



**RUHR-UNIVERSITÄT BOCHUM**

**LEE**

Energy Systems and  
Energy Economics  
Prof. Dr.-Ing. H.-J. Wagner

# Research Activities and Lectures

**July 2009**



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**LEE** is certified by DIN EN ISO 9001.

## Research

The chair has two fields of activities mainly focussing on:

- **Life cycle analysis and market introduction of new energy systems:**
  - Calculation of cumulated energy and life cycle analysis of low temperature solar systems, wind turbines, photovoltaics, and low-energy-houses.
  - Further development of tools for life cycle assessments for the evaluation of environmental performance and for mass flux analysis. Essential parts of the data base can be accessed via the internet.
  - System analysis and optimisation of efficient and innovative technologies like wind, hydrogen and solar energy.
- **Reactor simulation and safety:**
  - Development and improvement of physical models and computer modules for a strengthening of the capabilities of international severe accident analysis- and aerosol codes.
  - Severe accident analysis of cooling circuit and containment in order to improve prevention.
  - Progressive reactor concepts.

## International cooperations

**LEE** maintains a manifold of international cooperations – e.g. has the chair scientific cooperations with Tianjin University in China, Malavia National Institute of Technology in Indian and Shri Mata Vaishno Devi University in India – and good relationships to a great variety of organisations in- and outside Germany.

## EU SOCRATES/ERASMUS programme

The chair is responsible for the study exchange with the University of Sheffield (UK) within the EU SOCRATES/ERASMUS programme.

## **Current research projects, arranged by funding institutions:**

- **CHANGE – Change of sustained relevant routines in organisations**

An intervention instrument for the change of users' behaviour in public buildings is being developed under consolidation of engineer's and behavioural expertise in cooperation with praxis partners. On the engineer's side the task consists of analysing energetic buildings and of approaching the potential of behavioural energy conservation.

Promoted by: Ministry of Education and Research (BMBF)

Duration: 2008 - 2011.

- **MEM-BRAIN – Gas separation membrane for emission-free fossil-fuel power plants – Research theme 4: Analysis of energy systems**

The main focus of this project is on the integration of technologies for the gas separation using membranes in fossil-fuel power plants considering the energy supply system as a whole. In a system analysis the energy consumption and the environmental impact will be calculated.

Promoted by: Helmholtz Gesellschaft

Duration: 2008 – 2011.

- **Integration of solar heating and cooling in residential buildings with low-energy-house standard.**

Here different solar energy systems are analysed concerning primary energy as well as CO<sub>2</sub>-emissions and costs.

Promoted by: Federal Ministry of Economics and Technology (BMWV)

Duration: 2008 - 2010

- **Accompanying research of supportive measures “Competition Energy Efficient City”**

Sustainable and exemplary approaches for the increase of energy efficiency in the system “city” are the centre of this project. A “component”-catalog and a roadmap are created, which allows representing the building and business stock concerning the emission output.

Promoted by: Ministry of Education and Research (BMBF)

Duration: 2008 - 2010.

- **H<sub>2</sub>-design cells: Design of Natural Light-driven H<sub>2</sub> Production – From Molecular to Mass-Fermentation**

This project focuses on the dimension of components such as hydrogen collection and storage devices as well as on scaling photobioreactors for reaching a high surface-to-volume-ratio.

Promoted by: Ministry of Education and Research (BMBF)

Duration: 2009 - 2012.

- **EUROTRANS**

This is a European research programme for the transmutation of high level nuclear waste in an accelerator driven system.

Promoted by: European Commission (EC)

Duration: 2005 - 2010.

- **ATHLET-CD**

Here the ATHLET-CD model basis is being analysed and evaluated by application on selected experiments.

Promoted by: Federal Ministry of Economics and Technology (BMWi)

Duration: 2005 - 2010.

- **COCOSYS**

External validation and analysis of the containment code system COCOSYS for the calculation of operations in the reactor containment are done.

Promoted by: Federal Ministry of Economics and Technology (BMWi)

Duration: 2006 - 2009.

- **External validation and analysis of the integral code ASTEC**

Model analysis and assessment of the code ASTEC is validated with selected experiments and comparison with the respective simulation results of the code COCOSYS and ATHLET-CD.

Promoted by: Federal Ministry of Economics and Technology (BMWi)

Duration: 2008 - 2011.

- **EU-Network of excellence SARNET II**

The main focus of this project is on the knowledge sharing between approximately 50 EU institutions for the optimisation of the European research activities for severe reactor accidents. Assignment and prioritisation of the research demands.

Promoted by: European Commission (EC), Duration: 2009 - 2013.

## **Overview of topics of finished research projects**

Over the recent years several research projects were finished. Here are the main topics as following:

- Model experiment MEX V: Innovation and modern energy techniques.
- Wholistic analysis of conventional and innovative energy supply systems for low-energy-buildings and settlements.
- Compilation and application of indicators on sustainability by means of selected renewable energy sources.
- Energy demand analysis of low-energy-houses in consideration of innovative technologies (EduaR&D).
- Fundamentals of a biotechnological and biomimetical approach of hydrogen production – system analytical research, energy balancing and environmental research.
- Influence of resuspension processes on the source term and contribution to the modelling of water pools adapted to COCOSYS.
- Feasibility study of geothermal heat supply of Ruhr-Universität Bochum and surrounding area.
- Innovative modelling and optimising of the production of renewable energy converters: temporal decoupling of supply and consumption.

## **Offered software**

After request for the password at [www.lee.rub.de](http://www.lee.rub.de), the following software can be downloaded:

- EMIL – Database for the calculation of the cumulated energy.
- KEAPOLIS – Planning software for the capture of the integral energy complexity in low-energy-house settlements.

## **Lectures**

The chair of Energy Systems and Energy Economics (**LEE**) is integrated in the Institute of Energy Technology and belongs to the Faculty of Mechanical Engineering of the Ruhr-Universität Bochum.

The faculty gives students the possibility to choose between three courses of study: *Mechanical Engineering*, *Environmental Engineering and Management of Resources*, and *Sales Engineering and Product Management*. The chair is involved in all three fields of study. A brief description of the contents of the courses follows.

### **Energy economics**

Here the main topics are formation of terms and characteristics of the energy economy, energy resources and consumption world-wide and in Germany, the ways of energy from the deposit to the end-user from a technical point of view, price mechanism for oil, coal, gas, price formations and tariff forming of grid-bounded energy sources shown at the electricity example, organisational structure of the energy economy, liberalisation, energy stock market, environmental effects of the energy transformation.

### **Energy conversion systems**

This course mainly deals with physical and technical basics, design and functionality of selected energy plants and systems. In particular: “centralised” supply systems – like coal-, gas fired combined cycle and nuclear power plants – and “decentralised” supply plants – like block thermal power plants, combined heat and power plants, boiler plants, renewable energies (selection), and fuel cell systems.

### **Renewable energies**

The mayor items include electricity generation by solar thermal as well as photovoltaic plants and wind energy conversion systems. In particular: present structure of electricity generation and request from the view of the electrical energy supply, energy availability (solar, wind), functionality and design-options of solar thermal power plants, wind turbines and photovoltaic energy conversion and their design, connection to the electricity grid, costs, and entering of compensation for electricity fed into the grid.

## **Safety- and reliability analysis for technical plants and systems**

This course's issue are methods for the assessment of safety, reliability, and the risk of technological systems and their use.

## **Hydro power plants**

Here the main topics are construction, functionality, and the role of hydro power in electricity supply, overview of the modern use of hydro power, energy economical and statutory guidelines, physical-technical basics of the hydro power use, technical construction and components of river- and storage power stations as well as use of the sea energies.

## **Investment and costing**

This course mainly deals with the contemplation of basic aspects of costs, selected methods of investment (e.g.: method of capital value and annuity), description of external costs and value benefit analysis.

## **Energy caused pollution and greenhouse gases**

Here the main topics are air pollution by conversion of fossil energy sources and greenhouse gases. In particular: height, structure and origin of emissions of pollutants, technical possibilities of emission reduction (primary and secondary measures), spreading of air pollutants, chemical conversions, smog, consequences for the health, statutory measures, politics of air pollution control, greenhouse, climate change and Kyoto politics.

## **Reactor theory**

The major items include basic characteristics of the reactor and the application in the nuclear power plant technology, structure of the matter. Nucleus structure, binding energy, nuclear transformation types of radioactivity. Nuclear fission, energy release, generation of neutrons, nuclear fission as chain reaction, multiplication factor (four-factor-formula). Neutron flow density distribution, neutron diffusion. Diffusion-, multiple group- and transport theory.

## **Nuclear power plant technology**

This course's emphasis is on classification of various reactor types and discussion as power plant reactors. Thermo-dynamical aspects, design of the reactor core and the primary system, and selected safety arrangements. Fuel cycle facilities for changing and storing the fuel elements. Reactor safety and radiation protection, possible accidents,

accident courses and radiological consequences, function of different radiation barriers and safety demands.

### **Project management**

This course gives an overview of an appreciation of the difficulties for all subject, task, and working areas of a practical project leading or processing. Details of project planning and -organisation. Presentation of the different phases a project contains. In particular: Project management, -running, and -controlling, time- and cost planning, different kinds of configuration, communication, product treaty management, as well as soft skills.

### **Strategic management and business management**

This course gives an overview of management needs in industrial companies: Motivation, training and communication of staff leadership. Strategic planning instruments in companies. Benchmarking for cost optimisation, instruments for leading people and instruments for change management.

### **Process technology and resource management**

The chair's contributions to this cycle of lectures are principles of Life Cycle Assessment: Material flow cumulated energy demand and cumulated emissions, proceedings of Life Cycle Assessment and definitions of impact categories.

### **Graduate School**

The Graduate School of Energy Efficient Production and Logistics of the Engineering Unit Ruhr is a joint constitution of the departments of Mechanical Engineering of the Ruhr-Universität Bochum and the Technische Universität Dortmund. The aim of the Graduate School is to promote highly talented graduates in natural sciences and engineering in international teams to open up the NRW labour market for them. Core topics are the mathematic-physical description as well as analysis and optimisation of industrial manufacturing processes under energy efficiency and CO<sub>2</sub> reduction aspects. The doctoral programme of the Graduate School is based on a well-structured curriculum, designed to guide budding researchers towards completion of their doctoral thesis within three years. On the part of the Ruhr-Universität Bochum the Chair coordinates the Graduate School with the Deputy Head of School Univ.- Prof. Dr.-Ing. H.-J. Wagner.

## **Professors**

Univ.-Prof. Dr.-Ing. Hermann-Josef Wagner

apl. Prof. Dr.-Ing. Marco K. Koch (academic director)

Prof. Dr.-Ing. Hermann Unger (emeritus)

## **Honorary Professors**

Prof. Dr.-Ing. Rudolf Benz

Prof. Dr.-Ing. Thomas Hoffmann

## **Secretary**

Manuela Kötter

## **Lecturer**

Dr.-Ing. Andreas Richei,

## **Employees**

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Dipl.-Ing. Jörg Burkhardt

Dipl.-Ing. Alexa Epe

Dipl.-Ing. Thomas Große Böckmann

Dipl.-Ing. Mathias Hoffmann

Dipl.-Ing. Thorsten Hollands

Dipl.-Ing. Andreas Klesse

Dipl.-Ing. Miriam Klöcker

Dipl.-Ing. Philipp Kruse

Dipl.-Ing. Ulf Schittek

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Dipl.-Ing. Stefanie Weber

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