International MINTernship-Program

Transatlantic Energy Research Experiment

(TE-Rex)

Projects available at KIT

Summer 2016

1. Power market design US vs EU

2. Helium cooling for plasma facing components

3. Thermal hydraulics Simulations and Experiments for the Safety Assessment of METal cooled reactors (SESAME)

4. Integration of European energy markets to an agent-based spot market model

5. Data Management for Energy Informatics

6. Occupants’ comfort at warm temperatures and high humidity

7. Internal coupling of the Code DYNSUB with the USNRC Code TRACE

General Contact
Dr. Kai Rebensburg
International Students Office (IStO)
Karlsruher Institute of Technology (KIT)
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# 1. Power market design US vs EU

## Abstract of the project
The two largest market areas for electricity are in the US and the EU respectively. Both are liberalized markets in contrast to a state owned, monopoly driven electricity supply system. However, there are still great differences between separate market areas within those two regions and even greater between the US and the EU. An example is the locational pricing in the PJM which is opposed to the approach of a uniform market price for the whole German market area.

## Tasks
The student will study the market design of the European electricity market mostly by reading reports and papers. He will create an active discussion about the differences in market design within the EU and compared to the US by preparing a discussion on a regularly basis (e.g. weekly). The student will develop a framework in order to identify important differences in market design in a easy-to-comprehend way.

## Requirements
A deep understanding of energy economics is imperative. Knowledge about electricity markets and different designs (e.g. nodal pricing, zonal pricing, congestion management) will prove very helpful. Most important is a desire to learn more about electricity market designs and the ability to communicate open questions and results.

## Language Skills
Fluency in English

## Software Skills
MS Office (Word, Power Point, Excel)

## Other skills
Curiosity, structured way of working, ability to work independently and autonomously, communication

## Minimum Duration of the project
4 weeks, 6 weeks

## Type of research project
Project in a research institute

## Responsible Professor
Prof. Wolf Fichtner

## Supervisor/Mentor of the project
Hans Schermeyer

## Supervisor’s Telephone Number
+49 721 608-44458

## Supervisor’s Email
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## Faculty, Institute or Name of the Company
Chair of Energy Economics

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Institut für Industriebetriebslehre und Industrielle Produktion (IIP)
Lehrstuhl für Energiewirtschaft
Forschungsgruppe Dezentrale Energiesysteme und Netze
Hertzstraße 16
76187 Karlsruhe
# 2. Helium cooling for plasma facing components

## Abstract of the project

The so-called "First Wall" is the plasma facing component covering most of the surface of planned fusion reactors (DEMO project). This component will experience heat flux densities in the range of 200-1000kW/m² and thus require intensive cooling. Our HETREX project is dedicated to optimize the cooling channel shape to allow high heat flux densities while keeping temperatures in the wall material and the pumping power for the helium cooling gas flow limited. For this task, we perform flow experiments for basic research and apply computational fluid dynamics (CFD) to develop according components.

## Tasks

1. Performing heat transfer experiments with structured surface channels
2. Performing flow structure measurements using Laser Doppler Anemometry and other flow measurement techniques
3. Computational fluid dynamics simulations to validate numerical models against experimental data from tasks 1 and 2
4. Apply validated numerical models to design plasma facing components

## Requirements

For experiments (Tasks 1 and 2):

Any experimental experience is welcome. The specific needed experimental skills will taught on the job. MATLAB or similar tools will be used for data analysis. Some knowledge of german language is helpful in interaction with workshops.

For simulations (Tasks 3 and 4):

Basic knowledge of CFD is required. We will use Ansys Fluent or CFX for the tasks. Either english or german language required.

## Language Skills

Fluency in English

## Software Skills

Helpful:
Matlab, SciLab, Fluent, CFX, Ansys, CATIA

## Minimum Duration of the project

10 weeks, up to six months

## Type of research project

Project in a research institute

## Responsible Professor

Prof. Robert Stieglitz

## Supervisor/Mentor of the project

Dr. Frederik Arbeiter

## Supervisor’s Telephone Number

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## Supervisor’s Email

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## Faculty, Institute or Name of the Company

KIT-INR

## Address

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D-76344 Eggenstein Leopoldshafen
Germany
### 3. Thermal hydraulics Simulations and Experiments for the Safety Assessment of MEtal cooled reactors (SESAME)

<table>
<thead>
<tr>
<th>Abstract of the project</th>
<th>The SESAME project will improve the safety of liquid metal fast reactors by making available new safety related experimental results and improved numerical approaches. These will allow system designers to improve the safety relevant equipment leading to enhanced safety standards and culture. At the same time, SESAME will maintain and further develop the European experimental facilities and numerical tools.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tasks</td>
<td>Numerical simulation of flow in rod bundles using CFD approach</td>
</tr>
</tbody>
</table>
| Requirements            | - fundamental knowledge of flow and heat transfer  
                          | - first experience in CFD simulation                                                                           |
| Language Skills         | Fluency in English                                                                                           |
| Software Skills         | CFD codes                                                                                                   |
| Other skills            | not required                                                                                                |
| Minimum Duration of the project | up to six months                                      |
| Type of research project | Project in a research institute                                                                               |
| Responsible Professor   | Xu Cheng                                                                                                     |
| Supervisor/Mentor of the project | Xu Cheng                              |
| Supervisor’s Telephone Number | 45356                                      |
| Supervisor’s Email      | xu.cheng@kit.edu                                                                                              |
| Faculty, Institute or Name of the Company | Mechanical engineering |
| Address                 | Institut für Fusionstechnologie und Reaktortechnik (IFRT)  
                          | Vincenz-Prießnitz Str. 3  
                          | 76131 Karlsruhe                                                  |
# Integration of European energy markets to an agent-based spot market model

## Abstract of the project

The integration of European energy markets is proceeding in a high pace. Modelling the energy system in order to shape energy and climate policy only on a national level is becoming more and more difficult. This is why the student can, depending on the individual skills, contribute to the integration of different European countries into the market model.

## Tasks

Different tasks can include:

- research of relevant data on electricity market data
- literature research regarding different methodologies to include the modelling of different technologies (e.g. renewables, hydropower) into the model
- implementation of different methods in Java code (depending on personal preferences/coding skills)

## Requirements

- preferably some background in energy economics, market design or relevant technologies
- computer skills: some knowledge on data processing/handling.
- Relevant software includes: Java, SQL, Matlab and the like. depending on the individual knowledge, the extend of programming or data handling work can be adjusted.

## Language Skills

Fluency in English

## Software Skills

- computer skills: some knowledge on data processing/handling. Aditionally, coding skills are advantageous
- Relevant software includes: Java, SQL, Matlab and the like, but also excel, R or SPSS. Depending on the individual knowledge, the extend of programming or data handling work can be adjusted.

## Other skills

- capable and willing to work in a team
- enthusiasm for energy related topics, especially economic aspects related to renewable energies

## Minimum Duration of the project

6 weeks, 10 weeks, up to six months

## Type of research project

Project in a research institute

## Responsible Professor

Prof. Wolf Fichtner

## Supervisor/Mentor of the project

Dogan Keles, Joris Dehler, Florian Zimmermann

## Supervisor’s Telephone Number

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## Supervisor’s Email

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## Faculty, Institute or Name of the Company

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## Address

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## 5. Data Management for Energy Informatics

### Abstract of the project

The Institute for Applied Computer Science of the KIT develops Generic Data Services (GDS) to manage data from an energy lab project that studies the challenges and possible solutions for future energy systems. The GDS comprise services for user access, security and privacy, encryption, metadata management, database and file system access, data object identification. Measurement and simulation time series with very high data rates require Big Data solutions and complex data analyses. Together with other data, like documents, image data, ontology data and metadata require the consideration of data workflows over the whole data life cycle.

### Tasks

Analyses of requirements of energy applications, power grid and energy system modeling, object oriented software engineering in Java, service development with REST and SOAP, distributed data base management (MySQL, MongoDB, Neo4j, Cassandra).

### Requirements

Programming language Java, object oriented software engineering.

### Language Skills

Fluency in English

### Software Skills

See requirements.

### Other skills

No other requirements.

### Minimum Duration of the project

10 weeks

### Type of research project

Project in a research institute

### Responsible Professor

Dr. Karl-Uwe Stucky

### Supervisor/Mentor of the project

Dr. Karl-Uwe Stucky

### Supervisor’s Telephone Number

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### Supervisor’s Email

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### Faculty, Institute or Name of the Company

Institute for Applied Computer Science (IAI)

### Address

Karlsruher Institute for Technology (KIT)  
Institute for Applied Computer Science (IAI)  
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### Abstract of the project

The project “raum/klima/putz” is financed by Baden-Wuerttemberg foundation. Its main goal is to describe physical (mostly hygric) requirements for the development of an indoor plaster material, which should improve occupants’ thermal comfort by reducing high humidity peaks under summer conditions. These situations might occur more frequently with climate change affecting future weather conditions in the state of Baden-Wuerttemberg until the year 2050. Four KIT research groups (meteorologists, civil engineers, material researchers and building physicists) are cooperating in the project. In the Building Science Group (fbta) the impact of the outdoor climate on the indoor climate and the effects of the indoor climate on the occupants’ thermal comfort perception are investigated. Thus the work package includes 2 topics: building simulation and experiments in a test facility for indoor comfort (LOBSTER = Laboratory for Occupant Behaviour, Satisfaction, Thermal Comfort and Environmental Research).

### Methodologies applied

Within the task of building simulation different weather data sets (describing future climate scenarios) have to be processed with TRNSYS or Energy+. Those dynamic simulation tools are used to model the thermal performance of a room hour by hour throughout one year. Different settings of a room and various plaster materials will be analysed with respect to moisture buffering (ad- and desorption). The resulting profiles of indoor temperature and humidity will be rated against comfort limits for humidity which exist in current standards for air-conditioned buildings. In the summer of 2016 experiments will be performed in our test facility, where voluntary test persons will be exposed to warm and humid indoor conditions for evaluating their perception of comfort and for investigating different comfort levels. The results will be compared to the above mentioned comfort limits and used to prove or adapt those limits. Also other existing indices, which have been developed over time for describing the combined effects of warm temperatures and high humidity on the human body, will be examined. The most suitable rating scheme will then be transferred into the building simulation.

### Tasks

Possible tasks to be assigned to the research assistant depending on the individual interests and skills of the student research assistant she/he could be involved in different tasks of the project:

- building simulation, either with focus on modelling the occupant comfort with regard to temperature and humidity, or with focus on implementing the moisture buffer functions of the plaster
- assisting with the experiments in the LOBSTER
<table>
<thead>
<tr>
<th>(organisation, preparation, communication with test persons, modification of the questionnaires) - statistical analysis of the experiments and/or simulation data - programming routines for building control (LABVIEW) or data analysis (VBA or R)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Requirements</td>
</tr>
<tr>
<td>- A basic understanding/interest of/in mechanics and physics - Good knowledge in MS Office</td>
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<tr>
<td>Language Skills</td>
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<tr>
<td>Fluency in English</td>
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<tr>
<td>Software Skills</td>
</tr>
<tr>
<td>- Experience in statistics and relevant software (SPSS, R) could be beneficial - Knowledge in programming (LabView, JAVA, VBA) could be beneficial</td>
</tr>
<tr>
<td>Other skills</td>
</tr>
<tr>
<td>- Experience in user surveys and psychology could be beneficial</td>
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<tr>
<td>Minimum Duration of the project</td>
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<tr>
<td>Type of research project</td>
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<tr>
<td>Responsible Professor</td>
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<tr>
<td>Supervisor/Mentor of the project</td>
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<tr>
<td>Supervisor’s Telephone Number</td>
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<td>Supervisor’s Email</td>
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<tr>
<td>Faculty, Institute or Name of the Company</td>
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<td>Address</td>
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</tbody>
</table>
### 7. Internal coupling of the Code DYNSUB with the USNRC Code TRACE

#### Abstract of the project

The main goal of this project is to develop numerical tools to perform safety evaluation for Boiling Water Reactors (BWR’s). Therefore, the neutronic kinetic solver DYN3D was integrated into the system TRACE/PARCS. The new system called TRADYN is being tested and validated using the BWR Peach Bottom benchmark. Additionally, TRADYN will be extended in order to integrate a subchannel code (SUBCHANFLOW).

#### Tasks

The student will have the following activities:
1. Review of TRADYN system (codes involved, coupling way, transfer of information)
2. Review of thermal hydraulic code SUNCHANFLOW (models, manipulation of DATA, applications for BWR’s)
3. Base on SUBCHANFLOW input deck for Oskarsham-2, develop a Peach Bottom Nuclear Power Plant model.
4. Extent the SUNCHANFLOW preprocessor for BWR’s
5. Test the developed model using TRADYN

#### Requirements

- Experience in Linux system.
- Programming skills (Fortran 90)
- General knowledge of thermal hydraulic

#### Language Skills

- Fluency in English

#### Software Skills

- Experience in Linux system

#### Other skills

- Teamwork

#### Minimum Duration of the project

10 weeks

#### Type of research project

Project in a research institute

#### Responsible Professor

Prof. Dr. Robert Stieglitz

#### Supervisor/Mentor of the project

Ms. C. Jose Angel Gonzalez Vargas

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