HITEC
Graduate School
for energy & climate

H I T E C

Helmholtz **I**nterdisciplinary Doctoral **T**raining in **E**nergy and **C**limate Research

What is HITEC?

Forschungszentrum Jülich and five partner universities in the region – RWTH Aachen University, University of Bochum, University of Düsseldorf, University of Cologne and University of Wuppertal – are pursuing the common goal of turning their PhD students in the fields of energy and climate research into the experts so urgently required and, furthermore, providing PhD students with a scientific understanding of the complex relations between *the energy supply and its impacts on climate change*. To this end, they have established the HITEC Graduate School with an extremely attractive range of courses tailored to the requirements of the highly competitive science environment and the demands of the job market.

Characteristics of HITEC Graduates

- excellent scientific qualifications in energy and climate research;
- multidisciplinary appreciation of the scientific, technical and social dimensions of energy and climate issues;
- necessary know-how for a successful career in the academic sector or in industry.

Highly trained young graduates embark upon one of the most productive and creative phases of their scientific career during work on their PhD. HITEC intends to create conditions providing optimum support for these talented young researchers. Joint lectures and practical training encourage their understanding of topics and the related methods, including joint use of the scientific infrastructure. A good supervision concept, which also envisages further training for supervisors, improves approaches to teaching and learning. PhD students organize thematically overarching events on their own responsibility, enabling them to experience the scientific and technical challenges of their field and thus not only to increase the sum of knowledge but also to expand the horizons of their own intellectual abilities. By visiting their mentors at international research institutions or in industry, they will learn to place their own research in an international and application-relevant context. Training in career skills rounds off the three-year PhD period. The doctoral degree is conferred by one of the participating universities. HITEC graduates are attractive to employers whether in research, industry or for other positions.

Who Can Become a HITEC Student?

HITEC is open to graduates with a master's degree or equivalent in science or engineering, and for certain topics with a degree in the human sciences. All PhD students accepted by the Jülich Institute of Energy and Climate Research are automatically enrolled in the HITEC programme (from 1 October 2011). The partner universities also send suitable PhD students to the HITEC Graduate School. Altogether, the HITEC Graduate School will comprise about 200 PhD students.

What Does HITEC Training Include?

Scientific/subject-related training
Curriculum: orientation week; HITEC Theme Days and Methods Days (lecture format; joint events in Jülich or at the universities); HITEC labs (practical training); retreat for PhD students organized by the students. The specific HITEC courses will be held in English.
Specific offers by institutes: subject-related introductory modules; seminars with lectures; attendance of international conferences or participation in a winter or summer school.

Transferable skills
Acquisition of key qualifications: presenting, self- and project management, communication in interdisciplinary and international teams; responsible involvement in organizing the HITEC retreat

HEINRICH HEINE UNIVERSITÄT DÜSSELDORF · BERGISCHE UNIVERSITÄT WUPPERTAL · RUB · RWTH AACHEN UNIVERSITY · JÜLICH FORSCHUNGSZENTRUM

Mentoring concept:
Sparring partners: an internal mentor (scientist) from a different institute (or sub-institute) and an external mentor (leading scientist from abroad or nationa/international industrial representative) for each PhD. Support for new international students: if required; cultural mentor or 'buddy': experienced German PhD student who helps the foreign student to acclimatize.

Quality management
Central application and comparable acceptance procedure for all PhD students; transparent supervision concept including supervisor training (from postdoc onward) in order to professionalize supervision; PhD agreement; PhD Committee.

Interdisciplinary approach
PhD students from various disciplines and institutes take part in the following events: *introductory week, HITEC Theme and Methods Days, HITEC Labs, Retreat.* These events thus provide participants with a framework in which to get to know each other in interdisciplinary groups, to exchange opinions on their topics, possibly to obtain new methodological ideas, and to establish a network for future energy and climate topics. Networking and interdisciplinarity are the declared goals of HITEC, where the methodological bridge spanning all major topics should be used as a common platform for this interdisciplinary exchange. At the end of the PhD phase students have the opportunity to communicate their science to an interdisciplinary audience and to win the HITEC Communicator Aard.

HITEC Organization and Management

Spokesman:	Prof. Dr. Uwe **Rau**
Steering Committee:	Prof. Dr. Uwe **Rau**, Jülich Prof. Dr. Martin **Riese**, Jülich Prof. Dr.-Ing. Tilmann **Beck**, Jülich Svenja **Ebert**, Jülich (PhD student) Prof. Dr. Dirk **Sauer**, RWTH Aachen University Prof. Dr.-Ing. Roland **Span**, University of Bochum Prof. Dr. Georg **Pretzler**, University of Düsseldorf Prof. Dr. Susanne **Crewell**, University of Cologne Prof. Dr. Ralf **Koppmann**, University of Wuppertal
Members:	Professors, university lecturers, senior scientists, PhD representatives
Advisory Board:	Prof. Dr. Martine **Baelmans**, University of Leuven, Belgium Prof. Dr. T.W. **Clyne**, University of Cambridge, UK Dr.-Ing. Dirk **Goldschmidt**, Siemens AG, Germany Prof. Dr. Donal **Murtagh**, Chalmers University of Technology, Gothenburg, Sweden Prof. Dr. Jenny **Nelson**, Imperial College London, UK Dr. Beate **Scholz** (Chairwoman), Scholz – consulting training coaching, Germanyv Prof. Dr. Hans Jürgen **Seifert**, KIT, Germany
Management:	Dr. Bärbel **Köster**, Managing Director Katharina **Kräußle**, Assistant

HITEC Research

The range of topics at HITEC reflects the research areas at the Jülich Institute of Energy and Climate Research and its university partners: energy technology, development of technological solutions for issues of renewable, fossil and nuclear energy research and atmospheric research. A detailed breakdown of the research areas is as follows: material structure, materials properties, materials synthesis and manufacturing processes (Jülich, RWTH Aachen University, University of Bochum); photovoltaics (Jülich, RWTH Aachen University); safety research and reactor technology (Jülich, RWTH Aachen University); plasma physics (Jülich, University of Bochum, University of Düsseldorf); atmospheric research (Jülich, University of Wuppertal, University of Cologne); systems research/energy economy, energy industry (Jülich, RWTH Aachen University).

Materials: synthesis, manufacturing processes, structure and properties

Materials development and materials characterization for efficient gas and steam power plants; high-temperature fuel cells (SOFCs) and thermally highly stressed components for future fusion plants; thermal barrier coatings for advanced power plants; metallic high-temperature materials; metals with functional porosity; NiTi shape memory alloy; composite fibre materials; membranes; ceramic materials used as structural materials or coating systems; high-temperature corrosion behaviour of materials and coatings; thermochemical properties of alloys and inorganic compounds; micro- and nanostructural diagnostics

Plasma physics
Fusion research: plasma-wall interaction, fusion technology and diagnostics with the cross-cutting topics of fusion materials and components for the first wall of fusion reactors and also computer assisted boundary layer physics (HPC)

Photovoltaics
Silicon thin-film solar cells: solar cell technology; interface analysis; components; materials science and materials characterization, creating and optimizing process technology; application of the technology: development of colour sensors on the basis of thin-film silicon

Safety research and reactor technology
Nuclear systems; fuel cycles; waste management; simulation and validation
innovative reactors; hydrogen safety; fuel/materials; partitioning; transmutation; deep burn; characterization; conditioning; repository safety; simulation (HPC)

Fundamental Electrochemistry
scientific fundamentals for the development of new, electrochemically active, and electron and / or ion-conducting materials for electrochemical energy storage and conversion.

Chemical analyses
Analysis of materials characterization for energy: elements, isotopes (identification and quantification); layers, surfaces and interfaces (distribution in depth and area); understanding of processes in the environment; quantification of inorganic and organic (trace) elements; structural determination of inorganic and organic materials; metabolic studies on organic and biological systems

Systems analysis and technology evaluation
Systems analysis and technology evaluation; energy and climate policy; energy economy

Stratosphere
Role played by the atmosphere (UTLS) in the climate system: change in radiation drive; distribution of greenhouse gases, water vapour and cirrus clouds; interactions between ozone and climate: delay in recovery of the ozone layer, influence of climate, risks of climate engineering; atmospheric couplings: change in circulation, wave dynamics, stratosphere-troposphere exchange; integrated measuring systems: satellites, aircraft, research balloons, atmospheric simulation.

Troposphere
Photochemistry and radicals; reactive trace substances; aerosols; global monitoring; global modelling;
chemical mechanisms and inverse modelling

HITEC Programme

Events

1. *Orientation Week*

During the orientation week new doctoral fellows are introduced to the research of all Jülich IEK-institutes, their field of research and their scientific infrastructure. They also learn about *Good Scientific Practise.* Lab tours are performed by senior doctoral fellows. Docs meet docs from other IEK-institutes and start their network on campus.

2. *HITEC Theme and Methods Days*

give an insight into the range of topics investigated at HITEC and provide individual PhD students with scientific competence in the field of energy and climate outside the context of their own institute. HITEC Days are one-day lecture events on topics or methods from the field of energy and climate organized jointly by the partners for the HITEC PhD students and held at Jülich or at the partner universities. If necessary, additional external speakers can be invited so that the topic can be dealt with as exhaustively as possible from all sides.

Requirement for the HITEC certificate: four HITEC Days in three years

3. *HITEC Labs*

HITEC Labs complement HITEC Scientific Days in the form of hands-on practical training lasting two to three days for small groups of PhD students from various HITEC fields. They provide methodological know-how from the cross-cutting fields of materials, substances and systems, physicochemical, technological and socio-economic processes, synthesis, analysis and simulation linking the specialist topics. The scientific and methodological know-how provided by all the HITEC partners as well as the scientific infrastructure will prove to be particularly attractive for recruiting very good PhD students. HITEC will contribute towards enhancing the visibility of energy and climate research in the region.

Requirement for the HITEC certificate: one HITEC Lab in three years

4. *Retreat*

Second-year PhD students organize a three-day retreat (symposium held outside Jülich); at this event, they present their projects and the scientific methods employed and discuss them with their fellow PhD students (no senior scientists are present)

Requirement for the HITEC certificate: one 2-3-day Retreat in 2nd year

5. *Training in Transferable Skills*

HITEC includes training in transferable skills provided by the *impulsplus* company, who developed the seminars exclusively for HITEC students. Courses in the starter pack (obligatory: four to six months after starting HITEC programme) comprising:

- presenting
- project and self management,
- communication in intercultural/international teams

  in two modules of three and two days, respectively. Students attend the modules in assigned groups so that PhD students from different institutes have the opportunity to get to know each other personally and to establish open and collegial contacts.

  For second-year PhD students, the two-day course on
- science writing “Getting Published” is compulsory.

Requirement for the HITEC certificate: five days in 1st year and two days in 2nd year

6. Seminars, Lectures

as announced by the individual institutes

Supervision

Each PhD student is assigned:

I. a supervisor (principal referee, Doktorvater/Doktormutter)

II. second referee

III. scientific advisor (Betreuer; may be indentical with I or II)

Requirement For the HITEC Certificate:

IV. internal mentor (scientist from a different IEK institute or from the university)
- invitation to presentations given by PhD student, at least two discussions per year -

V. external mentor (international scientist or industrial representative)
one or two visits in 2nd and 3rd years

Additional Measures

- **For the HITEC Certificate**, it is expected that every PhD student as a rule attends two international conferences or summer/winter schools.
- **HITEC-Go:** Funding is available for 10 stays abroad per year each lasting two to three months. Funds are advertised and allocated on the basis of the applications.
- **HITEC-Come:** PhD students may invite guests for a research visit or for scientific presentations.
- **Scientific Writing:** All doctoral student are eligible to one personal scientific writing training unit during the PhD phase, while working on a scientific paper.

HITEC Prize:

Communicator prize: for the PhD student giving the best presentation of their PhD thesis to an interdisciplinary audience during the yearly HITEC Symposium