IWU Kassel Course Outline:
Environmental Engineering - Renewable Energy Sources

CLASS HOURS

45 Contact Hours + Preparation work; 5 ECTS credits

ACADEMIC DIRECTOR

Prof. Dr.-Ing. Stephan Theobald
Section Leader - Hydraulic Engineering and Water Resources Management (University of Kassel)

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LECTURERS

Wind Energy
Michael von Bonin – Research fellow at Fraunhofer Institute for Energy Economics and Energy System Technology – Energy Economics and System Design

GIS as a Linkage Tool
Dr.-Ing. René Burghardt - Specialist in landscape ecology at the facultuy of Architecture, Urban Planning, Landscape Planning (University of Kassel)

Photovoltaic
Dr.-Ing. Stefan Bofinger – Head of Analyses and Consultancy in Energy Economics department at Fraunhofer Institute for Energy Economics and Energy System Technology

Solar Thermal Systems
Dr.Ing. Janybek Orozaliev - Head of Thermal Components and Systems department / Institute of Thermal Engineering (University of Kassel)

Low Energy Housing
Dr. Dietrich Schmidt, Head of Power-Heat-Systems Department of the Fraunhofer Institute for Energy Economics and Energy System Technology

Renewable Energy and Wastewater
Dr.-Ing. Wernfried Schier / Michael Garbowski M. Sc. – Research Associates / Urban Water Management (University of Kassel)

Hydropower
Dr.-Ing. Klaus Träbing – Acting Director at the Institute for Water Engineering and Water Resources Management (University of Kassel)

Bioenergy and Land Use
Apl. Prof. Dr. Rüdiger Schaldach; Center for Environmental Systems Research

Geothermal Energy
Prof. Dr.-Ing. O. Reul; Head of Department Geotechnical Engineering (University of Kassel)

Introduction and Tutorial
Janik Holst: Tutor/ Engineering Student at the University of Kassel

Excursions and Company Visits
Various lecturers

1) COURSE CONTENTS

COURSE DESCRIPTION

The seminar takes a closer look at Renewable Energy Sources embedded in the German Energy System Transformation 'Energiewende' from a German and European Perspective

TOPICS COVERED*

Wind Energy
The wind energy class starts with a short introduction into history and development of wind turbines. Furthermore the lecture will cover topics concerning wind turbines such as the basics of wind energy physics, technical and economic issues. The installation, operation and maintenance of wind turbines will be taught along with facts about onshore and offshore wind farms and their pros and cons.

GIS as a Linkage Tool
Geographic Information System (GIS) provides the basic structure and architecture for regional and urban planning systems and allows multi-level access. Modern GIS is used as a linkage and communication tool between the potential estimation of renewable energy and modern planning processes.

Photovoltaics
The lecture deals with basic principles of solar cells and components of PV-systems for different applications. The development of grid connected systems in Germany is discussed – large systems and building integrated systems - as well as PV-applications for rural electrification.

Solar Thermal Systems
Solar thermal systems cover the basics of sky geometry and solar radiation. Different types of solar collectors will be introduced and explained in detail. Applications like small & large scale systems and solar water storages are part of the class.

Low Energy Housing
The lecture answers the questions where and how energy is used in buildings, how much energy is used, what kind of systems (HVAC) are used, and compares typical American systems (AC) with Central European systems. Energy efficient buildings are 'more' sustainable because about 80 % of the environmental load is caused by energy processes, importance of insulation and air-tightness.
The lecture further looks at dependencies between energy use in buildings and (renewable) energy production: How can we influence/optimise the system to use more renewable energy sources and to be more efficient? Low temperature/high temperature cooling opens the way for the integration of renewable energy sources andalso passive means of heating and cooling (night cooling etc.) play a decisive role.

Renewable Energy and Waste Water
This course examines the question why we should use biomass as an energy source. Biomass is stored sun energy and can be used as biogas. The historic development of biogas technology worldwide and in Germany is examined as well as how biogas is produced. It also

presents the basic functioning of modern biogas plants. Besides, the seminar investigates the possibilities to use heat energy, potential energy and bioenergy from waste water.

Hydro Power
The hydro power class consists of topics such as technological basics of hydro power and different types of water turbines. Hydro power and hydromorphological standards as a tool to evaluate the energetic and economic impacts of hydropower in Germany will be taught.

Bioenergy and Land-Use
The lecture covers the scientific basis of the use of bioenergy and global land-use changes. It raises the question how we can design a system of sustainable bioenergy use. It also presents land-use modelling illustrated by a case study from Brazil.

Geothermal Energy
This lecture provides an overview of geothermal energy and deals with geophysical and geological foundations concerning the earth's structure, thermal cycling and causes of regional and local differences with respect to thermic flow.
Several geophysical methods of geothermic prospection are also introduced. Furthermore, applied geothermal projects are presented, while their technical value and problems are discussed.

Tutorial
As a preparation for the exam, the international students attend a tutorial in the last week of the IWU. Our tutor summarises and reviews the content of the lectures with the students and clarify remaining questions.

Excursions
The seminar also offers a practical insight into the realisation of the German Energy System Transformation. Excursions are planned to related sites in the surrounding area of or in Kassel, such as (depending on availability)

- Bioenergy village Jühnde (Lower Saxony): Is Germany's first village producing heat and electricity by means of renewable biomass (energetic plants in form of silage and wood chips), thus creating a CO2 neutral balance. The biomass, which can be easily stored and is available in continually good quality, can be used flexibly to meet the changing demands of heat and electricity.
- Viessman Academy in Allendorf (Eder): Viessmann Group is an international heating system manufacturer producing e. g. energy-efficient solar thermal systems, photovoltaic systems, heat pumps, biomass heating systems (wood), biogas systems for commercial, industrial, and residential purposes ranging from 1.5 to 120,000 kW.
- Autarcon in Kassel: Is a start-up company founded by former students of the University of Kassel. AUTARCON stands for innovative, decentralized, energetically self- sufficient drinking water treatment and supply. Worldwide the SuMeWa|SYSTEM supplies sustainably and reliably drinking water with the help of photovoltaics - especially in developing regions.

*program is subject to change.

COURSE MATERIALS

You will receive an e mail concerning Introductory recommendation before the course starts. All further materials will be given during the course.

2. CLASS PARTICIPATION, ASSIGNMENTS AND EXAMS

PROFESSIONALISM AND CLASS PARTICIPATION
Regular attendance in lectures and field trips. No more than 10% of the contact hours can be missed for successful completion of the class

ASSIGNMENTS
Active participation in discussions and presentations, independent study

EXAM
Students have to write an exam (written exam) covering all seminar topics at the end of the course (2h)

3. GRADING AND ECTS

ACADEMIC STANDARDS
Upon successful completion 5 ECTS will be awarded

GRADING SCALE

German Grade	Definition
Very good (1.0 – 1.3)	Outstanding achievement
Good (1.7 – 2.3)	Performance above the average standard
Satisfactory (2.7 – 3.3)	Performance meets the average standard
Sufficient (3.7 – 4.0)	In spite of errors performance conforms to requirements
Fail (4.3 – 5.0)	Does not meet minimum criteria