer Gesichtspunkte, 2014, Master's thesis

Current further education courses or conferences on energy issues held on a regular basis

Automatisierungsforum Westküste 2013

Organiser: West Coast UAS, Faculty of Engineering

Target group: Automation and process engineers

Homepage: www.fh-westkueste.de

Prof. Dr. Gunther Gehlert

Professorship: Building and environmental engineering
At the University of Applied Sciences since: 2011

Core competences in energy research

1. Fuel cell heaters
2. Energy management
3. Concepts for Heating and Cooling

Management responsibilities in transfer organisations and facilities relevant to energy research

_Head of the Green Building System Engineering degree programme, West Coast UAS (FHW)

_Founder of the Center for Energy-efficient Building Technology

Congress presentations on energy issues

_Gehlert, Gunther: Zukunftsweisende KWK-Technologie für Haushalte, TGA Symposium, Cologne University of Applied Sciences 2010.

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Patents and patent applications on energy issues (since 2002)

Designation of proprietary right: WO 2006/105855 A1

All holders: G. Gehlert, J. Laubach, Wehrle Umwelt GmbH

All inventors: G. Gehlert, J. Laubach

Brief description: Procedure for the energy-saving separation of substances by means of membranes.

New professions as part of the energy transition

Interview with Prof. Gunther Gehlert on the Bachelor's course entitled Green Building System Engineering at the West Coast University of Applied Sciences

What is special about the course that started in 2011, which you designed?

We have developed a course that is so far unique in Schleswig-Holstein. It combines supply engineering with automation engineering on an interdisciplinary basis. This concerns facilities technology in buildings – chiefly heating and air conditioning technology, but also all the other technical installations in a building. On the other hand the course covers automation engineering so that graduates are in a position to incorporate the technical building trades in regulatory concepts. There are also architectural aspects such as insulating a building.

What skills do the students acquire?

The aim is to educate people who understand large buildings overall. For example they have to learn the interaction between heat insulation systems and heating systems and know how the whole systems can be automated and linked up. The students acquire detailed knowledge from us in this field and have to be in a position to find solutions to any problem or assignment.

In what sort of professional fields will graduates be able to work?

They are wide-ranging – a typical area is work in planning offices for building engineering. We already have students who are working there as student trainees. They plan things like the refurbishment of schools, universities or prisons. Also property management companies or hospital administrators employ their own engineers specifically for their buildings. The Westküstenklinikum in Heide for example is employing a trainee student from us.

What demand do you see on the employment market?

The demand is enormous! We already recognise that skilled staff are needed at larger installation companies and manufacturers such as those involved with heating. The demand is being driven by the energy transition in Germany and accelerated through support programmes, which support energy-related refurbishment of buildings. Another aspect is that many private house owners have previously been unsure about energy-related refurbishment and have waited. There is an enormous requirement for advice here. In particular heating systems will be replaced en masse in future. Graduates from our new course will also be required in this process.

Prof. Dr. Reiner Johannes Schütt



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Professorship: Controls/electric drives

At the University of Applied Sciences since: 1998

Core competences in energy research

1. Wind turbine controls
2. Grid integration of decentralised power generating systems and stores
3. Smart grids

Management responsibilities in transfer organisations and facilities relevant to energy research

- _ Speaker of the E/I working group in CEwind eG, Kompetenzzentrum Windenergie (Center of Excellence for Wind Energy)
- _ Member of the Advisory Board of CE Wind Energy Schleswig-Holstein

Energy and climate protection R&D projects (since 2010)

SmartRegion Pellworm

Funded by: BMU/BMWi

Funding volume: €180,000

Project duration: 7/2012 to 6/2015

Cooperating partners:

Fraunhofer IDMT, Ilmenau

Saft Batteries GmbH, Nuremberg

Gustav Klein GmbH, Schongau

E.ON-Hanse AG, Quickborn

E.ON-New Build and Technologies GmbH, Essen

Schleswig-Holstein Netz AG, Quickborn, RWTH Aachen

Fraunhofer Umsicht, Oberhausen

The main aim of the overall project is to provide a stable, cost-efficient and market-oriented electricity supply on the island of Pellworm with the aid of a hybrid storage system. Pellworm's electricity supply shall be based on existing and future renewable energy generators and be supplemented by decentralised, complementary, large-scale storage, as well as controllable, distributed loads and generators. The decentralised systems and the grid components shall be automated, the communications and information solutions shall be procured and operated. A selected customer portfolio shall be supplied through a direct marketing concept. Appropriate knowledge shall be gathered from the planning, construction and operation in order to transfer suitable solutions to other regions.

The sub-objective of the FHW work is integration of the decentralised generators, consumers and grid components in the new energy supply system by adopting appropriate engineering automation solutions on one side, and appropriate non-engineering measures to produce technology acceptance on the other. The knowledge gained during planning, construction and operation shall be processed to allow other regions to profit from it.



Smart Region Pellworm

Photo: Municipality of Pellworm

Active harmonic control for decentralised, small and medium capacity energy generation facilities for the low-voltage and medium-voltage grid

Funded by: ZPW

Funding volume: €180,000

Project duration: 3 years until 12/2012

Cooperating partners:

CEwind

The demands for feed-in from decentralised energy generation facilities to the public electricity grid are increasing. In addition to active reactive power control, adherence to limit values in terms of grid harmonics, system disturbances and flicker are demanded. An active harmonic control (AHC) allows fluctuations in grid voltage to be recognised and compensated for with the aid of the fed-in line currents. AHC is currently not state of the art. The method is based on the detection and compensation of harmonics by applying rapid, mains-side, pulse-controlled inverter control algorithms. In regions with poor energy supply grids or regions with a large number of decentralised generation facilities, systems with AHC can provide a substantial competitive advantage compared to systems without AHC. It is anticipated that the systems with AHC will be integrated into intelligent generation and load management systems or will supplement existing facilities without AHC. The project results demonstrate how wind turbines, in particular, can be used for grid quality improvement by appropriately expanding the control software.

Enhanced open- and closed-loop control methods for optimising the operating behaviour of wind turbines

Funded by: ZPW

Funding volume: €170,000

Project duration: 3 years

Cooperating partners:

CEwind

For the manufacturers of wind turbines (WT), suppliers, certifiers, insurers and large operators, it is of great interest to investigate whether new open- and closed-loop control methods lead to optimised operating behaviour. Extensive testing with regard to their effectiveness is required prior to integration in the WT. In this project the test and integration of the new methods for WTs was made possible by developing the necessary hardware and software systems.

Current further education courses or conferences on energy issues held on a regular basis Energiesymposium Westküste

Date: Every 3rd Thursday in November of the respective year

Organiser: Verein zur Förderung von Studium und Transfer der FHW e. V.

Target group: North German engineers

Homepage: www.fh-westkueste.de/fe/studiumtransfer/veranstaltungen-projekte

Publications in professional journals covering energy issues

_Schütt, R. (2012): Steuerung und Regelung von Windenergiesystemen, in: Einführung in die Windenergietechnik, ed. CEwind eg, Hanser Verlag, 2012.

_Schütt, R. (2012): Future electrical energy supply for the Isle of Pellworm, Proceedings of the IEEE Conference Electricity.

_Schütt, R., Naujocks, O.: Simulation von digitalen Steuerungen und Regelungen in ATP-EMTP, Proceedings of the 5th ASIM Workshop Wismar, 19 and 20 May 2011.

_Schütt, R., Naujocks, O.: Effective Harmonic-Measurement And Code-Generation For Active Harmonic Compensation With Wind Turbines, Proceedings of the European Wind Energy Conference 2009 (EWEA), Marseille.

_Schütt, R., Naujocks, O. (2010): Erweiterung und Optimierung eines Rapid Prototyping Systems, automatisierungstechnische praxis edition 04/2010, Oldenbourg Verlag.

Congress presentations on energy issues

_Schütt, R.: Activities of future electrical energy supply on the Isle of Pellworm and other regions with a large production surplus of renewable energy sources, IEEE Electricity Conference Electricity, Eilat, Israel, November 2012.

_Schütt, R., Naujocks, O.: Using Wind Turbine Facilities to improve Power Quality by decreasing Harmonic Pollution, 11th German Wind Energy Conference DEWEK, November 2012.

_Schütt, R., Naujocks, O.: Simulation of an Active Harmonic Compensator using ATP-EMTP, EEUG Conference, Zwickau, September 2012.

_Schütt, R.: Dezentrale Energieversorgung am Beispiel der Insel Pellworm, GMDS/INFORMATIK conference, Braunschweig, 19.09.2012.

The most important Bachelor's/Master's theses on energy issues supervised by the professorship/working group

_Andreas Asmus, Rotorpositionierung für 3MW-WEA, 2013

_Sven Letanowski, Direktvermarktung für ein Smart-Grid, 2013

_Karthik Raghuchandra, Essential Functionalities of a Wind Park Control System

_Björn Zastrow, Benchmark zur Leistungsfähigkeit von WEA-Steuerungen

_Carina Carl, Systemdienstleistungen von Windenergieanlagen



Gesellschaft für Energie und
Klimaschutz Schleswig-Holstein GmbH

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The Gesellschaft für Energie und Klimaschutz Schleswig-Holstein GmbH (EKSH) is a non-profit-making limited liability company (GmbH), funded by the Federal State of Schleswig-Holstein, E.ON Hanse AG and a company set up by the universities in the region, namely University of Flensburg, Flensburg UAS, Kiel University, Kiel UAS, Lübeck University, Lübeck UAS and West Coast UAS. The EKSH was established on 1 November 2011 and is financed from assets that were brought in by the former Innovationsstiftung Schleswig-Holstein foundation.

The EKSH focusses its activities on selected topics, in particular climate protection through energy-saving measures, energy advice, energy efficiency, renewable energy, sustainable and cost-effective generation, storage, distribution and use of energy.

The EKSH acts on the suggestions and project proposals of its shareholders and third parties from Schleswig-Holstein and develops its own projects. It sponsors projects, e.g. applied R&D projects, doctoral scholarships as well as demonstration, consultation and information projects. Preferably with other partners, the EKSH organises specialist conferences and other information and consultation projects. There are tenders for R&D projects and doctoral scholarships, for which scientists from Schleswig-Holstein can apply. Applications are assessed by a specialist panel and a decision is then made.

Examples of support:

“HWT energy and climate protection” programme
Collaboration amongst scientists from universities with companies in the energy and climate protection sector is

supported in the HWT programme. Projects for which support can be provided are those with relevant questions for the Federal State of Schleswig-Holstein regarding the subjects of energy production and climate protection, energy consumption and energy efficiency or energy supply and energy industry. A maximum of €150,000 is available per project. So far 13 projects have been sponsored.

“EKSH doctoral scholarship” programme

A programme for Master's graduates of universities, who wish to work and study for a doctorate on a research project at a university in Schleswig-Holstein in the field of energy and climate protection. Up to €1,500 is paid tax-free every month for a maximum of three years. In addition, a one-off payment of up to €1,500 is granted every year for materials and travel costs associated with the dissertation.

Individual projects:

- › CO₂ Footprint of milk production for moors and all other areas of countryside in Schleswig-Holstein (Kiel University)
- › Energy efficiency in buildings: Support for the course “Green Building System Engineering” (West Coast UAS)
- › “Yooweedoo Climate Challenge” – support for student projects on energy and climate protection (Kiel University)
- › “Kieler Energiediskurs (Kiel energy discourse)” event, up to three dates per semester, run jointly with the Faculty of Business, Economics and Social Sciences at Kiel University and the Kiel Institute for the World Economy, Wissenschaftszentrum Kiel

You can read about other projects supported by the EKSH at universities on the following pages.

Current studies on the economic effects of renewable energy

What impact does the expansion of renewable energy in Schleswig-Holstein have on the added value and employment? The Institute for Regional Research at Kiel University has compiled a study on this subject on behalf of the EKSH. The results are to be presented at the 11th “Kieler Energiediskurs” on 3 November 2014 in Kiel. More details at www.kieler-energiediskurs.de

At the Faculty of Agricultural and Nutritional Sciences of Kiel University there are currently also investigations being undertaken on behalf of the EKSH on the subject of “Factual implementation, regional distribution and economic effects of the intervention regulation under nature conservation law for wind turbines in Schleswig-Holstein”. These results will also be available in autumn 2014.

Project support
provided by the EKSH

EKSH SUPPORTS PILOT PROJECTS FOR ENERGY EFFICIENCY AT UNIVERSITIES

Climate protection on the campus

Dr. Norbert Kopytziok

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The universities are discovering the green campus. They are also looking at intelligent ways to save energy in Schleswig-Holstein. The Gesellschaft für Energie und Klimaschutz Schleswig-Holstein (EKSH) is supporting two pilot projects at Kiel University (CAU) and at Kiel UAS. All universities are intended to benefit from the results, which will be accessible to the public.

At Kiel University it has literally clicked with “klik”: This is the abbreviation for the “2030 climate concept”, with which Kiel University has set itself the target of becoming climate-neutral by 2030. These measures are planned:

- › optimise energy demand and expenditure on mobility
- › use water more sparingly
- › reduce soil sealing and
- › avoid household refuse

In order to become climate-neutral by 2030, it is not only substantial investment that is needed but also major changes to the behaviour of the players at the University. Kiel University estimates the potential for saving energy by changing behaviour to be up to ten per cent. The University started an innovative participation campaign for this purpose in 2013, appealing first to teaching staff and employees. The EKSH is sponsoring this pilot project with €150,000. The ambitious target: to use eight per cent less electricity and four per cent less thermal energy during the next few years. The University first selected the teaching staff and employees as these usually remain at the University for longer periods of time. The students are also to become involved in the second stage. “klik” wants to make all the members of the University aware of the subject through electricity saving campaigns, courses for staff, creating incentive schemes and other measures.

Saving energy is an important issue at Kiel University.

Photo: Kiel University (CAU)



“Clean lecture theatre air” project

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Students at several universities suffer from this: poor air quality in full lecture theatres. Kiel UAS discovered that in the small lecture theatre building which was constructed in 1997 the ventilation system remained unsatisfactory despite various measures to optimise the air. In a pilot project an innovative, but so far still controversial ventilation system is to be tested. The EKSH is sponsoring the project with €85,000.

Lecture theatre 1, space for 125 students – usually full during lectures. Although a proven ventilation system is in operation here with ceiling extraction, vents on steps and heat recovery, the problem can quickly be detected in the air: The air quality deteriorates particularly when the

lecture theatre is full. Even the installation of larger duct cross-sections did not lead to any improvement.

Now a new system called BAOPT is dominating the discussions. It is said to solve all the problems with a deliberately random flow of air in the rooms. The control system invented by the building technology specialist Albert Bauer (Ismaning) is intended to bring about the desired changes even in buildings with old air conditioning systems. Whether it will also work on the Kiel UAS campus, is now to be researched by Kiel UAS until 2014 in tests on two lecture theatres. Desired side-effect: Energy savings of 30 per cent. The results are to be presented to the public.

Specialist conference on “energy efficiency measures at universities”

10 years of EMAS: Environmental protection management is worthwhile!

The Federal State of Schleswig Holstein spent €34 million in 2012 on energy and heat (without the University Medical Center Schleswig-Holstein). This is what was pointed out on 1 July 2014 in Lübeck by the Head of the Specialist Department of Energy and Waste Management Petra Smolny from Gebäudemanagement Schleswig-Holstein (Building Management Schleswig-Holstein, GMSH) at a conference. These are costs that conceal substantial potential for savings – also for universities. Approximately 30 experts therefore exchanged ideas at the science campus in Lübeck on energy efficiency measures at universities in Schleswig-Holstein. They had accepted the invitation from Lübeck UAS and the Gesellschaft

für Energie und Klimaschutz EKSH, which had been issued for the 10th anniversary celebrations of the EMAS in Lübeck. Topics included energy management, energy saving measures, new ventilation strategies in lecture theatres and increasing energy efficiency.

EMAS is a quality seal of the European Union and represents sustainable environmental management. Since the introduction of EMAS at Lübeck UAS, Vice President Prof. Dr. Joachim Litz discovered that the consumption of heat, electricity and water has fallen substantially. The money saved was to the benefit of courses. The behaviour of members of the university has also changed markedly in other areas as a result of EMAS. The system created good foundations for integrated energy management.

All the lectures at the conference can be read on the Internet: www.eksh.org/archiv



Host Prof. Dr. Joachim Litz. Litz is also the Chairman of the shareholders' meeting of the EKSH. Photo: Lübeck UAS

Saving energy is a job for SHEff-Z

Prof. Dr. Hans-Jürgen Block (Chairman of the sponsoring association)
Dr. Winfried Dittmann (Managing Director)
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The exhibition building is a certified passive house.

Good advice on efficient housing and building technology – independent of manufacturers and free of charge

SHeff-Z in Neumünster at the Holstenhallen is a permanent exhibition on modern housing and building technology. It was developed in 2011 by Innovationsstiftung Schleswig-Holstein (ISH) as a climate protection project. The investment costs for the exhibition were borne by the ISH and it sponsored the on-going costs for a certain period over the start-up phase lasting several years. The Foundation was wound up at the end of 2011 and became a charitable organisation, the Gesellschaft für Energie und Klimaschutz GmbH (EKSH), which is involved in this project funded by an association with over 50 members (including companies, associations and organisations as well as universities).

The exhibition building that was constructed as a passive house shows the latest energy-efficient housing technology on the market: Innovative heating technology (including micro CHP, geothermal heat pumps, pellet heating), insulated building materials, building automation and electricity saving devices and lighting (LED). In the exhibition, which is continuously updated and supported by high quality lectures and advisory services, the SHeff-Z is primarily addressing private house owners and tenants. There is a special educational programme for schools called the “Energy Checker”.

The SHeff-Z was designed as a nationwide lighthouse project to save energy and promote energy efficiency and has obtained national recognition: in 2012 it received the award Ausgewählter Ort 2012 (Selected Landmark 2012) in the competition called “365 Orte im Land der Ideen” (365 Landmarks in the Land of Ideas). This was followed in the autumn of 2013 by the “Umweltpreis der Wirtschaft” (Business environmental prize).

The Verbraucherzentrale Schleswig-Holstein (consumer association of Schleswig-Holstein) also uses the SHeff-Z as an attractive location for its energy advisory services. Twice a month an energy adviser from the consumer association sits in the “green office” in the SHeff-Z. SHeff-Z and the consumer association also organise the “Energy course” together, a seven-part series of tips for builders. The topics range from “Step by step energy refurbishment” and “Modern heating technology” to “Small-scale wind turbines” and various grants.



The SHeff-Z team after it was awarded the Umweltpreis der Wirtschaft on 23 September 2013 in Kiel (from left): Swea Evers, Dr. Winfried Dittmann, Joachim Knofius and the two Directors Angela Zett and Prof. Dr. Hans-Jürgen Block (Chairman). Photo: Neumann

The exhibition is open on Wednesdays and Thursdays from 2 pm to 6 pm, Fridays from 10 am to 6 pm and Saturdays from 10 am to 4 pm. Groups are also able to visit outside the usual opening hours. On Fridays and Saturdays a free 60-minute consultation can be arranged with an energy advisor from the network of the Bundesverband Gebäudeenergieberater Ingenieure Handwerker (GIH-Nord e.V.).

Index of names

	Page
Prof. Dr. Sabah Badri-Höher	Kiel UAS 106
Prof. Dr. Sebastian Bauer	Kiel University 78
Prof. Dr. Joachim Berg	Flensburg UAS 59
Prof. Dr. Friedrich Blödown	Flensburg UAS 60
Prof. Dr. Michael Bischoff	Lübeck UAS 134
Prof. Dipl.-Ing. Benedict Boesche	Kiel UAS 107
Prof. Dr. Jens Born	Flensburg UAS 62
Prof. Dr. Johannes Bröcker	Kiel University 80
Prof. Dr. Cecil Bruce-Boye	Lübeck UAS 136
Prof. Georg Conradi	Lübeck UAS 138
Prof. Christoph Corves, Ph.D.	Kiel University 81
Prof. Dr. Rainer Dittmar	West Coast UAS 144
Prof. Dr. Gordon H. Eckardt	Kiel UAS 108
Prof. Dr. Ronald Eisele	Kiel UAS 109
Prof. Dr. habil. Mohammed Es-Souni	Kiel UAS 112
Prof. Dr. Torsten Faber	Flensburg UAS 64
Prof. Dr. Stefan Fischer	Lübeck University 130
Prof. Dr.-Ing. Friedrich W. Fuchs	Kiel University 83
Prof. Dr. Gunther Gehlert	West Coast UAS 145
Prof. Dr. Gerd Hagedorn	Flensburg UAS 66
Prof. Dr. Eberhard Hartung	Kiel University 86
Prof. Dr. Wilhelm Hasselbring	Kiel University 87
Prof. Dr. Horst Hellbrück	Lübeck UAS 140
Prof. Dr. Dr. Christian H. C. A. Henning	Kiel University 88
Prof. Dr. Michael Herczeg	Lübeck University 131
Prof. Dr. Hans-Jürgen Hinrichs	Kiel UAS 113
Prof. Dr. Frank Hinrichsen	Flensburg UAS 67
Prof. Dr. Olav Hohmeyer	University of Flensburg 56
Prof. Dr. Rainer Horn	Kiel University 90
Prof. Dr. Clemens Jauch	Flensburg UAS 68
Prof. Dr. Christian Jung	Kiel University 92
Prof. Dr. Constantin Kinias	Kiel UAS 114
Prof. Gernot Klepper, Ph.D.	Kiel Institute for the World Economy 51
Prof. Dr. Siegfried Kreußler	Lübeck UAS 142
Prof. Dr. Uwe Latacz-Lohmann	Kiel University 93
Prof. Dr. Mojib Latif	Helmholtz Centre for Ocean Research Kiel 48
Prof. Dr. Klaus Lebert	Kiel UAS 118
Prof. Dr. Martin Leucker	Lübeck University 133
Prof. Dr. Marco Liserre	Kiel University 95
Prof. Dr. Dirk Ludewig	Flensburg UAS 70
Prof. Dr. Thomas Meurer	Kiel University 97
Prof. Dr. Mario Oertel	Lübeck UAS 143
Dr. Sonja Peterson	Kiel Institute for the World Economy 52
Prof. Peter Quell	Kiel UAS 120
Dr. Hermann van Radecke	Flensburg UAS 71
Prof. Dr. Yves Reckleben	Kiel UAS 121
Prof. Dr. Katrin Rehdanz	Kiel University 98
Prof. Dr. Till Requate	Kiel University 100
Prof. Dr. Kay Rethmeier	Kiel UAS 123
Prof. Dr. Alois Schaffarczyk	Kiel UAS 124
Prof. Dr. Ulf Schümann	Kiel UAS 126
Prof. Dr. Reiner Johannes Schütt	West Coast UAS 146
Prof. Dr. Carsten Schultz	Kiel University 101
Prof. Dr. Friedhelm Taube	Kiel University 102
Prof. Dr. Michael Thiemke	Flensburg UAS 73
Prof. Dr. Ilja Tuschy	Flensburg UAS 74
Prof. Dr. Holger Watter	Flensburg UAS 76
Prof. Dr. Christoph Weber	Kiel UAS 127
Prof. Dr. Harald Wehrend	Kiel UAS 128
Prof. Dr. Jochen Wendiggensen	Flensburg UAS 77
Prof. Dr. Rainer Wulfes	Kiel UAS 129